

**SECTION 02200  
BAR WRAPPED STEEL CYLINDER PIPE**

**PART I: GENERAL**

**1.1 GENERAL REQUIREMENTS**

- A. Furnishing and installing new bar wrapped steel cylinder pipe and fittings for buried water lines for sizes twenty inches (20 In) to sixty inches (60 In).

**1.2 MEASUREMENT AND PAYMENT**

A. Unit Prices.

1. No separate payment will be made for bar wrapped steel cylinder pipe under this Section. Include cost in price for water lines.
2. Maintain, on site, minimum of two (2) – three degree (3°) and two – five degree (5°) grade angle adapters. Adapters are considered “extra unit price.” When used during construction, adapter shall be paid at the unit price bid.
3. 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 shall be included in Total Stipulated Price.

**1.3 REFERENCES**

A. AASHTO – American Association of State Highway and Transportation Officials.

1. Standard Specifications for Highway Bridges.

B. AREMA – American Railway Engineering and Maintenance-of-Way Association.

1. Manual of Railway Engineering, Volume II, Chapter 15.

C. ASTM – American Society for Testing and Materials.

1. ASTM A615 – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
2. ASTM C33 – Standard Specification for Concrete Aggregates.
3. ASTM C35 – Standard Specification for Inorganic Aggregates for Use in Gypsum Plaster.
4. ASTM C150 – Standard Specification for Portland Cement.
5. ASTM C497 – Standard Test Method for Concrete Pipe, Manhole Sections or Tile, Testing.
6. ASTM C1107 (CRD C-621) – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
7. ASTM D512 – Standard Test Methods for Chloride Ion in Water.
8. ASTM D1293 – Standard Test Methods for pH of Water.
9. ASTM E165 – Standard Test Methods for Dye Penetration.

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10. ASTM E340 – Standard Test Method for Macroetching Metals and Alloys.
11. ASTM E709 – Standard Test Methods for Magnetic Particle Testing.
12. ASTM E1032 – Standard Test Methods for Radiographic Examination of Weldments.
- D. ANSI – American National Standards Institute.
  1. ANSI/AWS A3.0 – Standard Welding Terms and Definitions.
- E. AWWA – American Water Works Association.
  1. AWWA C206 – Standard for Field Welding of Steel Water Pipe.
  2. AWWA C207 – Standard for Steel Pipe Flanges for Waterworks Service – Sizes 4 in. through 144 in.
  3. AWWA C301 – Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids.
  4. AWWA C303 – Standard for Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type.
  5. AWWA C304 – Standard for Design of Prestressed Concrete Cylinder Pipe.
  6. AWWA M9 – Concrete Pressure Pipe.
- F. CFTS – City of Friendswood Technical Specifications.
- G. NSF – National Science Foundation.
  1. NSF 61 – Drinking Water System Components – Health Effects.
- H. SSPC – Steel Structures Painting Council.
  1. SSPC SP 7 – Surface Preparation Specification No. 7 Brush Off Blast Cleaning.

#### 1.4 SUBMITTALS

- A. Conform to requirements of Section 01330 – Submittal Procedures.
- B. Submit shop drawings and certification signed and sealed by a Professional Engineer registered in the State of Texas showing following:
  1. Manufacturer's pipe design calculations.
  2. Lay schedule of pictorial nature indicating alignment and grade, laying dimensions, welding procedures, fabrication, fitting, flange and special details, with the plan view of each pipe segment sketched, detailing pipe invert elevations, horizontal bends, welded joints and other critical features. Indicate station numbers for pipe and fittings corresponding to the Drawings. Do not start production of pipe and fittings prior to review and approval by the Project Manager. Provide final approved lay schedule on CD-ROM in Adobe portable document format (\*PDF).
  3. Include hot tapping procedure.
  4. Submit certification from manufacturer that design was performed for project in accordance with requirements of this Section.

