Section 02507

PRESTRESSED CONCRETE CYLINDER PIPE

PART 1 G E N E R A L

1.1 SECTION INCLUDES

1. Prestressed concrete cylinder pipe (PCCP) and fittings for buried water lines sizes 20 inches and larger.

1.2 MEASUREMENT AND PAYMENT

1. Unit Prices.

    1. No separate payment will be made for PCCP under this Section. Include cost in price for water lines.

    2. Maintain on site minimum of two 3-degree and two 5-degree grade angle adapters. Adapters are considered "extra unit price." When used during construction, adapter will be paid at unit price.

    3. Refer to Section 01270 - Measurement and Payment for unit price procedures.

2. Stipulated Price (Lump Sum). If Contract is Stipulated Price Contract, payment for work in this Section is included in total Stipulated Price.

1.3 REFERENCES

1. AASHTO - Standard Specifications for Highway Bridges.

2. AREA - Manual of Railway Engineering, Volume II, Chapter 15.

3. ASTM A 648 - Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Pipe.

4. ASTM C 33 - Standard Specification for Concrete Aggregates.

5. ASTM C 35 - Standard Specification for Inorganic Aggregates for Use in Gypsum Plaster.

6. ASTM C 150 - Standard Specification for Portland Cement.

7. ASTM C 497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.

8. ASTM C 1107 (CRD C-621) - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

9. ASTM D 512 - Standard Test Methods for Chloride Ion In Water.

10. ASTM D 1293 - Standard Test Methods for pH of Water.

11. ASTM E 165 - Standard Test Methods for Dye Penetration.

12. ASTM E 340 - Standard Test Methods for Macroetching Metals and Alloys.

13. ASTM E 709 - Standard Test Methods for Magnetic Particle Testing.

14. ASTM E 1032 - Standard Test Methods for Radiographic Examination of Weldments.

15. ANS1/AWS A3.0 - Standard Welding Terms and Definitions.

16. AWWA C 206 - Standard for Field Welding of Steel Water Pipe.

17. AWWA C 207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 in. through 144 in.

18. AWWA C 301 - Standard for Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids.

19. AWWA C 304 - Standard for Design of Prestressed Concrete Cylinder Pipe.

20. AWWA M 9 - Standard for Concrete Pressure Pipe.

21. NSF 61 - Drinking Water System Components - Health Effects.

22. SSPC SP 7 - Surface Preparation Specification No. 7 - Brush Off Blast Cleaning.

1.4 SUBMITTALS

1. Conform to requirements of Section 01330 - Submittal Procedures.

2. Submit shop drawings and certification signed and sealed by Professional Engineer registered in State of Texas showing following:

    1. Manufacturer's pipe design calculations.

    2. Provide lay schedule of pictorial nature indicating alignment and grade, laying dimensions, welding procedures, fabrication, fitting, flange, and special details, with 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 Drawings. Do not start production of pipe and fittings prior to review and approval by City Engineer. 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.

3. Within 30 calendar days following Notice to Proceed and before initiation of manufacture of prestressing wire, submit following:

    1. Name and location of prestressing wire manufacturer.

    2. General description of quality control procedures used by wire manufacturer. Include physical and chemical property tests utilized, testing frequency and test records; and description of methods employed to assure compliance with AWWA C301 regarding wire surface temperature, type of thermometer, location of temperature measurement, frequency of temperature tests and test records.

    3. Approximate dates when wire will be manufactured for use in pipe.

    4. Hydrogen embrittlement sensitivity test report for wire.

4. 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.

5. Submit following within 45 days after manufacturing of pipe and fittings:

    1. Prestressing wire records.

        1. ASTM A 648 for wire.

        2. Steel reports as required in AWWA C301, Section 4.4.7.

        3. Records of testing accomplished to measure wire surface temperature as required in AWWA C301, Section 4.4.8.

        4. Results of other tests of steel reinforcement required in AWWA C301, Section 4.4.

        5. Wire tension records required in AWWA C301, Section 4.4.8. Indicate heat and coil of prestressing wire used.

    2. Test results.

1. Hydrostatic testing, acid etching, dye penetration, magnetic particle and x-ray weld test reports as required.

2. Compressive strength (28 day) test results for each type of coating, lining and core mix design.

3. Pipe manufacturer's certification that PCCP:

1. Cylinder assembly has been hydrostatically tested at factory for two (2) minutes minimum in accordance with Section 2.01 J and AWWA C301.

