



Suggested Specifications:  
Steel Pipe for Water Transmission



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# Suggested Specifications - Steel Pipe for Water Transmission

## Cement-mortar Lined and Tape Coated

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### PART 1 - GENERAL

#### 1.01 Description

**Scope of Work:** Provide and install steel pipe of the sizes and in the locations shown on the Plans and as specified herein.

#### 1.02 Quality Assurance

**Commercial Standards:** Unless otherwise stated, the latest edition for any commercial standards and all manufacturing tolerances referenced, therein shall apply.

<b>ANSI/AWS D1.1</b>	Structural Welding Code- Steel
<b>ANSI/AWS B2.1</b>	Specification for Welding Procedure and Performance Qualification
<b>ANSI/AWWA C200</b>	Steel Water Pipe – 6 In. (150 mm) and Larger
<b>ANSI/AWWA C205</b>	Cement-Mortar Protective Lining and Coating for Steel Water Pipe – 4 In. (100 mm) and Larger- Shop Applied
<b>ANSI/AWWA C206</b>	Field Welding of Steel Water Pipe
<b>ANSI/AWWA C207</b>	Steel Pipe Flanges for Waterworks Service – Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
<b>ANSI/AWWA C208</b>	Dimensions for Fabricated Steel Water Pipe Fittings
<b>ANSI/AWWA C209</b>	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipe
<b>ANSI/AWWA C210</b>	Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
<b>ANSI/AWWA C214</b>	Tape Coating Systems for the Exterior of Steel Water Pipelines
<b>ANSI/AWWA C215</b>	Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines
<b>ANSI/AWWA C216</b>	Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fitting
<b>ANSI/AWWA C222</b>	Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings
<b>ASME Section IX</b>	International Boiler & Pressure Vessel Code: Welding and Brazing Qualifications

**ASTM A1011** Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

**ASTM A1018** Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability

**AWWA M11** Steel Water Pipe: A Guide for Design and Installation

#### A. Qualifications

1. Manufacturers who are fully experienced, reputable, and qualified in the manufacture of the products to be furnished shall furnish all steel pipe and fittings. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

2. Pipe cylinders, coating, lining and fabrication of specials shall be the product of one manufacturer that has not less than 5 years successful experience manufacturing pipe of the particular type and size indicated. The Pipe Manufacturer must have a certified quality assurance program. This certified program shall be ISO 9001:2000 or other equivalent nationally recognized program as approved by the Engineer.

#### 1.03 Submittals

##### A. Shop Drawings

Drawings shall be submitted to the Engineer for approval and shall include the following:

1. Pipeline layout showing stations and elevations.
2. Details of standard pipe, joints, specials and fittings.

##### B. Design

1. Calculations for pipe design and fittings reinforcement and/or test data.
2. Details of joint bonding and field welded joint restraint calculations.

##### C. Certifications

1. The Contractor shall furnish a certified affidavit of compliance that meets or exceeds the requirements of these specifications for all pipe and fittings furnished.
2. Linings for potable piping shall be NSF certified

## 1.04 Verifications

### A. Inspections

1. All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of AWWA C200 and AWWA coating and lining standard as supplemented by the requirements herein.

### B. Tests

1. Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA C200 and AWWA coating and lining standards.

2. The Contractor shall perform required tests at no additional cost to the Owner. The Engineer shall have the right to witness all testing conducted by the Contractor; provided, that the Contractor's schedule is not delayed for the convenience of the Engineer.

### C. Welding Requirements

1. All welding procedures used to fabricate pipe shall be qualified under the provision of AWS B2.1 or ASME Section IX.

### D. Welder Qualifications

1. Skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used shall do all welding. Welders shall maintain current qualifications under the provisions of AWS B2.1 or ASME Section IX. Machines and electrodes similar to those in the work shall be used in qualification tests. The Contractor shall furnish all material and bear the expense of qualifying welders.

## 1.05 Handling, Storage and Shipping

**A.** Pipe shall be studded as required to maintain roundness of +/- 1% during shipping and handling.

**B.** Coated pipe shall be shipped on padded bunks with nylon belt tie-down straps or padded banding located approximately over studding.

**C.** Coated pipe shall be stored on padded skids, sand or dirt berms, sand bags, old tires or other suitable means so that coating will not be damaged.

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

**E.** Prior to shipment, dielectrically coated pipe shall be visually inspected for coating damage by the following procedure:

1. When visual inspection shows a dielectric coating system has sustained physical damage, the area in question shall be subjected to an electrical holiday test. Voltage shall be per AWWA C214.

2. When the area is tested and there are no holidays or no tearing of the material, (wrinkling or bruising of tape may be permitted) then the area shall be noted "OK" and shipped with no patching required.

3. When the damaged area does show damage going clear to the steel from either a visual inspection or a jeep from a holiday detector, the area shall be repaired in accordance with Section 2.02 of these specifications and per manufacturer's recommendations.

## 1.06 Markings

**A.** The Contractor shall legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word "top" or other suitable marking shall be painted or marked on the outside top spigot end of each pipe section.

## PART 2 - PROJECTS

### 2.01 Materials

#### A. Pipe

1. Steel pipe shall conform to AWWA C200. Steel plate used in the manufacture and fabrication of steel pipe shall meet the requirements of ASTM A1011 or A1018. All longitudinal and girth seams, whether straight or spiral, shall be butt-welded using an approved electric-fusion-weld process.

2. Pipe shall be designed for \_\_\_\_\_ psi working pressure with an additional \_\_\_\_\_ psi allowance for surge. Pipe design shall be in accordance with AWWA M11.

3. Pipe shall be bedded and backfilled per the Plan details or manufacturer's recommendations utilizing an E' value for design check per AWWA M11 Chapter 6.

4. Pipe is to be furnished principally in 50-foot net laying lengths with shorter lengths, field trim pieces and closure pieces as required by Plan and profile for location of elbows, tees, reducers and other in-line fittings or as required for construction. The pipe fabricator shall prepare a pipe laying schedule showing the location of each piece by mark number with station and invert elevation at each bell end.

#### B. Fittings

1. Unless otherwise shown on the Plans, all specials and fittings shall conform to the dimensions of AWWA C208. Pipe material used in fittings shall be of the same material and pressure class as the adjoining pipe. The minimum radius of elbows shall be 2 1/2 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11 1/4-degrees (one cut elbow up to 22 1/2-degrees). If elbow radius is less than 2 1/2 times the pipe diameter, stresses shall be checked per AWWA M11 and the pressure class increased if necessary.

## PART 2 - Projects (continued)

### 2.01 Materials

#### B. Fittings

2. Fittings shall be equal in pressure class design as the adjoining pipe. Specials and fittings, unless otherwise shown on the Plans, shall be made of segmentally welded sections from hydrostatically tested pipe, with ends compatible with the type of joint or coupling specified for the pipe. All welds made after hydrostatic testing of the straight sections of pipe shall be tested per the requirements of AWWA C200 Section 5.2.2.1.

#### C. Joints

##### 1. Rolled Groove Rubber Gasket Joint

- a. The standard joint shall be a rolled groove rubber gasket joint unless otherwise noted on the Plans. Rolled groove rubber gasket joints shall conform to AWWA C200 and as shown in Chapter 8 of AWWA M11.
- b. The O-ring gasket shall have sufficient volume to approximately fill the area of the groove and shall conform to AWWA C200.
- c. The joint shall be suitable for a working pressure equal to the class of pipe furnished and shall operate satisfactorily with a deflection angle, the tangent of which is not to exceed  $1.00/D$  where D is the outside diameter of the pipe in inches with a pull-out of 1-inch.
- d. Rolled groove rubber gasket joints may be furnished only by a manufacturer who has furnished pipe with joints of similar design for comparable working pressure and pipe diameters that has been in successful service for a period of at least 5 years.

##### 2. Lap Weld

- a. Lap weld joints shall conform to AWWA C200 and as shown in Chapter 8 of AWWA M11.
- b. Lap field welded joints shall be used where restrained joints are required or indicated on the Plans. The standard bell shall provide for a 2 1/2-inch lap. The minimum lap shall be 1-inch. The maximum joint deflection or offset shall be a 1-inch joint pull.
- c. Lap welded joints shall be welded either externally or internally. Holdbacks for coating and linings shall be provided as shown on the approved shop drawings. "Weld-after-backfill" of interior welds may be performed any time after joint completion and backfilling has been completed.

d. Unless otherwise shown on the Plans, all field joints shall be lap welded for diameters 78-inches and greater.

##### 3. Mechanical Couplings

- a. Mechanical couplings where indicated on the Plans shall be Smith Blair Style 411, Baker Style 200, Victaulic Depend-O-Loc or equal.
- b. Insulating mechanical couplings where indicated on the Plans shall be double insulated Smith Blair Style 416, Baker Style 216, or equal for working pressures up to 150 psi only.
- c. Couplings for buried service shall have all metal parts painted with epoxy paint and conform to AWWA C210.
- d. Pipe ends for mechanical couplings shall conform to AWWA C200 and M11. The shop applied outside coating shall be held back as required for field assembly of the mechanical coupling or to the harness lugs or rings. Harness lugs or rings and pipe ends shall be painted with one shop coat of epoxy conforming to AWWA C210.
- e. Pipe for use with sleeve-type couplings shall have plain ends at right angles to the axis.

##### 4. Flanges

- a. Flanges shall be in accordance with AWWA C207 Class D for operating pressures to 175 psi on 4-inch through 12-inch diameter, and operating pressures to 150 psi on diameters over 12-inches. Flanges shall be AWWA C207 Class E for operating pressures over 150 psi to 275 psi or shall be AWWA C207 Class F for pressures to 300 psi (drilling matches ANSI B 16.5 Class 250). Shop lining and coating shall be continuous to the end of the pipe or back of the flange. Flange faces shall be shop coated with a soluble rust preventive compound.
- b. Gaskets shall be full face, 1/8-inch thick, cloth-inserted rubber, Garlock 3000, John Crane Co. Style 777 or equal.

##### 5. Bolts and Nuts for Flanges

- a. Bolts for flanges shall be carbon steel, ASTM A 307, Grade B for Class B and D flanges and nuts shall be ASTM A 563, Grade A heavy hex. Bolts for Class E and F flanges shall be ASTM A 193, Grade B7 and nuts shall be ASTM A 194, Grade 2H heavy hex.

6. All unwelded pipe joints shall be bonded for electrical continuity in accordance with the Pipe Manufacturer's recommendations unless otherwise specified in the Plans.

## PART 2 - Projects (continued)

### 2.02 Linings and Coatings

#### A. Cement-mortar Lining

1. Interior surface of all steel pipe, fittings and specials shall be lined in the shop with cement-mortar lining applied centrifugally and conforming with AWWA C205.
2. Holdbacks shall be left bare and be provided as shown on the approved shop drawings. Holdbacks shall be filled with cement mortar after joint completion per AWWA C205.
3. Defective linings as identified in AWWA C205 shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints.
4. Fittings shall be cement-mortar lined per AWWA C205. Pipe and fittings too small to cement-mortar line may be lined with AWWA C210 epoxy or AWWA C222 polyurethane.
5. Cement-mortar lining shall be kept moist during storage and shipping. The Contractor shall provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings to prevent drying out the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

#### B. Polyethylene Tape Coating

1. The prefabricated multi-layer cold applied tape coating system for straight-line pipe shall be in accordance with AWWA C214. The system shall consist of a three-layer system totaling 80 mils.
  - a. An acceptable alternate is a two-layer extruded polyolefin coating system in accordance with AWWA C215.
2. Coating of Fittings, Specials and Joints
  - a. Fittings, specials and joints that cannot be machine coated, shall be coated in accordance with AWWA C209. Prefabricated tape shall be Type II and shall be compatible with the tape system used for straight-line pipe. The system shall consist of 2 layers totaling 70 mils.
  - b. Alternate coating methods for fittings, specials and field joints are shrink sleeves per AWWA C216, liquid epoxy per AWWA C210, or polyurethane per AWWA C222.
  - c. Joint bonds shall be completely encapsulated by the coating system as per manufacturer's recommendations.
  - d. Coating repair for fittings and specials shall be in accordance with the procedure described below for straight-line pipe.
3. Coating repair shall be made using tape and primer conforming to AWWA C209 Type II and manufacturer's recommendations. The tape and primer shall be compatible with the tape system used for straight-line pipe.
  - a. An alternative repair method shall be to install heat shrink sleeves in accordance with AWWA C216 and manufacturer's recommendations

## PART 3 - THE EXECUTION

### 3.01 Installation

**A.** The Contractor shall provide and install all required piping and accessories in accordance with the contract documents and manufacturer's recommendations. Pipe installation as specified in this section supplements AWWA M11.

#### B. Installing Buried Piping

1. Handle pipe in a manner to avoid any damage to the pipe. Do not drop or roll pipe into trenches under any circumstances.
2. Inspect each pipe and fitting before lowering into the trench. Inspect the interior and exterior protective coatings. Repair damaged areas in the field in accordance with Section 2.02. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.
3. Grade the bottom of the trench and place a 4-inch minimum layer of select or scarified material under the pipe. Before laying each section the pipe, check the grade and correct any irregularities found. The trench bottom shall form a uniform bearing and support for the pipe.
4. At the location of each joint, dig bell (joint) holes in the bottom of the trench and at the sides to permit completion and visual inspection of the entire joint.
5. Keep the trench in a dewatered condition during pipe laying.
6. When the pipe laying is not in progress, including the noon hours, close the open ends of the pipe. Do not permit trench water, animals, or foreign objects to enter the pipe.

