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**PART III – MINIMUM DESIGN STANDARDS
SECTION 120**

**WATER TRANSMISSION LINES
(LARGER THAN 24" DIAMETER)
ADDITIONAL DESIGN REQUIREMENTS**

120.1 GENERAL

Transmission lines larger than twenty-four (24") inch diameter may be Steel (S), or Ductile Iron (DI). Steel and ductile iron pipe shall be cement mortar lined. Steel pipe shall be coated at the factory with an exterior tape coating system in accordance with AWWA Standard C214. Ductile iron pipe shall be coated with an asphaltic shop coating and encased with polyethylene in accordance with ANSI/AWWA C105/A21.5

Except as herein modified, the pipe shall conform to the applicable AWWA specification set forth in Section 30, Table 30.1. Metallic type pipe shall be designed, manufactured, tested, inspected and cathodically protected in accordance with Section 30 and this section of these standard specifications. Minimum wall thickness of steel pipe shall be approved by the City Engineer or designee.

120.2 PRE-MANUFACTURE OF PIPE REQUIREMENTS

Within twenty (20) calendar days following the "Notice of Award", the Contractor shall obtain from the supplier and submit to the Engineer for review four (4) complete sets of the following:

120.2.1 Design Calculations

Design calculations (steel pipe only) shall comprise concise, yet complete, stress analysis of each critical section of pipe wall, girth joints, harness system, specials, outlets and appurtenances, sufficient to ascertain conformance of the pipe and fittings with these specifications. All steel pipe shall be designed in accordance with AWWA Manual M11.

120.2.2 Shop Drawings

Shop drawings shall accurately indicate the precise geometry; type, gauge, diameter, strength, manufacturing tolerance and thickness of the elements to be incorporated in manufacture of the pipe, joints, fittings and appurtenances.

120.2.3 Pipe Laying Schedule and Marking Diagram

Laying schedule shall indicate by consecutive number the order and direction of installation of each pipe section, special fitting, valves, access manholes, nozzles, outlets, and other appurtenances. In addition, the laying schedule shall include:

- A. The station and elevation to which the bell end of each pipe shall be laid and all changes in gradient or horizontal alignment.
- B. All elements of curves and bends, both in horizontal and vertical alignment.
- C. The limits of each reach of any welded joints, closures or concrete encasements.

120.2.4 Submittal Reviews and Revisions

The Engineer will inspect and return two (2) copies of design calculations, working drawings and other submittals to the Contractor properly executed and marked either "Reviewed", "Revise and Resubmit", "Furnish as Noted" or "Rejected" within twenty (20) calendar days after receipt thereof.

The Contractor shall review and back check indicated revisions deemed necessary by the Engineer to correct defects. He shall revise submittals returned to him that have been marked "Revise and Resubmit" or marked "Rejected", and shall resubmit in quadruplicate said revisions to the Engineer within fifteen (15) calendar days after the Contractor's receipt thereof. Further revisions, if and when required, will be handled in accordance with the above procedure.

Only upon the Contractor's receipt of submittals marked or designated "Reviewed" or "Furnish as Noted" shall the manufacturer of pipe commence: Provided that said drawings designated "Furnish as Noted" are corrected and resubmitted to the Engineer immediately. Upon receipt of duly executed "Reviewed" design calculations, laying diagrams and shop drawings, the Contractor shall immediately forward to the Engineer eight (8) prints of each such approved submittals for use during construction.

Neither the inspection nor lack of inspection of any drawings, design calculation, material list, laying schedule, sample or piece of data (furnished to the Engineer for his review) shall waive any of the requirements of these Specifications, Drawings and Contract Documents or relieve the Contractor of any obligations thereunder; and defective workmanship, work, materials and finished product may be rejected notwithstanding conformance with Drawings and other submittals reviewed by the Engineer.

120.3 **MATERIAL FABRICATION, TESTING AND CERTIFICATION**

The Engineer or his designated representative shall be permitted to make inspections necessary during the manufacture of the pipe and appurtenances to determine compliance with the specifications.

