

Section 02635**STEEL PIPE AND FITTINGS****1.0 GENERAL****1.01 SECTION INCLUDES**

- A New steel pipe and fittings for water mains, pumping facilities, and casings.
- B References to Technical Specifications:
 - 1. Section 01350 – Submittals
 - 2. Section 02636 – Polyurethane Coatings on Steel or Ductile Iron Pipe
 - 3. Section 02510 – Water Mains
- C Referenced Standards:
 - 1. American Society for Testing and Materials (ASTM)
 - a. ASTM A 36, “Standard Specification for Carbon structural Steel”
 - b. ASTM A 570, “Standard Practice for Roof System Assemblies Employing Steel Deck, Performed Roof Insulation, and Bituminous Built-Up Roofing”
 - c. ASTM A 53, “Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless”
 - d. ASTM A 135, “Standard Specification for Electric-Resistance-Welded Steel Pipe”
 - e. ASTM A 139, “Standard Specification for Electric-Fusion (arc)-Welded Steel Pipe (NPS 4 and Over)”
 - f. ASTM C 150, “Standard Specification for Portland Cement”
 - g. ASTM C 33, “Standard Specification for Concrete Aggregates”
 - h. ASTM D 512, “Standard Test Method for Chloride Ion in Water”
 - i. ASTM D 1293, “Standard Test Method for pH of Water”
 - j. ASTM D 4541, “Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers”
 - 2. American Water Works Association (AWWA)
 - a. AWWA C200 Steel Water Pipe – 6 in. and Larger
 - b. AWWA C206 Field Welding of Steel Water Pipe
 - c. AWWA M11 Steel Water Pipe: A Guide for Design and Installation, Fourth Edition
 - d. AWWA C207 Steel Pipe Flanges for Waterworks Service – Sizes 4 in. Through 144 in.
 - e. AWWA C214 Tape Coating Systems for the Exterior of Steel Water Pipelines
 - f. AWWA C210 Liquid-Epoxy Coating Systems for the Interior and Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines

- g. AWWA C205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe – 4 in. and Larger – Shop Applied
 - h. AWWA C602 Cement-Mortar Lining of Water Pipelines in Place-4 in. and Larger
 - i. AWWA C209 Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines
- 3. American National Standards Institute (ANSI)
 - 4. National Sanitation Foundation (NFS)

1.02 MEASUREMENT AND PAYMENT

- A Unless indicated as a Bid Item, no separate payment will be made for steel pipe and fittings under this Section. Include cost in Bid Items for water mains, pumping facilities and casings.

1.03 SUBMITTALS

- A Make Submittals required by this Section under the provisions of Section 01350 – Submittals.
- B Submit Shop Drawings for aerial crossings and water plant/facilities. Include design of new pipe and fittings indicating alignment and grade, laying dimensions, lining and coating systems, proposed welding procedures, fabrication, fitting, flange, and special details.
- C Show station numbers for pipe and fittings corresponding to Plans.

1.04 QUALITY CONTROL

- A Provide manufacturer's certifications that all pipe and fittings have been hydrostatically tested at factory in accordance with AWWA C200, Section 3.4.
- B Provide manufacturer's affidavits that polyurethane coatings, linings and tape coatings comply with applicable requirements of this Section and that coatings were applied and allowed to cure at a temperature 5 degrees above the dew point.
- C Provide manufacturer's affidavits that mortar coatings and linings comply with applicable requirements of this Section and that linings were applied and allowed to cure at a temperature above 32 degrees F.
- D Prior to work being started, provide proof of certification of qualification for all welders employed for type of work, procedures and positions involved. Qualifications shall be in accordance with AWWA C206.
- E Production of pipe and fittings prior to review by the Engineer shall be at Contractor's risk.

2.0 PRODUCTS**2.01 STEEL PIPE**

- A Provide steel pipe designed and manufactured in conformance with AWWA C200 and AWWA M11 except as modified herein. Steel shall be minimum of ASTM A 36, ASTM A 570 Grade 36, ASTM A 53 Grade B, ASTM A 135 Grade B, or ASTM A 139 Grade B.
- B Minimum Allowable Steel-Wall Thickness: In accordance with following table for HS-20 live loads and depths of bury of up to 16 feet and AWWA C200 new uncoated welded steel.