- C. Submit inspection procedures to be used by manufacturer and for quality control and assurance for materials and welding. Submit standard repair procedures that describe in detail shop and field work to be performed. Repair defects such as substandard welds, excessive radial offsets (misalignment), pitting, gouges, cracks, etc.
- D. Submit following within forty-five days (45 D) after manufacturing of pipe and fittings:
  - 1. Steel:
    - a. Steel reports as required in AWWA C303, Section 5.2.5.
    - b. Results of other tests of steel reinforcement required in AWWA C303, Section 5.2.
  - 2. Test Results.
    - a. Hydrostatic testing, acid etching, magnetic particle and x-ray weld test reports as required.
    - b. Compressive strength [seven day (7 D) and twenty-eight day (28 D)] test results for each type of coating and lining mix design.
  - 3. Submit pipe manufacturer's certification that Bar Wrapped Steel Cylinder Pipe:
    - a. Cylinder assembly has been hydrostatically tested at factory.
    - b. Mortar coatings and linings were applied and allowed to cure at temperature above thirty-two degrees Fahrenheit (32° F).
- E. Submit the following for nonshrink grout for special applications:
  - 1. Manufacturer's technical literature including the specifications for mixing, placing and curing grout.
  - 2. Results of tests performed by certified independent testing laboratory showing conformance to ASTM C1107, Nonshrink Grout and requirements of this Technical Specification.
  - 3. Certification that product is suitable for use in contact with potable water.
- F. Submit certification for welder and welding operator demonstrating their certification within past six months (6 Mos) in accordance with AWWA C206. Indicate certified procedures and position each welder is qualified to perform.
- G. Calibration within last twelve months (12 Mos) for equipment such as scales, measuring devices and calibration tools used in manufacture of pipe. Each device used in manufacture of pipe is required to have tag recording date of last calibration. Devices are subject to inspection by the Project Manager.

#### 1.5 QUALITY CONTROL

- A. Manufacturer is to have permanent quality control department and laboratory facility capable of performing inspection and testing required. Inspection procedures and manufacturing process are subject to

inspection by the Project Manager. Perform manufacturer tests and inspections required by AWWA C303 as modified by these Technical Specifications. Correct nonconforming conditions.

1. Cylinder and Joint Ring Assembly:
  - a. Review mill certifications for conformance to requirements of these Technical Specifications.
  - b. Perform physical testing of each heat of steel for conformance to applicable ASTM standards.
  - c. Inspect physical dimensions and overall condition of joint rings and cylinder/joint ring assembly to verify compliance with requirements of AWWA C303. Maximum allowable thickness variation of cylinder shall not be less than the determined thickness.
    - 1) Cylinders with a nominal diameter of ten inches (10 In) to sixteen inches (16 In) shall have a tolerance of plus or minus three-sixteenths inch ( $\pm 3/16$  In).
    - 2) Cylinders with a nominal diameter of eighteen (18) inches to sixty inches (60 In) shall have a tolerance of plus or minus one-quarter of an inch ( $\pm 1/4$  In).
  - d. Test cylinder/joint ring weld for tensile strength. Test one specimen for each five hundred (500) cylinder/joint ring assemblies in addition to those tests required by AWWA C301.
  - e. Reject pipe with dented steel cylinders.
2. Bar Rod
  - a. Review mill certifications for conformance to requirements of Technical Specifications.
  - b. Inspect rod spacing during placement on cylinder.
  - c. Test rod splices for each production run or minimum of once a week, whichever is less, for conformance with minimum strength criteria.
3. Pipe Lining Coating:
  - a. Review mill certificates for each load of cement for conformance to ASTM C150.
  - b. Perform sieve analyses weekly for each source of coarse and fine aggregate for conformance to ASTM C33.
  - c. Inspect kiln recorder charts daily to confirm proper curing environment.
  - d. Verify mortar thickness on each size of pipe to a tolerance of one-sixteenth of an inch ( $1/16$  In) more or less than the required thickness.
  - e. Perform absorption tests in accordance with ASTM C497, Method A, on cured mortar samples taken from pipes.
  - f. Check mortar batch proportions, moisture content and