#### C. Joints Assembly

1. Rolled Groove Rubber Gasket Joint
  - a. Clean exposed ends of joint surfaces.
  - b. Thoroughly lubricate the gasket with material approved by the Pipe Manufacturer.
  - c. Place gasket in grooved spigot and relieve tension by inserting a dull instrument under the gasket and completing at least two revolutions around the joint circumference.
  - d. Upon completion of insertion of spigot (including any angular deflection as shown on the approved shop drawing) and prior to releasing from slings the entire placement of the gasket should be checked with a feeler gauge per manufacturer's recommendations. If gasket has disengaged or rolled, immediately pull the joint apart and reinstall the joint with a new gasket if required. Again verify proper placement of gasket with feeler gauge.
  - e. It is recommended that bonding wires or clips be installed as supplied by the Pipe Manufacturer unless otherwise specified in the Plans.
  - f. Grout the interior of the joints with cement mortar per AWWA C205. Complete the exterior of the joints with heat-shrink sleeves per AWWA C216 and manufacturer's recommendations.

## PART 3 - THE EXECUTION

### C. Joints Assembly (continued)

#### 2. Lap Field Welded Joints

- a. Clean exposed end of joint surfaces.
- b. Provide a minimum overlap of 1-inch at any location around the joint circumference.
- c. Field welders and field weld procedures shall be certified in accordance with AWS D1.1.
- d. At the Contractor's option, provide a full fillet weld per AWWA C206 either on the inside or outside of the pipe. Inside welding may be performed after backfilling in accordance with manufacturer's recommendations.
- e. Testing of field welds shall be in accordance with AWWA C206.
- f. Grout the interior of the joints with cement mortar per AWWA C205. Complete the exterior of the joints with heat-shrink sleeve per AWWA C216 and manufacturer's recommendations.

#### 3. Flanged Joints

- a. Bolt holes of flanges shall straddle the horizontal and vertical centerlines of the pipe. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing; lubricate bolts with graphite or oil.
- b. Insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
- c. Execute care when tightening joints to prevent undue strain upon valves, pumps and other equipment.
- d. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or re-tighten the bolts and nuts, and retest the joints

### 3.02 Field Quality Control

- A.** Perform hydrostatic pressure test in the presence of the Engineer in accordance with Section \_\_\_\_\_. Field test pressure should not exceed 120% of the pipes rated pressure class as measured at the lowest elevation for the section being tested. Leakage allowance shall be per AWWA M11 Chapter 12.
- B.** Provide all necessary piping between the reach being tested and the water supply, together with all required materials and equipment.
- C.** Provide dished heads, blind flange or bulkheads as necessary to isolate and test pipeline.
- D.** Methods and scheduling of tests to be approved by the Engineer.
- E.** Protect pipes and provide thrust restraint as required to complete test.
- F.** Provide for proper legal disposal of test water.

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## Cement-mortar Lined and Pritec® Coated

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##### C. Certifications

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2. Linings for potable piping shall be NSF certified

## PART 1 - GENERAL

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1. All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of AWWA C200 and AWWA coating and lining standard as supplemented by the requirements herein.

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1. All welding procedures used to fabricate pipe shall be qualified under the provision of AWS B2.1 or ASME Section IX.

#### D. Welder Qualifications

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### 1.05 Handling, Storage and Shipping

**A.** Pipe shall be studded as required to maintain roundness of +/- 1% during shipping and handling.

**B.** Coated pipe shall be shipped on padded bunks with nylon belt tie-down straps or padded banding located approximately over studding.

**C.** Coated pipe shall be stored on padded skids, sand or dirt berms, sand bags, old tires or other suitable means so that coating will not be damaged.

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

**E.** Prior to shipment, dielectrically coated pipe shall be visually inspected for damage to the coating by the following procedure:

1. When visual inspection shows a dielectric coating system has sustained physical damage, the area in question shall be subjected to an electrical holiday test. Voltage shall be per AWWA C215.

2. When the area is tested and there are no holidays, the area shall be noted "OK" and shipped with no patching required.

3. When the damaged area does show damage going clear to the steel from either a visual inspection or a jeep from a holiday detector, the area shall be repaired in accordance with Section 2.02 of these specifications and per manufacturer's recommendations.

### 1.06 Markings

**A.** The Contractor shall legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word "top" or other suitable marking shall be painted or marked on the outside top spigot end of each pipe section.

## PART 2 - PROJECTS

### 2.01 Materials

#### A. Pipe

1. Steel pipe shall conform to AWWA C200. Steel plate used in the manufacture and fabrication of steel pipe shall meet the requirements of ASTM A1011 or A1018. All longitudinal and girth seams, whether straight or spiral, shall be butt-welded using an approved electric-fusion-weld process.

2. Pipe shall be designed for \_\_\_\_\_ psi working pressure with an additional \_\_\_\_\_ psi allowance for surge. Pipe design shall be in accordance with AWWA M11.

3. Pipe shall be bedded and backfilled per the Plan details or manufacturer's recommendations utilizing an E' value for design check per AWWA M11 Chapter 6.

4. Pipe is to be furnished principally in 50-foot net laying lengths with shorter lengths, field trim pieces and closure pieces as required by Plan and profile for location of elbows, tees, reducers and other in-line fittings or as required for construction. The pipe fabricator shall prepare a pipe laying schedule showing the location of each piece by mark number with station and invert elevation at each bell end.

#### B. Fittings

1. Unless otherwise shown on the Plans, all specials and fittings shall conform to the dimensions of AWWA C208. Pipe material used in fittings shall be of the same material and pressure class as the adjoining pipe. The minimum radius of elbows shall be 2 1/2 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11 1/4-degrees (one cut elbow up to 22 1/2-degrees). If elbow radius is less than 2 1/2 times the pipe diameter, stresses shall be checked per AWWA M11 and the pressure class increased if necessary.



## PART 2 - Projects (continued)

### 2.01 Materials

#### B. Fittings

2. Fittings shall be equal in pressure class design as the adjoining pipe. Specials and fittings, unless otherwise shown on the Plans, shall be made of segmentally welded sections from hydrostatically tested pipe, with ends compatible with the type of joint or coupling specified for the pipe. All welds made after hydrostatic testing of the straight sections of pipe shall be tested per the requirements of AWWA C200 Section 5.2.2.1.

#### C. Joints

##### 1. Rolled Groove Rubber Gasket Joint

- a. The standard joint shall be a rolled groove rubber gasket joint unless otherwise noted on the Plans. Rolled groove rubber gasket joints shall conform to AWWA C200 and as shown in Chapter 8 of AWWA M11.
- b. The O-ring gasket shall have sufficient volume to approximately fill the area of the groove and shall conform to AWWA C200.
- c. The joint shall be suitable for a working pressure equal to the class of pipe furnished and shall operate satisfactorily with a deflection angle, the tangent of which is not to exceed  $1.00/D$  where  $D$  is the outside diameter of the pipe in inches with a pull-out of 1-inch.
- d. Rolled groove rubber gasket joints may be furnished only by a manufacturer who has furnished pipe with joints of similar design for comparable working pressure and pipe diameters that has been in successful service for a period of at least 5 years.

##### 2. Lap Weld

- a. Lap weld joints shall conform to AWWA C200 and as shown in Chapter 8 of AWWA M11.
- b. Lap field welded joints shall be used where restrained joints are required or indicated on the Plans. The standard bell shall provide for a 2 1/2-inch lap. The minimum lap shall be 1-inch. The maximum joint deflection or offset shall be a 1-inch joint pull.
- c. Lap welded joints shall be welded either externally or internally. Holdbacks for coating and linings shall be provided as shown on the approved shop drawings. "Weld-after-backfill" of interior welds may be performed any time after joint completion and backfilling has been completed.
- d. Unless otherwise shown on the Plans, all field joints shall be lap welded for diameters 78-inches and greater.

##### 3. Mechanical Couplings

- a. Mechanical couplings where indicated on the Plans shall be Smith Blair Style 411, Baker Style 200, Victaulic Depend-O-Loc or equal.
- b. Insulating mechanical couplings where indicated on the Plans shall be double insulated Smith Blair Style 416, Baker Style 216, or equal for working pressures up to 150 psi only.
- c. Couplings for buried service shall have all metal parts painted with epoxy paint and conform to AWWA C210.
- d. Pipe ends for mechanical couplings shall conform to AWWA C200 and M11. The shop applied outside coating shall be held back as required for field assembly of the mechanical coupling or to the harness lugs or rings. Harness lugs or rings and pipe ends shall be painted with one shop coat of epoxy conforming to AWWA C210.
- e. Pipe for use with sleeve-type couplings shall have plain ends at right angles to the axis.

##### 4. Flanges

- a. Flanges shall be in accordance with AWWA C207 Class D for operating pressures to 175 psi on 4-inch through 12-inch diameter, and operating pressures to 150 psi on diameters over 12-inches. Flanges shall be AWWA C207 Class E for operating pressures over 150 psi to 275 psi or shall be AWWA C207 Class F for pressures to 300 psi (drilling matches ANSI B 16.5 Class 250). Shop lining and coating shall be continuous to the end of the pipe or back of the flange. Flange faces shall be shop coated with a soluble rust preventive compound.
- b. Gaskets shall be full face, 1/8-inch thick, cloth-inserted rubber, Garlock 3000, John Crane Co. Style 777 or equal.

##### 5. Bolts and Nuts for Flanges

- a. Bolts for flanges shall be carbon steel, ASTM A 307, Grade B for Class B and D flanges and nuts shall be ASTM A 563, Grade A heavy hex. Bolts for Class E and F flanges shall be ASTM A 193, Grade B7 and nuts shall be ASTM A 194, Grade 2H heavy hex.

6. All unwelded pipe joints shall be bonded for electrical continuity in accordance with the Pipe Manufacturer's recommendations unless otherwise specified in the Plans.

## PART 2 - Projects (continued)

### 2.02 Linings and Coatings

#### A. Cement-mortar Lining

1. Interior surface of all steel pipe, fittings and specials shall be lined in the shop with cement-mortar lining applied centrifugally and conforming with AWWA C205.
2. Holdbacks shall be left bare and be provided as shown on the approved shop drawings. Holdbacks shall be filled with cement mortar after joint completion per AWWA C205.
3. Defective linings as identified in AWWA C205 shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints.
4. Fittings shall be cement-mortar lined per AWWA C205. Pipe and fittings too small to cement-mortar line may be lined with AWWA C210 epoxy or AWWA C222 polyurethane.
5. Cement-mortar lining shall be kept moist during storage and shipping. The Contractor shall provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings to prevent drying out the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

#### B. Polyethylene Tape Coating

1. Steel pipe shall be coated with an extruded polyolefin coating system in accordance with AWWA C215.2. Coating of Fittings, Specials and Joints
2. Coating of Fittings, Specials and Joints
  - a. Fittings, specials and joints that cannot be machine coated, shall be coated in accordance with AWWA C209. Prefabricated tape shall be Type II and shall be compatible with the tape system used for straight-line pipe. The system shall consist of 2 layers totaling 70 mils.
  - b. Alternate coating methods for fittings, specials and field joints are shrink sleeves per AWWA C216, liquid epoxy per AWWA C210, or polyurethane per AWWA C222.
  - c. Joint bonds shall be completely encapsulated by the coating system as per manufacturer's recommendations.
  - d. Coating repair for fittings and specials shall be in accordance with the procedure described below for straight-line pipe.
3. Coating repair shall be made using tape and primer conforming to AWWA C209 Type II and manufacturer's recommendations. The tape and primer shall be compatible with the tape system used for straight-line pipe.
  - a. An alternative repair method shall be to install heat shrink sleeves in accordance with AWWA C216 and manufacturer's recommendations

## PART 3 - THE EXECUTION

### 3.01 Installation

**A.** The Contractor shall provide and install all required piping and accessories in accordance with the contract documents and manufacturer's recommendations. Pipe installation as specified in this section supplements AWWA M11.

#### B. Installing Buried Piping

1. Handle pipe in a manner to avoid any damage to the pipe. Do not drop or roll pipe into trenches under any circumstances.
2. Inspect each pipe and fitting before lowering into the trench. Inspect the interior and exterior protective coatings. Repair damaged areas in the field in accordance with Section 2.02. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.
3. Grade the bottom of the trench and place a 4-inch minimum layer of select or scarified material under the pipe. Before laying each section the pipe, check the grade and correct any irregularities found. The trench bottom shall form a uniform bearing and support for the pipe.
4. At the location of each joint, dig bell (joint) holes in the bottom of the trench and at the sides to permit completion and visual inspection of the entire joint.
5. Keep the trench in a dewatered condition during pipe laying.
6. When the pipe laying is not in progress, including the noon hours, close the open ends of the pipe. Do not permit trench water, animals, or foreign objects to enter the pipe.

