SECTION 02250
STEEL PIPE AND FITTINGS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS
- A. Steel pipe and fittings for water lines for aerial crossings, aboveground piping and encasement sleeves.
- B. Specifications identify requirements for small-diameter less than or equal to twenty inches (20 In).

1.2 MEASUREMENT AND PAYMENT
- A. Unit Prices:
  1. No payment will be made for steel pipe and fittings under this Section. Refer to Section 02400 – Water Lines for measurement and payment.
  2. Refer to Section 01270 – Measurement and Payment for unit price procedures.
- B. Stipulated Price (Lump Sum):
  1. If Contract is Stipulated Price Contract, payment for work in this Section is included in Total Stipulated Price.

1.3 REFERENCES
- A. AASHTO – American Association of State Highway and Transportation Officials.
  1. AASHTO – Standard Specifications for Highway Bridges.
- B. ASME – American Society of Mechanical Engineers.
  1. ASME B16.1 – Cast-Iron Pipe Flanges and Flanged Fittings.
- C. ASTM – American Society for Testing and Materials.
  1. ASTM A36 – Standard Specification for Carbon Structural Steel.
  2. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  3. ASTM A105 – Standard Specification for Carbon Steel Pipe Forgings for Piping Applications.
  4. ASTM A106 – Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
  5. ASTM A135 – Standard Specification for Electric-Resistance-Welded Steel Pipe.
  6. ASTM A139 – Standard Specification for Electric-Fusion (ARC) – Welded Steel Pipe (NPS 4 and Over).
  7. 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.
  8. ASTM D4541 – Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

D. AWWA – American Water Works Association.
   1. AWWA C200 – Standard for Steel Water Pipe 6 in. and Larger.
   2. AWWA C206 – Standard for Field Welding of Steel Water Pipe.
   3. AWWA C207 – Standard for Steel Pipe Flanges for Waterworks Service – Sizes 4 in. through 144 in.
   4. AWWA C210 – Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
   5. AWWA M11 – Steel Pipe – A Guide for Design and Installation.

E. CFTS – City of Friendswood Technical Specifications.

F. SSPC – Steel Structure Painting Council.
   1. SSPC Good Painting Practice, Volume 1.
   2. SSPC SP1 – Surface Preparation Specification No. 1 Solvent Cleaning.
   3. SSPC SP5 – Joint Surface Preparation Standard White Blast Cleaning.
   4. SSPC SP6 – Surface Preparation Specification No. 6 Commercial Blast Cleaning.
   5. SSPC SP10 – Surface Preparation Specification No. 10 Near-White Blast Cleaning.
   6. SSPC VIS1 – Visual Standard for Abrasive Blast Cleaned Steel.

1.4 SUBMITTALS

A. Conform to requirements of Section 01330 – Submittal Procedures. For aerial crossings and above ground piping, include lay schedule of new pipe and fittings indicating alignment and grade, laying dimensions, lining and coating systems, proposed welding procedures, fabrication, fitting, flange and special details. Show station numbers for pipe and fittings corresponding to the Drawings.

B. Submit manufacturer's certifications that pipe and fittings are new and unused.

C. Submit manufacturer's certifications that pipe and fittings have been hydrostatically tested at factory in accordance with AWWA C200.

D. Submit manufacturer's affidavits that coatings and linings comply with applicable requirements of this Section and:
   1. Polyurethane coatings were applied in strict accordance with manufacturer's recommendation and allowed to cure at temperature five degrees Fahrenheit (5° F) above dew point.
   2. Linings were applied and allowed to cure at temperature above thirty-two degrees Fahrenheit (32° F).

E. Submit certification from National Association of Corrosion Engineers (NACE) Certified Coatings Inspector, having Level III certification for coatings and linings, that steel pipe furnished on project was properly inspected and any defective coating detected was properly repaired.

1.5 QUALITY CONTROL

A. Prior to start of work, provide proof of certification of qualification for

welders employed for type of work, procedures and positions involved. Provide welder qualifications in accordance with AWWA C206.

B. Shop-applied coatings and linings; provide services of an independent coating and lining inspection service or testing laboratory with qualified coating inspectors. Perform inspection by NACE trained inspectors under supervision of NACE Level III Certified Coatings Inspector verifying compliance with same requirements specified in Paragraph 3.2.

C. Coatings: Measure temperature and dew point of ambient air before applying coatings. Inspect physical dimensions and overall condition of coatings. Inspect for visible surface defects, thickness and adhesion of coating to surface and between layers.