120.3.1 Certification

The manufacturer, via the Contractor, shall furnish the Engineer four (4) copies of the following certifications as to compliance with the specifications:

Mill analysis and test of steel. Hydrostatic test reports. Compliance of materials and application of linings and coating. Usage of Type V or modified Type II cement as required in mortar coatings on pipe, specials and fittings.

120.3.2 Marking Pipe and Specials

The manufacturer shall legibly mark and number in sequence all steel pipe sections and specials in accordance with the laying schedule and pipe installation survey laying stations. All pipe specials shall be marked at each end with the top field centerline stations.

120.3.3 Lining and Coating Protection

It shall be the responsibility of the manufacturer to provide adequate strutting to prevent damage to the coating and lining caused by deflections beyond the specified allowable limits for the type of pipe supplied during handling, loading, transporting, unloading and storing.

Any additional strutting or stulling required during installation to prevent damage to the coating and/or lining caused by deflections beyond the allowable limits shall be the responsibility of the Contractor. The Contractor shall be responsible to be sure that all strutting remains in place until after the pipe section, special or fitting has been properly backfilled.

The manufacturer shall provide a polyethylene or other suitable bulkhead on the ends of the pipe section and on all special openings to prevent drying out of the linings. The Contractor shall be responsible to assure that the polyethylene or bulkheads remain intact on the pipe ends until the section or fitting is being installed in the trench.

120.3.4 Standard Joints

Standard joints for transmission line pipe shall be either an expanded bell and rolled spigot or the Carnegie bell and spigot end ring (steel pipe only), each with rubber gasket. Mechanically coupled, flanged, mechanical, restrained or welded joints may be required where called for on the drawings.

The joint construction shall be suitable for at least 250 psi water service and regardless of type shall be designed to be self-centering. The bells and spigots shall have a smooth close sliding fit at the self-centering surface, and the joint shall be capable of either symmetrical or asymmetrical joint closure and shall remain water-tight under all conditions of water service.

The joint assemblies shall be so formed and accurately manufactured that when the pipes are drawn together in the trench; they shall form a continuous watertight conduit with smooth and uniform interior surface and shall provide for a slight movement of any pipe in the pipeline due to contraction, settlement or lateral displacement.

The maximum tolerances permitted in the construction of the joint shall be that stated in the pipe manufacturer's design as approved. Any fabrication performed prior to approval of details shall be at the Contractor's risk. Approval by the engineer shall not be held to relieve the Contractor of any part of the Contractor's responsibility to meet all of the requirements of these specifications or of the responsibility for the correctness of the joint details.

120.3.5 Harnessed Joints

Harness joint designs for steel pipe shall be submitted to the Engineer for approval. On steel transmission lines twenty seven (27) inches diameter and larger, the joint harness designs shall include considerations of stresses induced not only in the attachments, but also in joint rings and steel cylinder by thrust at bulkheads, bends, reducers, and valves resulting from the internal working pressure including the transient pressures. Design stresses shall not exceed fifty (50) percent of the specified minimum yield strength of the grade of steel utilized when longitudinal thrust is uniformly distributed around the circumference of the joint.

The manufacturer shall supply a mechanical method of joint restraint suitable to the engineer that will allow for expansion, contraction and deflection after assembly.

Proof-of-design tests need not be conducted specifically for a project. Certified reports covering tests of harnessed joints constructed in the identical fashion as that proposed may be found acceptable.

120.3.6 Flanges and Nozzles

Flanges in the line and for outlets of the size and at locations shown on the drawings shall meet the requirements of AWWA Standard C-207, Class "D", minimum 150 psi working

pressure. Flanges may be either ring type flanges or hub type flanges, but all flanges supplied must be of the same type and class. Blind flanges shall be designed in accordance with ASME Unified Pressure Vessel Code, Section VIII. The design pressure for blind flanges shall be minimum 150 psi.

Bolt holes in all flanges shall straddle field vertical centerline. Bolt holes for insulating flanges shall be 3/16" larger than the bolt diameter.

Gaskets for standard flanged outlets shall be 1/8" ring type compressed cloth inserted rubber Garlock 3000 or approved equal. Insulating flange gaskets shall be PSI - Pacific Seal gaskets with sleeves and double insulating washers or approved equal.

Nozzles shall have 1/4" minimum wall thickness.