#### C. Joints Assembly

1. Rolled Groove Rubber Gasket Joint
  - a. Clean exposed ends of joint surfaces.
  - b. Thoroughly lubricate the gasket with material approved by the Pipe Manufacturer.
  - c. Place gasket in grooved spigot and relieve tension by inserting a dull instrument under the gasket and completing at least two revolutions around the joint circumference.
  - d. Upon completion of insertion of spigot (including any angular deflection as shown on the approved shop drawing) and prior to releasing from slings the entire placement of the gasket should be checked with a feeler gauge per manufacturer's recommendations. If gasket has disengaged or rolled, immediately pull the joint apart and reinstall the joint with a new gasket if required. Again verify proper placement of gasket with feeler gauge.
  - e. It is recommended that bonding wires or clips be installed as supplied by the Pipe Manufacturer unless otherwise specified in the Plans.
  - f. Grout the interior of the joints with cement mortar per AWWA C205. Complete the exterior of the joints with heat-shrink sleeves per AWWA C216 and manufacturer's recommendations.

## PART 3 - THE EXECUTION (continued)

### C. Joints Assembly

#### 2. Lap Field Welded Joints

- a. Clean exposed end of joint surfaces.
- b. Provide a minimum overlap of 1-inch at any location around the joint circumference.
- c. Field welders and field weld procedures shall be certified in accordance with AWS D1.1.
- d. At the Contractor's option, provide a full fillet weld per AWWA C206 either on the inside or outside of the pipe. Inside welding may be performed after backfilling in accordance with manufacturer's recommendations.
- e. Testing of field welds shall be in accordance with AWWA C206.
- f. Grout the interior of the joints with cement mortar per AWWA C205. Complete the exterior of the joints with heat-shrink sleeve per AWWA C216 and manufacturer's recommendations.

#### 3. Flanged Joints

- a. Bolt holes of flanges shall straddle the horizontal and vertical centerlines of the pipe. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing; lubricate bolts with graphite or oil.
- b. Insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
- c. Execute care when tightening joints to prevent undue strain upon valves, pumps and other equipment.
- d. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or re-tighten the bolts and nuts, and retest the joints

### 3.02 Field Quality Control

- A.** Perform hydrostatic pressure test in the presence of the Engineer in accordance with Section \_\_\_\_\_. Field test pressure should not exceed 120% of the pipes rated pressure class as measured at the lowest elevation for the section being tested. Leakage allowance shall be per AWWA M11 Chapter 12.
- B.** Provide all necessary piping between the reach being tested and the water supply, together with all required materials and equipment.
- C.** Provide dished heads, blind flange or bulkheads as necessary to isolate and test pipeline.
- D.** Methods and scheduling of tests to be approved by the Engineer.
- E.** Protect pipes and provide thrust restraint as required to complete test.
- F.** Provide for proper legal disposal of test water.

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# Suggested Specifications - Steel Pipe for Water Transmission

## Cement-mortar Lined and Coated

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### PART 1 - GENERAL

#### 1.01 Description

**Scope of Work:** Provide and install steel pipe of the sizes and in the locations shown on the Plans and as specified herein.

#### 1.02 Quality Assurance

**Commercial Standards:** Unless otherwise stated, the latest edition for any commercial standards and all manufacturing tolerances referenced, therein shall apply.

<b>ANSI/AWS D1.1</b>	Structural Welding Code- Steel
<b>ANSI/AWS B2.1</b>	Specification for Welding Procedure and Performance Qualification
<b>ANSI/AWWA C200</b>	Steel Water Pipe – 6 In. (150 mm) and Larger
<b>ANSI/AWWA C205</b>	Cement-Mortar Protective Lining and Coating for Steel Water Pipe – 4 In. (100 mm) and Larger- Shop Applied
<b>ANSI/AWWA C206</b>	Field Welding of Steel Water Pipe
<b>ANSI/AWWA C207</b>	Steel Pipe Flanges for Waterworks Service – Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
<b>ANSI/AWWA C208</b>	Dimensions for Fabricated Steel Water Pipe Fittings
<b>ANSI/AWWA C210</b>	Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
<b>ANSI/AWWA C222</b>	Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings
<b>ASME Section IX</b>	International Boiler & Pressure Vessel Code: Welding and Brazing Qualifications
<b>ASTM A1011</b>	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
<b>ASTM A1018</b>	Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability
<b>AWWA M11</b>	Steel Water Pipe: A Guide for Design and Installation

#### A. Qualifications

1. Manufacturers who are fully experienced, reputable, and qualified in the manufacture of the products to be furnished shall furnish all steel pipe and fittings. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

2. Pipe cylinders, coating, lining and fabrication of specials shall be the product of one manufacturer that has not less than 5 years successful experience manufacturing pipe of the particular type and size indicated. The Pipe Manufacturer must have a certified quality assurance program. This certified program shall be ISO 9001:2000 or other equivalent nationally recognized program as approved by the Engineer.

#### 1.03 Submittals

##### A. Shop Drawings

Drawings shall be submitted to the Engineer for approval and shall include the following:

1. Pipeline layout showing stations and elevations.
2. Details of standard pipe, joints, specials and fittings.

##### B. Design

1. Calculations for pipe design and fittings reinforcement and/or test data.
2. Details of joint bonding and field welded joint restraint calculations.

##### C. Certifications

1. The Contractor shall furnish a certified affidavit of compliance that meets or exceeds the requirements of these specifications for all pipe and fittings furnished.
2. Linings for potable piping shall be NSF certified

#### 1.04 Verifications

##### A. Inspections

1. All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of AWWA C200 and AWWA coating and lining standard as supplemented by the requirements herein.

##### B. Tests

1. Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA C200 and AWWA coating and lining standards.

## PART 1 - GENERAL (continued)

### B. Tests

2. The Contractor shall perform required tests at no additional cost to the Owner. The Engineer shall have the right to witness all testing conducted by the Contractor; provided, that the Contractor's schedule is not delayed for the convenience of the Engineer.

### C. Welding Requirements

1. All welding procedures used to fabricate pipe shall be qualified under the provision of AWS B2.1 or ASME Section IX.

### D. Welder Qualifications

1. Skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used shall do all welding. Welders shall maintain current qualifications under the provisions of AWS B2.1 or ASME Section IX. Machines and electrodes similar to those in the work shall be used in qualification tests. The Contractor shall furnish all material and bear the expense of qualifying welders.

### 1.05 Handling, Storage and Shipping

A. Pipe shall be studded as required to maintain roundness of +/- 1% during shipping and handling.

B. Coated pipe shall be shipped on padded bunks with nylon belt tie-down straps or padded banding located approximately over studding.

C. Coated pipe shall be stored on padded skids, sand or dirt berms, sand bags, old tires or other suitable means so that coating will not be damaged.

D. Coated pipe shall be handled with wide belt slings.

### 1.06 Markings

A. The Contractor shall legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word "top" or other suitable marking shall be painted or marked on the outside top spigot end of each pipe section.

## PART 2 - PROJECTS

### 2.01 Materials

#### A. Pipe

1. Steel pipe shall conform to AWWA C200. Steel plate used in the manufacture and fabrication of steel pipe shall meet the requirements of ASTM A1011 or A1018. All longitudinal and girth seams, whether straight or spiral, shall be butt-welded using an approved electric-fusion-weld process.

2. Pipe shall be designed for \_\_\_\_\_ psi working pressure with an additional \_\_\_\_\_ psi allowance for surge. Pipe design shall be in accordance with AWWA M11.

3. Pipe shall be bedded and backfilled per the Plan details or manufacturer's recommendations utilizing an E' value for design check per AWWA M11 Chapter 6.

4. Pipe is to be furnished principally in 50-foot net laying lengths with shorter lengths, field trim pieces and closure pieces as required by Plan and profile for location of elbows, tees, reducers and other in-line fittings or as required for construction. The pipe fabricator shall prepare a pipe laying schedule showing the location of each piece by mark number with station and invert elevation at each bell end.

#### B. Fittings

1. Unless otherwise shown on the Plans, all specials and fittings shall conform to the dimensions of AWWA C208. Pipe material used in fittings shall be of the same material and pressure class as the adjoining pipe. The minimum radius of elbows shall be 2 1/2 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11 1/4-degrees (one cut elbow up to 22 1/2-degrees). If elbow radius is less than 2 1/2 times the pipe diameter, stresses shall be checked per AWWA M11 and the pressure class increased if necessary.

2. Fittings shall be equal in pressure class design as the adjoining pipe. Specials and fittings, unless otherwise shown on the Plans, shall be made of segmentally welded sections from hydrostatically tested pipe, with ends compatible with the type of joint or coupling specified for the pipe. All welds made after hydrostatic testing of the straight sections of pipe shall be tested per the requirements of AWWA C200 Section 5.2.2.1.

#### C. Joints

1. Rolled Groove Rubber Gasket Joint

a. The standard joint shall be a rolled groove rubber gasket joint unless otherwise noted on the Plans. Rolled groove rubber gasket joints shall conform to AWWA C200 and as shown in Chapter 8 of AWWA M11.

b. The O-ring gasket shall have sufficient volume to approximately fill the area of the groove and shall conform to AWWA C200.

c. The joint shall be suitable for a working pressure equal to the class of pipe furnished and shall operate satisfactorily with a deflection angle, the tangent of which is not to exceed 1.00/D where D is the outside diameter of the pipe in inches with a pull-out of 1-inch.

## PART 2 - PROJECTS (continued)

### 1. Rolled Groove Rubber Gasket Joint

d. Rolled groove rubber gasket joints may be furnished only by a manufacturer who has furnished pipe with joints of similar design for comparable working pressure and pipe diameters that has been in successful service for a period of at least 5 years.

### 2. Lap Weld

a. Lap weld joints shall conform to AWWA C200 and as shown in Chapter 8 of AWWA M11.

b. Lap field welded joints shall be used where restrained joints are required or indicated on the Plans. The standard bell shall provide for a 2 1/2-inch lap. The minimum lap shall be 1-inch. The maximum joint deflection or offset shall be a 1-inch joint pull.

c. Lap welded joints shall be welded either externally or internally. Holdbacks for coating and linings shall be provided as shown on the approved shop drawings. "Weld-after-backfill" of interior welds may be performed any time after joint completion and backfilling has been completed.

d. Unless otherwise shown on the Plans, all field joints shall be lap welded for diameters 78-inches and greater.

### 3. Mechanical Couplings

a. Mechanical couplings where indicated on the Plans shall be Smith Blair Style 411, Baker Style 200, Victaulic Depend-O-Loc or equal.

b. Insulating mechanical couplings where indicated on the Plans shall be double insulated Smith Blair Style 416, Baker Style 216, or equal for working pressures up to 150 psi only.

c. Couplings for buried service shall have all metal parts painted with epoxy paint and conform to AWWA C210.

d. Pipe ends for mechanical couplings shall conform to AWWA C200 and M11. The shop applied outside coating shall be held back as required for field assembly of the mechanical coupling or to the harness lugs or rings. Harness lugs or rings and pipe ends shall be painted with one shop coat of epoxy conforming to AWWA C210.

e. Pipe for use with sleeve-type couplings shall have plain ends at right angles to the axis.

### 4. Flanges

a. Flanges shall be in accordance with AWWA C207 Class D for operating pressures to 175 psi on 4-inch through 12-inch diameter, and operating pressures to 150 psi on diameters over 12-inches. Flanges shall be AWWA C207 Class E for operating pressures over 150 psi to 275 psi or shall be AWWA C207 Class F for pressures to 300 psi (drilling matches ANSI B 16.5 Class 250). Shop lining and coating shall be continuous to the end of the pipe or back of the flange. Flange faces shall be shop coated with a soluble rust preventive compound.

### 4. Flanges (continued)

b. Gaskets shall be full face, 1/8-inch thick, cloth-inserted rubber, Garlock 3000, John Crane Co. Style 777 or equal.

### 5. Bolts and Nuts for Flanges

a. Bolts for flanges shall be carbon steel, ASTM A 307, Grade B for Class B and D flanges and nuts shall be ASTM A 563, Grade A heavy hex. Bolts for Class E and F flanges shall be ASTM A 193, Grade B7 and nuts shall be ASTM A 194, Grade 2H heavy hex.

6. All unwelded pipe joints shall be bonded for electrical continuity in accordance with the Pipe Manufacturer's recommendations unless otherwise specified in the Plans.

## 2.02 Linings and Coatings

### A. Cement-mortar Lining

1. Interior surface of all steel pipe, fittings and specials shall be lined in the shop with cement-mortar lining applied centrifugally and conforming with AWWA C205.

2. The pipe ends shall be left bare where field welded joints occur as shown on the Plans. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted.

3. Defective linings as identified in AWWA C205 shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints.

4. Fittings shall be cement-mortar lined per AWWA C205. Pipe and fittings too small to cement-mortar line may be lined with AWWA C210 epoxy or AWWA C222 polyurethane.

5. Cement-mortar lining shall be kept moist during storage and shipping. The Contractor shall provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings to prevent drying out the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

### B. Cement-mortar Coating

1. All pipe shown on the Plans to be cement-mortar coated shall be coated with 3/4-inch thickness of reinforced cementmortar coating in accordance with AWWA C205.

### C. Fittings

1. Fittings shall be lined and coated per AWWA C205. Fittings too small to cement mortar line may be lined with AWWA C210 epoxy or AWWA C222 polyurethane.

