

STANDARD SPECIFICATIONS

SECTION 15076

CEMENT-MORTAR LINED AND COATED STEEL PIPE

PART 1 - GENERAL

A. Description

This section describes materials, fabrication, installation, and testing of cement-mortar lined and coated steel pipe, in accordance with the applicable requirements of AWWA C200, C205, and C208.

B. Related Work Specified Elsewhere

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| 1. | Trenching, Backfilling, and Compacting: | 02223 |
| 2. | Painting and Coating: | 09900 |
| 3. | Corrosion Protection and Joint Bonding: | 13310 |
| 4. | Chlorination of Domestic Water Mains for Disinfection: | 15041 |
| 5. | Hydrostatic Testing of Pressure Pipelines: | 15042 |

C. Submittals

Shop drawings shall be submitted in accordance with the following:

1. Piping layout drawings showing location and dimensions of all pipe and fittings. Include laying lengths of valves, meters, and other equipment which determine piping dimensions. Label or number each fitting or piece of pipe and provide the following information for each item:
 - a. Materials of construction, including references to industry standards being met (i.e. ASTM, ANSI, AWWA, etc.)
 - b. Inside diameter, steel wall thickness, internal design pressure (cement-mortar lining and coating thicknesses) for each class of pipe to be furnished
 - c. Order of installation and closure locations for length adjustment and for construction convenience
 - d. Pipe invert station and elevation of each change of grade and alignment
 - e. Elements of curves and bends, both in horizontal and vertical alignment, including elements of the resultant true angular deflections in cases of combined curvature

- f. Paint primer type and thickness where joints and other cement-mortar holdbacks occur
 - g. Call out types and sizes, and dimensions of grooved-end collars, flanges, reinforcing collars, wrapper plates, and crotch plates
 - h. Limits of each reach of field-welded joints and of concrete encasement
 - i. Locations of manholes and other points of access
 - j. Location of valves and other mechanical equipment
 - k. Locations of bulkheads for field hydrostatic testing of pipeline
- 2. Manufacturer's certificates of compliance with prescribed industry standards (i.e. AWWA C200, C205, and C208, ASTM C150, etc.)
 - 3. Detail drawings of:
 - a. Fittings
 - b. Joints
 - c. Butt Straps
 - d. Bulkheads and means of attachment to pipe
 - 4. Mill test reports on each heat from which steel is rolled
 - 5. Test reports on physical properties of rubber used in gaskets

D. Qualifications of Manufacturers

Only manufacturers who manufacture a complete lined and coated pipe can be qualified for this work. All pipe manufacturing operations shall be performed at the same location for all pieces of pipe. Supervisors of cement-mortar coating operations shall have at least two years continuous recent experience in the application of cement-mortar coating systems for steel pipe.

E. Design Criteria

- 1. The nominal diameter or inside diameter of the pipe and other fabricated steel sections as shown on the plans is the clear diameter of the lined pipe after the application of the interior mortar lining.
- 2. Obtain the following information from the plans: elevation of the pipe invert and of the final ground surface; alignment of the pipeline; nominal internal diameter, after cement-mortar lining; minimum pipe wall thickness; and location of welded, double-welded and butt-welded joints.
- 3. The design pressure is the pressure class shown on the construction plans.

F. Inspection

The District reserves the right to inspect materials, production, or testing of pipe at the manufacturer's plant.

PART 2 - MATERIALSA. Steel Pipe

Steel shall be ASTM A 36, ASTM A 283 Grade C or D, ASTM A 570 Grade 30 or 33, having a 0.25% maximum carbon content. Spigot material shall be ASTM A 476, Grade 1012 or 1020.

B. Cement

Cement for cement-mortar lining shall be ASTM C 150, Type II or V. Cement for cement-mortar coating shall be ASTM C 150, Type V.

