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DIVISION IV

SANITARY SEWER AND WATER LINE MATERIALS SPECIFICATIONS

401. SCOPE: This division shall consist of materials specifications for the construction of water and sanitary sewer lines.

402. APPLICABLE SPECIFICATIONS: The specifications, standards, and publications, including the latest amendments thereto listed in these specifications by basic designation only, form a part of this specification to the extent indicated by the references thereto.

403. CONCRETE:

403.1 Cement:

403.1.1 All cement used in the work shall be a well-known brand of true Portland Cement and shall conform to the standard specifications for Portland Cement, A.S.T.M. Designation C-150. Unless otherwise permitted, the contractor shall use only one brand of cement in the work and under no conditions shall he use more than one brand of cement in the same structure. Cement which for any reason has become partially set or contains lumps or cakes will be rejected and shall be removed from the site of the work.

403.1.2 The acceptance or rejection of cement shall rest with the Engineer and any cement failing to meet the requirements specified herein may be rejected at his direction. All rejected cement shall be plainly marked for identification, shall be immediately removed from the work, and shall not again be offered for inspection. Cement kept in storage for several months may be subject to repeated tests, if required.

403.1.3 The cement shall be delivered in strong cloth or paper bags. No cement shall be used and no cement shall be inspected unless delivered in the original package with the brand and name of the manufacturer plainly marked thereon. Each bag of cement shall contain approximately ninety-four (94) pounds of cement, net weight, and four bags shall be the equivalent of one barrel. Packages received in broken or damaged condition will be rejected or accepted only as fractional packages.

403.1.4 The contractor shall provide, at the site of the work, a suitable weather-tight building, or buildings, having a tight floor properly blocked or raised from the ground, for the storage of cement. The building shall be large enough to permit keeping on hand a supply of cement in quantity sufficient to prevent delays or interruptions to the work which might be due to the lack of cement. The cement shall be stored in such manner to permit easy access for the proper inspection and identification of each shipment. Cement in bags shall not be piled to height in excess of seven feet. Suitable accurate scales shall be provided by the contractor for weighing the cement. After it has been delivered to the job, the contractor will not be permitted to remove any of the cement to any other job or dispose of any of this cement in any way without the consent of the Engineer.

403.1.5 At the beginning of operations and at all other times while cement is required, the contractor shall have, at the site of the work, an ample supply of acceptable cement and shall carefully guard against possible shortage on account of rejection, irregular deliveries, or any other cause.

403.2 Water:

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403.2.1 All water used in mixing mortar or concrete shall be free from acid, alkali, oil, salt, vegetable, or other matter in sufficient quantity to be injurious to the finished product, and shall be from an approved source.

In calculating the total water content in any mix, the amount of moisture carried on the surface of the aggregate particles shall be included. The total water content per bag of cement for each batch of concrete shall not exceed 6-1/2

gallons of 54.1 pounds. In all cases, however, the amount of water to be used shall be the minimum amount necessary to produce a plastic mixture of the strength specified and of the desired durability, density, uniformity and workability. In general, the consistency of any mix shall be that required for the specific placing conditions and methods of placement, and ordinarily the slump shall be between 1-1/2" and 4-1/2" and in no case less than 1" nor more than 6" when tested in accordance with the current specifications for "Method of Test for Consistency of Portland Cement Concrete" of the American Society for Testing Materials.

An increase in the maximum water content to improve workability will not be permitted unless comparative tests under job conditions show conclusively that such increase in water at content will not result in a decrease in concrete strength and durability and provided further that such increase does not exceed one (1) gallon per cubic yard.

403.3 Aggregate:

403.3.1 Fine aggregate for concrete shall be clean, hard, durable, uncoated grains of natural sand or other sand acceptable to the Engineer. It shall be free from injurious amounts of dust, clay balls, soft or flaky particles, shale, alkali, organic matter, loam, or other deleterious substances. It shall not contain more than 3% by weight of material which can be removed by standard decantation tests, and when subjected to the colorimetric test for organic impurities of the Method of Test for Organic Impurities in Sands for Concrete, ASTM Designation C-40, and producing a color darker than the referenced standard color solution, it shall be rejected unless it passes the mortar strength test.