## PART 3 - THE EXECUTION

### 3.01 Installation

**A.** The Contractor shall provide and install all required piping and accessories in accordance with the contract documents and manufacturer's recommendations. Pipe installation as specified in this section supplements AWWA M11.

#### **B. Installing Buried Piping**

1. Handle pipe in a manner to avoid any damage to the pipe. Do not drop or roll pipe into trenches under any circumstances.
2. Inspect each pipe and fitting before lowering into the trench. Inspect the interior and exterior protective coatings. Repair damaged areas in the field in accordance with Section 2.02. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.
3. Grade the bottom of the trench and place a 4-inch minimum layer of select or scarified material under the pipe. Before laying each section the pipe, check the grade and correct any irregularities found. The trench bottom shall form a uniform bearing and support for the pipe.
4. At the location of each joint, dig bell (joint) holes in the bottom of the trench and at the sides to permit completion and visual inspection of the entire joint.
5. Keep the trench in a dewatered condition during pipe laying.
6. When the pipe laying is not in progress, including the noon hours, close the open ends of the pipe. Do not permit trench water, animals, or foreign objects to enter the pipe.

#### **C. Joints Assembly**

1. Rolled Groove Rubber Gasket Joint
  - a. Clean exposed ends of joint surfaces.
  - b. Thoroughly lubricate the gasket with material approved by the Pipe Manufacturer.
  - c. Place gasket in grooved spigot and relieve tension by inserting a dull instrument under the gasket and completing at least two revolutions around the joint circumference.
  - d. Upon completion of insertion of spigot (including any angular deflection as shown on the approved shop drawing) and prior to releasing from slings the entire placement of the gasket should be checked with a feeler gauge per manufacturer's recommendations. If gasket has disengaged or rolled, immediately pull the joint apart and reinstall the joint with a new gasket if required. Again verify proper placement of gasket with feeler gauge.
  - e. It is recommended that bonding wires or clips be installed as supplied by the Pipe Manufacturer unless otherwise specified in the Plans.
  - f. Grout the interior of the joints with cement mortar per AWWA C205.

#### 2. Lap Field Welded Joints

- a. Clean exposed end of joint surfaces.
- b. Provide a minimum overlap of 1-inch at any location around the joint circumference.
- c. Field welders and field weld procedures shall be certified in accordance with AWS D1.1.
- d. At the Contractor's option, provide a full fillet weld per AWWA C206 either on the inside or outside of the pipe. Inside welding may be performed after backfilling in accordance with manufacturer's recommendations.
- e. Testing of field welds shall be in accordance with AWWA C206.
- f. Grout the interior and exterior joints with cement mortar per AWWA C205.

#### 3. Flanged Joints

- a. Bolt holes of flanges shall straddle the horizontal and vertical centerlines of the pipe. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing; lubricate bolts with graphite or oil.
- b. Insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
- c. Execute care when tightening joints to prevent undue strain upon valves, pumps and other equipment.
- d. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or re-tighten the bolts and nuts, and retest the joints.

### 3.02 Field Quality Control

- A.** Perform hydrostatic pressure test in the presence of the Engineer in accordance with Section \_\_\_\_\_. Field test pressure should not exceed 120% of the pipes rated pressure class as measured at the lowest elevation for the section being tested. Leakage allowance shall be per AWWA M11 Chapter 12.
- B.** Provide all necessary piping between the reach being tested and the water supply, together with all required materials and equipment.
- C.** Provide dished heads, blind flange or bulkheads as necessary to isolate and test pipeline.
- D.** Methods and scheduling of tests to be approved by the Engineer.
- E.** Protect pipes and provide thrust restraint as required to complete test.
- F.** Provide for proper legal disposal of test water.

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# Suggested Specifications - Steel Pipe for Water Transmission

## Cement-mortar Lined and Polyurethane Coated

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### PART 1 - GENERAL

#### 1.01 Description

**Scope of Work:** Provide and install steel pipe of the sizes and in the locations shown on the Plans and as specified herein.

#### 1.02 Quality Assurance

**Commercial Standards:** Unless otherwise stated, the latest edition for any commercial standards and all manufacturing tolerances referenced, therein shall apply.

<b>ANSI/AWS D1.1</b>	Structural Welding Code- Steel
<b>ANSI/AWS B2.1</b>	Specification for Welding Procedure and Performance Qualification
<b>ANSI/AWWA C200</b>	Steel Water Pipe – 6 In. (150 mm) and Larger
<b>ANSI/AWWA C205</b>	Cement-Mortar Protective Lining and Coating for Steel Water Pipe – 4 In. (100 mm) and Larger- Shop Applied
<b>ANSI/AWWA C206</b>	Field Welding of Steel Water Pipe
<b>ANSI/AWWA C207</b>	Steel Pipe Flanges for Waterworks Service – Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
<b>ANSI/AWWA C208</b>	Dimensions for Fabricated Steel Water Pipe Fittings
<b>ANSI/AWWA C216</b>	Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fitting
<b>ANSI/AWWA C222</b>	Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings
<b>ASME Section IX</b>	International Boiler & Pressure Vessel Code: Welding and Brazing Qualifications
<b>STM A1011</b>	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
<b>ASTM A1018</b>	Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability
<b>AWWA M11</b>	Steel Water Pipe: A Guide for Design and Installation Systems and Specifications SSPC
<b>SSPC-PA 2</b>	Painting Manual, Volume 2 Chapter 7: Measurement of Dry Coating Thickness with Magnetic Gages

#### A. Qualifications

1. Manufacturers who are fully experienced, reputable, and qualified in the manufacture of the products to be furnished shall furnish all steel pipe and fittings. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

2. Pipe cylinders, coating, lining and fabrication of specials shall be the product of one manufacturer that has not less than 5 years successful experience manufacturing pipe of the particular type and size indicated. The Pipe Manufacturer must have a certified quality assurance program. This certified program shall be ISO 9001:2000 or other equivalent nationally recognized program as approved by the Engineer.

#### 1.03 Submittals

##### A. Shop Drawings

Drawings shall be submitted to the Engineer for approval and shall include the following:

1. Pipeline layout showing stations and elevations.
2. Details of standard pipe, joints, specials and fittings.

##### B. Design

1. Calculations for pipe design and fittings reinforcement and/or test data.
2. Details of joint bonding and field welded joint restraint calculations.

##### C. Certifications

1. The Contractor shall furnish a certified affidavit of compliance that meets or exceeds the requirements of these specifications for all pipe and fittings furnished.
2. Linings for potable piping shall be NSF certified

#### 1.04 Verifications

##### A. Inspections

1. All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of AWWA C200 and AWWA coating and lining standard as supplemented by the requirements herein.

##### B. Tests

1. Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA C200 and AWWA coating and lining standards.



## PART 1 - GENERAL (continued)

### B. Tests

2. The Contractor shall perform required tests at no additional cost to the Owner. The Engineer shall have the right to witness all testing conducted by the Contractor; provided, that the Contractor's schedule is not delayed for the convenience of the Engineer.

### C. Welding Requirements

1. All welding procedures used to fabricate pipe shall be qualified under the provision of AWS B2.1 or ASME Section IX.

### D. Welder Qualifications

1. Skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used shall do all welding. Welders shall maintain current qualifications under the provisions of AWS B2.1 or ASME Section IX. Machines and electrodes similar to those in the work shall be used in qualification tests. The Contractor shall furnish all material and bear the expense of qualifying welders.

### 1.05 Handling, Storage and Shipping

**A.** Pipe shall be studded as required to maintain roundness of +/- 1% during shipping and handling.

**B.** Coated pipe shall be shipped on padded bunks with nylon belt tie-down straps or padded banding located approximately over studding.

**C.** Coated pipe shall be stored on padded skids, sand or dirt berms, sand bags, old tires or other suitable means so that coating will not be damaged.

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

**E.** Prior to shipment, dielectrically coated pipe shall be visually inspected for coating damage by the following procedure:

1. When visual inspection shows a dielectric coating system has sustained physical damage, the area in question shall be subjected to an electrical holiday test. Voltage shall be per AWWA C222.

2. When the area is tested and there are no holidays, the area shall be noted "OK" and shipped with no patching required.

3. When the damaged area does show damage going clear to the steel from either a visual inspection or a jeep from a holiday detector, the area shall be repaired in accordance with Section 2.02 of these specifications and per manufacturer's recommendations.

### 1.06 Markings

**A.** The Contractor shall legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word "top" or other suitable marking shall be painted or marked on the outside top spigot end of each pipe section.

## PART 2 - PROJECTS

### 2.01 Materials

#### A. Pipe

1. Steel pipe shall conform to AWWA C200. Steel plate used in the manufacture and fabrication of steel pipe shall meet the requirements of ASTM A1011 or A1018. All longitudinal and girth seams, whether straight or spiral, shall be butt-welded using an approved electric-fusion-weld process.

2. Pipe shall be designed for \_\_\_\_\_ psi working pressure with an additional \_\_\_\_\_ psi allowance for surge. Pipe design shall be in accordance with AWWA M11.

3. Pipe shall be bedded and backfilled per the Plan details or manufacturer's recommendations utilizing an E' value for design check per AWWA M11 Chapter 6.

4. Pipe is to be furnished principally in 50-foot net laying lengths with shorter lengths, field trim pieces and closure pieces as required by Plan and profile for location of elbows, tees, reducers and other in-line fittings or as required for construction. The pipe fabricator shall prepare a pipe laying schedule showing the location of each piece by mark number with station and invert elevation at each bell end.

#### B. Fittings

1. Unless otherwise shown on the Plans, all specials and fittings shall conform to the dimensions of AWWA C208. Pipe material used in fittings shall be of the same material and pressure class as the adjoining pipe. The minimum radius of elbows shall be 2 1/2 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11 1/4-degrees (one cut elbow up to 22 1/2-degrees). If elbow radius is less than 2 1/2 times the pipe diameter, stresses shall be checked per AWWA M11 and the pressure class increased if necessary.

2. Fittings shall be equal in pressure class design as the adjoining pipe. Specials and fittings, unless otherwise shown on the Plans, shall be made of segmentally welded sections from hydrostatically tested pipe, with ends compatible with the type of joint or coupling specified for the pipe. All welds made after hydrostatic testing of the straight sections of pipe shall be tested per the requirements of AWWA C200 Section 5.2.2.1.

## PART 2 - PROJECTS (continued)

### C. Joints

#### 1. Rolled Groove Rubber Gasket Joint

- a. The standard joint shall be a rolled groove rubber gasket joint unless otherwise noted on the Plans. Rolled groove rubber gasket joints shall conform to AWWA C200 and as shown in Chapter 8 of AWWA M11.
- b. The O-ring gasket shall have sufficient volume to approximately fill the area of the groove and shall conform to AWWA C200.
- c. The joint shall be suitable for a working pressure equal to the class of pipe furnished and shall operate satisfactorily with a deflection angle, the tangent of which is not to exceed  $1.00/D$  where D is the outside diameter of the pipe in inches with a pull-out of 1-inch.
- d. Rolled groove rubber gasket joints may be furnished only by a manufacturer who has furnished pipe with joints of similar design for comparable working pressure and pipe diameters that has been in successful service for a period of at least 5 years.

#### 2. Lap Weld

- a. Lap weld joints shall conform to AWWA C200 and as shown in Chapter 8 of AWWA M11.
- b. Lap field welded joints shall be used where restrained joints are required or indicated on the Plans. The standard bell shall provide for a 2 1/2-inch lap. The minimum lap shall be 1-inch. The maximum joint deflection or offset shall be a 1-inch joint pull.
- c. Lap welded joints shall be welded either externally or internally. Holdbacks for coating and linings shall be provided as shown on the approved shop drawings. "Weld-after-backfill" of interior welds may be performed any time after joint completion and backfilling has been completed.
- d. Unless otherwise shown on the Plans, all field joints shall be lap welded for diameters 78-inches and greater.

#### 3. Mechanical Couplings

- a. Mechanical couplings where indicated on the Plans shall be Smith Blair Style 411, Baker Style 200, Victaulic Depend-O-Loc or equal.
- b. Insulating mechanical couplings where indicated on the Plans shall be double insulated Smith Blair Style 416, Baker Style 216, or equal for working pressures up to 150 psi only.
- c. Couplings for buried service shall have all metal parts painted with epoxy paint and conform to AWWA C222.

#### 3. Mechanical Couplings

- d. Pipe ends for mechanical couplings shall conform to AWWA C200 and M11. The shop applied outside coating shall be held back as required for field assembly of the mechanical coupling or to the harness lugs or rings. Harness lugs or rings and pipe ends shall be painted with one shop coat of epoxy conforming to AWWA C222.
- e. Pipe for use with sleeve-type couplings shall have plain ends at right angles to the axis.

#### 4. Flanges

- a. Flanges shall be in accordance with AWWA C207 Class D for operating pressures to 175 psi on 4-inch through 12-inch diameter, and operating pressures to 150 psi on diameters over 12-inches. Flanges shall be AWWA C207 Class E for operating pressures over 150 psi to 275 psi or shall be AWWA C207 Class F for pressures to 300 psi (drilling matches ANSI B 16.5 Class 250). Shop lining and coating shall be continuous to the end of the pipe or back of the flange. Flange faces shall be shop coated with a soluble rust preventive compound.
- b. Gaskets shall be full face, 1/8-inch thick, cloth-inserted rubber, Garlock 3000, John Crane Co. Style 777 or equal.