D. Final Inspection:
   1. Before shipment, inspect each finished pipe, fitting, special and accessory for markings, metal thickness, coating thickness, lining thickness (if shop applied), joint dimensions and roundness.
   2. Inspect for coating placement and defects. Test exterior coating for holidays.
      a. Inspect linings for thickness, pitting, scarring and adhesion.

E. Ensure workmen engaged in manufacturing are qualified and experienced in performance of their specific duties.

PART II: PRODUCTS

2.1 STEEL PIPE

A. Manufacture pipe with nominal diameter twenty inches (20 In) and less, but more than two inches (2 In), to conform to ASTM A106 or A 53 Grade B, standard weight.

B. Provide steel pipe and encasement sleeves designed and manufactured in conformance with AWWA C200 and AWWA M11 except as modified herein. Steel to be minimum of A36, ASTM A1011 Grade 36, ASTM A53 Grade B, ASTM A135 Grade B or ASTM A139 Grade B.

C. Minimum Allowable Steel-Wall Thickness shall be as specified in TABLE 4.1 – STEEL WALL THICKNESS FOR CARRIER PIPE in this Section.
   1. Review pipe and fitting design for conditions exceeding those specified herein.
   2. Provide pipe with wall thickness of no less than listed in TABLE 4.1 – STEEL WALL THICKNESS FOR CARRIER PIPE in this Section.

D. Minimum Diameter for Casing Pipe shall be as specified in TABLE 4.2 – MINIMUM DIAMETER FOR CASING PIPE in this Section.
   1. Provide casing pipe with wall thickness of no less than listed in TABLE 4.2 – MINIMUM DIAMETER FOR CASING PIPE in this Section.

2. Casing pipe: AWWA C200 new uncoated welded steel.
3. Verify casing diameter required with dimensions of casing spacer.

E. Provide pipe sections in lengths of not less than sixteen feet (16 Ft) except as required for special sections and not greater than forty feet (40 Ft).

F. Provide short sections of steel pipe not less than four feet (4 Ft) in length unless indicated on the Drawings or specifically permitted by the Project Manager.

G. Fittings: Factory forged for sizes two inches (2 In) through twenty inches (20 In); long radius bends; beveled ends for field butt welding; wall thickness equal to or greater than pipe to which fitting is to be welded unless otherwise shown on the Drawings.

H. Joints:
1. Standard field joint for steel pipe and encasement sleeve: AWWA C206. Single-welded, butt joint.
2. Provide mechanically coupled or flanged joints for valves and fittings, as shown on the Drawings. Flanges: AWWA C207, Class D; same diameter and drilling as Class 125 cast iron flanges ASME B16.1. Maintain electrically isolated flanged joints between steel and cast iron by using epoxy-coated bolts, nuts, washers and insulating type gasket.
3. Elbows to be standard weight seamless elbows per ASTM A106, Grade A or B.
4. Flanges for pipe twenty inches (20 In) in diameter and less, but more than two inches (2 In), shall be ANSI one hundred fifty pound (150 Lb) flat face, slip on or weld neck flanges, meeting ASTM A105 requirements. Where flanges are to join to valves with raised face flanges, use ANSI one hundred fifty pound (150 Lb) raised flange.
5. Provide same coating for exposed portions of nuts and bolts as flanges which they secure.

I. Fabricate flanges with over-size bolt holes, with flanges drilled in pairs, to accommodate insulating sleeves.

2.2 INTERNAL LINING SYSTEMS FOR STEEL PIPE, ALL INSTALLATIONS

A. Supply steel pipe with epoxy lining, capable of conveying water at temperatures not greater than one hundred forty degrees Fahrenheit (140° F). Provide linings conforming to American National Standards Institute/National Sanitation Foundation (ANSI/NFS) Standard 61 and certification to be from organization accredited by ANSI. Unless otherwise noted, coat exposed (wetted) steel parts of flanges, blind flanges, bolts, access manhole covers, etc., with epoxy lining, as specified in TABLE 4.3 EPOXY LINING in this Section.

B. Epoxy Lining AWWA C210, White or approved equal for shop and field joint applied, except as modified in this Section. Provide material from same

manufacturer. For Pipe larger than two inches (2 In) in diameter protect interior surface with liquid two-part chemically cured epoxy primer specified for interior surfaces.

1. Total allowable dry film thickness for system:
   a. Minimum: Twelve (12) mils.
   b. Maximum: Eighteen (18) mils.
   c. Minimum field adhesion: Seven hundred pounds per square inch (700 psi).
2. Dry film thicknesses for approved alternate products in accordance with product manufacturer's recommendations.
3. Lining system may consist of three (3) or more coats of same approved alternate epoxy lining without use of separate primer.