CASING PIPE
(ENCASEMENT SLEEVES)

CASING PIPE SIZE	MINIMUM WALL		APPROXIMATE WEIGHT PER LINEAR FOOT UNCOATED
	O.D.	THICKNESS	
8"	8.625"	0.219"	19.64
10"	10.75"	0.219"	24.60
12"	12.75"	0.219"	29.28
14"	14.00"	0.219"	32.00
16"	16.00"	0.219"	36.86
20"	20.00"	0.250"	52.73
24"	24.00"	0.250"	63.41
30"	30.00"	0.250"	79.43

- C Provide pipe sections in lengths of no less than 20 feet except as required for special fittings or closure sections.
- D Fittings: Factory forged for sizes 4 inches through 24 inches; long radius bends; beveled ends for field butt welding; wall thickness: equal to or greater than pipe to which fittings is to be welded; unless otherwise shown on the Plans.
- E Joints:
1. Standard field joint for steel pipe; including casings: AWWA C206.
 - a. Single-welded, lap joint.
 - b. Double-welded, butt joint.
 2. Provide mechanically coupled or flanged joints where required for valves and fittings, and as shown on Plans. Flanges: AWWA C207, Class D; same diameter and drilling as Class 125 cast iron flanges, ASA B16.1. Maintain electrically isolated flanged joints between steel and cast iron by using epoxy-

coated bolts, nuts, washers and insulating type gasket unless otherwise approved by Engineer.

- F Make curves and bends by use of beveled joints unless otherwise indicated on Plans. Contractor may submit details of other methods of providing curves and bends for consideration by the Engineer. If other methods are deemed satisfactory, install at no additional cost to Owner.
- G Provide shop coated and shop lined steel pipe with minimum of one coat of shop applied primer approved for use in potable water transmission on all exposed steel surfaces. Primer for tape coated steel pipe to be used for field-applied coatings shall have no less than 5 percent solids. Provide primer compatible with coating system and in accordance with coating manufacturer's recommendations.
- H Standard or Special Sections: Within 1/8 inch + of specified or theoretical lengths. Flanges: Square with pipe with bolt holes straddling both horizontal and vertical axis. Provide 1/2-inch gap between pipe ends where pipe is to be coupled with sleeve couplings.

2.02 EXTERNAL COATING SYSTEMS FOR BURIED STEEL PIPE

- A General: Supplied with either tape coatings as specified herein.
 1. Tape Coating: AWWA C214; 80-mil, shop-applied, Polyken YG-III, Tek-Rap Yard-Rap, or equal, except as modified herein. Components: primer, one 20-mil layer of inner-layer tape for corrosion protection and two 30-mil layers of outer-layer tape for mechanical protection. Primer: compatible with tape coating, supplied by coating-system manufacturer. Provide pipe with shop coatings cut back from joint ends to facilitate joining and welding of pipe. Taper successive tape layers by 1-inch staggers to facilitate field wrapping of joints. Cut back approximately 4 to 4-1/2 inches to facilitate welding. Inner and outer tape widths:

DIAMETER	TAPE WIDTH
4" – 6"	6"
8" – 12"	9"
14" – 16"	12"
18" – 24"	18"

2.03 EXTERNAL COATING SYSTEM FOR STEEL PIPE IN TUNNEL, CASING OR AUGER HOLES

- A Provide exterior coating system of pipe in augered holes or casing, without annular grout, as specified in Section 02636 – Polyurethane Coatings on Steel or Ductile Iron Pipe. No additional exterior coating is required for mortar coated pipe.

2.04 EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVEGROUND (OR EXPOSED)

A Provide a 3-coat epoxy/polyurethane coating system as designated below.