#### 5. Bolts and Nuts for Flanges

- a. Bolts for flanges shall be carbon steel, ASTM A 307, Grade B for Class B and D flanges and nuts shall be ASTM A 563, Grade A heavy hex. Bolts for Class E and F flanges shall be ASTM A 193, Grade B7 and nuts shall be ASTM A 194, Grade 2H heavy hex.

6. All unwelded pipe joints shall be bonded for electrical continuity in accordance with the Pipe Manufacturer's recommendations unless otherwise specified in the Plans.

### 2.02 Linings and Coatings

#### A. Cement-mortar Lining

1. Interior surface of all steel pipe, fittings and specials shall be lined in the shop with cement-mortar lining applied centrifugally and conforming with AWWA C205.
2. Holdbacks shall be left bare and be provided as shown on the approved shop drawings. Holdbacks shall be filled with cement mortar after joint completion per AWWA C205.
3. Defective linings as identified in AWWA C205 shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints.
4. Fittings shall be cement-mortar lined per AWWA C205. Pipe and fittings too small to cement-mortar line may be lined with AWWA C210 epoxy or AWWA C222 polyurethane.

## PART 2 - PROJECTS (continued)

### A. Cement-mortar Lining

5. Cement-mortar lining shall be kept moist during storage and shipping. The Contractor shall provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings to prevent drying out the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

### B. Polyurethane Coating

1. Polyurethane coating shall be per AWWA C222 to a minimum thickness of 25 mils, measured in accordance with SSPC-PA 2. Coating shall be continuous to the ends of the pipe except where field welding is indicated. Exterior field joints shall be completed utilizing heatshrink sleeves per AWWA C216.

2. Coating repairs shall be per AWWA C222 and paint manufacturer's recommendations.

## PART 3 - THE EXECUTION

### 3.01 Installation

**A.** The Contractor shall provide and install all required piping and accessories in accordance with the contract documents and manufacturer's recommendations. Pipe installation as specified in this section supplements AWWA M11.

### B. Installing Buried Piping

1. Handle pipe in a manner to avoid any damage to the pipe. Do not drop or roll pipe into trenches under any circumstances.

2. Inspect each pipe and fitting before lowering into the trench. Inspect the interior and exterior protective coatings. Repair damaged areas in the field in accordance with Section 2.02. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

3. Grade the bottom of the trench and place a 4-inch minimum layer of select or scarified material under the pipe. Before laying each section the pipe, check the grade and correct any irregularities found. The trench bottom shall form a uniform bearing and support for the pipe.

4. At the location of each joint, dig bell (joint) holes in the bottom of the trench and at the sides to permit completion and visual inspection of the entire joint.

5. Keep the trench in a dewatered condition during pipe laying.

6. When the pipe laying is not in progress, including the noon hours, close the open ends of the pipe. Do not permit trench water, animals, or foreign objects to enter the pipe.

### C. Joints Assembly

#### 1. Rolled Groove Rubber Gasket Joint

- a. Clean exposed ends of joint surfaces.
- b. Thoroughly lubricate the gasket with material approved by the Pipe Manufacturer.

#### 1. Rolled Groove Rubber Gasket Joint

c. Place gasket in grooved spigot and relieve tension by inserting a dull instrument under the gasket and completing at least two revolutions around the joint circumference.

d. Upon completion of insertion of spigot (including any angular deflection as shown on the approved shop drawing) and prior to releasing from slings the entire placement of the gasket should be checked with a feeler gauge per manufacturer's recommendations. If gasket has disengaged or rolled, immediately pull the joint apart and reinstall the joint with a new gasket if required. Again verify proper placement of gasket with feeler gauge.

e. It is recommended that bonding wires or clips be installed as supplied by the Pipe Manufacturer unless otherwise specified in the Plans.

f. Grout the interior of the joints with cement mortar per AWWA C205. Complete the exterior of the joints with heat-shrink sleeves per AWWA C216 and manufacturer's recommendations.

#### 2. Lap Field Welded Joints

a. Clean exposed end of joint surfaces.

b. Provide a minimum overlap of 1-inch at any location around the joint circumference.

c. Field welders and field weld procedures shall be certified in accordance with AWS D1.1.

d. At the Contractor's option, provide a full fillet weld per AWWA C206 either on the inside or outside of the pipe. Inside welding may be performed after backfilling in accordance with manufacturer's recommendations.

e. Testing of field welds shall be in accordance with AWWA C206.

f. Grout the interior of the joints with cement mortar per AWWA C205. Complete the exterior of the joints with heat-shrink sleeve per AWWA C216 and manufacturer's recommendations.

#### 3. Flanged Joints

a. Bolt holes of flanges shall straddle the horizontal and vertical centerlines of the pipe. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing; lubricate bolts with graphite or oil.

b. Insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.

c. Execute care when tightening joints to prevent undue strain upon valves, pumps and other equipment.

d. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or re-tighten the bolts and nuts, and retest the joints

## PART 3 - THE EXECUTION (continued)

### 3.02 Field Quality Control

- A.** Perform hydrostatic pressure test in the presence of the Engineer in accordance with Section \_\_\_\_\_. Field test pressure should not exceed 120% of the pipes rated pressure class as measured at the lowest elevation for the section being tested. Leakage allowance shall be per AWWA M11 Chapter 12.
- B.** Provide all necessary piping between the reach being tested and the water supply, together with all required materials and equipment.
- C.** Provide dished heads, blind flange or bulkheads as necessary to isolate and test pipeline.
- D.** Methods and scheduling of tests to be approved by the Engineer.
- E.** Protect pipes and provide thrust restraint as required to complete test.
- F.** Provide for proper legal disposal of test water.

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# Suggested Specifications - Steel Pipe for Water Transmission

## Polyurethane Lined and Tape Coated

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### PART 1 - GENERAL

#### 1.01 Description

**Scope of Work:** Provide and install steel pipe of the sizes and in the locations shown on the Plans and as specified herein.

#### 1.02 Quality Assurance

**Commercial Standards:** Unless otherwise stated, the latest edition for any commercial standards and all manufacturing tolerances referenced, therein shall apply.

<b>ANSI/AWS D1.1</b>	Structural Welding Code- Steel
<b>ANSI/AWS B2.1</b>	Specification for Welding Procedure and Performance Qualification
<b>ANSI/AWWA C200</b>	Steel Water Pipe – 6 In. (150 mm) and Larger
<b>ANSI/AWWA C206</b>	Field Welding of Steel Water Pipe
<b>ANSI/AWWA C207</b>	Steel Pipe Flanges for Waterworks Service – Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
<b>ANSI/AWWA C208</b>	Dimensions for Fabricated Steel Water Pipe Fittings
<b>ANSI/AWWA C209</b>	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipe
<b>ANSI/AWWA C210</b>	Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
<b>ANSI/AWWA C214</b>	Tape Coating Systems for the Exterior of Steel Water Pipelines
<b>ANSI/AWWA C215</b>	Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines
<b>ANSI/AWWA C216</b>	Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fitting
<b>ANSI/AWWA C222</b>	Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings
<b>ASME Section IX</b>	International Boiler & Pressure Vessel Code: Welding and Brazing Qualifications
<b>ASTM A1011</b>	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

<b>ASTM A1018</b>	Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability
<b>AWWA M11</b>	Steel Water Pipe: A Guide for Design and Installation
<b>SSPC-PA 2</b>	Systems and Specifications SSPC Painting Manual, Volume 2 Chapter 7: Measurement of Dry Coating Thickness with Magnetic Gages

#### A. Qualifications

1. Manufacturers who are fully experienced, reputable, and qualified in the manufacture of the products to be furnished shall furnish all steel pipe and fittings. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.
2. Pipe cylinders, coating, lining and fabrication of specials shall be the product of one manufacturer that has not less than 5 years successful experience manufacturing pipe of the particular type and size indicated. The Pipe Manufacturer must have a certified quality assurance program. This certified program shall be ISO 9001:2000 or other equivalent nationally recognized program as approved by the Engineer.

#### 1.03 Submittals

##### A. Shop Drawings

Drawings shall be submitted to the Engineer for approval and shall include the following:

1. Pipeline layout showing stations and elevations.
2. Details of standard pipe, joints, specials and fittings.

##### B. Design

1. Calculations for pipe design and fittings reinforcement and/or test data.
2. Details of joint bonding and field welded joint restraint calculations.

##### C. Certifications

1. The Contractor shall furnish a certified affidavit of compliance that meets or exceeds the requirements of these specifications for all pipe and fittings furnished.
2. Linings for potable piping shall be NSF certified

## PART 1 - GENERAL (continued)

### 1.04 Verifications

#### A. Inspections

1. All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of AWWA C200 and AWWA coating and lining standard as supplemented by the requirements herein.

#### B. Tests

1. Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA C200 and AWWA coating and lining standards.

2. The Contractor shall perform required tests at no additional cost to the Owner. The Engineer shall have the right to witness all testing conducted by the Contractor; provided, that the Contractor's schedule is not delayed for the convenience of the Engineer.

#### C. Welding Requirements

1. All welding procedures used to fabricate pipe shall be qualified under the provision of AWS B2.1 or ASME Section IX.

#### D. Welder Qualifications

1. Skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used shall do all welding. Welders shall maintain current qualifications under the provisions of AWS B2.1 or ASME Section IX. Machines and electrodes similar to those in the work shall be used in qualification tests. The Contractor shall furnish all material and bear the expense of qualifying welders.

### 1.05 Handling, Storage and Shipping

**A.** Pipe shall be studded as required to maintain roundness of +/- 1% during shipping and handling.

**B.** Coated pipe shall be shipped on padded bunks with nylon belt tie-down straps or padded banding located approximately over studding.

**C.** Coated pipe shall be stored on padded skids, sand or dirt berms, sand bags, old tires or other suitable means so that coating will not be damaged.

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

**E.** Prior to shipment, dielectrically coated pipe shall be visually inspected for damage to the coating by the following procedure:

1. When visual inspection shows a dielectric coating system has sustained physical damage, the area in question shall be subjected to an electrical holiday test. Voltage shall be per AWWA C214.

2. When the area is tested and there are no holidays or no tearing of the material (wrinkling or bruising of tape may be permitted), then the area shall be noted "OK" and shipped with no patching required.

3. When the damaged area does show damage going clear to the steel from either a visual inspection or a jeep from a holiday detector, the area shall be repaired in accordance with Section 2.02 of these specifications and per manufacturer's recommendations.

### 1.06 Markings

**A.** The Contractor shall legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word "top" or other suitable marking shall be painted or marked on the outside top spigot end of each pipe section.

## PART 2 - PROJECTS

### 2.01 Materials

#### A. Pipe

1. Steel pipe shall conform to AWWA C200. Steel plate used in the manufacture and fabrication of steel pipe shall meet the requirements of ASTM A1011 or A1018. All longitudinal and girth seams, whether straight or spiral, shall be butt-welded using an approved electric-fusion-weld process.

2. Pipe shall be designed for \_\_\_\_\_ psi working pressure with an additional \_\_\_\_\_ psi allowance for surge. Pipe design shall be in accordance with AWWA M11.

3. Pipe shall be bedded and backfilled per the Plan details or manufacturer's recommendations utilizing an E' value for design check per AWWA M11 Chapter 6.

4. Pipe is to be furnished principally in 50-foot net laying lengths with shorter lengths, field trim pieces and closure pieces as required by Plan and profile for location of elbows, tees, reducers and other in-line fittings or as required for construction. The pipe fabricator shall prepare a pipe laying schedule showing the location of each piece by mark number with station and invert elevation at each bell end.

#### B. Fittings

1. Unless otherwise shown on the Plans, all specials and fittings shall conform to the dimensions of AWWA C208. Pipe material used in fittings shall be of the same material and pressure class as the adjoining pipe. The minimum radius of elbows shall be 2 1/2 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11 1/4-degrees (one cut elbow up to 22 1/2-degrees). If elbow radius is less than 2 1/2 times the pipe diameter, stresses shall be checked per AWWA M11 and the pressure class increased if necessary.

## PART 2 - Projects (continued)

### 2.01 Materials

#### B. Fittings

2. Fittings shall be equal in pressure class design as the adjoining pipe. Specials and fittings, unless otherwise shown on the Plans, shall be made of segmentally welded sections from hydrostatically tested pipe, with ends compatible with the type of joint or coupling specified for the pipe. All welds made after hydrostatic testing of the straight sections of pipe shall be tested per the requirements of AWWA C200 Section 5.2.2.1.

#### C. Joints

##### 1. Rolled Groove Rubber Gasket Joint

- a. The standard joint shall be a rolled groove rubber gasket joint unless otherwise noted on the Plans. Rolled groove rubber gasket joints shall conform to AWWA C200 and as shown in Chapter 8 of AWWA M11.
- b. The O-ring gasket shall have sufficient volume to approximately fill the area of the groove and shall conform to AWWA C200.
- c. The joint shall be suitable for a working pressure equal to the class of pipe furnished and shall operate satisfactorily with a deflection angle, the tangent of which is not to exceed  $1.00/D$  where D is the outside diameter of the pipe in inches with a pull-out of 1-inch.
- d. Rolled groove rubber gasket joints may be furnished only by a manufacturer who has furnished pipe with joints of similar design for comparable working pressure and pipe diameters that has been in successful service for a period of at least 5 years.