403.3.2 Fine aggregate shall be graded approximately within the limits shown in the following table. If not enough fines are available in the natural sands, limestone dust or other approved fines shall be added:

<u>Percent Passing Standard Square Mesh Screens</u>			
<u>No. 4</u>	<u>No. 20</u>	<u>No. 50</u>	<u>No. 100</u>
95-100	50-75	5-25	0-5

The substances designated below shall not be present in excess of the following percentages by weight:

Removed by Decantation	3 percent
Shale	1 percent
Coal or Lignite	1 percent
Cinders and Clinkers	0.5 percent

The sum of the percentages of the above deleterious substances shall not exceed five (5) percent by weight.

403.3.3 Coarse aggregate shall consist of the best available crushed limestone or other approved material. River gravel or other material with smooth surfaces shall not be used without specific written approval of the Engineer. Coarse aggregate shall be clean, tough, sound, durable rock and shall not contain harmful quantities of foreign material and must be satisfactory to the Engineer.

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403.3.4 Coarse aggregate shall be graded approximately within the limits shown in the following table:

Aggregate Max. Size	<u>Percent Passing Standard Square Mesh Screens</u>							
	2-1/2"	2"	1-1/2"	1"	3/4"	1/2"	3/8"	No. 4
2"	100	95-100	60-95	50-83	40-70	20-40		0-5
1-1/2"		100	95-100		40-70		10-30	0-5
3/4"				100	95-100		40-75	0-5

403.3.5 Coarse aggregate shall conform to Standard Specifications for Concrete Aggregates, ASTM Designation C33, except as to gradation. The maximum size aggregate to be used in structures six inches thick and under shall be three-quarters inch; in structures from six inches to ten inches thick, the maximum size of aggregate shall be one and one-half inches. If required, the contractor shall furnish test certificates showing the aggregates meet the above requirements.

The substances designated shall not be present in excess of the following percentages by weight:

Removed by Decantation	1.25 percent
Shale	0.50 percent
Coal or Lignite	0.50 percent
Soft Fragments	5.00 percent
Cinders and Clinkers	0.50 percent

The sum of the percentages of the above deleterious substances shall not exceed five (5) percent by weight.

403.3.6 In case the concrete resulting from the mixture of the aggregates is not of a workable character or does not make the proper finished surface, the Engineer may require a different grading in order to secure the desired results, or they may allow the use of inert admixtures to correct deficiencies, upon proper showing that such use will not materially lower the strength or increase the permeability of the concrete.

403.4 Steel Reinforcement:

403.4.1 All reinforcing steel shall be Grade 60 deformed bars and shall conform to the requirements of the Standard Specifications for Billet Steel Bars for Concrete Reinforcement, ASTM Designation A 15, for intermediate or hard grades. Wire fabric shall conform to Standard Specifications for Welded Steel Wire Fabric for Concrete Reinforcement, ASTM Designation A185.

403.4.2 The Engineer reserves the right to require a test of three specimens of each size of bar from each carload received on the work. These tests shall be made by a laboratory or testing firm approved by the Engineer and the cost of such testing shall be included in the price bid for steel reinforcement.

403.5 Strength and Proportion:

403.5.1 The structural concrete shall have a compressive strength of not less than three thousand (3,000) pounds per square inch and the concrete for street repairs shall have a compressive strength of not less than three thousand five hundred (3,500) pounds per square inch as determined from test cylinders at twenty-eight days, made, cured, and broken, as hereinafter specified.

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403.5.2 The concrete shall be mixed in the approximate proportion of 1:2-1/2:4-1/4 and shall contain not less than one and one quarter barrels of cement per cubic yard of finished concrete. With the approval of the Engineer, admixtures may be added in order to increase workability.

403.6 Testing of Concrete:

403.6.1 During the progress of the work, a reasonable number of compression tests shall be made when and if required by the Engineer. Each test shall consist of not less than two test cylinders. At least one test shall be made for each one hundred cubic yards of concrete placed. The test cylinders shall be made and stored in accordance with the Standard Method of Making and Curing Concrete Compression and Flexure Test Specimens in the Field, ASTM Designation C31, and shall be tested in accordance with the requirements relating to making compression tests on concrete test specimens as given in the Method of Test for Compression Strength of Molded Concrete Cylinders, ASTM Designation C39.