2.3 EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVEGROUND AND IN VAULTS (EXPOSED)

A. Provide three (3) coat epoxy/polyurethane coating system as specified in TABLE 4.4 – THREE PART EPOXY/POLYURETHANE COATINGS in this Section. Provide material from same manufacturer.
B. Total Allowable Dry Film Thickness (DFT) for System:
   1. Minimum: Nine and one-half (9.5) mils
   2. Maximum: Twelve and one-half (12.5) mils
C. Clean bare pipe free from mud, mill lacquer, oil, grease or other contaminant. Inspect and clean surfaces according to SSPC SP1 to remove oil, grease and loosely adhering deposits prior to blast cleaning. Remove visible oil and grease spots by solvent wiping. Use only approved safety solvents which do not leave residue. Use preheating to remove oil, grease, mill scale, water and ice provided pipe is preheated in uniform manner to avoid distortion.
D. Remove surface imperfections such as slivers, scabs, burrs, weld spatter and gouges, presence of metallic defects may be cause for rejection of pipe.

PART III: EXECUTION

3.1 PIPING INSTALLATION

A. Conform to applicable provisions of Section 02400 – Water Lines, except as modified in this Section.
B. Comply with the following:
   1. Bedding and Backfilling: Conform to requirements of Section 02125 – Excavation and Backfill for Utilities.
   2. For pipes with coating: Do not roll or drag pipe on ground, move pipe in such a manner as not to damage pipe or coating. Carefully inspect pipe for abrasions and repair damaged coating before pipe is installed.
C. Static Electricity:

1. Properly ground steel pipeline during construction as necessary to prevent build-up of static electricity.
2. Electrically test where required after installation is complete.

D. Do not bury steel pipe, unless it is large diameter water line.

3.2 EXTERNAL COATING SYSTEM FOR STEEL PIPE INSTALLED ABOVE GROUND AND IN VAULTS (EXPOSED) AND EPOXY INTERNAL LINING SYSTEM.

A. Safety: Paints, coatings and linings specified in this Section are hazardous materials. Vapors may be toxic or explosive. Protective equipment, approved by appropriate regulatory agency, is mandatory for personnel involved in painting, coating and lining operations.

B. 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.

C. Surface Preparation:
1. Prepare surfaces for painting by using 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 surface defects such as gouges, pits, welding and torch-cut slag, welding flux and spatter by grinding to one-quarter inch (1/4 In) 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 job site 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-Tex Coarse or Extra Coarse Press-O-Film Tape or approved equal. Furnish tapes to the Project Manager.
   d. Do not blast if metal surface may become wet before priming commences or when metal surface is less than five degrees Fahrenheit (5° F) above dew point.
6. Evaluate degree of cleanliness for surface preparation with use of Pictorial Surface Preparation Standards for Painting Steel

Surfaces, SSPC Vis1.

7. Remove dust and abrasive residue from freshly blasted surfaces by brushing or blowing with clean, dry air. Test cleanliness by placing three-quarters inch by four inch (3/4 In x 4 In) piece of clear Scotch type tape on blasted surface, then removing and placing tape on three inch by five inch (3 In x 5 In) white index card. Re-clean areas exhibiting dust or residue.

D. Coating and Lining Application:

1. Environmental Conditions: Do not apply coatings or linings when metal temperature is less than fifty (50) degrees F; when ambient temperature is less than five degrees Fahrenheit (5° F) above dew point; when expected weather conditions are such that ambient temperature will drop below forty degrees Fahrenheit (40° F) within six hours (6 Hrs) after application; or when relative humidity is above eighty-five percent (85%). 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 field-applied coatings and linings to maintain proper humidity levels.
2. Application Procedures:
   a. Apply in accordance with manufacturer's recommendations and requirements of this Section. Provide finish free of runs, sags, curtains, pinholes, orange peel, fish eyes, excessive over spray or delaminations.
   b. Thin materials only with manufacturers recommended thinners. Thin only with an 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. Thoroughly dry pipe before primer is applied. Apply primer immediately after cleaning surface. Apply succeeding coats before contamination of undersurface occurs.
4. Cure a minimum of twenty-four hours (24 Hrs) at seventy-seven degrees Fahrenheit (77° F) before successive coats are applied. During curing process, provide force air ventilation in volume sufficient to maintain solvent vapor levels below published threshold limit value. Apply successive coats within recoat threshold time as recommended by coating or lining manufacturer on printed technical data sheets or through written communications. Brush blast joints of pipe which have been shop primed and are to receive intermediate and finish coats in field prior to application of additional coats. After interior coatings are applied, provide forced air ventilation in sufficient volume and for sufficient length of time to ensure proper curing

before filling pipe with water.