C. Fittings

1. Definition: A fitting shall be defined as a piece of pipe other than a straight full length joint. Elbows, manhole sections, reducers, and sections of pipe with outlets shall be considered fittings.
2. Pressure Rating: Fittings 4 through 10-inches diameter shall be designed for 250 psi (or 50 psi greater than the class of pipe, whichever is greater) and conform to ANSI B16.9. Fittings 12-inches diameter and larger shall comply with AWWA C208.
3. Materials: Material for fittings 4 through 10-inches shall comply with ASTM A 234, Grade WPB. Material for fittings larger than 10-inches but less than or equal to 30-inches in diameter shall be the same as the pipe or shall comply with ASTM A 283 (Grade D), ASTM A 36, or ASTM A 570 (all grades). Cement-mortar lining and I.D. dimensions shall be the same as the specified pipe.
4. Allowable Stresses: Allowable circumferential stress at the design internal pressure shall not be greater than 40% of minimum yield stress. Minimum wall thickness of steel fitting shall be the same as the pipe of same size per ANSI B36.10.
5. Grooved End Fittings: Fittings smaller than 24-inches diameter with grooved ends shall have square cut grooves, flexible type, with dimensions as shown in AWWA C606, Table 3. Steel wall thickness shall be standard weight, ANSI B36.10. Cement-mortar lining and I.D. dimensions shall be the same as for the specified pipe.
6. Welding Fittings: Welding fittings shall be standard weight, Ladish Co., or approved equal.

D. Flanges

Flanges shall be AWWA C207, Class D, flat face, except where Class E or Class F flanges are required. Weld-neck flanges (conforming to ANSI B16.5) shall be provided for piping 4-inches in diameter and smaller to connect to flanged valves, fittings and equipment. Slip-on or weld-neck flanges shall be provided for piping 4-inches in diameter. Flanges shall match the connecting flanges on adjacent fitting, valve or piece of equipment.

E. Bolts, Nuts, and Gaskets for Joints and Flanges

Rubber gaskets shall be furnished for all joints, along with other parts, including flange gaskets, bolts, nuts, washers, jumper rods, and flange insulation kits. One bolt/gasket set shall be provided for each flange.

1. Materials: Bolts and nuts for flanges shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M for bolts, and ASTM A 194, Grade 8M for nuts.
2. Washers: A washer shall be provided for each nut. Washers shall be of the same material as the nuts.
3. Gaskets: Gaskets shall be composed of synthetic fiber with rubber binder and shall be fullface, 1/16-inch-thick Garlock 3400, Anchor 441, or approved equal.
4. Bolts for Flange Insulation Kits: Bolts for flange insulation kits shall conform to ASTM A 193, Grade B7. Nuts shall conform to ASTM A 194, Grade 2H.

F. Flange Insulation Kits

Flange insulation kits suitable for the design pressure of the pipeline shall be provided where shown on the drawings and shall be as specified in Section 13110, Corrosion Protection and Joint Bonding.

G. Grooved-End Couplings

Grooved-end couplings shall be malleable iron, ASTM A 47, or ductile iron, ASTM A 536. Bolts shall conform to ASTM A 183, 110,000 psi tensile strength. Gaskets shall be EPDM and shall conform to ASTM D 2000. Couplings for pipe 24-inches in diameter and smaller shall be flexible type, square cut groove, per AWWA C606, and shall be Victaulic Style 77, Gustin-Bacon Figure 100, or approved equal.

H. Outlets

1. Outlets 2-1/2-inches in Diameter and Smaller: Outlets of sizes 2-1/2-inches in diameter and smaller shall be of the thredolet type, per AWWA Manual M-11, Figure 13.23. Outlets shall be 3,000 pound WOG forged steel per ASTM A 105 or ASTM A 216, Grade WCB. Threads shall comply with ASNI B2.1. Outlets shall be Bonney Forge Co. "Thredolet," Allied Piping Products Co. "Branchlet," or for contracts between District and contractor, approved equal.
2. Outlets larger than 2-1/2-inches in Diameter: For outlets larger than 2-1/2-inches in diameter, flanged tees shall be used.

I. Length of Pipe Sections

Pipe sections shall be limited to 40 feet or less. For sections longer than 30 feet, spreader beams, and lifting straps shall be used to lift pipe sections at the third points.

J. Joints

1. Above Ground Joints: Joints above ground or in vaults and structures shall be flanged or grooved end.

2. Buried Joints: Buried joints shall be:
 - a. Bell and Carnegie shape spigot with rubber gasket
 - b. Bell-and-spigot lap welded
 - c. Butt-strap joints may also be used for closures
3. Grooved-End Joints: Grooved-end joints shall be flexible, square-cut grooved, per AWWA C606.

K. Product Marking

Each length of straight pipe and each special shall be plainly marked at the bell end to identify the design pressure or head, the steel wall thickness, the date of manufacture, and the proper location of the pipe item by reference to the layout schedule. For beveled pipe, the degree of bevel and the point on the circumference to be laid uppermost shall be shown.