403.6.2 All test specimens shall be kept as near to the point of sampling as possible and yet receive the same protection from the elements as is given to the portions of the structure being built. Specimens shall be protected from injury. They shall be sent to a testing laboratory approved by the Engineer after a minimum of three days of field curing and while in the laboratory shall be kept in the ordinary air at the temperature of approximately 70°F. until tested.

403.7 Portland Cement Mortar:

403.7.1 Portland Cement Mortar shall consist of Portland Cement, fine aggregate and water. All materials for mortar shall conform to requirements of the following specifications:

Portland Cement - A.S.T.M. Designation C 150, Section 403.1,
Concrete Materials;
Sand - 403.3; Fine Aggregate;
Water - 403.2; Water

403.7.2 All equipment, tools and machinery used in mixing and handling mortar shall be approved by the Engineer.

403.7.3 The proportions of Portland Cement, fine aggregate and water shall be such as to produce a plastic mortar. The workability shall be consistent with the type of work for which it is used in order to secure the best results.

The mortar as specified for the several types of work shall be proportioned one part cement and three parts by volume fine aggregate.

Proportioning of batches shall be by volume unless otherwise shown on the plans or specified in the Special Provisions. One sack of cement weighing ninety-four (94) pounds shall be considered one (1) cubic foot. Correction for bulking of the fine aggregate shall be made as directed by the Engineer.

403.8 Responsibility of Contractor for Strength:

403.8.1 It is the intent of these specifications that the contractor shall guarantee that concrete of the specified compressive strength is incorporated in the structures and that the responsibility for producing the required grades of concrete is assumed by the contractor.

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403.8.2 Should the average strengths shown by test cylinders fall below the strengths required, the Engineer will require any or all of the following changes: amount of cement, grading of aggregate, or ratio of the water to the cement used. If the tests disclosed that the strength of the concrete is insufficient for the structure as built, the Engineer may condemn the part of any structure in which concrete of insufficient strength has been placed and the contractor, at his cost, shall remove and replace such concrete meeting these specifications.

403.9 Experimental Concrete Mixes:

403.9.1 The contractor shall make experimental mixes prior to the placing of the concrete and at any time during the progress of the work when necessary to demonstrate that the concrete will meet these specifications. Materials for making experimental mixes shall be furnished by the contractor and these materials shall be identical with those intended for use in the work. The cost of the materials shall be borne by the contractor and shall be included in the price bid for concrete.

404. CAST IRON AND DUCTILE IRON PIPE, FITTINGS AND VALVES:

404.1 Pipe and Fittings:

404.1.1 Where Ductile Iron Pipe (DIP) three (3) inches in diameter and larger is specified or required, it shall conform to, and be tested in accordance with, the current American Standard Specification for Ductile Iron Pipe, Centrifugally Cast in metal molds or sand-lined molds, for water or other liquids, AWWA Designation C 151 (ANSI A21.51). Ductile iron pipe less than three (3) inches in diameter shall conform to the manufacturer's standards, either centrifugally or statically cast with a minimum thickness of 0.25 inches. The ductile iron (nodular cast iron) shall conform to ASTM Specification A536 with physical properties of Grade 60-40-18. Length of joints shall be either eighteen or twenty feet. The minimum standard thickness of each size pipe shall be as follows:

<u>Pipe Size</u>	<u>Thickness Class</u>
3" thru 4"	51
6" thru 24"	50
30" thru 54"	51

For larger diameter or deep cover special design will be provided.

404.1.2 Where Cast Iron Pipe (CIP) is specified or required, it shall conform to, and be tested in accordance with, the American Standard for Gray Iron Pipe Centrifugally Cast in Metal Molds for water or other liquids, AWWA Designation C106. Lengths shall be either eighteen feet or twenty feet. Strength of iron shall be 18/40 and the minimum standard thickness of each size pipe shall be as follows:

<u>Pipe Size</u>	<u>Thickness Class</u>
3" thru 10"	22
12"	23
14" thru 24"	24
30" thru 48"	25

404.1.3 Where Cast Iron Pipe (CIP) and Ductile Iron Fittings are specified or required, they shall conform to, and be tested in accordance with the American Standard for Gray Iron and Ductile Iron Fittings, 3-inch through 48-inch for water and other liquids, AWWA Designation C110. Pressure rating shall be 250 psi. All sleeves shall be the longest of the lengths allowed.