2. Mortar coatings and linings were applied or allowed to cure at temperature above 32 degrees Fahrenheit.

6. Submit following for nonshrink grout for special applications:

1. Manufacturer's technical literature including specifications for mixing, placing, and curing grout.

2. Results of tests performed by certified independent testing laboratory showing conformance to ASTM C 1107, Nonshrink Grout and requirements of this specification.

3. Certification product is suitable for use in contact with potable water.

7. Submit certification for welder and welding operator demonstrating their certification within past 6 months in accordance with AWWA C 301. Indicate certified procedures and position each welder is qualified to perform.

8. Submit certification showing calibration within last 12 months 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 City Engineer.

1.5 QUALITY CONTROL

1. Manufacturer 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 City Engineer. Perform manufacturer tests and inspections required by AWWA C 301 as modified by these Specifications. Repair defects when as substandard welds, excessive radial offsets (misalignment), pitting, gouges, cracks, other nonconforming conditions.

1. Cylinder and Joint Ring Assembly:

1. Review mill certifications for conformance to requirements of Specifications.

2. Perform physical testing of each heat of steel for conformance to applicable ASTM standards.

3. Inspect physical dimensions and overall condition of joint rings and cylinder/joint ring assembly to verify compliance with requirements of AWWA C 301.

4. Test cylinder/joint ring weld for tensile strength. Test one specimen for each 500-cylinder/joint-ring assemblies in addition to those tests required by AWWA C 301.

5. Reject pipe with dented steel cylinders.

2. Prestressing Wire:

1. Inspect wire spacing during wire placement on core.

2. Test wire splices for each production run or a minimum of once a week, whichever is less, for conformance with minimum strength criteria.

3. Pipe Cores and Coating:

1. Review mill certificates for each load of cement for conformance to ASTM C 150.

2. Perform sieve analysis weekly for each source of coarse and fine aggregate for conformance to ASTM C 33.

3. Inspect kiln recorder charts daily to confirm proper curing environment.

4. Prior to prestressing, inspect each core for voids, chips, cracks, deleterious surfaces and foreign matter.

5. Check outer core moisture of each pipe core immediately prior to applying mortar coating.

6. Check mortar batch proportions, moisture content and slurry application rate. Check coating thickness over wire on each pipe.

7. Check physical integrity of cured mortar coating.

8. Reject pipe with cracks in mortar coating exceeding 0.01 inches wide.

4. Protective Coatings: Check daily application rate and resulting dry film thickness.

2. Gaskets: Randomly test rubber cord for diameter, tensile strength, elongation, compression set, hardness, and specific gravity after oven aging on one out of 100 gaskets.

3. Weld Testing:

   1. Perform macroetching tests for full-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 E 340.

   2. Perform ultra-sonic or x-ray testing of manual butt 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 set of weld test specimens in accordance with ANS1/AWS A3.0 on each size, grade and wall thickness at minimum of every 3,000 feet of pipe manufactured. Perform no less than one test per project by each welding machine and each operator.

4. Cast four standard test cylinders each day for each 50 cubic yards of mortar coating or portion thereof for each coating and lining placed in day. Perform compressive strength test at 28 days. No cylinder test result shall be less than 80 percent of specified strength.

5. Make available copy of Physical and Chemical testing reports for steel cylinders and provide reports at request of City Engineer.

6. Check physical dimensions of pipe and fittings: Physical dimensions to include pipe lengths, pipe LD., pipe O.D. and bend angles.