- slurry application rate. Check coating thickness over wire on each pipe.
- g. Check physical integrity of cured mortar coating. Check cured mortar coating for soundness on every pipe in field in addition to manufacturing plant.
- h. Reject pipe with cracks in mortar coating exceeding one hundredth inches (0.01 In) wide.
- 4. Protective Coatings: Check daily application rate and resulting dry film thickness.
- B. Gaskets:
  - 1. Randomly test rubber cord for diameter, tensile strength, elongation, compression set, hardness and specific gravity after oven aging on one (1) out of one hundred (100) gaskets.
  - 2. Stretch test each gasket splice to twice its unstretched length and inspect for defects.
- C. Weld Testing
  - 1. Perform macroetching tests for complete penetration production welds on normal production weld tests. Complete joint penetration welds are defined in ANSI/AWS A3.0. Verify complete joint penetration by means of macroetch of joint weld cross section. Macroetch technique in accordance with ASTM E340.
  - 2. Perform ultrasonic or x-ray testing of manual welds for fittings and special pipes. Perform dye penetration testing of manual lap welds for fittings and special pipes and for joint ring weld onto cylinder.
  - 3. Perform minimum of one (1) set of weld test specimens in accordance with ANSI/AWS A3.0 on each size, grade and wall thickness at minimum of every three thousand feet (3000 Ft) of pipe manufactured; but perform no less than one (1) test per project by each welding machine and each operator.
- D. Cast four (4) standard test cylinders each day for each fifty cubic yards (50 Cy) of concrete mortar coating or portion thereof for each coating and lining mix design placed in each day. Perform compressive strength test at twenty-eight days (28 D). No cylinder test result shall be less than eighty percent (80%) of specified strength. Reject pipe that does not meet minimum strength requirements.
- E. Make available copy of Physical and Chemical testing reports for steel cylinders and provide reports at request of the Project Manager.
- F. Check physical dimensions of pipe and fittings: Physical dimensions to include at least pipe lengths, pipe I.D., pipe O.D. and bend angles.

## **PART II: PRODUCTS**

### **2.1 MATERIALS**

- A. Furnish pipe by same manufacturer.

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- B. Provide bar wrapped steel cylinder pipe in conformance with AWWA C303 and AWWA M9, except as modified herein. Produce pipe cylinder to conform to AWWA C303 except modify Section 4.5 to require that total cross-sectional area of bell ring plus cross-sectional area of bar reinforcement over bell ring exceed circumferential steel area in like length of barrel area by one-third (1/3).
- C. Use of pipe from inventory is permitted only if the specifications and certifications are met. Provide testing records for such pipe.
- D. Do not use bar wrapped steel cylinder pipe in aerial crossings, exposed or other unburied areas.
- E. Pipe Manufacturer:
  - 1. Must have minimum of five years (5 Yrs) of manufacturer's pipe installations that have been in successful and continuous service.
  - 2. Must maintain on site or in plant minimum of four (4) – twenty-two and one-half degree (22-1/2°) bends per ten thousand linear feet (10000 Lf) of water line. Any combination of bends may be substituted at manufacturer's option [i.e. two (2) – eleven and one-fourth degree (11-1/4°) bends are equivalent to one (1) – twenty-two and one-half degree (22-1/2°) bend and shall be counted as one (1) fitting]. Must be capable of delivering bends to job site within twelve hours (12 Hrs) of notification. These fittings are in addition to any fittings called out on the Drawings and must be available at all times.
- F. Pipe Design Conditions:
  - 1. Working pressure: One hundred pounds per square inch (100 psi).
  - 2. Hydrostatic field test pressure: One hundred fifty pounds per square inch (150 psi).
  - 3. Maximum pressure due to surge: One hundred fifty pounds per square inch (150 psi).
  - 4. Minimum pressure due to surge: Minus five pounds per square inch (-5 psi).
  - 5. Unit weight of soil: One hundred twenty pounds per cubic foot (120 pcf) minimum, unless otherwise specified.
  - 6. Minimum trench width: O.D. of pipe + four feet (+4 Ft).
  - 7. Pipe and Fittings: Designed to withstand most critical simultaneous application of external loads including construction loads and internal pressures.
  - 8. Design: Design pipe and fittings to withstand most critical simultaneous application of external loads and internal pressures. Base design on minimum of AASHTO HS-20 loading, AREA E-80 loads and depths of bury as indicated on the Drawings. Design pipes with Marston's earth loads for transition width trench for all heights of cover.
    - a. Calculate moments and thrusts in wall based on earth

