02620 - REINFORCED CONCRETE PRESSURE PIPE, STEEL CYLINDER TYPE

City of San Diego, CWP Guidelines

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NTS: The reinforced concrete pressure pipe, steel cylinder type, covered by this Section 02620, which conforms to AWWA C 300's rational design method and joint design, is primarily intended for pressure applications of up to 250 psi where very limited amounts of leakage are acceptable. This pipe is normally furnished with a Carnegie bell and spigot steel joint with a single rubber gasket. For subaqueous installations and pipelines installed below the water table, the double rubber gasket feature is required. See paragraph 2.5 H.

This Section is coordinated with Section 02600 such that it requires inclusion of that Section in the Contract Document.

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PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

A. The WORK of this Section includes providing reinforced concrete pressure pipe, steel cylinder type, and all appurtenant work.

1.2 RELATED SECTIONS

A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

1. Section 02140 Dewatering
2. Section 02200 Earthwork
3. Section 02600 Pipeline Construction
4. Section 02653 Steel Pipe and Specials
5. Section 02666 Water Pipeline Testing and Disinfection
6. Section 03300 Cast-in-Place Structural Concrete
7. Section 06650 Plastic Liner for Concrete Surfaces]
8. Section 09800 Protective Coating
9. Section 15025 Cathodic Protection System

1.3 STANDARD SPECIFICATIONS

A. Except as otherwise indicated in this Section of the Specifications, the CONTRACTOR shall comply with the Standard Specifications for Public Works Construction (SSPWC), as specified in Section 01090 - REFERENCE STANDARDS.

1.4 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

1.	ANSI B16.5	Pipe Flanged and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys
2.	ANSI/ASTM D2000	Classification System for Rubber Products in Automotive Applications
3.	ANSI/AWS D1.1	Structural Welding Code
4.	ASTM A 36	Specification for Structural Steel
5.	ASTM A 283	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes, and Bars
6.	ASTM A 307	Specification for Carbon Steel Bolts and Studs, 6,000 psi Tensile
7.	ASTM A 325	Specification for High-Strength Bolts for Structural Steel Joints
8.	ASTM C 150	Specification for Portland Cement
9.	ASTM C 494	Specification for Chemical Admixtures for Concrete
10.	AWWA C206	Field Welding of Steel Water Pipe
11.	AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4-in through 144-in
12.	AWWA C300	Reinforced Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids

1.5 SHOP DRAWINGS AND SAMPLES

A. The following shall be submitted in compliance with Section 01300 and AWWA C300, as applicable:

1. Drawings of pipes, valves, fittings, and appurtenances.

2. Joint and pipe/fitting wall construction details which indicate the type and thickness of cylinder; the position, type, size, and area of wire or reinforcement; manufacturing tolerances; and all other pertinent information required for the manufacture of the product.

3. Fittings and specials details such as elbows, wyes, tees, outlets, connections, test bulkheads, and nozzles or other specials where indicated which indicate amount and position of all reinforcement. All fittings and specials shall be properly reinforced to withstand the internal pressure, both circumferential and longitudinal, and the indicated external loading conditions.

4. Design calculations [including a complete stress analysis] of each critical section of pipe wall, girth joints, and specials - sufficient to ascertain conformance of pipe and fittings with the Specifications.

5. Material lists and steel reinforcement schedules which include and describe all materials to be utilized.

6. Full and complete information regarding location, type, size, and extent of all welds shall be shown on the shop drawings. The shop drawings shall distinguish between shop and field welds. Shop drawings shall indicate by welding symbols or sketches the details of the welded joints, and the preparation of parent metal required to make them. Joints or groups of joints in which welding sequence or technique are especially important shall be carefully controlled to minimize shrinkage stresses and distortion.

B. **Test Results**: Furnish results of all tests as specified in AWWA C300 and as indicated herein.

1.6 FACTORY INSPECTION AND TESTING

A. The CONTRACTOR shall be responsible for all costs associated with inspection and testing of materials, products, or equipment at the place of manufacture. This shall include costs for travel, meals, lodging, and car rental for [two] OWNER-designated inspectors for [ ] days required to complete such inspections or observations exclusive of travel days, if the place of manufacture, fabrication and factory testing is more than fifty (50) miles outside the geographical limit of the City. The CONTRACTOR shall not be responsible for salary or salary-related costs of the inspectors. The CONTRACTOR shall comply with the requirements of Section 01400.