Surface Preparation	SSPC SP10 Near White Blast Clean 2.0 to 3.0 mils surface profile
Prime Coat 2.0 to 4.0 mils DFT	ACRO 4422 Inhibitive Epoxy Primer, or approved equal
Intermediate Coat 4.0 to 6.0 mils DFT	ACRO 4460 Chemical Resistant Epoxy, or approved equal
Finish Coat 1.5 to 2.0 mils DFT	ACRO 4428 Polyurethane, or approved equal

B Total minimum allowable dry film thickness for system: 10 mils.

C All materials shall be from same manufacturer.

2.05 INTERNAL LINING SYSTEMS FOR STEEL PIPE

A General: Supply steel pipe with either epoxy lining or shop applied cement mortar lining, capable of conveying water at temperatures not greater than 140°F. All linings shall conform to American National Standards Institute/National Sanitation Foundation (ANSI/NFS) Standard 61 and certified by an organization accredited by ANSI. Unless otherwise noted, coat all exposed (wetted) steel parts of flanges, blind flanges, bolts, access manhole covers, etc., with epoxy lining, as specified herein.

B Epoxy Lining: AWWA C210 - White, or approved equal for shop and field joint applied, except as modified herein.

1. Surface Preparation: SSPC-SP-10(64); Near White Blast Clean; 2.0 to 3.0 mils surface profile.
2. Prime Coat: ACRO 4460 NSF Certified Epoxy - Buff; 4.0 to 6.0 mils DFT or approved equal.
3. Intermediate Coat: ACRO 4460 NSF Certified Epoxy - Buff; 4.0 to 6.0 mils DFT or approved equal.
4. Finish Coat: ACRO 4460 NSF Certified Epoxy - White 4.0 to 6.0 mils DFT or approved equal.
5. Minimum allowable dry film system thickness: 12.0 mils.
6. Maximum allowable dry film system thickness: 18.0 mils.
7. Minimum field adhesion: 700 psi.
8. Dry film thicknesses for approved alternate products in accordance with the product manufacturer's recommendations.
9. The lining system may consist of three or more coats of the same approved alternate epoxy lining without the use of a separate primer.

10. Provide materials from the same manufacturer.

- C Shop Applied Cement Mortar Lining: AWWA C205; shop-applied, cement mortar linings, except as specified herein 3/8 inch minimum thickness for pipe diameters 24 inches and smaller. Pipe with cut back lining from joint ends no more than 2 inches to facilitate joining and welding of pipe.

2.06 MORTAR FOR EXTERIOR JOINTS

- A Cement Mortar: One part cement to two parts of fine, sharp clean sand; mix with water to a consistency of thick cream.
- B Portland Cement: ASTM C 150, Type II.
- C Sand:
1. Inside joints: AWWA C602; fine graded natural sand.
 2. Outside joints: ASTM C 33; natural sand with 100 percent passing No. 16 sieve.
- D Water: total dissolved solids less than 1000 mg/l; ASTM D 512 chloride ions less than 100 mg/l for slurry and mortar cure; ASTM D 1293 pH greater than 6.5.

3.0 EXECUTION

3.01 PIPING INSTALLATION

- A Conform to applicable provisions of Section 02510 – Water Mains except as modified herein.

3.02 EXTERNAL COATING SYSTEM FOR BURIED STEEL PIPE

- A Tape Coating System:
1. Inspect pipe, prior to shipment, for holidays and damage to coating. Perform electrical holiday test of minimum of 6,000 volts with a 60 cycle current audio detector. If test indicates no holidays and outer wrap(s) is torn, remove damaged layers of outer wrap by carefully cutting with sharp razor-type utility knife. Wash with Xylol area to be patched and at least 4 inches of undamaged tape where hand-applied tape wrap will overlap. AWWA C209 cold-applied tape; compatible with tape-wrapping system applied for each layer of outer-wrap tape that has been removed. If damaged area shows holiday when tested, remove outer layers and expose inner wrap. Prime exposed area and overlaps with light coat of primer. Firmly press into place patch of inner wrap of sufficient size to extend 4 inches from holidays in all directions. Holiday test patch to verify that it is installed satisfactorily. Retrim outer layer of tape to expose first wrap of outer-wrap tape sufficiently to allow minimum lap of 2 inches in all directions. Wash exposed outer wrap tape with Xylol and prime. Apply two layers of AWWA C209 outer wrap with 35 mils minimum thickness.