- load.
9. Increase longitudinal steel area (cylinder thickness) to prevent cylinder stress from exceeding forty percent (40%) of minimum yield point at rated working pressure and sixty-seven percent (67%) of minimum yield point at rated maximum surge pressure where pipe and fittings are subjected to longitudinal stresses induced by restrained joints or thrust blocks.
  10. Groundwater Level: Design for most critical ground water level condition.
  11. Modulus of elasticity (E) = Thirty million pounds per square inch (30000000 psi).
  12. Design stress due to working pressure shall be no greater than fifty percent (50%) of minimum yield and stress not to exceed sixteen thousand five hundred pounds per square inch (16500 psi) for mortar coated pipe.
  13. Design stress due to maximum hydraulic surge pressure shall be no greater than seventy-five percent (75%) of minimum yield and stress shall not exceed twenty-four thousand seven hundred fifty pounds per square inch (24750 psi) for mortar coated pipe.
  14. Modulus of soil reaction (E) < One thousand five hundred pounds per square inch (1500 psi). If E > One thousand pounds per square inch (1000 psi), do not use silty sand (SM) for embedment.
  15. Deflection lag factor (DI) = One and two tenths (1.2).
  16. Bedding constant (K) = One tenth (0.1).
  17. Fully saturated soil conditions:  $hw = h$  = depth of cover above top of pipe.
  18. Provide minimum inside clear diameter for casing in accordance with Section 02275 - Pipe and Casing Augering for Sanitary Sewers.
  19. Design pipe for transmitting potable water, unless otherwise shown on the Drawings.
  20. Augered Sections: Provide constant outside diameter from bell to spigot end for pipe. Design pipe and pipe joints to carry loads including but not limited to: overburden and lateral earth pressures, subsurface soil, grouting, other conditions of service, thrust of jacks and any stress anticipated during handling and installation.
- G. Coatings and Linings:
1. Provide Portland cement; ASTM C150, Type I or II. Provide one type of cement for entire project.
  2. Water Absorption Test: ASTM C497, Method A; perform on samples of cured mortar coating taken from each working shift. Cure mortar coating samples in same manner as pipe.
    - a. Test Value: Average minimum of three (3) samples taken from same working shift, no greater than nine

- percent (9%) for average value and eleven percent (11%) for individual value.
- b. Test Frequency: Perform tests each working shift until conformance to absorption requirements has been established by ten (10) consecutive passing test results, at which time testing may be performed weekly. Resume testing for each working shift if absorption test results fail until conformance to absorption requirements is reestablished by ten (10) consecutive passing test results.
  3. Apply one (1) coat of primer to exposed steel parts of steel bell and spigot rings. Prior to coating, blast clean in accordance with SSPC-SP7 (Brush Off Blast Cleaning). Apply primer in accordance with manufacturer's recommendations.
  4. Coat and line access inlets, service outlets and test inlets with same coating and lining of water line pipe in accordance with AWWA C303, Section 4, unless otherwise indicated on the Drawings.
  5. Do not defer placing of coating of any portion of pipe length. Verify cement mortar coating thickness on each size of pipe by nondestructive method before removing pipe from coating machine.
  6. Remove and replace disbonded lining or coating. Reject pipe requiring patches larger than one hundred square inches (100 SqIn) or twelve inches (12 In) in greatest dimension. Allow no more than one (1) patch on either lining or coating of pipe. Provide WELD-CRETE Probond Epoxy Bonding Agent ET-150, parts A and B; Sikadur 32 Hi-Mod or approved equal bonding agent for pipe patching.
- H. Fittings and Specials:
1. Design fittings to same internal and external loads as straight pipe.
  2. Manufacture in accordance with Section 02255 – Steel Pipe and Fittings for Large Diameter Water Lines.
  3. Provide fabricated bends or fittings with minimum radius of two and one-half (2-1/2) times pipe diameter.
  4. Design test plugs to withstand forces generated by hydrostatic test and test pressure from either side. Do not exceed fifty percent (50%) of minimum yield for design stresses due to hydrostatic pressure. Assume opposite side of plug does not contain water.
  5. Provide no specials less than four feet (4 Ft) in length unless indicated on the Drawings or approved by the Project Manager.
  6. Butt Straps for Closure Piece: Provide at locations indicated on the Drawings or authorized by the Project Manager. Minimum twelve inch (12 In) wide split butt strap; minimum plate thickness