B. **Inspection:** All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of AWWA C300, as supplemented by the requirements herein. The CONSTRUCTION MANAGER shall be notified in writing of the manufacturing starting date not less than 14 calendar days prior to the start of any phase of the pipe manufacture.

C. During the manufacture of the pipe, the CONSTRUCTION MANAGER shall be given access to all areas where manufacturing is in process and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.

D. **Tests:** Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA C300.

E. Tensile tests of production welds on steel cylinders and on lap-or butt-welded reinforcement bars shall be accomplished at the start of production and at intervals not to exceed each 5000 feet of pipe thereafter. Each test shall consist of at least two samples prepared and tested in accordance with the applicable provisions of ASTM. Cylinder weld samples shall develop a stress of not less than 90 percent of the specified minimum strength of the material being tested.

F. The CONTRACTOR shall perform said material tests at no additional cost to the OWNER. The CONSTRUCTION MANAGER will witness all testing conducted by the CONTRACTOR, provided, that the CONTRACTOR schedule is not delayed for the convenience of the CONSTRUCTION MANAGER.

G. In addition to those tests specifically required, the CONSTRUCTION MANAGER may request additional samples of any material including mixed concrete and lining and coating samples for testing by the OWNER. The additional samples shall be furnished at no additional cost to the OWNER.

H. **Welding Requirements:** All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

I. All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in welding procedures and materials to be used. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the WORK shall be used in qualification tests. The CONTRACTOR shall furnish all material and bear the expense of qualifying welders.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Reinforced concrete cylinder pipe shall conform to AWWA C300, subject to the following supplemental requirements. The pipe shall be of the diameter and pressure class indicated, shall be furnished complete with rubber gaskets, and all specials and bends shall be provided as required.

B. **Markings:** Legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation. All special pipe sections and fittings shall be marked at each end with top field centerline. The word "top" shall be painted or marked on the outside top spigot end of each pipe section.

C. **Strutting:** Adequate strutting shall be provided on all specials, fittings, and straight pipe to avoid damage to the pipe and fittings during handling, storage, hauling, and installation.

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NTS: In areas where differential settlement or liquefaction may occur, specify only raised bell joints and limit pipe length to 4 feet maximum. Consider including or modifying Standard Detail C-195.

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D. **Laying Lengths:** Maximum pipe laying lengths shall be 24 ft with shorter lengths provided as required.

E. **Finish:** The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness. The interior and exterior surfaces shall be concentric. Pipe manufactured by pouring and vibrating methods within stationary internal and external forms shall have smooth, glossy surfaces, relatively free from pits and air holes. Pits or air

holes greater than 3/8-inch in any dimension on the inside or outside surfaces of the pipe shall be repaired. Fractures, cracks or chips extending into the pipe wall in such a manner as to reduce the strength of the pipe shall not be permitted.

F. **Bonding and Electrical Conductivity:** Where bonded joints are required, the outer cage reinforcement shall be bonded to the inner layer of steel by welding a minimum of two 3/8-inch diameter mild steel bars between the outer cage and the joint rings at each end of the pipe in accordance with the details shown.

G. **Closures and Correction Pieces:** Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing indicated. The locations of correction pieces and closure assemblies are shown on the Drawings. Any change in location or number of said items shall be as accepted by the CONSTRUCTION MANAGER.

2.2 PIPE DESIGN CRITERIA

A. **General:** Except as provided in this Section, reinforced concrete pressure pipe, steel cylinder type, shall be designed in accordance with Appendix A of AWWA C300 to withstand the following loading conditions:

1. Internal pressure only.

2. A combination of operating pressure, surge pressure, and dead loads (earth, pipe and water).

3. A combination of operating pressure, dead loads, and live loads.

4. Dead loads and live loads with no internal pressure.

B. The minimum thickness of steel cylinder shall be [No. 14 gauge (0.0747 in)].

C. The magnitude of moment and thrust for each of the loading conditions shall be determined by use of Olander coefficients found in Engineering Nomographs No. 6, U.S. Department of Interior, Bureau of Reclamation. The design bedding angle shall be [45] [60] [75] [90] degrees. Moment and thrust caused by internal pressure, weight of the water inside the pipe and of the pipe shell shall also be included.

D. **Combined Loading Criteria:** Under the combined loads shown for design working pressures and earth loads, the compressive stress in the concrete shall not exceed 45 percent of the 28-day concrete compressive strength.