2. Regardless of results of electrical holiday test, bubbles in tape coating system are not allowed. Cut out bubbles and patch as detailed above.
 3. Field repairs and applications of coatings: AWWA C209 around joint cutbacks except as modified herein. Field-welded joints: clean shop-primed ends of weld splatter, damaged primer and rust to achieve required surface preparation prior to field repair of linings and coatings.
 - a. Immediately prior to placing joint in trench, remove shop-applied primer by abrasive blasting, solvent or other method as approved by the Engineer. Avoid damage to adjacent existing coatings. Clean surfaces to achieve surface preparation at least equivalent to SSPC SP6 in accordance with AWWA C209. Solvent: environmentally safe and compatible with coating-system primer.
 - b. Apply primer immediately prior to application of first layer of tape to achieve maximum bond. Apply tape while primer is still "tacky" with 3-inch minimum overlap over shop-applied coating.
 4. Do not expose tape coatings to harmful ultraviolet light for more than 90 days. Discard (remove) and replace outer layer of tape coating when exposure exceeds 90 days. In case of factory applied coatings, remove joint from site for removal and reapplication of outer layer of tape coatings.
- B At Owner's option, coating system and application may be tested and inspected at plant site in accordance with AWWA C214.
- C Cement Mortar Coating: AWWA C205; 1-inch minimum thickness; cut back from joint ends no more than 2 inches to facilitate joining and welding of pipe.

3.03 EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVEGROUND, IN VAULTS, TUNNELS OR CASINGS, AND INTERNAL LINING FOR ALL INSTALLATIONS

- A Cement Mortar Lining: AWWA C205; 1/2-inch minimum thickness; cut back from joint ends to facilitate joining and welding of pipe.
- B Safety: Paints, coatings, and linings specified herein are hazardous materials. Vapors may be toxic or explosive. Protective equipment, approved by appropriate regulatory agency, is mandatory for all personnel involved in painting, coating, and lining operations.
- C Workmanship:
1. Application: By qualified and experienced workers who are knowledgeable in surface preparation and application of high-performance industrial coatings.
 2. Paint Application Procedures: SSPC Good Painting Practices, Volume 1.
- D Surface Preparation:
1. Prepare all surfaces for painting with abrasive blasting.
 2. Schedule cleaning and painting so that detrimental amounts of dust or other contaminants do not fall on wet, newly-painted surfaces. Protect surfaces not intended to be painted from effects of cleaning and painting operations.

3. Prior to blasting, clean surfaces to be coated or lined of grease, oil and dirt by steaming or detergent cleaning in accordance with SSPC SP1.
 4. Metal and Weld Preparation: Remove all surface defects such as gouges, pits, welding and torch-cut slag, welding flux and spatter by grinding to 1/4-inch minimum radius.
 5. Abrasive Material:
 - a. Blast only as much steel as can be coated same day of blasting.
 - b. Use sharp, angular, properly-graded abrasive capable of producing depth of profile specified herein. Transport abrasive to jobsite in moisture-proof bags or airtight bulk containers. Copper slag abrasives are not acceptable.
 - c. After abrasive blast cleaning, verify surface profile with replica tape such as Tes-Text Coarse or Extra Coarse Press-O-Film Tape, or approved equal. Furnish tapes to Owner for filing and future reference.
 - d. Do not blast if metal surface may become wet before priming commences, or when metal surface is less than 5 degrees F above dew point.
 6. Remove all dust and abrasive residue from freshly blasted surfaces by brushing or blowing with clean, dry air.
- E Coating and Lining Application:
1. Environmental Conditions: Do not apply coatings or linings when metal temperature is less than 50 degrees F; when ambient temperature is less than 5 degrees F above dew point; when expected weather conditions are such that ambient temperature will drop below 40 degrees F within 6 hours after application of coating; or when relative humidity is above 85 percent. Measure relative humidity and dew point by use of sling psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychrometric Tables. Provide dehumidifiers for all field-applied coatings and linings to maintain proper humidity levels.
 2. Application Procedures:
 - a. Apply coatings and linings in accordance with manufacturer's recommendations and requirements of this Section. Provide a finish free of runs, sags, curtains, pinholes, orange peel, fish eyes, excessive overspray or de-laminations.
 - b. Thin materials only with manufacturer's recommended thinners. Thin only amount required to adjust viscosity for temperature variations, proper atomization and flow-out. Mix material components using mechanical mixers.
 - c. Discard catalyzed materials remaining at end of day.
 3. Apply primer immediately after surface has been cleaned. Thoroughly dry pipe before primer is applied. Apply succeeding coats before contamination of under surface occurs.
 4. Allow each coat of paint either to dry or cure amount of time recommended by coating or lining manufacturer before successive coats of paint are applied. Apply all successive coats of paint within recoat threshold time as