##### 2. Lap Weld

- a. Lap weld joints shall conform to AWWA C200 and as shown in Chapter 8 of AWWA M11.
- b. Lap field welded joints shall be used where restrained joints are required or indicated on the Plans. The standard bell shall provide for a 2 1/2-inch lap. The minimum lap shall be 1-inch. The maximum joint deflection or offset shall be a 1-inch joint pull.
- c. Lap welded joints shall be welded either externally or internally. Holdbacks for coating and linings shall be provided as shown on the approved shop drawings. "Weld-after-backfill" of interior welds may be performed any time after joint completion and backfilling has been completed.
- d. Unless otherwise shown on the Plans, all field joints shall be lap welded for diameters 78-inches and greater.
- e. Pipe for use with sleeve-type couplings shall have plain ends at right angles to the axis.

##### 3. Mechanical Couplings

- a. Mechanical couplings where indicated on the Plans shall be Smith Blair Style 411, Baker Style 200, Victaulic Depend-O-Loc or equal.
- b. Insulating mechanical couplings where indicated on the Plans shall be double insulated Smith Blair Style 416, Baker Style 216, or equal for working pressures up to 150 psi only.
- c. Couplings for buried service shall have all metal parts painted with polyurethane paint and conform to AWWA C222.
- d. Pipe ends for mechanical couplings shall conform to AWWA C200 and M11. The shop applied outside coating shall be held back as required for field assembly of the mechanical coupling or to the harness lugs or rings. Harness lugs or rings and pipe ends shall be painted with one shop coat of polyurethane conforming to AWWA C222. The inside lining shall be continuous to the end of the pipe.

##### 4. Flanges

- a. Flanges shall be in accordance with AWWA C207 Class D for operating pressures to 175 psi on 4-inch through 12-inch diameter, and operating pressures to 150 psi on diameters over 12-inches. Flanges shall be AWWA C207 Class E for operating pressures over 150 psi to 275 psi or shall be AWWA C207 Class F for pressures to 300 psi (drilling matches ANSI B 16.5 Class 250). Shop lining and coating shall be continuous to the end of the pipe or back of the flange. Flange faces shall be shop coated with a soluble rust preventive compound.
- b. Gaskets shall be full face, 1/8-inch thick, cloth-inserted rubber, Garlock 3000, John Crane Co. Style 777 or equal.

##### 5. Bolts and Nuts for Flanges

- a. Bolts for flanges shall be carbon steel, ASTM A 307, Grade B for Class B and D flanges and nuts shall be ASTM A 563, Grade A heavy hex. Bolts for Class E and F flanges shall be ASTM A 193, Grade B7 and nuts shall be ASTM A 194, Grade 2H heavy hex.

6. All unwelded pipe joints shall be bonded for electrical continuity in accordance with the Pipe Manufacturer's recommendations unless otherwise specified in the Plans.

## PART 2 - Projects (continued)

### 2.02 Linings and Coatings

#### A. Polyurethane Lining

1. Polyurethane lining shall be per AWWA C222 to a minimum thickness of 20 mils, measured in accordance with SSPC-PA 2. Lining shall be continuous to the ends of the pipe except where field welding is indicated.
2. Lining repair shall be per AWWA C222 and manufacturer's recommendations.

#### B. Polyethylene Tape Coating

1. The prefabricated multi-layer cold applied tape coating system for straight-line pipe shall be in accordance with AWWA C214. The coating shall consist of a three-layer system totaling 80 mils.
  - a. An acceptable alternate to the prefabricated multi-layer cold applied tape coating system is an extruded polyolefin coating per AWWA C215.
2. Coating of Fittings, Specials and Joints
  - a. Fittings, specials and joints that cannot be machine coated, shall be coated in accordance with AWWA C209. Prefabricated tape shall be Type II and shall be compatible with the tape system used for straight-line pipe. The system shall consist of 2 layers totaling 70 mils.
  - b. Alternate coating methods for fittings, specials and field joints are shrink sleeves per AWWA C216, liquid epoxy per AWWA C210, or polyurethane per AWWA C222.
  - c. Where joint bonds are required, they shall be completely encapsulated by the coating system as per manufacturer's recommendations.
  - d. Coating repair for fittings and specials shall be in accordance with the procedure described below for straight-line pipe.
3. Coating repair shall be made using tape and primer conforming to AWWA C209 Type II and manufacturer's recommendations. The tape and primer shall be compatible with the tape system used for straight-line pipe.
  - a. An alternative repair method shall be to install heat shrink sleeves in accordance with AWWA C216 and manufacturer's recommendations

## PART 3 - THE EXECUTION

### 3.01 Installation

**A.** The Contractor shall provide and install all required piping and accessories in accordance with the contract documents and manufacturer's recommendations. Pipe installation as specified in this section supplements AWWA M11.

#### B. Installing Buried Piping

1. Handle pipe in a manner to avoid any damage to the pipe. Do not drop or roll pipe into trenches under any circumstances.
2. Inspect each pipe and fitting before lowering into the trench. Inspect the interior and exterior protective coatings. Repair damaged areas in the field in accordance with Section 2.02. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.
3. Grade the bottom of the trench and place a 4-inch minimum layer of select or scarified material under the pipe. Before laying each section the pipe, check the grade and correct any irregularities found. The trench bottom shall form a uniform bearing and support for the pipe.
4. At the location of each joint, dig bell (joint) holes in the bottom of the trench and at the sides to permit completion and visual inspection of the entire joint.
5. Keep the trench in a dewatered condition during pipe laying.
6. When the pipe laying is not in progress, including the noon hours, close the open ends of the pipe. Do not permit trench water, animals, or foreign objects to enter the pipe.

#### C. Joints Assembly

1. Rolled Groove Rubber Gasket Joint
  - a. Clean exposed ends of joint surfaces.
  - b. Thoroughly lubricate the gasket with material approved by the Pipe Manufacturer.
  - c. Place gasket in grooved spigot and relieve tension by inserting a dull instrument under the gasket and completing at least two revolutions around the joint circumference.
  - d. Upon completion of insertion of spigot (including any angular deflection as shown on the approved shop drawing) and prior to releasing from slings the entire placement of the gasket should be checked with a feeler gauge per manufacturer's recommendations. If gasket has disengaged or rolled, immediately pull the joint apart and reinstall the joint with a new gasket if required. Again verify proper placement of gasket with feeler gauge.
  - e. It is recommended that bonding wires or clips be installed as supplied by the Pipe Manufacturer unless otherwise specified in the Plans.
  - f. Complete the interior of the joints with polyurethane per AWWA C222. Complete the exterior of the joints with heat-shrink sleeves per AWWA C216 and manufacturer's recommendations.



## PART 3 - THE EXECUTION (continued)

### C. Joints Assembly

#### 2. Lap Field Welded Joints

- a. Clean exposed end of joint surfaces.
- b. Provide a minimum overlap of 1-inch at any location around the joint circumference.
- c. Field welders and field weld procedures shall be certified in accordance with AWS D1.1.
- d. At the Contractor's option, provide a full fillet weld per AWWA C206 either on the inside or outside of the pipe. Inside welding may be performed after backfilling in accordance with manufacturer's recommendations.
- e. Testing of field welds shall be in accordance with AWWA C206.
- f. Complete the interior of the joints with polyurethane per AWWA C222. Complete the exterior of the joints with heat-shrink sleeve per AWWA C216 and manufacturer's recommendations.

#### 3. Flanged Joints

- a. Bolt holes of flanges shall straddle the horizontal and vertical centerlines of the pipe. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing; lubricate bolts with graphite or oil.
- b. Insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
- c. Execute care when tightening joints to prevent undue strain upon valves, pumps and other equipment.
- d. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or re-tighten the bolts and nuts, and retest the joints

### 3.02 Field Quality Control

- A.** Perform hydrostatic pressure test in the presence of the Engineer in accordance with Section \_\_\_\_\_. Field test pressure should not exceed 120% of the pipes rated pressure class as measured at the lowest elevation for the section being tested. Leakage allowance shall be per AWWA M11 Chapter 12.
- B.** Provide all necessary piping between the reach being tested and the water supply, together with all required materials and equipment.
- C.** Provide dished heads, blind flange or bulkheads as necessary to isolate and test pipeline.
- D.** Methods and scheduling of tests to be approved by the Engineer.
- E.** Protect pipes and provide thrust restraint as required to complete test.
- F.** Provide for proper legal disposal of test water.

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# Suggested Specifications - Steel Pipe for Water Transmission

## Polyurethane Lined and Coated

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### PART 1 - GENERAL

#### 1.01 Description

**Scope of Work:** Provide and install steel pipe of the sizes and in the locations shown on the Plans and as specified herein.

#### 1.02 Quality Assurance

**Commercial Standards:** Unless otherwise stated, the latest edition for any commercial standards and all manufacturing tolerances referenced, therein shall apply.

<b>ANSI/AWS D1.1</b>	Structural Welding Code- Steel
<b>ANSI/AWS B2.1</b>	Specification for Welding Procedure and Performance Qualification
<b>ANSI/AWWA C200</b>	Steel Water Pipe – 6 In. (150 mm) and Larger
<b>ANSI/AWWA C206</b>	Field Welding of Steel Water Pipe
<b>ANSI/AWWA C207</b>	Steel Pipe Flanges for Waterworks Service – Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
<b>ANSI/AWWA C208</b>	Dimensions for Fabricated Steel Water Pipe Fittings
<b>ANSI/AWWA C216</b>	Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fitting
<b>ANSI/AWWA C219</b>	Bolted, Sleeve-Type Couplings for Plain-End Pipe
<b>ANSI/AWWA C222</b>	Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings
<b>ASME Section IX</b>	International Boiler & Pressure Vessel Code: Welding and Brazing Qualifications
<b>ASTM A1011</b>	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
<b>ASTM A1018</b>	Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability
<b>AWWA M11</b>	Steel Water Pipe: A Guide for Design and Installation
<b>SSPC-PA 2</b>	Systems and Specifications SSPC Painting Manual, Volume 2 Chapter 7: Measurement of Dry Coating Thickness with Magnetic Gages

#### A. Qualifications

1. Manufacturers who are fully experienced, reputable, and qualified in the manufacture of the products to be furnished shall furnish all steel pipe and fittings. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

2. Pipe cylinders, coating, lining and fabrication of specials shall be the product of one manufacturer that has not less than 5 years successful experience manufacturing pipe of the particular type and size indicated. The Pipe Manufacturer must have a certified quality assurance program. This certified program shall be ISO 9001:2000 or other equivalent nationally recognized program as approved by the Engineer.

#### 1.03 Submittals

##### A. Shop Drawings

Drawings shall be submitted to the Engineer for approval and shall include the following:

1. Pipeline layout showing stations and elevations.
2. Details of standard pipe, joints, specials and fittings.

##### B. Design

1. Calculations for pipe design and fittings reinforcement and/or test data.
2. Details of joint bonding and field welded joint restraint calculations.

##### C. Certifications

1. The Contractor shall furnish a certified affidavit of compliance that meets or exceeds the requirements of these specifications for all pipe and fittings furnished.
2. Linings for potable piping shall be NSF certified

#### 1.04 Verifications

##### A. Inspections

1. All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of AWWA C200 and AWWA coating and lining standard as supplemented by the requirements herein.

##### B. Tests

1. Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA C200 and AWWA coating and lining standards.

## PART 1 - GENERAL (continued)

### B. Tests

2. The Contractor shall perform required tests at no additional cost to the Owner. The Engineer shall have the right to witness all testing conducted by the Contractor; provided, that the Contractor's schedule is not delayed for the convenience of the Engineer.

### C. Welding Requirements

1. All welding procedures used to fabricate pipe shall be qualified under the provision of AWS B2.1 or ASME Section IX.

### D. Welder Qualifications

1. Skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used shall do all welding. Welders shall maintain current qualifications under the provisions of AWS B2.1 or ASME Section IX. Machines and electrodes similar to those in the work shall be used in qualification tests. The Contractor shall furnish all material and bear the expense of qualifying welders.

### 1.05 Handling, Storage and Shipping

**A.** Pipe shall be studded as required to maintain roundness of +/- 1% during shipping and handling.

**B.** Coated pipe shall be shipped on padded bunks with nylon belt tie-down straps or padded banding located approximately over studding.

**C.** Coated pipe shall be stored on padded skids, sand or dirt berms, sand bags, old tires or other suitable means so that coating will not be damaged.

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

**E.** Prior to shipment, dielectrically coated pipe shall be visually inspected for damage to the coating by the following procedure:

1. When visual inspection shows a dielectric coating system has sustained physical damage, the area in question shall be subjected to an electrical holiday test. Voltage shall be per AWWA C222.

2. When the damaged area does show damage going clear to the steel from either a visual inspection or a jeep from a holiday detector, the area shall be repaired in accordance with Section 2.02 of these specifications and per manufacturer's recommendations.

### 1.06 Markings

**A.** The Contractor shall legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word "top" or other suitable marking shall be painted or marked on the outside top spigot end of each pipe section.

## PART 2 - PROJECTS

### 2.01 Materials

#### A. Pipe

1. Steel pipe shall conform to AWWA C200. Steel plate used in the manufacture and fabrication of steel pipe shall meet the requirements of ASTM A1011 or A1018. All longitudinal and girth seams, whether straight or spiral, shall be butt-welded using an approved electric-fusion-weld process.