E. For design purposes, the 28-day concrete compressive strength shall not exceed 6,000 psi.

F. **Earth Load Criteria:** For depths of cover of 10 feet or greater, the earth load shall be computed assuming the trench/embankment condition as applicable. For depths of cover of less than 10 feet, HS-20 live load shall be included. For depths of cover of 3 feet or less, HS-20 live load plus impact shall be included. The determination of live load and impact factors shall be as recommended by AASHTO in "Standard Specifications for Highway Bridges."

2.3 MATERIALS

A. **Cement:** Cement for concrete and mortar shall conform to the requirements of AWWA C300; provided, that cement shall be Type [II] [V]. A fly ash or pozzolan shall not be used as a cement replacement.

B. **Admixtures:** At the manufacturer's option, a water-reducing set-controlling admixture, referred to as WRA, may be used in the concrete. The admixture shall conform to ASTM C 494 for type D chemical admixture and shall be compatible with the cement specified. Calcium chloride shall not be used.

2.4 SPECIALS AND FITTINGS

A. Unless otherwise required, all specials and fittings shall be, at the option of the CONTRACTOR, of the following types:

1. Outlets greater than 40 percent of nominal pipe diameter: Outlets in which the nominal diameter of the outlet exceeds 40 percent of the nominal pipe diameter and all elbows, wyes, reducers, and increasers, shall be mortar-lined and mortar-coated steel plate specials or fittings designed and fabricated in accordance with the requirements of Section 02653. Resistance to moments and thrusts resulting from combined loads shall be provided by one of the following methods:

   a. The mortar-lined-and-mortar-coated special may be fully encased in crushed rock backfill, lean concrete, or soil-cement as described in Section 02200.

   b. The steel plate special may be designed with stiffener rings to provide the required resistance to bending moments and thrusts. Stiffener rings shall be fabricated from material conforming to the requirements of ASTM A 283, Grades C or D, ASTM A 36, or equal, and shall be designed for a maximum stress of 15,000 psi. Stiffener rings shall be cement-mortar coated to provide protection equal to that provided for the pipe.

   c. The steel plate special may be designed as provided in Section 02653 for resistance to internal pressure, then designed with additional mesh or bar reinforcement in accordance with the provisions of AWWA C 300, Appendix A, for resistance to combined loads. Wall thicknesses for this alternative shall be equal to that of the adjoining pipe and shall consist of pneumatically-placed cement mortar. Reinforcement pads or collars of suitable dimensions shall be used to develop the full strength of mesh or bar reinforcement at discontinuities at outlets.

2. Outlets less than 40 percent of nominal pipe diameter: Outlets, tees, or nozzles in which the nominal diameter of the outlet does not exceed 40 percent of the nominal pipe diameter may be designed and fabricated as steel plate specials as described above, or at the option of the CONTRACTOR, may be built into the wall of the pipe in accordance with the provisions of AWWA C300. Outlets in the walls of concrete cylinder pipe shall utilize an outer sleeve with suitable pads or collars for each layer of reinforcement around which the concrete shall be poured and consolidated. After concrete casting and curing, the outlet shall be inserted into and through the sleeve and suitably welded. No method will be permitted in which chipping or sawing of concrete is required for installation of outlets. Pads or collars shall be of adequate dimensions to fully develop the strength of both layers of circumferential pipe reinforcement.

3. Elbows: Unless otherwise shown, the minimum radius of elbows shall be 2.5 times the nominal pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11-1/4 degrees.

B. Access manholes with covers shall be as shown. All threaded outlets shall be forged steel suitable for 3000 psi service.

C. Moderate deflections and long radius curves may be made by means of beveled joint rings, by pulling standard joints, by using short lengths or pipe, or a combination of these methods except that pulled joints shall not be used in combination with bevels. The maximum total allowable angle for beveled joints shall be 5 degrees per pipe joint. The maximum allowable angle for pulled joints shall be in accordance with the manufacturer's recommendations or the angle which results from a 3/4-inch pull out from normal joint closure, whichever is less. All horizontal deflections or fabricated angles shall fall on the alignment.

D. All vertical deflections shall fall on the alignment, and at locations adjacent to underground obstructions, points of minimum earth cover, and pipeline outlets and structures. The pipe angle points shall match the angle points shown.

E. **Protection of Pipe Fitting Lining:** For all pipe fittings with plant-applied concrete or cement mortar linings, the CONTRACTOR shall provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings to facilitate curing and to prevent drying out of the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe fitting is installed.

