

## SUGGESTED SPECIFICATION

# Steel Pipe for Water Transmission Cement Mortar Lined and Tape Coated

## AWWA C200

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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.

ANSI/AWS D1.1	Structural Welding Code- Steel
ANSI/AWWA C200	Steel Water Pipe—6 In. (150 mm) and Larger
ANSI/AWWA C205	Cement mortar Protective Lining and Coating for Steel Water Pipe – 4 In. (100 mm) and Larger- Shop Applied
ANSI/AWWA C206	Field Welding of Steel Water Pipe
ANSI/AWWA C207	Steel Pipe Flanges for Waterworks Service—Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
ANSI/AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
ANSI/AWWA C209	Cold-Applied Tape Coatings for Water Pipe, Special Sections, Connections and Fittings
ANSI/AWWA C214	Tape Coatings for Steel Water Pipe

ANSI/AWWA C216	Heat-Shrinkable Cross-Linked Polyolefin Coatings for the Exterior of Special Sections, Connections, and Fitting
ANSI/AWWA C222	Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings
ANSI/AWWA C604	Installation of Buried Steel Pipe – 4 inch and Larger
ASME Section IX	International Boiler & Pressure Vessel Code: Welding and Brazing Qualifications
AWWA M11	Steel Water Pipe: A Guide for Design and Installation
SSPC-PA 2	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, lining, coating and fabrication of specials shall be the product of one manufacturer that has not less than five years successful experience manufacturing pipe of the particular type and size indicated. The Pipe Manufacturer must have a certified quality assurance program and all manufacturing, coating or lining operations must be performed at one facility. 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 verification of 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. Pipe linings in contact with potable water shall be NSF certified.

## **1.04 Verification**

### **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 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 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.** Coated pipe shall be shipped on padded bunks with nylon belt tie-down straps or padded banding located approximately over stulling.
- B.** 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.
- C.** Coated pipe shall be handled with wide belt slings. Chains, cables or other equipment likely to cause damage to the pipe coating or lining shall not be used.
- D.** Prior to shipment, dialectically 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 the applicable AWWA coating standard.
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.

## PART 2: PRODUCTS

### 2.01 Materials

#### A. Pipe

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

1. *SPECIFIER OPTION:* Pipe shall be designed for \_\_\_\_\_ psi working pressure with an additional \_\_\_\_\_ psi allowance for surge. Pipe design shall be in accordance with AWWA M11. *(in no case shall design be less than 150 psi or 75 psi for surge)*

*OR:*

Pipe pressure zones shall be designed for a maximum of 50% of yield at working pressure and 75% of yield at the maximum pressure (test or transient) as shown on the plans. *(In no case shall design pressure be less than 150 psi for working or 225 psi for maximum pressure.)*

2. Pipe shall be bedded and backfilled per the Plan details utilizing an E' value for design check per AWWA M11 Chapter 5, External Loads on Buried Pipe.
3. 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 AWWA M11 and the dimensions of AWWA C208. Pipe material used in fittings shall be of the same material and pressure class as the adjoining pipe. The radius of elbows shall be 2 ½ times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11 ¼-degrees (one cut elbow up to 22 ½-degrees). If elbow radius is less than 2 ½ times the pipe diameter, stresses shall be checked per AWWA M-11.
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 segmental 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.

## 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 6 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 O-ring gasket joint shall be used where unrestrained joints are shown on the plans. The design maximum joint deflection or offset shall be a 1-inch joint pull.
  - 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 has been in successful service for a period of at least five years.
2. Lap Weld
  - a. Lap weld joints shall conform to AWWA C200 and as shown in Chapter 6 of AWWA M11.
  - b. Lap field welded joints shall be used where restrained joints are required or indicated on the Plans. The design 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, Romac Style 400, ClampTite, 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.
  - c. Couplings for buried service shall have all metal parts painted with polyurethane paint conforming to AWWA C222 or epoxy per 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. Harness lugs or rings shall be painted with polyurethane 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.
  - b. 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).
  - c. 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.
  - d. Gaskets shall be per C207 Table 1.
5. Bolts and Nuts for Flanges
  - a. Bolts for flanges shall be carbon steel, ASTM A 193, Grade B7 and nuts shall be ASTM A 194, Grade 2H heavy hex in accordance with AWWA C207.
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 in conformity 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 to limit shrinkage cracking. The supplier 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. Do not remove bulkheads prior to installation.

## **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
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.
2. 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: 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 and AWWA C604.

## **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. Lubricate the bell or gasket with lubricant approved by the 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. 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 required 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' qualifications and field weld procedures shall be in accordance with AWWA C206 and 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. Install Flanged Joints per AWWA M11 and AWWA C604
- b. Boltholes of flanges shall straddle the horizontal and vertical centerlines of the pipe. Clean flange faces, bolts and nuts by wire brushing just prior to installation to provide good sealing surfaces. Select gasket per AWWA C207 Table 1 and install gasket per C604.
- c. Insert the bolts (or studs), lubricate the bolt and finger tighten the nut onto the bolt or stud. Progressively tighten bolts per the bolting pattern selected in AWWA C604 to the appropriate torque value. Retighten bolts after 4-6 hours as gasket relaxes.
- d. Execute care when tightening joints to prevent undue strain upon valves, pumps and other equipment.
- e. If flanges leak under pressure testing, loosen or remove the nuts and bolts, 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 125% of the pipes rated pressure class as measured at the lowest elevation for the section being tested. Leakage allowance shall be per AWWA C604.
- 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.