E. Testing of Coatings and Linings:
   1. Inspect pipe for holidays and damage to coating:
      a. If test indicates no holidays and coating is damaged, remove deficient or damaged layers of coating and repair in accordance with coating manufacturer's recommendations.
   2. Perform holiday test in accordance with NACE Standard Recommended Practice, RPO 188-90, Discontinuity (Holiday) Testing of Protective Coatings.
   3. Begin testing of completed coating after coating has sufficiently cured, usually one day (1 D) to five days (5 D). Consult coating manufacturer for specific curing schedule.
   4. Perform adhesion test on pipe in accordance with ASTM D4541.
   5. For coating thickness of twenty (20) mils or less, test with wet sponge low-voltage holiday detector. For coating thickness in excess of twenty (20) mils, test with high-voltage holiday detector. Perform electrical holiday test with sixty (60) cycle current audio detector. Select test voltage as specified in TABLE 4.5 – MINIMUM VOLTAGES FOR HIGH VOLTAGE SPARK TESTING in this Section.

3.3 JOINTS AND JOINTING

A. Welded Joints:
   1. Conform to requirements of Section 02400 – Water Lines.
   2. Field weld to be full penetration butt welded joints for steel pipe and encasement sleeves for entire circumference.
   3. The City shall employ an independent certified testing laboratory to perform weld acceptance tests on welded joints. Testing Laboratory shall test by X-ray methods for butt welds, for 100 percent of joint welds. The Project Manager has final decision as to suitability of welds tested.

B. Flanged Joints: Conform to requirements of Section 02400 – Water Lines.

C. Joint Grouting and Testing: Conform to requirements of Section 02400 – Water Lines.

3.4 COATINGS AND LININGS INSPECTION RESPONSIBILITIES

A. Contractor is responsible for quality control of coatings and linings applications and testing and inspection stipulated in this Section. The Project Manager is responsible for quality assurance and reserves the right to inspect or acquire services of an independent third-party inspector who is fully knowledgeable and qualified to inspect surface preparation and application of high-performance coatings at all phases of coatings and linings, work, field- or shop-applied. Contractor is responsible for proper application and performance of coatings and linings whether or not the Project Manager provides such inspection.

PART IV: TABLES

4.1 MINIMUM ALLOWABLE STEEL-WALL THICKNESS

CARRIER PIPE			
Nom. Pipe Size (In.)	Min. Wall		Approx. Wt. Per L.F. Uncoated (Lb.)
	O.D. (In.)	Thick. (In.)	
4	4.50	0.250	11.35
6	6.625	0.280	18.97
8	8.625	0.322	28.55
10	10.75	0.365	40.48
12	12.75	0.375	49.56
16	16.00	0.375	62.58
20	20.00	0.375	78.60

4.2 – MINIMUM DIAMETER FOR CASING PIPE

MINIMUM DIAMETER CASING PIPE (ENCASEMENT SLEEVES)			
Corresp. Casing Pipe Size (In.)	Min. Wall		Approx. Wt. Per L.F. Uncoated (Lb.)
	O.D. (In.)	Thick. (In.)	
8	8.625	0.219	19.64
10	10.75	0.219	24.60
12	12.75	0.219	29.28
16	16.00	0.219	36.86
18	18.00	0.250	47.39
20	20.00	0.250	52.73
24	24.00	0.250	63.41

4.3 EPOXY LINING

Surface Preparation 2.0 to 3.0 mils surface profile	SSPC – 5 (64) White Blast Clean
Prime Coat 4.0 to 6.0 mils DFT	NSF Certified Epoxy – Buff or approved Equal
Intermediate Coat 4.0 to 6.0 mils DFT	NSF Certified Epoxy – Buff or approved Equal
Finish Coat 4.0 to 6.0 mils DFT	NSF Certified Epoxy – White or approved Equal

4.4 – THREE PART EPOXY/POLYURETHANE COATINGS

Surface Preparation 2.0 to 3.0 mils surface profile	SSPC SP10 Near White Blast Clean
Prime Coat 4.0 to 6.0 mils DFT	Inhibitive Epoxy Primer or approved equal
Intermediate Coat 4.0 to 6.0 mils DFT	Chemical Resistant Epoxy or approved equal
Finish Coat 1.5 to 2.5 mils DFT	Polyurethane or approved equal Barr Blue Color as approved by the Project Manager

4.5 – MINIMUM VOLTAGES FOR HIGH VOLTAGE SPARK TESTING

MINIMUM VOLTAGES FOR HIGH VOLTAGE SPARK TESTING	
Total Dry Film Thickness (mils)	Suggested Inspection (V)
20 to 40	3,000
41 to 55	4,000
56 to 80	6,000

END OF SECTION