2. Pipe shall be designed for \_\_\_\_\_ psi working pressure with an additional \_\_\_\_\_ psi allowance for surge. Pipe design shall be in accordance with AWWA M11.

3. Pipe shall be bedded and backfilled per the Plan details or manufacturer's recommendations utilizing an E' value for design check per AWWA M11 Chapter 6.

4. Pipe is to be furnished principally in 50-foot net laying lengths with shorter lengths, field trim pieces and closure pieces as required by Plan and profile for location of elbows, tees, reducers and other in-line fittings or as required for construction. The pipe fabricator shall prepare a pipe laying schedule showing the location of each piece by mark number with station and invert elevation at each bell end.

#### B. Fittings

1. Unless otherwise shown on the Plans, all specials and fittings shall conform to the dimensions of AWWA C208. Pipe material used in fittings shall be of the same material and pressure class as the adjoining pipe. The minimum radius of elbows shall be 2 1/2 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11 1/4-degrees (one cut elbow up to 22 1/2-degrees). If elbow radius is less than 2 1/2 times the pipe diameter, stresses shall be checked per AWWA M11 and the pressure class increased if necessary.

#### B. Fittings

2. Fittings shall be equal in pressure class design as the adjoining pipe. Specials and fittings, unless otherwise shown on the Plans, shall be made of segmentally welded sections from hydrostatically tested pipe, with ends compatible with the type of joint or coupling specified for the pipe. All welds made after hydrostatic testing of the straight sections of pipe shall be tested per the requirements of AWWA C200 Section 5.2.2.1.

#### C. Joints

1. Rolled Groove Rubber Gasket Joint

a. The standard joint shall be a rolled groove rubber gasket joint unless otherwise noted on the Plans. Rolled groove rubber gasket joints shall conform to AWWA C200 and as shown in Chapter 8 of AWWA M11.

b. The O-ring gasket shall have sufficient volume to approximately fill the area of the groove and shall conform to AWWA C200.

## PART 2 - PROJECTS (continued)

### C. Joints

#### 1. Rolled Groove Rubber Gasket Joint

c. The joint shall be suitable for a working pressure equal to the class of pipe furnished and shall operate satisfactorily with a deflection angle, the tangent of which is not to exceed  $1.00/D$  where D is the outside diameter of the pipe in inches with a pull-out of 1-inch.

d. Rolled groove rubber gasket joints may be furnished only by a manufacturer who has furnished pipe with joints of similar design for comparable working pressure and pipe diameters that has been in successful service for a period of at least 5 years.

#### 2. Lap Weld

a. Lap weld joints shall conform to AWWA C200 and as shown in Chapter 8 of AWWA M11.

b. Lap field welded joints shall be used where restrained joints are required or indicated on the Plans. The standard bell shall provide for a 2 1/2-inch lap. The minimum lap shall be 1-inch. The maximum joint deflection or offset shall be a 1-inch joint pull.

c. Lap welded joints shall be welded either externally or internally. Holdbacks for coating and linings shall be provided as shown on the approved shop drawings. "Weld-after-backfill" of interior welds may be performed any time after joint completion and backfilling has been completed.

d. Unless otherwise shown on the Plans, all field joints shall be lap welded for diameters 78-inches and greater.

#### 3. Mechanical Couplings

a. Mechanical couplings where indicated on the Plans shall be Smith Blair Style 411, Baker Style 200, Victaulic Depend-O-Loc or equal.

b. Insulating mechanical couplings where indicated on the Plans shall be double insulated Smith Blair Style 416, Baker Style 216, or equal for working pressures up to 150 psi only.

c. Couplings for buried service shall have all metal parts painted with polyurethane paint and conform to AWWA C222.

d. Pipe ends for mechanical couplings shall conform to AWWA C200 and M11. Harness lugs or rings and pipe ends shall be painted with one shop coat of polyurethane conforming to AWWA C222. The inside lining shall be continuous to the end of the pipe. Coating holdbacks will be utilized only in areas where field welding is shown on the Plans.

e. Pipe for use with sleeve-type couplings shall have plain ends at right angles to the axis.

#### 4. Flanges

a. Flanges shall be in accordance with AWWA C207 Class D for operating pressures to 175 psi on 4-inch through 12-inch diameter, and operating pressures to 150 psi on diameters over 12-inches. Flanges shall be AWWA C207 Class E for operating pressures over 150 psi to 275 psi or shall be AWWA C207 Class F for pressures to 300 psi (drilling matches ANSI B 16.5 Class 250). Shop lining and coating shall be continuous to the end of the pipe or back of the flange. Flange faces shall be shop coated with a soluble rust preventive compound.

b. Gaskets shall be full face, 1/8-inch thick, cloth-inserted rubber, Garlock 3000, John Crane Co. Style 777 or equal.

#### 5. Bolts and Nuts for Flanges

a. Bolts for flanges shall be carbon steel, ASTM A 307, Grade B for Class B and D flanges and nuts shall be ASTM A 563, Grade A heavy hex. Bolts for Class E and F flanges shall be ASTM A 193, Grade B7 and nuts shall be ASTM A 194, Grade 2H heavy hex.

6. All unwelded pipe joints shall be bonded for electrical continuity in accordance with the Pipe Manufacturer's recommendations unless otherwise specified in the Plans.

### 2.02 Linings and Coatings

#### A. Polyurethane Lining

1. Polyurethane lining shall be per AWWA C222 to a minimum thickness of 20 mils, measured in accordance with SSPC-PA 2. Lining shall be continuous to the ends of the pipe except where field welding is indicated.

2. Lining repair shall be per AWWA C222 and manufacturer's recommendations.

#### B. Polyurethane Coating

1. Polyurethane coating shall be per AWWA C222 to a minimum thickness of 25 mils, measured in accordance with SSPC-PA 2. Coating shall be continuous to the ends of the pipe except where field welding is indicated. Exterior field joints shall be completed utilizing heat-shrink sleeves per AWWA C216.

2. Coating repair shall be per AWWA C222 and paint manufacturer's recommendations.

## PART 3 - THE EXECUTION

### 3.01 Installation

**A.** The Contractor shall provide and install all required piping and accessories in accordance with the contract documents and manufacturer's recommendations. Pipe installation as specified in this section supplements AWWA M11.

#### **B. Installing Buried Piping**

1. Handle pipe in a manner to avoid any damage to the pipe. Do not drop or roll pipe into trenches under any circumstances.
2. Inspect each pipe and fitting before lowering into the trench. Inspect the interior and exterior protective coatings. Repair damaged areas in the field in accordance with Section 2.02. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.
3. Grade the bottom of the trench and place a 4-inch minimum layer of select or scarified material under the pipe. Before laying each section the pipe, check the grade and correct any irregularities found. The trench bottom shall form a uniform bearing and support for the pipe.
4. At the location of each joint, dig bell (joint) holes in the bottom of the trench and at the sides to permit completion and visual inspection of the entire joint.
5. Keep the trench in a dewatered condition during pipe laying.
6. When the pipe laying is not in progress, including the noon hours, close the open ends of the pipe. Do not permit trench water, animals, or foreign objects to enter the pipe.

#### **C. Joints Assembly**

##### 1. Rolled Groove Rubber Gasket Joint

- a. Clean exposed ends of joint surfaces.
- b. Thoroughly lubricate the gasket with material approved by the Pipe Manufacturer.
- c. Place gasket in grooved spigot and relieve tension by inserting a dull instrument under the gasket and completing at least two revolutions around the joint circumference.
- d. Upon completion of insertion of spigot (including any angular deflection as shown on the approved shop drawing) and prior to releasing from slings the entire placement of the gasket should be checked with a feeler gauge per manufacturer's recommendations. If gasket has disengaged or rolled, immediately pull the joint apart and reinstall the joint with a new gasket if required. Again verify proper placement of gasket with feeler gauge.
- e. It is recommended that bonding wires or clips be installed as supplied by the Pipe Manufacturer unless otherwise specified in the Plans.
- f. Complete the interior of the joints with polyurethane per AWWA C222. Complete the exterior of the joints with heat-shrink sleeves per AWWA C216 and manufacturer's recommendations.

##### 2. Lap Field Welded Joints

- a. Clean exposed end of joint surfaces.
- b. Provide a minimum overlap of 1-inch at any location around the joint circumference.
- c. Field welders and field weld procedures shall be certified in accordance with AWS D1.1.
- d. At the Contractor's option, provide a full fillet weld per AWWA C206 either on the inside or outside of the pipe. Inside welding may be performed after backfilling in accordance with manufacturer's recommendations.
- e. Testing of field welds shall be in accordance with AWWA C206.
- f. Complete the interior of the joints with polyurethane per AWWA C222. Complete the exterior of the joints with heat-shrink sleeve per AWWA C216 and manufacturer's recommendations.

##### 3. Flanged Joints

- a. Bolt holes of flanges shall straddle the horizontal and vertical centerlines of the pipe. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing; lubricate bolts with graphite or oil.
- b. Insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
- c. Execute care when tightening joints to prevent undue strain upon valves, pumps and other equipment.
- d. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or re-tighten the bolts and nuts, and retest the joints

## PART 3 - THE EXECUTION (continued)

### 3.02 Field Quality Control

- A.** Perform hydrostatic pressure test in the presence of the Engineer in accordance with Section \_\_\_\_\_. Field test pressure should not exceed 120% of the pipes rated pressure class as measured at the lowest elevation for the section being tested. Leakage allowance shall be per AWWA M11 Chapter 12.
- B.** Provide all necessary piping between the reach being tested and the water supply, together with all required materials and equipment.
- C.** Provide dished heads, blind flange or bulkheads as necessary to isolate and test forcemain.
- D.** Methods and scheduling of tests to be approved by the Engineer.
- E.** Protect pipes and provide thrust restraint as required to complete test.
- F.** Provide for proper legal disposal of test water.

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# Suggested Specifications - Steel Pipe for Water Transmission

## Bar-wrapped, Steel Cylinder Type

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### PART 1 - GENERAL

#### 1.01 Description

**Scope of Work:** Provide and install steel pipe of the sizes and in the locations shown on the Plans and as specified herein.

#### 1.02 Quality Assurance

**Commercial Standards:** Unless otherwise stated, the latest edition for any commercial standards and all manufacturing tolerances referenced, therein shall apply.

<b>ANSI/AWS D1.1</b>	Structural Welding Code- Steel
<b>ANSI/AWS B2.1</b>	Specification for Welding Procedure and Performance Qualification
<b>ANSI/AWWA C206</b>	Field Welding of Steel Water Pipe
<b>ANSI/AWWA C207</b>	Steel Pipe Flanges for Waterworks Service – Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
<b>ANSI/AWWA C208</b>	Dimensions for Fabricated Steel Water Pipe Fittings
<b>ANSI/AWWA C210</b>	Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
<b>ANSI/AWWA C303</b>	Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type
<b>ASTM A615</b>	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
<b>ASME Section IX</b>	International Boiler & Pressure Vessel Code: Welding and Brazing Qualifications
<b>ASTM A1011</b>	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
<b>ASTM A1018</b>	Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability
<b>AWWA M9</b>	Concrete Pressure Pipe
<b>AWWA M11</b>	Steel Water Pipe: A Guide for Design and Installation

#### A. Qualifications

1. Manufacturers who are fully experienced, reputable, and qualified in the manufacture of the products to be furnished shall furnish all steel pipe and fittings. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.
2. Pipe cylinders, coating, lining and fabrication of specials shall be the product of one manufacturer that has not less than 5 years successful experience manufacturing pipe of the particular type and size indicated. The Pipe Manufacturer must have a certified quality assurance program. This certified program shall be ISO 9001:2000 or other equivalent nationally recognized program as approved by the Engineer.

#### 1.03 Submittals

##### A. Shop Drawings

Drawings shall be submitted to the Engineer for approval and shall include the following:

1. Pipeline layout showing stations and elevations.
2. Details of standard pipe, joints, specials and fittings.
3. Welder certifications and qualifications.
4. Details of stulling and shipping packaging.

##### B. Design

1. Calculations for pipe design and fittings reinforcement and/or test data.
2. Details of joint bonding and field welded joint restraint calculations.

##### C. Certifications

1. The Contractor shall furnish a certified affidavit of compliance that meets or exceeds the requirements of these specifications for all pipe and fittings furnished.
2. Linings for potable piping shall be NSF certified

#### 1.04 Verifications

##### A. Inspections

1. All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of AWWA C303 and as supplemented by the requirements herein.

##### B. Tests

1. Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA C303.

## PART 1 - GENERAL (continued)

### B. Tests

2. The Contractor shall perform required tests at no additional cost to the Owner. The Engineer shall have the right to witness all testing conducted by the Contractor; provided, that the Contractor's schedule is not delayed for the convenience of the Engineer.

### C. Welding Requirements

1. All welding procedures used to fabricate pipe shall be qualified under the provision of AWS D1.1, AWS B2.1 or ASME Section IX. Welding procedures shall be required for, but not limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds.

### D. Welder Qualifications

1. Skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used shall do all welding. Welders shall maintain current qualifications under the provisions of AWS B2.1 or ASME Section IX. Machines and electrodes similar to those in the work shall be used in qualification tests. The Contractor shall furnish all material and bear the expense of qualifying welders.