PART 2 P R O D U C T S

1.6 PRESTRESSED CONCRETE CYLINDER PIPE

1. Furnish pipe by same manufacturer.

2. Provide prestressed concrete cylinder pipe in conformance with AWWA C 301, AWWA C 304 and AWWA M 9 except as modified in this Section. Use of pipe from inventory is permitted only if specifications and certifications are met. Provide testing records for pipe.

3. Do not use prestressed concrete cylinder pipe in aerial crossings, exposed or other unburied areas.

4. Pipe manufacture.

    1. Must have minimum of 5 years of manufacturer's pipe installations that have been in successful and continuous service.

    2. Must maintain on site or in plant minimum of four 22.5E bends per 10,000 linear feet of water line. Any combination of bends may be substituted at manufacturer's option (i.e. two 11.25E bends are equivalent to one 22.5E bend and will be counted as one fitting). Must be capable of delivering bends to job site within 12 hours of notification. These fittings are in addition to fittings called out on Drawing and must be available at all times.

5. Pipe Design Conditions:

    1. Working pressure: 100 psi.

    2. Hydrostatic field test pressure: 150 psi.

    3. Maximum pressure due to surge: 150 psi.

    4. Minimum Pressure due to surge: -5 psi.

    5. Unit weight of soil: 120 pcf minimum, unless otherwise specified.

    6. Minimum trench width: O.D. of pipe + four (4) feet.

    7. Pipe and Fittings: Designed to withstand most critical simultaneous application of external loads including construction loads and internal pressures.

    8. Design: Based on minimum of AASHTO HS-20 loading, AREA Cooper E-80 loads when under railroads, and depths of bury as indicated. Design pipe with Marston's earth loads for transition width trench for all heights of cover.

        1. Calculate moments and thrusts in wall based on height of earth load.

        2. For earth load heights up to 16 feet, use bedding sand as bedding material and use ninety degree Olander coefficients for earth load and water weight contained in pipe along with 15 degree Olander coefficients for pipe weight.

        3. For earth load heights 16 feet and greater, use cement stabilized sand as bedding material below springline of pipe and use, one hundred and fifty degree Olander coefficients for earth load and water weight.

    9. Groundwater level: Assume below pipe for pipe design. Assume equal to natural ground surface for other conditions.

10. Design pipe for transmitting potable water, unless otherwise shown on Drawings.

11. Manufacture pipe for adverse environmental conditions in accordance with Section 7.5.5 of AWWA C304.

12. Design pipe for buried conditions and kept empty for up to 365 days.

13. Tunnel and Augered sections. Provide constant outside diameter from bell to spigot end for pipe. Exclude structural benefits associated with primary liner. 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 stress anticipated during handling and installation.

6. Coatings and Linings:

1. Provide Portland cement; ASTM C 150, Type I or II.. Provide one type of cement for entire project.

2. Water Absorption Test: ASTM C 497, Method A; perform on samples of cured mortar coating taken from each working shift. Cure mortar coating samples in same manner as pipe.

1. Test value: Average minimum of 3 samples taken from same working shift, no greater than 9 percent for average value, 11 percent for individual value.

2. Test frequency: Perform tests each working shift until conformance to absorption requirements has been established by 10 consecutive passing test results, at which time testing may be performed weekly. Resume testing for each working shift when absorption test results fail until conformance to absorption requirements is reestablished by 10 consecutive passing test results.

3. Apply one 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, test inlets and air release/vacuum relief riser pipe with same coating and lining of water line in accordance with AWWA C 301, Section 4, unless otherwise indicated on Drawings.

5. Do not exceed two hours between application of first and last course when cement mortar is applied in more than one course, otherwise 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 100 square inches or 12 inches in greatest dimension. Allow no more than one 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.

7. Fittings and specials:

   1. Design fittings to same internal and external loads as straight pipe.

   2. Manufacture in accordance with Section 02518 - Steel Pipe and Fittings for Large Diameter Water Lines.

   3. Provide fabricated bends or fittings with minimum radius of 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 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 4 feet in length unless indicated on Drawings or approved by City Engineer.