L. Painting and Coating

1. General: Unless noted otherwise, buried pipe shall be cement-mortar coated per AWWA C205.
2. Exposed Pipe: Pipe located above ground or in vaults and structures shall be epoxy lined and coated in accordance with Section 09900, Painting and Coating. Primer shall be shop applied.
3. Grooved-End Couplings: Grooved-end couplings shall be coated the same as the adjacent pipe.

M. Lining

Unless noted otherwise, pipe and fittings shall be cement-mortar lined per AWWA C205.

PART 3 - EXECUTION

A. General

1. Steel Cylinder Thickness: Steel cylinder thickness shall be minimum 10 gauge. Steel cylinder thickness shall be as called for on the construction plans. Pipe 12-inches in diameter and smaller shall be standard steel pipe per ASTM A53 "Welded and Seamless Steel Pipe". It shall have a wall thickness known as standard weight per ANSI B36.10.
2. Fittings:
 - a. Dimensions shall be per AWWA C208.
 - b. Allowable circumferential stress at the design internal pressure shall not exceed 40% of minimum yield stress.
 - c. Outlet reinforcement at branches and openings shall be determined by the procedure given in ANSI B31.3, paragraph 304.3. If reinforcement is required, it shall be accomplished as described below:

- The type of reinforcement for fittings with outlets shall be selected from the following table:

Steel Pipe Reinforcement	Type of Reinforcement
Max. 0.5	Collar
Max 0.7	Wrapper Plate
To 1.0	Crotch Plate

Where R=
$$\frac{\text{ID outlet}}{\text{I.D. cyl.} \times \sin B}$$

Where B = Angle between the longitudinal axis of the main run and the branch.

- For collar reinforcement, select an effective shoulder width "W" of a collar from the inside surface of the steel outlet to the outside edge of the collar, measured on the surface of the cylinder of the main run, shall be selected such that:

$$W = (1/3 \text{ to } 1/2) \times \frac{\text{I.D. outlet}}{\sin B}$$

The minimum thickness "T" of the collar is determined by:

$$T = \frac{P \times \text{I.D. main run} \times \text{I.D. outlet} \times (2 - \sin B)}{4 \times F \times W \times \sin B}$$

Where P = Design internal pressure

F = Allowable design stress =
40% of minimum yield stress

B = As in part c.1 above

Collars may be oval in shape or rectangular with rounded corners.

- For a wrapper plate, the above collar formula shall be used except that the wrapper is of thickness "T", its total width is (2W + ID outlet/sinB), and it wraps entirely around the main pipe.
- Base crotch plate design on Swanson, H. S. et al., DESIGN OF WYE BRANCHES FOR STEEL PIPES, summarized in AWWA Manual M 11, Chapter 13.
- Long Radius Curves and Vertical Curves:

For curved alignment, straight or beveled pipe of normal or one-half normal lengths pulled partially open on one side of the joint may be used with a welded mitered bend of up to 10 degrees next to the joint ring. Pipes with a bend in excess of 10 shall be designed as fittings.

Joints shall not be pulled more than one-half of the watertight extensibility provided by the bell and spigot design.

B. Fabrication

1. Reference Standards: Fabrication shall comply with ANSI B31.3, Chapter V. Welding procedure and performance qualifications shall be in accordance with Section IX, Articles II and III, respectively, of the ASME Boiler and Pressure Vessel Code.
2. Welding
 - a. The pipe cylinder shall be fabricated by butt welding, spiral seam, or straight seam. Girth welds shall be limited to two per pipe section, butt welded. Longitudinal welds shall be limited to one seam. Longitudinal joints of adjacent shell courses shall be staggered.
 - b. The shielded metal arc welding (SMAW) process shall be used for welding. All welding shall be done by qualified, certified welders.
 - c. Welds shall be in accordance with ANSI B31.3, paragraph 327.4.
 - d. Welding preparation shall comply with ANSI B31.3, paragraph 327.3. Limitations on imperfections in welds shall conform to the requirements in ANSI B31.3.
 - e. Welding electrodes shall comply with AWS A5.1.
 - f. Each layer of deposited weld metal shall be cleaned using a power-driven wire brush prior to depositing the next layer of weld metal. The final pass shall be cleaned by a power-driven wire brush.
 - g. A minimum of three passes shall be used for welded joints. Welds shall be full circumferential.
 - h. Beveled ends for butt welding shall conform to ANSI B16.25. Slag shall be removed by chipping or grinding. Surfaces shall be clean of paint, oil, rust, scale, slag, and other material detrimental to welding. When welding the reverse side, slag shall be chipped out before welding.