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404.2 Joints:

404.2.1 Cast Iron and Ductile Iron Pipe and Fittings shall be jointed with any of the end types as specified below, unless a particular end type is specified. Flange ends shall be used only where specifically noted on the drawings except that the valve connection end of all tapping sleeves shall be flanged.

404.2.2 Push-on joints shall conform to, and be tested in accordance with, the American Standard for Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings, AWWA Designation C111.

404.2.3 Mechanical joints shall conform to, and be tested in accordance with, the American Standard for Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings, AWWA Designation C111.

404.2.4 Bell and spigot joints shall consist of square, braided, sterilized hemp and 99.73 percent pure lead caulking.

404.2.5 Flange joints shall conform to the American Standard for Cast Iron Pipe Flanges and Flanged Fittings, A.S.A. Designation B.16.1.

404.3 Coating and Lining:

404.3.1 Cast Iron and Ductile Iron Pipe and Fittings shall be bituminous coated outside and cement-mortar lined inside with seal coat in accordance with American Standards for Cement Mortar Lining for Ductile Iron and Gray Iron Pipe and Fittings for Water, AWWA Designation C104.

404.4 Gate Valves:

404.4.1 Where gate valves are specified or required, they shall conform to, and be tested in accordance with, the AWWA Standard for Gate Valves, 3-inch through 48-inch NPS for Water and Sewage Systems, AWWA Designation C500. Valves shall have double disc parallel seats, non-rising stem, vertical mounting "O" ring stem seal, counterclockwise opening, and ends to fit the pipe or fitting to which attached.

404.5 Butterfly Valves:

404.5.1 Where butterfly valves are specified or required, they shall conform to, and be tested in accordance with the AWWA Standard for Rubber- Seated Butterfly Valves, AWWA Designation C504. Valves shall have operators which are side mounted with plumb, non-rising stems, counterclockwise opening, and have mechanical joint connections of the size shown on the plans.

404.6 Air Relief Valves:

404.6.1 Where air relief valves are specified or required, the valve shall be heavy-duty combination air release and vacuum type for 250 psi water working pressure, tested to 250 psi unless otherwise specified, two-inch size. Body, cover, and baffle shall be cast iron. All internal parts to be either highest quality stainless steel or bronze, and the inside of valve coated with rust inhibitor.

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404.7 Check Valves:

404.7.1 Where check valves are specified or required, they shall conform to, and be tested in accordance with the AWWA Standard for Swing- Check Valves for Ordinary Water Works Service, AWWA Designation C508. They shall be horizontally mounted, single disc, swing type with a full diameter passage providing minimum pressure loss. Valves shall be of the non- slamming type designed for the future installation of outside lever and weight. Disc faces and seat rings shall be bronze. Ends shall fit the pipe or fitting to which attached (push-on, mechanical, bell and spigot, or flanged).

404.8 Fire Hydrants:

404.8.1 Fire hydrants shall conform to the AWWA Standard for Dry- Barrel Fire Hydrants, AWWA Designation C502 as to design, composition, quality of materials, workmanship and shall be manufactured by Mueller or M & H. Substitutes will not be permitted.

All fire hydrants shall be 6" mechanical joint connection, 5-1/4" valve openings furnished with two 2-1/2" nozzles, and one 4-1/2" pumper connection, with National Standard threads. Two 2-1/2" nozzles shall be spaced 180 degrees apart, with the 4-1/2" pumper nozzle centered between them.

Hydrants shall be of the compression type and shall have incorporated in their design a special section or bolts which intentionally have a lower breaking point than the balance of the unit (traffic flange).

Hydrants shall have a 1-1/2" pentagon shaped operating nut, open left and shall be sized for 3-1/2 feet depth of bury.

All nozzles shall be equipped with chained caps provided with gaskets made of suitable plastic or neoprene.

All fire hydrants shall be painted with two coats of Pittsburg, first line, or approved equal paint. Colors are to be designated by the City Fire Department to conform with color-coding system.

404.8.2 Where fire hydrant extensions are specified or required, they shall be of the proper design to accommodate the make of fire hydrant installed.