- equal to thinnest member being joined; fabricated from material equal in chemical and physical properties to thinnest member being joined. Permit no angular deflection at butt-strap joints.
7. Provide minimum six inch (6 In) welded outlet for inspecting each closure section, unless access manway is within forty feet (40 Ft) of closure section.
  8. Provide Densco petroleum based tape or approved equal for exposed portions of nuts and bolts.
- I. Joints:
1. AWWA C303 rubber-gasketed or welded bell-and-spigot type except where flanged joints are required for valves and fittings as shown on the Drawings. Refer to Section 02400 – Water Lines for details on joints and jointing.
  2. Rubber-Gasketed Joints: Single weld bell and spigot ring onto steel cylinder. In thrust areas, double weld bell and spigot onto steel cylinder.
  3. Restrained Joints: Restrain joints by welding or harnessing joints.
    - a. Design Pressure: One and one-half (1.5) times working pressure.
    - b. Harnessed Joints: AWWA M9, clamp or snap ring type, except where prohibited.
    - c. Groundwater Level: Assumed to be equal to natural ground surface.
    - d. Provide restrained joint pipe with adequate cylinder thickness to transmit full thrust generated by internal pressure across joints.
      - 1) Calculate distance of restrained joints based on resistance along each leg of bend with thrust based on bend angle.
      - 2) Cylinder thickness shall not be less than that defined in AWWA C303, Table 2 and minimum nominal cylinder thickness.
      - 3) Allow cylinder thickness to reduce linearly from maximum calculated thickness to minimum thickness required by design over required length (as determined in Paragraph 2.1.I.3.d.1) of restrained joints.
      - 4) Provide full circumferential welds at joints required to be welded.
- J. Use only fully circumferentially welded joints in areas considered potentially petroleum contaminated, within tunnels and under foreign pipelines. Perform welding in accordance with Section 02250 – Steel Pipe and Fittings and Section 02255 – Steel Pipe and Fittings for Large Diameter Water Lines.
- K. Pipe Flanges: AWWA C207 for standard steel flanges of pressure class

corresponding to pipe class.

- L. Pipe lengths: Provide pipe sections in standard lengths with minimum length of sixteen feet (16 Ft) and maximum length of twenty-five feet (25 Ft) and as indicated on approved shop the Drawings or approved by the Project Manager. Gasketed joints are allowed on standard lengths of pipe. Nonstandard pipe lengths shall be approved by the Project Manager and joints must be welded as specified herein to achieve equal to or greater than standard pipe length before gasketed joints can be used. Internally and externally mark pipe section with durable marking to show location and pipe pressure.
- M. Hydrostatic Test of Cylinder: In accordance with AWWA C303, at point of manufacture. Hold test for minimum two minutes (2 Min) for thorough inspection of cylinder. Repair or reject cylinders revealing leaks or cracks.
- N. Transport fittings with end caps. Remove end caps just prior to installation.
- O. Transport fittings thirty-six inches (36 In) in diameter and larger with stulls. Remove stulls after completion of backfill.
- P. Provide radius of curve as indicated on the Drawings unless approved by the Project Manager. Make curves and bends by deflecting joints, by use of beveled joints or by combination of two (2) methods, unless otherwise indicated on the Drawings. Do not exceed deflection angle recommended by pipe manufacturer. Provide beveled pipe sections of standard length used in curved alignment, except when shorter sections are required to limit radius of curvature. In such case, provide sections throughout curve of substantially equal length.
- Q. When manufacturing straight pipe sections, manual welding is allowed for following:
  - 1. Tack welding of coils and plates during continuous pipe making process.
  - 2. Rewelding and repairing structural defects in plate and automatic machine welds.
  - 3. Attaching new coil of steel to previous coil.