2.5 DESIGN OF PIPE

A. **General:** The pipe furnished shall be reinforced concrete pressure pipe, steel cylinder type, with steel joint rings and rubber gaskets. The pipe shall consist of a light gauge steel cylinder with attached steel joint rings surrounded by one or more cages of welded steel reinforcement which are embedded in a portland cement concrete core of uniform thickness.

B. The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements previously stated and, except as hereinafter modified, shall conform to AWWA C300 and Appendix A thereto.

C. **Pipe Dimensions:** The pipe shall be of the diameter and pressure class indicated.

D. **Fitting Dimensions:** The fittings shall be of the diameter and pressure class indicated.

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NTS: The Specifier shall add special considerations and criteria for joint design, for information of the pipe manufacturer, to withstand any anticipated: future settlement in soft ground; liquefaction induced by seismic activity; joint rotation which may be necessary to accommodate changes in line and grade; and other special project-specific features.

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E. **Joint Design:** Joint rings on straight pipe shall be manufactured so that bells and spigots are perpendicular to the axis of the pipe within plus or minus 1/4-inch when measured from one side of the pipe. The concrete core shall be a uniform distance from the ends of the bell and spigot joint rings as shown. The joints shall be so constructed that after the pipe is laid, the offset on the inside of the pipe at any joint will not be more than 1/8-inch (except for bevels), and the clear space provided for grouting between pipe ends at the outside of the joint rings shall be not less than 1/4-inch.

F. The joint rings shall be checked for size and shape on accurate templates before being incorporated in the core. Circumferences so measured shall not exceed tolerances specified in AWWA C300.

G. The joint rings shall telescope together to properly compress the rubber gasket, and there shall be no annular space between the outside of the spigot ring and the inside of the bell ring contact surface in excess of 1/8-inch, measured in a radial direction when the pipe is joined in the field and the joint is fully telescoped.

H. Joint assembly design shall be a Carnegie bell and spigot steel joint with a single rubber gasket and as shown. [For special applications only, such as subaqueous installations or pipelines installed below the water table, the CONTRACTOR shall provide double rubber gaskets for the Carnegie bell and spigot steel joint.]

[2.6 LINING OF PIPE

A. The pipe shall be lined with plastic complying with Section 06650. Installation of plastic liner shall also comply with Section 06650.]

[2.7 EXTERIOR COATING OF PIPE

A. **Coal-Tar Epoxy Protective Coating:** The exterior surface of all pipe and fittings shall be protected with a minimum of 25-mil thick 100 percent solids coal-tar epoxy coating in compliance with Section 09800. The coating may be applied to freshly placed, partially cured, or cured [cement-mortar coating] [concrete surface]. Application shall be in accordance with the manufacturer's printed instructions.]

2.8 PIPE APPURTENANCES

A. **Flanges:** Where the design pressure is 150 psi or less, flanges shall conform to either AWWA C207 Class D or ANSI B16.5 150-lb class. Where the design pressure is greater than 150 psi, up to a maximum of 275 psi, flanges shall conform to either AWWA C207 Class E or ANSI B16.5 150-lb class. Where the design pressure is greater than 275 psi up to a maximum of 700 psi, flanges shall conform to ANSI B16.5 300-lb class. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown. Attachment of the flanges to the pipe shall conform to the applicable requirements of AWWA C207.

B. The machined faces of all flanges shall be shop-coated with a rust-preventive compound. Edges and back faces of attached flanges shall be shop-coated with a bitumastic undercoat. All surfaces of blind flanges, except the machined surfaces and surfaces exposed to water during pipeline operation, shall be shop-coated with a bitumastic undercoat. The inside of blind flanges shall be cement-mortar coated, the thickness to be the same as the cement-mortar lining for pipe as stated herein.

C. Blind flanges shall be in accordance with AWWA C207.

D. Insulated flanges shall have bolt holes 1/4-inch diameter greater than the bolt diameter.

E. Gaskets for flanges shall be 1/8-inch ring-type, manufactured from compressed non-asbestos sheet packing.

F. **Insulating Flange Sets:** Insulating flange sets shall be provided where indicated. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers and a steel washer.

G. Insulating gaskets shall be full face. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2-inch or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2-inch, insulating sleeves and washers shall be 2-piece and shall be made of polyethylene or phenolic. Steel washers shall be in accordance with ASTM A 325.