405. STEEL PIPE AND FITTINGS:

405.1.1 Where steel pipe is specified or required, it shall conform to the AWWA Standard for Steel Water Pipe 6-inches and larger, AWWA Designation C200. Only the following mill pipes specified under AWWA C200 shall be acceptable: ASTM A139, Grades B and C; ASTM A53, Grade B; ASTM A135, Grade B. Only the following steel plate fabricated under ASTM A134 shall be acceptable: ASTM A36, ASTM A572. All pipe shall be hydrostatically tested to 80% of the minimum yield point with the hydrostatic test pressure indicated on shop fabrication drawings. AWWA Designation C200 shall govern the testing. Pipe length shall be not less than 35 feet per joint, except for specials unless otherwise noted. There shall be no more than one longitudinal or girth seam per section. Nominal pipe diameter and steel thickness shall be as specified on the drawings. The diameter shown is the required inside diameter of steel pipe if coaltar lining is used or inside diameter of lining if mortar lining is used. All pipe shall be manufactured by an established manufacturer who has had at least three (3) years experience in successfully building this type of pipe. Openings for air valves, main connections, and blow-off connections must be provided with suitable

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reinforcements around the opening, welded to the body of the pipe. Openings of the sizes shown on the drawings shall be furnished with steel blind flanges of proper strength to withstand the working pressure of the line where no other provision is made for closing the openings. The pipe shall have ends for slip joints for field welding, beveled ends for field welding, beveled ends for field butt welding, or plain ends for mechanically coupled field joints.

405.1.2 Twenty-four inch (24") or smaller pipe shall be manufactured with ends of true circular shape, free from indentations, projections, or roll marks for a distance of eight inches (8") from the end of the pipe. This shall be done by hydraulic expansion or some other method satisfactory to the Engineer. The outside diameter of the pipe shall be true enough in dimension to permit the passage for a distance of eight inches (8") from the end of the pipe a ring gauge with a bore three-thirty seconds (3/32") of an inch larger than the outside diameter of the pipe.

405.1.3 Where steel fittings or specials are specified or required, they shall conform to all of the steel pipe specification requirements and to the AWWA Standard for Dimensions for Steel Water Pipe Fittings, AWWA Designation C208. Where fittings and specials are fabricated from mill pipe, they shall be fabricated from pipe hydrostatically tested to 80% of the pipe steel yield point with mitered joints dye checked for welding flaws. Where fittings and specials are fabricated from plate, they shall be hydrostatically tested to 80% of the minimum plate steel yield point. Changes in line and grade shall be made by steel specials or in the joints. Steel specials shall be used wherever the angle exceeds ten degrees (10°).

405.1.4 Where field cutting of steel pipe is permitted, pipe shall be cut by sawing. The inside lining shall be removed for a minimum of eight inches each side of the cut and the pipe surface shall be cleaned and brushed to bright metal. After welding, the inside lining shall be replaced in accordance with AWWA C203.

405.1.5 All steel blind flanges supplied in accordance with Section 405 shall be ASTM A36 Steel, 5/8-inch thick with approved gaskets and bolts. All bolts shall be carbon steel ASTM A307 Grade A only, in accordance with AWWA C207.

405.2 Joints:

405.2.1 Steel Pipe and fittings shall be jointed with any of the end types as specified below, unless a particular end type is specified. Flange ends shall be used only where specifically noted on the drawings.

405.2.2 Welded joints shall conform to, and be tested in accordance with the AWWA Standard for Field Welding of Steel Water Pipe, AWWA Designation C206.

405.2.3 Mechanically coupled joints shall consist of Dresser Couplings, Style 38, or equal, or as specified on the drawings.

405.2.4 Flanged joints shall conform to the AWWA Standard for Steel Pipe Flanges for Waterworks Service Sized 4-inch through 144 inch. AWWA Designation C207, Class E.