## 2.2 BAR ROD

- A. Conform to requirements of ASTM A615, AWWA C303 and this Technical Specification.
- B. Test foreign manufactured rod by local independent laboratory.
- C. Rod manufacturer shall be responsible for performing mechanical tests required in ASTM A615.
- D. Pipe manufacturer shall be responsible for requiring rod manufacturer to submit certified results of chemical and mechanical tests, performed by rod manufacturer. Pipe manufacturer is responsible for performing mechanical tests and is required to attest to such in affidavit of compliance.
- E. Do not use rod with visible pitting.

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**2.3 GROUT FOR JOINTS AND SPECIAL APPLICATION**

**A. Joint Grout:**

1. Cement Grout Mixture: One (1) part cement to two (2) parts of fine, sharp clean sand. Mix interior joint mortar with as little water as possible until very stiff but workable. Mix exterior joint mortar with water until it has consistency of thick cream.
2. Water: Potable water with total dissolved solids less than One thousand milligrams per liter (1000 mg/l); ASTM D512 chloride ions less than one hundred milligrams per liter (100 mg/l) for slurry and mortar cure; ASTM D1293 pH greater than 6.5. Use potable water with two hundred fifty parts per million (250 ppm) limit on chlorides and sulfates.
3. Portland Cement: ASTM C150, Type I or II. Provide one type of cement for entire project.
4. Sand:
  - a. Interior joints: ASTM C35 fine graded plaster sand.
  - b. Exterior joints: ASTM C33 natural sand with one hundred percent (100%) passing No. 16 sieve.
5. Mix cement grout to specific gravity of nineteen pounds per gallon (19 Lb/Gal) or greater as measured by grout/slurry balance. Use balance manufactured grout/slurry balance manufactured by Baroid or approved equal. Perform test in presence of and as requested by the Project Manager. Add additional cement grout or water to mixed cement grout to bring mix to proper moisture content or specific gravity. Discard cement grout mixed more than twenty minutes (20 Min) that is not at proper moisture content or specific gravity.

**B. Nonshrink Grout for Special Applications, Patches and Repairs.**

1. Conform to requirements of ASTM C1107, Nonshrink Grout.
2. Pre-blended factory-packaged material manufactured under rigid quality control.
3. Contain non-metallic natural aggregate, be nonstaining and noncorrosive.
4. Meeting NSF 61 Standard suitable for use in contact with potable water supply.
5. Exterior: Highly flowable to fill joint wrapper without leaving voids or trapped air. Interior capable of being placed with plastic consistency.
6. Non-bleeding and non-segregating at fluid consistency.
7. Contain no chlorides or additives which may contribute to corrosion of bar wrapped steel cylinder pipe.
8. Free of gas-producing, gas-releasing agents.
9. Resist attack by oil or water.
10. Mix, place and cure in accordance with manufacturer's recommendations. Upon seventy-two hours (72 Hrs) notice,

- provide services of qualified representative of nonshrink grout manufacturer to aid in use of product under job conditions.
11. Mix nonshrink grout to specific gravity of seventeen and seven-tenths pounds per gallon (17.7 Lb/Gal) or greater as measured by grout/slurry balance. Use grout/slurry balance manufactured by Baroid or approved equal. Perform test in presence of and as requested by the Project Manager. Add additional non-shrink grout to mixed non-shrink grout to bring to proper moisture content or specific gravity. Discard grout mixed more than twenty minutes (20 Min) that is not at proper moisture content or specific gravity.
  12. Compressive strength: ASTM C1107 two thousand five hundred pounds per square inch (2500 psi) minimum seven day (7 D) unconfined; five thousand pounds per square inch (5000 psi) minimum twenty-eight day (28 D) unconfined.
- C. Finished surface of lining and interior joint shall be comparable to surface rubbed with No. 16 Carborundum stone. Rub joint mortar sufficiently to bring paste to surface, to remove depressions and projections and to produce smooth, dense surface. Add cement to form surface paste as necessary. Leave interior with clean, neat and uniform-appearing finish.
  - D. Joint Wrapper: Minimum width of nine inches (9 In) for thirty-three inch (33 In) diameter and smaller; minimum width of twelve inches (12 In) for diameters greater than thirty-three inch (33 In) hemmed at edge to allow threading with minimum five-eighths inch (5/8 In) wide steel strap. Provide minimum six inch (6 In) wide Ethafoam strip sized, positioned and sewn such that two circumferential edges of Ethafoam are one and one-half inches (1-1/2 In) from outer edge of wrapper.