H. **Flange Bolts:** All thread studs shall be used on all valve flange connections and shall be in accordance with ASTM A 307, Grade B, with heavy hex nuts. Machine bolts may be used on all other flanged connections and shall be in accordance with ASTM A 307, Grade A, with hex nuts. Studs and bolts shall extend through the nuts a minimum of 1/4-inch.

I. **Mechanical Couplings:** The ends of the pipe, where indicated, shall be prepared for flexible steel couplings. Plain ends for use with couplings shall be smooth and round for a distance of 12 inches from the ends of the pipe, with outside diameter not more than 1/64-inch smaller than the nominal outside diameter of the pipe. The middle ring shall be tested by cold-expanding a minimum of one percent beyond the yield point to proof-test the weld to the strength of the parent metal. The weld of the middle ring shall be subjected to air test for porosity.

J. The followers shall be single-piece contoured mill section welded and cold-expanded as required for the middle rings. They shall be of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling. The shape of the follower shall be of such design as to provide positive confinement of the gasket.

K. Gaskets shall be rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions. The rubber in the gasket shall meet the following specifications:

1. Color - Jet Black
2. Surface - Non-blooming
3. Durometer Hardness - 74 ± 5
4. Tensile Strength - 1000 psi minimum
5. Elongation - 175 percent minimum

L. The gaskets shall be immune to attack by impurities normally found in water. All gaskets shall meet the requirements of ANSI/ASTM D 2000, AA709Z, meeting Suffix B13 Grade 3, except as noted above.

M. Where insulating couplings are required, both ends of the coupling shall have a wedge-shaped gasket which assembles over a rubber sleeve of an insulating compound in order to obtain insulation of all coupling metal parts from the pipe.

N. **Restrained Joints:** Where indicated, restrained joints shall be field-welded joints complying with AWWA C206 and/or joint harnesses of an approved previously-tested type. Designs shall include considerations of stresses induced in the steel cylinder, the attachments, the joint rings and any field welds caused by thrust at bulkheads, bends, reducers, and line valves resulting from the design working pressure. For field welded joints, design stresses shall not exceed 50 percent of the specified minimum yield strength of the grade of steel utilized, or 16,500 psi, whichever is less, for the part being examined when longitudinal thrust is assumed to be uniformly distributed around the circumference of the joint. At the CONTRACTOR's option, the steel cylinder area may be progressively reduced from the point of maximum thrust to the end of the restrained length. All joints to be field welded for thrust restraint shall have the joint rings attached to the cylinder with double fillet welds.

2.9 MANUFACTURERS

A. Pipeline appurtenances shall be of the following type and manufacture, or equal:

1. Threaded outlets: Vogt
2. Gasket flanges: Garlock No. 3200
3. Insulating gaskets: JM Red Devil, Type E
4. Mechanical couplings: Dresser, Rockwell, Romac
5. Grout bands, polyethylene foam-lined: Dow Chemical Company, Ethafoam 222

PART 3 -- EXECUTION

3.1 INSTALLATION OF PIPE

A. **General:** Pipe shall be installed in accordance with the manufacturer's instructions, the applicable provisions of SSPWC, Subsection 306-1.2, and these specifications.

B. **Pipe Laying:** When the pipe is being laid, it shall be turned and placed where possible, so that any slightly damaged portion will be on top. The damaged area shall be repaired for the protection of any exposed steel. All damaged areas shall be repaired using materials and methods recommended by the pipe manufacturer and as accepted by the CONSTRUCTION MANAGER.

C. Pipe struts shall be left in place until backfilling operations have been completed for specials and fittings 42 inches in diameter and larger. Struts in fabricated steel plate specials smaller than 42 inches may be removed immediately after laying; provided, that the deflection of the special during and after backfilling does not exceed that specified. After the backfill has been placed, the struts shall be removed and shall remain the property of the CONTRACTOR.

D. **Pipe and Specials Protection:** The openings of all pipe and specials where the pipe and specials have been cement mortar lined in the shop shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water or any undesirable substance. The bulkheads shall be so designed to prevent drying out of the interior of the pipe. Water shall be introduced into the pipe to keep the mortar moist where moisture has been lost due to damaged bulkheads. At all times, means shall be provided to prevent the pipe from floating.