C. Joint Ring Protective Coating

The exposed portion of joint rings shall be coated with a 3-mil minimum thickness organic zinc pigmented coating meeting U.S. Federal Specification TT-P-641.

D. Shop Hydrostatic Test

The steel cylinder with joint rings shall be stressed to 75% of the minimum yield stress of the steel.

E. Shop Testing of Fittings

1. Dye Penetrant Test: Seams in fittings which have not been previously shop hydrostatically tested shall be tested by the dye penetrant method.

2. Air-Soap Test: In addition to the dye penetrant method of testing, the air-soap method with air at 5 psi shall be used on joints susceptible to being tested by such a method.
3. Pressure Test in Lieu of Dye Penetrant Test: In lieu of the dye penetrant method of testing, completed fittings may be hydrostatically tested using the field hydrostatic test pressure or 125% of the design pressure, whichever is higher.

F. Delivery of Small Parts

Small parts, consisting of gaskets, bolts, nuts, washers, jumper rods, and flange insulation kits, shall be delivered to the job site in suitable containers, each marked to identify the contents.

G. Installation

1. Delivery and Temporary Storage of Pipe at Site

- a. Onsite Storage Limitation: Onsite pipe storage shall be limited to a maximum of one week, unless exception is approved by District.
- b. Care of Pipe: Care shall be taken to avoid cracking of the cement mortar coating and/or lining on steel pipe. If necessary, plastic sheet caps shall be used to close pipe ends and keep coatings and linings moist.

2. Handling of Pipe

- a. Moving Pipe: Pipes shall be lifted with handling beams or wide belt slings as recommended by the pipe manufacturer. Cable slings shall not be used. Pipe shall be handled in a manner to avoid damage to the pipe. Pipe shall not be dropped or dumped from trucks or into trenches under any circumstances.
- b. Internal Pipe Braces: Internal braces placed in steel pipes shall be maintained until backfilling is completed.
- c. Pipe Caps: Plastic caps placed over the ends of steel pipe shall not be removed until the pipe is ready to be placed in the trench. Plastic caps may be opened temporarily to spray water inside the pipe for moisture control.
- d. Inspection of Pipe: The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced. All foreign matter or dirt shall be removed from the interior of the pipe before lowering into position in the trench.

3. Placement of Pipe in Trench

- a. General: Dewatering, excavation, shoring, sheeting, bracing, backfilling material placement, material compaction, compaction testing, and pipe laying requirements and limitations shall be in accordance with Section 02223: Trenching, Backfilling and Compacting.
- b. Sanitation of Pipe Interior: During laying operations, tools, clothing, or other materials shall not be placed in the pipe.

- c. Prevention of Entry into Pipe: When pipe laying is not in progress, including lunch-hour, the ends of the pipe shall be closed using vermin-proof plugs constructed in a manner to also prevent entry by children.
 - d. Laying Pipe on Grades over 10 Percent: Pipes shall be laid uphill whenever the grade exceeds 10 percent.
 - e. Pipe Bedding Thickness: Pipe bedding thickness shall be as specified in Section 02223, Trenching, Backfilling, and Compacting.
 - f. Depressions at Joints and Pipe Sling Points: Depressions shall be dug into pipe base material to accommodate the pipe bell and external joint filler form, and to permit removal of the pipe handling slings.
 - g. Placement of Pipe on Pipe bedding: Pipe shall be lowered onto the bedding and installed to line and grade its full length on firm bearing except at the bell and at sling depressions. Unless specified otherwise, the tolerance on grade shall be ¼-inch; the tolerance on line shall be 1-inch. Grade shall be measured along the pipe invert.
 - h. Pipe Installation: Pipe shall be installed without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Precautions shall be taken to prevent pipe from being displaced by water entering trench. Damaged or displaced pipe shall be replaced or returned to specified condition and grade.
 - i. Trench Curvature and Pipe Deflection: The radius of curvature of the trench shall be determined by the maximum length of pipe section that can be used without exceeding the allowable deflection at a coupling. Refer to the various referenced sections on pipe by type for allowable deflection. The deflection at any flexible joint shall not exceed that prescribed by the manufacturer of the pipe. The manufacturer's printed installation guide outlining the radius of curvature that can be negotiated with pipe sections of various lengths shall be followed.
 - j. Equipment for Installation of Pipe: Proper implements, tools, and facilities as recommended by the pipe manufacturer's standard printed installation instructions shall be provided and used by the contractor for safe and efficient execution of the work. All pipe, fittings, valves, and accessories shall be carefully lowered into the trench using suitable equipment in such a manner as to prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.
 - k. Cutting and Machining Pipe: Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures for this operation. Pipe shall not be cut with a cold chisel, standard iron pipe cutter, nor any other method that may fracture the pipe or produce ragged, uneven edges.
4. Assembling Rubber Ring Joints
 - a. Cleaning Ends of Pipe: The ends of the pipe to be joined shall be cleaned of foreign material.