#### 2.4 CATHODIC PROTECTION

- A. Conform to requirements of Section 02285 – Cathodic Protection.
- B. Connect each joint of pipe with bonding straps or approved devices to maintain continuity of current. Provide bonding straps free of foreign material.
- C. Electrically isolate water line from other connections. Use insulating type joints or nonmetallic pipe unless otherwise indicated on the Drawings.
- D. Provide flange adapter with insulating kit as required when connecting new piping to existing piping.

#### 2.5 INSPECTION AND SHIPPING

- A. Permit the Project Manager to inspect pipes or witness pipe manufacturing. Inspection shall not relieve manufacturer of responsibilities to provide products that comply with applicable standards and these Technical Specifications. Should the Project Manager elect not to inspect manufacturing, testing or finished pipes, it shall in no way imply approval of products or tests.

- B. Manufacturer's Notification to Customer: Should the Project Manager wish to see specific pipes during manufacturing process, manufacturer shall provide the Project Manager with minimum of three weeks (3 Wks) advance notice of when and where production of those pipes shall take place.
- C. Repair damage to pipe or protective lining per manufacture specifications before final acceptance.
- D. Shipping: Where required, provide pipe and fittings with sufficient interior strutting or cross bracing to prevent deflection under their own weight.

## **PART III: EXECUTION**

### **3.1 INSTALLATION**

- A. Conform to requirements of Section 02400 – Water Lines. Do not install pipe without approved lay schedule.
- B. Install pipe within six months (6 Mos) of pipe being manufactured.
- C. Manufacturer shall make available services of representative, throughout project duration when deemed necessary by the Project Manager, to advise aspects of installation including but not limited to handling, storing, cleaning and inspecting, coatings and linings repairs and general construction methods affecting pipe.
- D. Bedding and Backfilling
  - 1. Conform to requirements of Section 02125 – Excavation and Backfill for Utilities.
  - 2. Take necessary precautions during bedding and backfilling operations to prevent deformation or deflection of cylindrical shape of pipe by more than allowable pipe deflection.
  - 3. Do not move trench support system (trench safety system) once bedding material is compacted.
  - 4. Align pipe at proper grade prior to joint connection and do not shift after jointing operation has been completed.
  - 5. Excavate outside specified trench section for bell holes and for spaces sufficient to permit removal of slings. Provide bell holes at proper locations for unrestricted access to joint. Form bell holes large enough to facilitate joint wrapping and to permit visual examination of process. Enlargement of bell holes shall be as required or directed by the Project Manager. Subsequent backfilling thereof shall not be considered as authorized additional excavation and backfill. Backfill bell holes and spaces to satisfaction of the Project Manager.
  - 6. Remove blocking after placing sufficient backfill to hold pipe in position.
- E. Follow nonshrink grout manufacturer's specifications for nonshrink grouting.
- F. Store pipe at job-site with securely-fastened plastic end caps to maintain moist pipe interior. Promptly replace damaged end caps to avoid

shrinkage or cracking of cement-mortar lining. Immediately replace damaged plastic end caps. Do not leave uncapped for more than four hours (4 Hrs).