   6. Butt Straps for Closure Piece: Provide at locations indicated on Drawings or authorized by City Engineer. Minimum 12-inch-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 6-inch welded outlet for inspecting each closure section, unless access manway is within 40 feet of closure section.

   8. Provide Densco petroleum based tape or approved equal for exposed portions of nuts and bolts.

8. Joints:

   1. AWWA C 301 rubber-gasketed or welded bell-and-spigot type except where flanged joints are required for valves and fittings as shown on Drawings. Refer to Section 02511 - 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. Bond as shown on Drawings to provide electrical continuity along entire pipeline.

3. Restrained Joints: Restrain joints by welding or harnessing joints.

    1. Design pressure: 1.5 times working pressure.

    2. Harnessed joints: AWWA M 9, clamp or snap ring type, except where prohibited.

    3. Groundwater level: Assumed to be equal to natural ground surface.

    4. 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) Calculate cylinder thickness not to be less than that defined in following table.

Inside Diameter (in)	Gauge Size
Greater than 84"	6
72" to 84"	8
48" to 66"	10
Less than 48"	12

        3) Allow cylinder thickness to reduce linearly from maximum calculated thickness or from minimum cylinder thickness (as determined in Paragraph 2.01 H.3.d.1, whichever controls, to minimum thickness required by design over required length (as determined in Paragraph 2.01 H.3.d.1) of restrained joints.

4. Use only fully circumferentially welded joints in areas considered potentially petroleum contaminated, within tunnels and under foreign pipelines. Perform welding in accordance with Section 02502 - Steel Pipe and Fittings and 02518 - Steel Pipe and Fittings for Large Diameter Water Lines.

5. Pipe Flanges: AWWA C 207 for standard steel flanges of pressure class corresponding to pipe class.

9. Pipe lengths: Provide pipe sections in standard lengths with minimum length of 16 feet and maximum length of 25 feet, and as indicated on approved shop Drawings or approved by City Engineer. Gasketed joints are allowed on standard lengths of pipe. Non-standard pipe

pipe lengths must be approved by City Engineer 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.

10. Hydrostatic Test of Cylinder: AWWA C 301, Section 4.6.4.3, at point of manufacture. Hold test for minimum 2 minutes for thorough inspection of cylinder. Repair or reject cylinders revealing leaks or cracks.

11. Transport fittings 42 inches in diameter and larger with end caps and stulls. Remove end caps just prior to installation. Remove stulls after completion of backfill operation.

12. Provide radius of curve as indicated on Drawings unless approved by City Engineer. Make curves and bends by deflecting joints, by use of beveled joints, or by combination of two methods, unless otherwise indicated on 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.

13. 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.

14. Prior to arrival on project site, identify pipe sections within limits of thrust restraint with permanent, brightly colored, and highly visible markings on outer pipe coating as approved by City Engineer.

1.7 PRESTRESSING WIRE

1. General

    1. Conform to requirement of ASTM A 648, AWWA C 301 and this specification.

    2. Furnish test results from independent manufacturer (i.e., manufacturer with no legal or financial ties to pipe manufacturer). Tests must have been performed within 12 months prior to submittal or when supplier changes.

    3. Test foreign manufactured wire by local independent laboratory.

    4. Prestressing wire surface temperature: Not more than 360 degrees at any point in drawing process. Audit surface temperature of wire throughout length of wire drawing process daily for each working shift producing ASTM A 648 wire.

5. Do not use wire with visible pitting or rust that cannot be wiped off.

6. Do not use wire that fails, for no observable mechanical reason other than tension force, during circumferential wrap. Do not splice, but reject this section of wire.

2. Perform mechanical tests per AWWA C301 - Steel Reinforcement except as modified below:

   1. Retest coil for which failed torsion test sample has radial, spiral (that is, longitudinal) split visible to unaided eye or evidenced by abrupt offset in wire surface detectable with fingernail.

   2. Test sample, for mechanical requirements, from 1 of each 10 consecutively produced coils or fraction thereof in each lot. Pipe manufacturer to establish procedures so samples are randomly selected from entire length of wire coils.