405.3 Lining and Coating:

405.3.1 Steel pipe and fittings shall be lined in accordance with the AWWA Standard for Cement Mortar Protective Lining and Coat for Steel Water Pipe, AWWA Designation C205, or the AWWA Standard for Coal-Tar Enamel Protective Coatings

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for Steel Water Pipe, AWWA Designation C203. The exterior of all underground pipe shall be cleaned, primed, and coated with coal-tar enamel, fibrous glass mat, and a bonded asbestos felt wrapper, and with either a whitewash coating or a final wrap of kraft paper, and the exterior of all above ground pipe shall be cleaned, primed, and painted, all in accordance with the AWWA Standard for Coal-Tar Enamel Protective Coatings and Linings for Steel Water Pipe, AWWA Designation C203, or in accordance with the AWWA Standard for Chlorinated Rubber-Alkyd Paint System for the Exterior of Above Ground Steel Water Piping. If mechanical couplings are used for field joints, the ends of the pipe shall be primed and enameled before the pipe is laid. If field welding is used, the pipe joints shall be furnished with the inside lining and outside coating held back twelve inches on each end for field welding. All of the lining and coating, including any field touch-up work, shall be done under the direction of the manufacturer of the lining and coating to the satisfaction of the Engineer. The lining at the joints on welded pipe may be patched with a minimum of two (2) coats of a coal tar or epoxy based paint which shall be compatible with the interior lining and which shall impart no taste or odor to the water in the lines.

406. REINFORCED CONCRETE PIPE AND FITTINGS:

406.1 Pipe and Fittings:

406.1.1 Where reinforced concrete pipe (RCP) and fittings are specified or required for water lines, they shall conform to and be tested in accordance with the AWWA Standard for Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids, AWWA Designation C301. All pipe shall be manufactured by an established manufacturer who has had at least three years' experience in successfully building this type of pipe. All specials and fittings shall be either of Type A or Type B and must be built to the details furnished by the manufacturer and approved by the Engineer. Each special and each length of straight pipe shall be plainly marked to indicate the head for which the pipe is designed and to indicate where the pipe will be used by reference to the layout drawings.

406.1.2 Where reinforced concrete pipe (RCP) and fittings are specified or required for sanitary sewers, they shall conform to and be tested in accordance with the specifications for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe, ASTM Designation C76, Class as shown on the drawings. No lengths of pipe shall be less than eight feet. All concrete pipe shall be coated inside with two (2) coats of a coal-tar base paint (Standard Inertol, or approved equal), with a twenty-four hour drying period between coats.

406.2 Joints:

406.2.1 Reinforced concrete pipe and fittings for water lines shall be jointed according to AWWA Standard for Prestressed Concrete Pressure Pipe Steel Cylinder Type, for Water and Other Liquids, AWWA Designation C301.

406.2.2 Reinforced concrete pipe and fittings for sanitary sewer shall be jointed with a single natural rubber or neoprene gasket and cement mortar formed by a diaper. It shall be formed in a continuous ring of suitable cross sections and of such size as to assure a watertight joint. Each length of pipe shall be provided with bell-and-spigot ends formed in the concrete wall. The spigot end shall contain a groove so that the gasket will be enclosed and compressed on four surfaces when the joint is in final position. All jointing materials shall be used in accordance with the manufacturer's instructions and subject to approval of the Engineer.

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407. VITRIFIED CLAY PIPE AND FITTINGS:

407.1 Pipe and Fittings:

407.1.1 Where vitrified clay pipe (VCP) and fittings are specified or required, all materials incorporated into the work shall be new and shall conform to the applicable specifications as follows.

407.1.2 Vitrified clay pipe and fittings shall conform to criteria established in ASTM C700 for Extra Strength vitrified clay pipe and fittings. Pipe may be of bell and spigot design or plain end pipe for use with appropriate compression sleeve couplings.

407.2 Joints:

407.2.1 All pipe shall be provided with suitable joints such as push-on or other types of joints which prevent lateral displacement and resistance to infiltration and exfiltration.

Joints for bell and spigot vitrified clay pipe shall conform to ASTM C-425.

Joints for plain and vitrified clay pipe shall conform to ASTM C594. All joints to existing pipe and between pipe of differing materials shall be accomplished by means of standard manufactured joints, transition couplings or adapters.

408. THERMOPLASTIC POLYVINYL CHLORIDE (PVC) WATER PIPE AND FITTINGS:

408.1 Pipe:

408.1.1 Where thermoplastic polyvinyl chloride (PVC) water pipe is specified or required, it shall conform to the AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inch, for water, AWWA Designation C900. PVC pipe shall conform to the dimensions shown in Table 2 of AWWA C900, Dimensions and Pressure Classes for Dimension Ratio (DR) for PVC 1120 Pipe with Cast Iron Pipe Equivalent ODS. The minimum DR shall be 18 and the minimum working pressure rating shall be 150 psi.