3.2 JOINT COATING AND LINING

A. **General:** The interior and exterior joint recesses shall be filled in accordance with the applicable provisions of SSPWC, Subsection 306-1.2.4 and the requirements stated herein. The cement for joint grout and mortar shall be portland cement acceptable under ASTM C 150 and shall be of the same type (II or V) used for the pipe.

B. **Joint Coating:** After the pipe has been laid and after sufficient backfill has been placed between the joints to hold the pipe securely in place, the outside annular space between pipe sections shall be completely filled with grout formed by the use of [polyethylene foam-lined fabric bands] [heavy-duty diapers]. The grout shall be composed of one part cement to not more than 2 parts sand, thoroughly mixed with water to a consistency of thick cream. The joint shall be filled with grout by pouring from one side only, and shall be rodded with a wire or other flexible rod or vibrated so that the grout completely fills the joint recess by moving down one side of the pipe, around the bottom of the pipe and up the opposite side. Pouring and rodding the grout shall be continued to allow completion of the filling of the entire joint recess in one operation. Care shall be taken to leave no unfilled space. Grouting of the outside joint spaces shall be kept as close behind the laying of the pipe as possible except that in no case shall grouting be closer than 3 joints of the pipe being laid.

C. **Grout Bands (Diapers):** The grout bands or heavy-duty diapers shall be [polyethylene foam-lined] fabric of sufficient strength to hold the fresh mortar, resist rodding of the mortar and allow excess water to escape. [The foam plastic shall be 100 percent closed cell, chemically inert, insoluble in water and resistant to acids alkalies and solvents.]

D. The fabric backing shall be cut and sewn into 9-inch wide strips with slots for the steel strapping on the outer edges. [The polyethylene foam shall be cut into strips 6 inches wide and slit to a thickness of 1/4-inch which will expose a hollow or open cell surface on one side. The foam liner shall be attached to the fabric backing with the open or hollow cells facing towards the pipe. The foam strip shall cover the full interior circumference of the grout band with sufficient length to permit an 8-inch overlap of the foam at or near the top of the pipe joint. Splices to provide continuity of the material will be permitted. The polyethylene foam material shall be protected from direct sunlight.]

3.3 INSTALLATION OF PIPE APPURTENANCES

A. **Protection of Appurtenances:** Appurtenances shall be coated with a minimum thickness of one inch of cement mortar having one part cement to not more than 2 parts plaster sand. [Following coating with cement mortar, the appurtenances shall be coated with coal-tar epoxy in accordance with Paragraph 2.6A.]

B. **Installation of Flanged Joints**: Before the joint is assembled, the flange faces shall be thoroughly cleaned of all foreign material with a power wire brush. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges. All bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable, approved and calibrated torque wrench. All clamping torque shall be applied to the nuts only.

C. All buried flanges shall be coated and protected in accordance with Section 09800.

D. Insulated Joints: Insulated joints and appurtenant features shall be made as indicated. Exercise special care when installing these joints to prevent electrical conductivity across the joint. After the

insulated joint is completed, an electrical resistance test will be performed by the CONSTRUCTION MANAGER. Should the resistance test indicate a short circuit, remove the insulating units to inspect for damages, replace all damaged portions, and reassemble the insulating joint. The insulated joint shall then be re-tested to assure proper insulation.

E. **Flexible Coupled Joints:** When installing flexible couplings, care shall be taken that the connecting pipe ends, couplings and gaskets are clean and free of all dirt and foreign matter with special attention being given to the contact surfaces of the pipe, gaskets and couplings. The couplings shall be assembled and installed in conformity with the recommendation and instruction of the coupling manufacturer.

F. Wrenches used in bolting couplings shall be of a type and size recommended by the coupling manufacturer. Coupling bolts shall be tightened so as to secure a uniform annular space between the follower rings and the body of the pipe with all bolts tightened approximately the same amount. Diametrically opposite bolts shall be tightened progressively and evenly. Final tightening shall be done with a suitable, approved and calibrated torque wrench set for the torque recommended by the coupling manufacturer. All clamping torque shall be applied to the nut only.

G. Upon completion of the coupled joint, the coupling and bare metal of the pipe shall be cleaned, primed and protected in accordance with the requirements of Section 09800.

H. **Joint Bonding:** Where indicated, all joints shall be bonded in accordance with the details shown. The pipe shall be cleaned to bare bright metal at the point where the bond is installed.

[I. Corrosion mitigation and testing materials, such as magnesium anodes, reference electrodes, and test lead wire shall be furnished and installed by the CONTRACTOR.]

** END OF SECTION **