3. Perform hydrogen embrittlement sensitivity testing on samples of prestressing wire. Test one set of pre-qualified samples for each anticipated wire manufacturing source anticipated by pipe manufacturer for project. Perform tension, wrapping, and torsion on wire samples. Perform pre-qualification testing prior to pipe manufacturing and for each source of supply for wire. Do not use wire failing to conform to test requirements of specification. Utilize only wire that meets both of following:

   1. Passed aforementioned test.

   2. Manufactured from same source and manufacturing procedures.

4. Hydrogen embrittlement sensitivity test.

   1. Apply tensile force using lever apparatus, closed still frame in either vertical or horizontal orientation, or stable hydraulic loading system equipped with force indicator. Use chronometer with precision of at least 0.1 hour and capable of being stopped automatically on fracture of sample.

   2. Use cylindrical ammonium thiocyanate (NH_4SCN_1) cell constructed of material which is inert to ammonium thiocyanate. Expose minimum 150 mm long sample to solution. Open and closed test cells permitted. Minimum internal diameter of cell (D_i): Provide minimum 5 ml of solution per cm^2 of surface area of sample in contact with solution. Calculate minimum diameter as follows:

      D_i # $[(200 + d) \times d]^{0.5}$ in mm, where d is wire diameter.

   3. Solution replacement is recommended, but not required, during test. When replacement is performed, continuously replace cell volume at rate not less than two times per 24-hour period.

4. Sample from lot of wire in which mechanical properties have been previously determined in accordance with ASTM A 648 and AWWA C301. Provide sample consisting of minimum of one (1) full loop of wire from each of minimum of ten (10) coils. Tag each loop with appropriate heat number and coil number permanently identifying source of wire.

5. Provide certified mill report for each heat represented in sample, showing chemical composition, including as minimum:

Carbon (C)	Titanium (Ti)
Manganese (MN)	Nickel (Ni)
Silicon (SI)	Chromium (Cr)
Phosphorus (P)	Vanadium (V)
Sulfur (S)	Copper (Cu)
Nitrogen (N)	Molybdenum (Mo)
Aluminum (Al)	

6. Analyze dissolved hydrogen concentration for purposes of establishing baseline value prior to conducting hydrogen embrittlement sensitivity tests.

7. Test minimum of ten (10) pieces, at least one (1) piece chosen from each of ten (10) or more coils represented in lot, in ammonium thiocyanate solution for determination of time to failure.

8. Clean each test piece by wiping with soft cloth and degreased in acetone, or in trichlorethylene, and air dry. Protect test piece by varnish or similar means, as necessary, in zones where it enters test cell to prevent crevice corrosion failures at these locations. When necessary, extend protection at least 25 mm into cell.

9. Place ammonium thiocyanate, solution concentration of 200 grams (99%) pure NH_4SCN per 800 ml of water, cell on test sample. Seal in place and then place cell/test sample assembly in tensioning device.

10. Apply load to test piece until force equal to 70% of ASTM A 648 class minimum tensile load is indicated. Maintain force within " 2.0% for duration of test.

11. Upon completion of application of force, fill cell with ammonium thiocyanate solution, preheated to temperature of 50EC " 1EC. Fill cell within one minute. Upon completion, set chronometer to zero to indicate test starting point.

12. Check applied force and adjust as necessary to ensure force is maintained within specified range at appropriate time intervals throughout test. Record times when force was checked or adjusted.

13. Adjust temperature of test solution in cell to 50EC " 1EC within 5 minutes of starting test. Maintain temperature throughout test.

14. Test is completed on fracture of sample or test time reaching 150 hours. Note time to fracture on chronometer, recorded to nearest 0.1 hour.

15. When fracture occurs elsewhere than within exposed test length, test is invalid. Record no time.

5. Hydrogen embrittlement sensitivity report, include following:

    1. Test samples:

        1. Wire manufacturer.

        2. Size and class of wire with heat number.

        3. Mechanical properties indicated by mean results from other required physical tests.

        4. Chemical composition.

    2. Test conditions:

        1. Cell design: Open or closed, with or without solution replacement and replacement rate.

        2. Physical length of test sample (exposed).

        3. Deviations from specified procedure.

        4. Copy of this specification and statement that procedures described herein have been followed, except where noted otherwise.