- b. Lubrication: After placing pipe in trench, a nontoxic water soluble vegetable soap solution shall be applied to the inside of the bell of the pipe in the trench and to the rubber gasket and spigot groove of the pipe to be installed. The rubber gasket shall be stretched into the groove of the spigot end of the pipe and distributed uniformly around the circumference.
 - c. Joint Assembly: Without tilting the pipe to be installed, the spigot shall be inserted into the bell of the pipe. Come-a-longs or pipe jacks shall be used to drive spigot end home horizontally. The joint recess recommended by pipe manufacturer for made-up joints shall be maintained. Where deflections at joints are required for curved alignment, the allowable joint opening on one side shall not be exceeded. A feeler gauge shall be used to verify proper placement of each gasket.
5. Flanged Connections
 - a. Bolthole Alignment: Pipe shall be set with flange boltholes straddling the pipe horizontal and vertical centerlines.
 - b. Nuts and Bolts: Nuts and bolts shall be lubricated with antisieze graphite prior to installation.
 - c. Flange Wrapping: Flanges which connect with buried valves or other equipment shall be wrapped with sheet polyethylene film as specified for the valves and equipment. The wrap shall be extended over the flanges and bolts and secured around the adjacent pipe circumference with tape.
 - d. Coating: Flanges and non-stainless steel bolts shall be completely coated as specified in Section 09900, Painting and Coating.
6. Installation of Bends, Tees, and Reducers

Fittings shall be installed utilizing standard installation procedures. Fittings shall be lowered into trench by means of rope, cable, chain, or other acceptable means without damage to the fittings. Cable, rope, or other devices used for lowering fitting into trench, shall be attached around exterior of fitting for handling. Under no circumstances shall the cable, rope or other device be attached through the fittings interior for handling. Fittings shall be carefully connected to pipe or other facility, and joint shall be checked to insure a sound and proper joint.
7. Installing Threaded Piping

Threaded piping shall be reamed, deburred, and cleaned before making up joints. Thread lubricant shall be applied to threaded pipe ends before installing fittings, couplings, unions, or joints.
8. Completion of Interior Joints for Mortar-Lined Pipes - 20-Inches in Diameter and Smaller

The contractor shall install an extruded botyl rubber pipe joint sealant, G5-79 as manufactured by General Sealants, Inc., or approved equal. The pipe joint sealant shall be applied per the manufacturer's instructions.

9. Completion of Interior Joints for Mortar-Lined Pipes Greater Than 24-Inches in Diameter
 - a. Backfill Requirement: The trench shall be backfilled before applying mortar at joints.
 - b. Cleaning and Application of Cement Mortar: Working inside the pipe, foreign substances which adhere to the steel joint rings shall be removed, the surface cleaned, and stiff cement mortar packed into each joint. The mortar shall be finished with a steel trowel to match the lining in the adjoining pipes.
 - c. Removal of Excess Mortar: Excess mortar and other construction debris shall be removed from the pipe interior.