The machined faces of all flanges shall be shop coated with rust preventative compound, Dearborn Chemical "No-Ox-Ld", Houghton "Rust-Veto 344" or Rust-Oleum "R-9" or approved equal. Edges and back faces of attached flanges shall be shop coated with Koppers "Bitumastic Mill Undercoat" or approved equal. All surfaces of blind flanges, except the machines surfaces, shall be shop coated with Koppers "Bitumastic Mill Undercoat" or approved equal.

120.3.7

Mechanical Couplings

Where mechanical couplings are required, the ends of the pipe shall be prepared for flexible steel couplings, Dresser, Baker or approved equal. Plain ends for use with couplings shall be smooth and round for a distance of twelve (12) inches from the ends of the pipe, with pipe diameter not more than 1/64" smaller than the nominal O.D. of the pipe. The middle ring of the coupling shall be truly round. After welding, all middle rings shall be tested by cold-expanding a minimum of one (1) 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.

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, in the opinion of the engineer, 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.

Gaskets shall be rubber-compounded 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:

Color - Jet Black	Tensile Strength - 1000 psi Minimum
Surface - Non-blooming	Elongation - 175% Minimum
Durometer Hardness - 74 ± 5	

The gaskets shall be immune to attack by impurities normally found in water. All gaskets shall meet the requirements of ASTM designation D2000 AA 709Z meeting Suffix B13 except as noted above.

In addition, 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.

Each coupling shall pass a resistance test of 10,000 ohms after being assembled on the pipe for 72 hours.

120.3.8 Closures and Correction Pieces

Closures and correction pieces for steel pipe shall be provided as required so that closures may be made due to different headings in the pipe laying operation and that correction may be made to get the pipe laying on station. Closures and correction pieces shall be provided as required by the Contractor and shall be approved by the Engineer.

Closures shall be so constructed as to have not less than a minimum of eighteen (18) inches and maximum of two (2) times the pipe I.D. adjustment, which may be made in the field.

The correction piece shall be a nominal length of pipe with a length of bare pipe on the spigot end for a field trim. Linings shall be held back six (6) inches from the required length on the spigot end.

120.3.9 Specials and Fittings

Unless otherwise specified herein or on the plans, all specials and fittings for steel transmission lines shall conform to the dimensions of the applicable AWWA or ASTM Standards. Specials and fittings shall be designed and constructed to be of equal or greater strength than the transmission line and shall have the same type of lining and coating as the abutting pipe. Specials and fittings shall be made of segmentally welded sections from hydrostatically tested Pipe cylinders, with ends to mate the type of joint or coupling specified. The deflection angle between adjacent segmented bands shall not be greater than 22 1/2 degrees.

Specials and fittings for steel pipe that cannot be mechanically lined and coated shall be lined and coated by hand, using the same materials as are used for the pipe and in accordance with the applicable AWWA Standards. Coatings and linings applied in this manner shall provide protection equal to that specified for the pipe. Fittings may be fabricated from pipe that has been mechanically lined and/or coated. Areas of lining and coating that have been damaged by such fabrication shall be repaired by hand applications in accordance with applicable AWWA Standards. Areas of cement-mortar linings repaired in this manner need not be reinforced with wire mesh.

Reinforcement for wyes, tees, and nozzles shall be designed in accordance with AWWA M-11 "Steel Pipe Manual". Reinforcement shall be designed for the working pressures indicated.

Access manholes with covers shall be 20" in diameter (O.D.) as detailed on the drawings. All threaded outlets shall be forged steel suitable for 3000 pound service.

Moderate deflections and long radius curves may be made by means of beveled joint rings, by deflecting a straight pipe, by using short lengths of pipe, or by a combination of any of these methods.

Unless specifically approved by the Engineer, all curves for steel pipe must begin with a pipe joint or fabricated angle at the P.C. and end with a pipe joint or fabricated angle at the P.T. within station locations shown on the Drawings. All deflection angles shall fall on the curve. The laying schedule P.I.'s must meet the P.I.'s as shown on the Drawings in the horizontal direction. The laying schedule for vertical P.I.'s must meet the P.I.'s as shown on the Drawings where interference is critical.