    3. Report results:

        1. Description of type of fracture and presence or absence of pitting and splits for each sample.

        2. Position of sample fracture in relation to test cell.

3. Table of individual sample times to failure.

4. Mean lifetime to failure and standard deviation for samples of diameter and class from wire manufacturer, using same wire drawing procedures.

4. Evaluate performance of wire in general, and specific performance as defined by following pass/fail criterion:

1. Pass/fail Criterion for ASTM A 648 prestressing wire. Wire considered passing provided mean time to failure minus one standard deviation for ten samples tested exceeds 75 hours.

2. Time to failure in hydrogen charging test of individual sample from group of ten (10) samples tested and reported less than, 75 hours. When one sample from group of ten (10) samples tested fails in less than 75 hours, single sample retest is permitted on sample from same loop of wire.

1) Reject lot when retest is less than 75 hours.

2) When retest is greater than 75 hours, use time (to failure) to replace rejected data in ten (10) sample groups mean and standard deviation from adjusted result.

1.8 GROUT FOR JOINTS AND SPECIAL APPLICATION

1. Joint Grout

1. Cement Grout Mixture: One part cement to two 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 1000 mg/1; ASTM D 512 chloride ions less than 100 mg/1 for slurry and mortar cure; ASTM D 1293 pH greater than 6.5. Use potable water with 250 ppm limit on chlorides and sulfates.

3. Portland Cement: ASTM C 150, Type I or II. Provide one type of cement for entire project.

4. Sand:

1. Interior joints: ASTM C 35 fine graded plaster sand.

2. Exterior joints: ASTM C 33 natural sand with 100 percent passing No. 16 sieve.

5. Mix cement grout to specific gravity of 19 lb/gallon or greater as measured by grout/slurry balance. Use grout/slurry balance manufactured by Baroid or approved equal. Perform test in presence of and at request of City Engineer. Add additional cement grout or water to mixed cement grout to bring mix to proper moisture content or specific gravity. Discard cement grout that has been mixed more than 20 minutes and is not at proper specific gravity or moisture content.

2. Nonshrink Grout for Special Applications, Patches and Repairs.

1. Conform to requirements of ASTM C 1107, Nonshrink Grout.

2. Pre-blended factory-packaged material manufactured under rigid quality control.

3. Contain non-metallic natural aggregate, be non-staining and non-corrosive.

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 prestressed concrete cylinder pipe.

8. Free of gas-producing, gas-releasing agents.

9. Resist attack by oil or water.

10. Use "EUCON N_S Grout" as manufactured by Euclid Chemical Company, Cleveland, Ohio; "Gilco Construction Grout" as manufactured by Cormix Construction Chemicals, Dallas, Texas; or approved equal.

11. Mix, place, and cure in accordance with manufacturer's recommendations. Upon 72 hours notice, provide services of qualified representative of nonshrink grout manufacturer to aid in use of product under job conditions.

12. Mix non-shrink grout to specific gravity of 17.7 lb/gallon or greater as measured by grout/slurry balance. Use grout/slurry balance manufactured by Baroid or approved equal. Perform test in presence of and at request of City Engineer. Add additional cement grout or water to bring mix to proper moisture content or specific gravity. Discard grout that has been mixed more than 20 minutes and is not at proper specific gravity or moisture content.

13. Compressive strength: ASTM C 1107 2500-psi minimum 7-day unconfined; 5000-psi minimum 28-day unconfined.

3. Finished surface of lining and interior joint to 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.

4. Joint Wrapper: Minimum width of 9 inches for 33-inch diameter and smaller; minimum width of 12 inches for diameters greater than 33-inch hemmed at edge to allow threading with minimum 5/8-inch wide steel strap. Provide minimum 6-inch wide wire Ethafoam strip sized, positioned, and sewn circumferential in center of wrapper.