10. Pipeline Closure Assemblies
 - a. General: Pipeline closure assemblies shall be employed to unite sections of pipeline laid from opposite directions; to adjust the field length of the pipeline to meet structures, other pipelines, and points established by design stations; and to close areas left open to accommodate temporary test bulkheads for hydrostatic testing. Either follower ring design or butt strap design shall be used. Follower ring closures shall be installed as recommended by the pipe manufacturer.
 - b. Butt Straps: Shaped steel butt straps shall be centered over the ends of the pipe sections they are to join. On pipes 39 inches in diameter and smaller, butt straps shall be welded to the outside of the pipes with complete circumferential fillet welds equal in size to the thinnest part being joined. The details shown on the drawings shall be referred to when joining larger pipes.
 - c. General Requirements for Cement Mortar Lining for Closure Assemblies: Closure assemblies shall be cement-mortar lined to a mortar thickness at least equal to the adjoining standard pipe sections. The steel shall be cleaned with wire brushes and a cement and water wash coat applied prior to applying the cement mortar. Where more than a 4-inch joint strip of mortar is required, welded wire mesh reinforcement having a 2-inch by 4-inch pattern of No. 13 gage shall be placed over the exposed steel. The mesh shall be installed so that the wires on the 2-inch spacing run circumferentially around the pipe. The wires on the 4-inch spacing shall be crimped to support the mesh 3/8 inch from the metal surface. The interior mortar shall have a steel-trowled finish to match adjoining mortar lined pipe sections.
 - d. Lining Closure Assemblies for Pipes 24-Inches in Diameter and Smaller: For lining of closure assemblies on pipelines 24-inches in diameter and smaller, threaded 5-inch nipples with galvanized plugs shall be provided around the perimeter of the closure at third-point intervals to facilitate mortar lining of the interior surface.
 - e. Mortar Coating Exterior Surfaces of Closure Assemblies: The exterior of closure assemblies shall be reinforced with wire mesh as described in Paragraph 3 above. The surface shall be coated with mortar, or a poured concrete encasement to cover all steel to a minimum thickness of 1-1/2 inches. Exterior mortar shall be protected to retard drying while curing. Concrete shall be poured and vibrated on one side of the closure assembly only, until mortar is visible on the opposite side, after which the coating can be completed over the top of the assembly.

11. Welded Joints

- a. Locations: Welded joints shall be provided where detailed on the plans.
- b. Reference Standard: Welding shall be in accordance with AWWA C206. Welder's qualification shall be in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. Current certifications shall be provided for all welders.
- c. Sequence: Interior joints shall not be welded before completing the backfilling operations.
- d. Joint Rings: Joint rings that are rusted or pitted where weld metal is to be deposited shall be cleaned by brushing or sand blasting.
- e. Restrictions: Concrete or other coating adjacent to the joint rings shall not be heated.
- f. Cleaning Requirements: Each layer of deposited weld metal shall be cleaned using a power-driven wire brush prior to depositing the next layer of weld metal.

12. Operations Incidental to Joint Completion

- a. Hydrostatic Testing: Joint completion shall be planned to accommodate temporary test bulkheads for hydrostatic testing.
- b. Bonding Pipe: Metallic jumper bonds or bars shall be installed on all non-welded pipe, as shown on plans and as specified within Section 13110: Corrosion Protection and Joint Bonding.

13. Completion of Exterior Pipe Joint for Cement-Mortar Coated Pipe

Outside joint recess shall be filled with cement-mortar grout using a fabric form placed around the joint and secured with steel straps. Grout shall be poured and rodded from one side only until it is visible on the opposite side. After approximately one hour, the joint shall be topped off with additional grout.

14. Thrust Restraint and Anchor Blocks

- a. Location: Thrust restraint and anchor blocks shall be provided on all pressure pipelines, and shall be installed as shown on the plans and at all rubber gasketed fittings that are not otherwise restrained. Thrust restraint blocks or anchor blocks shall be installed at all valves, tees, crosses, ends of pipelines, and at all changes of direction of the pipeline greater than 10 degrees deflection either vertically or horizontally when joints are not otherwise restrained.
- b. General Requirements: Thrust restraint and anchor blocks shall be of not less than 3,250 psi concrete (Class A); and shall provide a thrust bearing area to resist horizontal or downward thrust; and shall be of sufficient gross weight and area to give bearing against undisturbed vertical earth banks sufficient to absorb the thrust, allowing an earth bearing of 1,500 pounds per square foot maximum.