recommended by coating or lining manufacturer on printed technical data sheets or through written communications.

3.04 INSPECTION

- A Procure services of an independent testing laboratory or inspection service, approved by the Engineer, to perform tests on all portions of coating and lining applications. Laboratory shall supply services of NACE Certified Coatings Inspectors having Level III Certification for all coating and linings inspection work. Include cost of such testing in contract unit price bid for water main. Furnish copies of all test reports to the Engineer for review. If defective coatings or lining are revealed, cost of repair and testing of repair will be paid for by Contractor. The Engineer shall have full and final decision as to suitability of all coatings and linings tested.
- B For all field applied coatings and linings, including joints, notify Owner sufficiently in advance of work so that Owner can perform examination of and acceptance of surface preparation and application of each coat prior to application of next coat. Furnish appropriate test data to Owner verifying compliance with requirements of this Section of each coat prior to proceeding with next coat. Recoat or repair runs, overspray, roughness and/or abrasives in coating, or other indications of improper application in accordance with coating or lining manufacturer's and the Engineer's instructions.
- C Repairs, surface preparation and painting will be subject to inspection by Owner. Guidelines published by Steel Structures Painting Council will be used as basis for acceptance or rejection of cleaning, painting or coating application. SSPC VIS1, Pictorial Surface, along with single-probe magnetic pull-off type dry film thickness gages, electrical holiday detectors, and standard wet film thickness gages will be used to determine acceptability of paint applications.
- D Check film thickness with nondestructive magnetic pull-off gage such as Mikrotest Model DFG-100 or electronic thickness gage. National Bureau of Standards certified thickness calibration plates will be used to verify accuracy of thickness gage. Determine maximum and minimum thickness in accordance with SSPC PA2 for frequency and method. Evaluate each length of pipe under SSPC PA2. Consider each field joint area separate and discrete for purpose of DFT measurements. Perform five spot DFT measurements on each field joint area (15 individual readings). Check thickness of each individual coat as well as thickness of overall system with respect to compliance with this Section. Failure to meet either overall system thickness requirements or requirements of component coats shall be cause for rejection and recoat or repair of entire joint or length of pipe.
- E Holiday Test:
1. Begin inspection after coating has sufficiently cured, usually one to five days. (Consult coating manufacturer for specific curing schedule.)
 2. Use high-voltage d-c holiday detector such as D.E. Stearns Company Model 14/20 or Tinker & Rasor Model AP/W. Use 1600 volts, plus or minus 100 volts. Use brass brush type electrode.

3. Ground high-voltage d-c holiday detector to metal being inspected. Earth-type ground tape is not acceptable. Mark detected defects with white chalk, repair and reinspect.
4. Adhesion Tests: ASTM D 4541; pull-off testing using an Elcometer Model 106 Fixed Alignment Adhesion Tester. Adhesion testing may be directed by the Engineer on any length of pipe or joint which exceeds maximum coating thickness limitations specified in this Section.

3.05 COATINGS AND LININGS INSPECTION

- A Owner reserves right to inspect or acquire service of independent third-party inspector who is fully knowledgeable of, and qualified to inspect, surface preparation and application of high-performance coatings to inspect any and all phases of all coatings and linings work, whether field or shop applied. Contractor responsible for application and performance of coating and lining whether or not Owner provides such inspection.

END OF SECTION