1.9 CATHODIC PROTECTION

1. Connect each joint of pipe with bonding straps or approved devices to maintain continuity of current. Provide bonding straps free of foreign material.

2. Electrically isolate water line from other connections. Use insulating type joints or non-metallic pipe unless otherwise indicated on Drawings.

PART 3 E X E C U T I O N

1.10 INSTALLATION

1. Conform to requirements of Section 02511 - Water Lines. Do not install pipe without approved lay schedule.

2. Manufacturer will make available services of representative, throughout project duration when deemed necessary by City Engineer, 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.

3. Bedding and Backfilling:

   1. Conform to requirements of Section 02317 - Excavation and Backfill for Utilities.

   2. Align pipe at proper grade prior to joint connection and do not shift after jointing operation has been completed.

   3. Do not move trench support system (trench safety system) once bedding material is compacted.

   4. Excavate outside specified trench section for bell holes, and for spaces sufficient to

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 as required or directed by City Engineer. Subsequent backfilling thereof will not be considered as authorized additional excavation and backfill. Backfill bell holes and spaces to satisfaction of City Engineer.

5. Remove blocking after placing sufficient backfill to hold pipe in position.

6. Use cement-stabilized sand in areas of trench excavation 16 feet and greater, as bedding material up to springline of pipe.

4. Follow nonshrink grout manufacturer's specifications for nonshrink grouting.

5. Deviation of installed pipe in any one pipe section from line and grade shown on approved shop drawing layout will not exceed 2 inches from grade and 3 inches from line. No deviation from line and grade at contact interfaces are allowed.

6. Install each pipe section in sequence identified on lay schedule. Deviations from lay schedule sequence shall be approved by City Engineer and denoted on final lay schedule.

7. 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 City Engineer, in-place survey data for pipe laid each day and submit copy of data to City Engineer 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).

8. 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 of pipeline is complete.

1.11 CLOSURES AND APPROVED PIPE MODIFICATIONS

1. No modifications of standard pipe for closures will be permitted in field. No field cutting of pipe or exposure of prestressed wire is permitted without written approval from City Engineer.

2. Pipe manufacturer's representative and City Engineer to entirely witness closures and approved pipe modification efforts.

3. Provide minimum lap of 4 inches between member being joined and ed of butt strap. Weld on both interior and exterior, unless otherwise approved by City Engineer.

4. Provide full circumferential welds on joints required to be welded. Employ independent certified testing laboratory, approved by City Engineer, to perform weld tests on field welds. Include cost of testing in contract unit price for water line. Use magnetic particle test method for lap welds or X-ray methods for butt welds, for 100 percent of joint welds. Maintain records of tests. When defective weld is revealed, repair defective weld, and retest. Use wire and flux from same manufacturer throughout entire project.

5. Fill wrapper in field and allow 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.

6. Stretch test each gasket splice to twice its unstretched length and inspect for defects.

1.12 VISIBLE CRACKS

1. No visible cracks longer than 6 inches, measured to be within 15 degrees of line parallel to pipe longitudinal axis, are permitted except:

    1. In surface laitance of centrifugally cast concrete,

    2. In sections of pipe with steel reinforcing collars or wrappers, or

    3. Within 12 inches of pipe ends.

2. Repair interior lining cracks that exceed 1/16-inch (0.0625 inches) wide.

3. Reject pipe with exterior coating cracks that exceed 0.01 inches wide.

4. Immediately remove pipe from site when pipe has cracks exceeding limitations and cracks are not repairable.

1.13 FIELD REPAIR PROCEDURES FOR COATING/LINING

1. Areas less than or equal to 6 inches in diameter: Patch honeycomb and minor defects in concrete surfaces with non shrink grout conforming to section 2.03 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.

2. Pipe with defective coating areas greater than 6 inches in diameter cannot be used. Immediately remove pipe from project.

3. Reject pipe when steel cylinder is dented while making field repair. Immediately remove pipe from project.

END OF SECTION