- c. Thrust Restraint not Called for on the Plans: Thrust restraint elements, where not called for on the plans, shall be sized for 150 percent of operating pipeline pressure. Prior to construction, thrust and anchor block sizing shall be submitted to the District for approval. Pipe clamps, tie-rods, and their assembly shall meet the requirements of the National Fire Protection Association Bulletin No. 24, latest edition.
 - d. Concrete Placement: Concrete shall be placed against wetted and undisturbed soil, and the exterior of the fitting shall be cleaned and wetted to provide a good bond with the concrete. The concrete interface with the fitting shall be an area of not less than the projected area of the fitting normal to the thrust resultant and centered on the resultant.
 - e. Accessibility to Joints and Fittings: Unless otherwise directed by the District, thrust restraint and anchor blocks shall be placed so that the pipe and fitting joints are accessible for repair. Placement shall include isolation of adjacent utilities and shall ensure that bearing is against undisturbed soil.
 - f. Harness and Tie-Rods: Metal harness or tie-rods and pipe clamps shall be used to prevent movement if shown on the plans or directed by the District. The rods and clamp harnessing arrangement shall be installed utilizing flanged harness hold-downs or lugged fittings and pipe with saddle clamps placed to bear against the pipe bells. Saddle clamps around the barrel of the pipe, which depend on friction or setscrews to prevent sliding of the clamp, are not acceptable. The pipe clamps, tie rods and their assembly shall meet the requirements of the National Fire Protection Association Bulletin No. 24, 1981 Edition. All surfaces of exposed and buried steel rods, reinforcing steel, bolts, clamps, and other metal work shall be coated before installation and touched up after assembly as specified in Section 09900, Painting and Coating.
 - g. In-line Valves: Reinforcing steel tiedown rods shall be used on all in-line valves.
15. Blowoff Assemblies
- a. General: In-line type or end-of-line type blowoff assemblies per MNWD standard drawing W-10 shall be installed in accordance with the plans at locations noted, and at such additional locations as required by the District for removing water or sediment from the pipeline.
 - b. Location: The assembly shall be installed in a level section of pipe. The tap for blowoff in the line shall be no closer than 18 inches to a valve, coupling, joint, or fitting unless it is at the end of the main. No tap will be permitted in any machined section of asbestos cement pipe.
 - c. Restrictions: Blowoffs shall not be connected to any sewer, submerged in any stream, or installed in any manner that will permit back siphoning into the distribution system.
16. Combination Air and Vacuum Release Valves
- a. General: Air release valve assemblies and combination air and vacuum valves per MNWD standard drawing W-9 shall be installed at each point in the pipeline as shown on the drawings or as specified by the District, and in accordance with Section 15089: Air-Release and Vacuum-Release.

- b. Location: The tap for the air valves shall be made in a level section of pipe no closer than 18 inches to a bell, coupling, joint, or fitting. No tap shall be permitted in any machined section of asbestos cement pipe.

17. Aboveground Piping Installation/Support

- a. General: Installation of aboveground pipeline materials and appurtenances include requirements for buried pipeline materials and appurtenances as applicable.
- b. Supports: All exposed pipe shall be adequately supported with devices of appropriate design. Where details are shown, the supports shall conform thereto and shall be placed as indicated; provided, that the support for all piping shall be complete and adequate as herein specified, whether or not supporting devices are specifically called for. Pipe hangers and supports shall conform to the requirements of the latest editions of the MSS-SP58 and SP69 and ANSI/ASME B31.1.
- c. Grooved-End Pipe and Fittings: Grooved-end pipe and fittings shall be installed in accordance with the coupling manufacturer's recommendations and the following:
 - 1. Loose scale, rust, oil, grease, and dirt shall be cleaned from the pipe or fitting groove. The coupling manufacturer's gasket lubricant shall be applied to the gasket exterior including lips, pipe ends, and housing interiors.
 - 2. Coupling shall be fastened alternately and evenly until coupling halves are seated.

18. Cathodic Protection and Joint Bonding

All ferrous metal pipes and all pipes specified or shown on the plans to be cathodically protected shall be completed in accordance with Section 13110: Corrosion Protection and Joint Bonding.

19. Warning and Locator Tape

Warning and locator tape shall be installed on all recycled water pipelines. The pipe identification shall be in accordance with Section 15151, Domestic and Recycled Water Facilities Identification.

20. Disinfection

All potable water pipelines shall be disinfected in accordance with Section 15041, Chlorination of Domestic Water Mains and Services for Disinfection.

21. Testing

All piping shall be hydrostatically pressure tested in accordance with Section 15042, Hydrostatic Testing of Pressure Pipelines.

END OF SECTION