### 1.05 Handling, Storage and Shipping

**A.** Pipe shall be studded as required to maintain roundness of +/- 1% during shipping and handling.

**B.** Coated pipe shall be shipped on padded bunks with nylon belt tie-down straps or padded banding located approximately over studding.

**C.** Coated pipe shall be stored on padded skids, sand or dirt berms, sand bags, old tires or other suitable means so that coating will not be damaged.

**D.** Coated pipe shall be handled with wide belt slings.

### 1.06 Markings

**A.** The Contractor shall legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word "top" or other suitable marking shall be painted or marked on the outside top spigot end of each pipe section.

## PART 2 - PROJECTS

### 2.01 Materials

#### A. Pipe

The pipe furnished shall be concrete pressure pipe, barwrapped, with steel joint rings and rubber gaskets or field welded joints. Concrete pressure pipe, bar-wrapped, shall consist of a steel cylinder with attached steel joint rings, centrifugally lined with portland cement mortar, spirally wrapped with circumferential steel reinforcing bar under measured tension and coated with portland cement mortar. The pipe shall be of the diameter and class shown, shall be furnished complete with rubber gaskets or welded joints, as indicated in the Contract Documents, and all specials and bends shall be provided as required.

2. Pipe manufactured under AWWA C303 shall be fabricated from sheet conforming to the requirements of ASTM A1011 or A1018. All longitudinal and girth seams, whether straight or spiral, shall be welded using an approved electric-fusionweld process.

3. Pipe shall be designed for \_\_\_\_\_ psi working pressure with an additional \_\_\_\_\_ psi allowance for surge. Pipe design shall be in accordance with AWWA C303 and M9.

a. Bar-wrapped pipe shall be designed in accordance with AWWA C303 except that the area of steel cylinder shall be a minimum of 60% of the total steel area (cylinder plus rod reinforcement) but in no case shall the design stress (using a safety factor of 2.0 to yield strength) be greater than 18,000 psi, at design working pressure nor shall the design stress (using a safety factor of 1.5 to yield strength) be greater than 27,000 psi at design transient pressure. Unless otherwise specified  $P_w$  shall be assumed to equal the pipe class and  $P_t$  shall be assumed to equal  $1.33 P_w$ .

4. Maximum pipe laying lengths shall be 40 feet with shorter lengths provided as required by the Plans. Longer lengths may be used as approved by the Engineer.

5. All pipe and fittings shall be designed, manufactured, tested, inspected, and marked according to the applicable requirements and shall conform to AWWA C303 and M9.

#### B. Fittings

1. Unless otherwise shown on the Plans, all specials and fittings shall conform to the dimensions of AWWA C208. Pipe material used in fittings shall be of the same material and pressure class as the adjoining pipe. The minimum radius of elbows shall be 2 1/2 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11 1/4-degrees (one cut elbow up to 22 1/2-degrees.). If elbow radius is less than 2 1/2 times the pipe diameter, stresses shall be checked per AWWA M11 and wall thickness increased as required.

2. Closures and correction pieces shall be provided as required to conform to pipe stationing shown on the Plans.



## PART 2 - PROJECTS (continued)

### 2.01 Materials

#### C. Joints

##### 1. O-ring Rubber Gasket Joint

- a. The standard joint shall be O-ring unless otherwise noted on the Plans. O-ring joints shall conform to AWWA C303 and as shown in AWWA M9.
- b. The O-ring gasket shall have sufficient volume to approximately fill the area of the groove and shall conform to AWWA C303.
- c. The joint shall be suitable for a safe working pressure equal to the class of pipe furnished and shall operate satisfactorily with a deflection angle, the tangent of which is not to exceed  $1.00/D$  where D is the outside diameter of the pipe in inches with a pull-out of 1-inch.
- d. O-ring joints may be furnished only by a manufacturer who has furnished pipe with joints of similar design for comparable working pressure and pipe diameters that has been in successful service for a period of at least 5 years.

##### 2. Restrained Joints

- a. Restrained joints, where required for thrust restraint, shall be field welded joints. Design shall include considerations of stresses induced in the steel cylinder, the joint rings, and any field welds caused by thrust at bulkheads, bends, reducers, and line valves resulting from the design working pressure. For field welded joints, design stresses shall not exceed 50% of the specified minimum yield strength of the grade of steel utilized, or 18,000 psi, whichever is less, when longitudinal thrust is assumed to be uniformly distributed around the circumference of the joint.
  - i) The steel cylinder shall be designed and furnished with sufficient additional thickness to withstand 100% of the longitudinal stresses as a result of thrust conditions. In no case shall the steel cylinder thickness in the joint be less than the steel thickness required for the fittings. No reduction in cylinder thickness shall be allowed throughout the entire length of welded restrained joints.
  - ii) At the Contractor's option, welded joints for thrust restraint shall be either trimmed spigots as shown in Figure 9-12.B in AWWA M9 or lap weld joints as shown in Figure 8-1.A or D in AWWA M11.
  - iii) If the trimmed spigot option is used, the bell and spigot joint rings shall be welded on both the inside and outside at the connection to the steel cylinder. Additionally, the minimum thickness for the trimmed spigots and bell sections shall be equal to or greater than the required thickness for the fittings.

##### 3. Mechanical Couplings

- a. Mechanical couplings where indicated on the Plans shall be Smith Blair Style 411, Baker Style 200, Victaulic Depend-O-Loc or equal.
- b. Insulating mechanical couplings where indicated on the Plans shall be double insulated Smith Blair Style 416, Baker Style 216, or equal for working pressures up to 150 psi only.
- c. Couplings for buried service shall have all metal parts painted with epoxy paint and conform to AWWA C210.
- d. Pipe ends for mechanical couplings shall conform to AWWA C200 and M11. The shop applied outside coating shall be held back as required for field assembly of the mechanical coupling or to the harness lugs or rings. Harness lugs or rings and pipe ends shall be painted with one shop coat of epoxy conforming to AWWA C210.
- e. Pipe for use with sleeve-type couplings shall have plain ends at right angles to the axis.

##### 4. Flanges

- a. Flanges shall be in accordance with AWWA C207 Class D for operating pressures to 175 psi on 4-inch through 12-inch diameter, and operating pressures to 150 psi on diameters over 12-inches. Flanges shall be AWWA C207 Class E for operating pressures over 150 psi to 275 psi or shall be AWWA C207 Class F for pressures to 300 psi (drilling matches ANSI B 16.5 Class 250). Shop lining and coating shall be continuous to the end of the pipe or back of the flange. Flange faces shall be shop coated with a soluble rust preventive compound.
- b. Gaskets shall be full face, 1/8-inch thick, cloth-inserted rubber, Garlock 3000, John Crane Co. Style 777 or equal.

##### 5. Bolts and Nuts for Flanges

- a. Bolts for flanges shall be carbon steel, ASTM A 307, Grade B for Class B and D flanges and nuts shall be ASTM A 563, Grade A heavy hex. Bolts for Class E and F flanges shall be ASTM A 193, Grade B7 and nuts shall be ASTM A 194, Grade 2H heavy hex.

6. All unwelded pipe joints shall be bonded for electrical continuity in accordance with the Pipe Manufacturer's recommendations unless otherwise specified in the Plans.

### 2.02 Linings and Coatings

#### A. Cement-mortar Lining

Cement for mortar shall conform to the requirements of AWWA C303, provided that cement for mortar lining shall be Type II. A fly ash or pozzolan shall not be used as a cement replacement.

## PART 2 - PROJECTS (continued)

### A. Cement-mortar Lining

2. Except as otherwise noted, interior surfaces of all steel pipe, fittings, and specials shall be lined in the shop with cementmortar lining applied centrifugally in conformity with AWWA C303. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machined shall be of a type that has been used successfully for similar work and shall be approved by the Engineer. Every precaution shall be taken to prevent damage to the lining.

3. The pipe shall be left bare where field welded joints occur as shown on the Plans. Ends of the lining shall be left square and uniform. Feathered or uneven edges will not be permitted.

4. All defects, including, but not limited to, sand pockets, voids, oversanded areas, blisters, and cracking as a result of impacts, shall be cut out and replaced by hand or pneumatic placement to the same thickness as required for the cement-mortar lining. Temperature and shrinkage cracks in the cement-mortar lining less than 1/16 inch do not need repair if it can be demonstrated to the satisfaction of the Purchaser that the cracks will heal autogenously under continuous soaking in water. The autogenous healing process may be demonstrated by any procedure that keeps the pipe lining continually wet or moist. Pipe used in the demonstration shall be representative of the pipe to be supplied, and water for the moistening of the pipe shall be chemically similar to the water to be carried in the pipeline.

5. Cement-mortar lining shall be kept moist during storage and shipping. The Contractor shall provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings to prevent drying out the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

### B. Cement-mortar Coating

1. Cement for mortar shall conform to the requirements of AWWA C303, provided that cement for mortar coating shall be Type II. A fly ash or pozzolan shall not be used as a cement replacement.

2. All buried pipe, including bumped heads, shall be coated with a minimum 3/4-inch thick cement-mortar coating over the rod wrap. Unless otherwise shown on the Plans, exterior surfaces of pipe or fitting passing through structure walls shall be cementmortar coated from the center of the wall or from the wall flange to the end of the underground portion of pipe or fittings.

### C. Fittings

1. Fittings shall be lined and coated per AWWA C303. Fittings too small to cement mortar line may be lined with AWWA C210 epoxy or AWWA C222 polyurethane.

## PART 3 - THE EXECUTION

### 3.01 Installation

**A.** The Contractor shall provide and install all required piping and accessories in accordance with the contract documents and manufacturer's recommendations. Pipe installation as specified in this section supplements AWWA M9.

### B. Installing Buried Piping

1. Handle pipe in a manner to avoid any damage to the pipe. Do not drop or roll pipe into trenches under any circumstances.

2. Inspect each pipe and fitting before lowering into the trench. Inspect the interior and exterior protective coatings. Repair damaged areas in the field in accordance with Section 2.02. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

3. Grade the bottom of the trench and place a 4-inch minimum layer of select or scarified material under the pipe. Before laying each section the pipe, check the grade and correct any irregularities found. The trench bottom shall form a uniform bearing and support for the pipe.

4. At the location of each joint, dig bell (joint) holes in the bottom of the trench and at the sides to permit completion and visual inspection of the entire joint.

5. Keep the trench in a dewatered condition during pipe laying.

6. When the pipe laying is not in progress, including the noon hours, close the open ends of the pipe. Do not permit trench water, animals, or foreign objects to enter the pipe.

### C. Joints Assembly

#### 1. O-ring Rubber Gasket Joint

a. Clean exposed ends of joint surfaces.

b. Thoroughly lubricate the gasket with material approved by the Pipe Manufacturer.

c. Place gasket in grooved spigot and relieve tension by inserting a dull instrument under the gasket and completing at least two revolutions around the joint circumference.

d. Upon completion of insertion of spigot (including any angular deflection as shown on the approved shop drawing) and prior to releasing from slings the entire placement of the gasket should be checked with a feeler gauge per manufacturer's recommendations. If gasket has disengaged or rolled, immediately pull the joint apart and reinstall the joint with a new gasket if required. Again verify proper placement of gasket with feeler gauge.

e. It is recommended that bonding wires or clips be installed as supplied by the Pipe Manufacturer unless otherwise specified in the Plans.

f. Grout the interior and exterior of the joints with cement mortar per AWWA M9.

## PART 3 - THE EXECUTION (continued)

### C. Joints Assembly

#### 2. Restrained Joints

- a. Clean exposed end of joint surfaces.
- b. Provide a minimum overlap of 1-inch at any location around the joint circumference.
- c. Field welders and field weld procedures shall be certified in accordance with AWS D1.1.
- d. At the Contractor's option, provide a full fillet weld per AWWA 206 either on the inside or outside of the pipe. Inside welding may be performed after backfilling in accordance with manufacturer's recommendations.
- e. Testing of field welds shall be in accordance with AWWA C206.
- f. Grout the interior and exterior of the joints with cement mortar per AWWA M9.

#### 3. Flanged Joints

- a. Bolt holes of flanges shall straddle the horizontal and vertical centerlines of the pipe. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing; lubricate bolts with graphite or oil.
- b. Insert the nuts and bolts (or studs), finger tighten, and progressively tighten diametrically opposite bolts uniformly around the flange to the proper tension.
- c. Execute care when tightening joints to prevent undue strain upon valves, pumps and other equipment.
- d. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or re-tighten the bolts and nuts, and retest the joints

### 3.02 Field Quality Control

- A.** Perform hydrostatic pressure test in the presence of the Engineer in accordance with Section \_\_\_\_\_. Field test pressure should not exceed 120% of the pipes rated pressure class as measured at the lowest elevation for the section being tested. Leakage allowance shall be per AWWA M9.
- B.** Provide all necessary piping between the reach being tested and the water supply, together with all required materials and equipment.
- C.** Provide dished heads, blind flange or bulkheads as necessary to isolate and test pipeline.
- D.** Methods and scheduling of tests to be approved by the Engineer.
- E.** Protect pipes and provide thrust restraint as required to complete test.
- F.** Provide for proper legal disposal of test water.

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