- G. Deviation of installed pipe in any one (1) pipe section from line and grade shown on approved shop drawing layout shall not exceed two inches (2 In) from grade and three inches (3 In) from line. No deviation from line and grade at contact interfaces are allowed.
- H. Use adequate surveying methods, procedures and employ competent surveying personnel to ensure pipe sections are laid to line and grade and within stipulated tolerances. Measure and record, in form approved by the Project Manager, in-place survey data for pipe laid each day and submit copy of data to the Project Manager at end of that day. Survey data to include unique pipe number, deflection angle at pipe joint and whether beveled ends were used, invert elevation at pipe joint, deviation of joint from project line, deviation of joint from project grade, inside pipe joint lap measured at top, bottom and at springline (each side).
- I. Static Electricity:
  - 1. Properly ground steel pipeline during construction as necessary to prevent buildup of static electricity.
  - 2. Electrically test where required after installation of pipeline is complete.

### 3.2 DEFLECTION

- A. Allowable deflection from specified diameter determined as follows: Allowable Deflection =  $(D)_2/4000$ , (D= Nominal inside pipe diameter in inches).
- B. Deflection shall be measured by the Project Manager at location along pipe. Arithmetical averages of deflection are not acceptable.
- C. If deflection exceeds that specified, remove entire portion of deflected pipe section and install new pipe as directed by the Project Manager at no cost to the City.

### 3.3 CLOSURES AND APPROVED PIPE MODIFICATIONS.

- A. No modifications of standard pipe for closures shall be permitted in field. No field cutting of pipe or exposure of bar wire shall be permitted without written approval from the Project Manager.
- B. Pipe manufacturer's representative and the Project Manager to entirely witness closures and approved pipe modification efforts.
- C. Provide minimum lap of four inches (4 In) between member being joined and edge of butt strap. Weld on both interior and exterior, unless otherwise approved by the Project Manager.
- D. Provide full circumferential welds on joints required to be welded. Employ independent certified testing laboratory, approved by the Project Manager, to perform weld tests on field welds. Include cost of such testing in contract unit price for water line. Use magnetic particle test method for lap welds or X-ray methods for butt welds, for one hundred

percent (100%) of joint welds. Maintain records of tests. If defective weld is revealed, repair defective weld and retest. Use wire and flux from same manufacturer throughout entire project.

- E. Fill wrapper in field and allowing excess grout water to seep out. Refill wrapper as necessary. When joint mortar level has stabilized and begun to mechanically stiffen, lap Ethafoam wrapper over top of joint and secure in place.
- F. Stretch test each gasket splice to twice its unstretched length and inspect for defects.

### 3.4 VISIBLE CRACKS

- A. No visible cracks longer than six inches (6 In), measured to be within fifteen degrees (15°) of line parallel to pipe longitudinal axis, shall be permitted except:
  - 1. In surface laitance of centrifugally cast concrete,
  - 2. In sections of pipe with steel reinforcing collars or wrappers or
  - 3. Within twelve inches (12 In) of pipe ends.
- B. Repair interior lining cracks that exceed one-sixteenth inch (1/16 In), (0.0625 inches), wide.
- C. Reject pipe with exterior coating cracks that exceed one hundredth inches (0.01 In) wide.
- D. Immediately remove pipe from site if pipe has cracks exceeding limitations and cracks are not repairable.

### 3.5 FIELD REPAIR PROCEDURES FOR COATING/LINING

- A. Areas less than or equal to six inches (6 In) in diameter: Patch honeycomb and minor defects in concrete surfaces with nonshrink grout conforming to section 2.3.B. Use only manual or small (low pressure ) air chisels to chip away mortar coating or lining. Cut out unsatisfactory material and replace with nonshrink grout, securely bonded to existing coating or lining. Finish junctures between patches and existing concrete as inconspicuous as possible. Strike off nonshrink grout flush with surrounding surface after patch has stiffened sufficiently to allow for greatest portion of shrinkage. Finish surface in accordance with lining requirements.
- B. Pipe with defective coating areas greater than six inches (6 In) in diameter shall not be used. Immediately remove pipe from project.
- C. Reject pipe if steel cylinder is dented while making field repair. Immediately remove pipe from project.

**END OF SECTION**