408.2 Joints:

408.2.1 Jointing of plastic pipe shall be accomplished by push-on type joints. Push-on joints consisting of a rubber "O" ring shall be used. The contractor shall furnish to the Engineer details of the proposed joint in triplicate for approval before any such jointing material is delivered to the job site.

408.3 Fittings:

408.3.1 Fittings for PVC pipe 8-inches in diameter and smaller shall be Cast Iron Short Body Fittings in accordance with AWWA C110 specification for Cast Iron Fittings, 2-inch through 48-inch, for Water and Other Liquids. All fittings shall be designed and tested for 250 psi water working pressure.

409. CASTINGS:

409.1 Castings for valve boxes, valve vaults, manholes, lampholes, and other appurtenances shall conform to, and be tested in accordance with the specifications for Gray Cast Iron, ASTM Designation A48, Class 30, Design shall be according to the attached Standard Details. Frames and covers that are to be

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located within dedicated public right-of-way, or any other location subject to vehicular traffic, shall have all bearing surfaces machined so that fittings parts will not rattle or rock under traffic. All castings shall be subject to a hammer test before installation.

410. CONDUIT:

410.1 Where conduit (also known as encasement pipe) is specified or required, new steel pipe, conforming to ASTM A53 Grade B for welded and seamless steel pipe, shall be used unless otherwise indicated on the plans or by conditions of railroad or highway crossing permit. Wall thickness shall be 1/4-inch for highway crossings and 3/8-inch for railroad crossings.

411. VAULTS, PITS AND MANHOLES:

411.1 Manhole units shall conform to and be tested in accordance with one of the following: sewer brick (made from clay or shale), ASTM Designation C32 Grade MA; concrete building brick, ASTM Designation C55, Grade A.

411.2 Precast manholes shall conform to and be tested in accordance with the specifications for Precast Reinforced Concrete Manhole Risers and Tops, ASTM Designation C478, flat slab top type.

411.3 Cast-in-place manholes shall be constructed of 3000 psi concrete in accordance with Section 403.

412. SAND FOR CUSHION OR BACKFILL:

412.1 Sand shall be graded from fine to coarse, free from objectionable material, and containing not more than ten percent (10%) clay or loam by weight. One hundred percent (100%) shall pass a three-quarter inch screen, and ninety-five percent (95%) shall pass a number four screen.

413. SELECT SOIL FOR BACKFILL OR STREETS AND ALLEYS:

413.1 The backfill material for streets and alleys shall be select soil having a liquid limit not to exceed 40 and plastic index not to exceed 10. Trench excavation may be used for backfill if it meets the requirements of select soil as described herein.

414. CRUSHED STONE FOR SURFACING, BASE COURSE, AND STABILIZATION:

414.1 Crushed stone for surfacing and base course shall consist of hard durable particles of sand, gravel, mine chats, crushed rock, or a combination of any of these materials. Crushed stone for surfacing and base course shall be Traffic Bound Surface Course in accordance with the City Standard Specifications for Streets and Alley Construction.

414.2 Crushed stone for stabilization shall consist of hard durable particles of sand, gravel, mine chats, crushed rock, or a combination of any of these materials. The sieve analysis, Section 414.2.1, shall be as Size #67 in the Standard Sized of Course Aggregate for Highway Construction, ASTM Designation D448.

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414.2.1 Gradation for Type B and C bedding shall be as follows:

<u>Sieve Size</u>	<u>Percent Passing</u>
1"	100
3/4"	90-100
3/8"	20-55
4	0-10
8	0-5

415. BRASS AND COPPER GOODS FOR SERVICE LINES:

415.1 The material and workmanship for brass goods shall be of the highest quality and shall interchange with brass goods presently in use by the owner. Brass goods shall conform to the same precise standards as described in AWWA Specifications Number C800 Standard Specifications for underground service line fittings.

Brass goods shall contain 85 percent copper and 5 percent each of tin, lead, and zinc and shall be tested by hydrostatic pressure of 200 pounds per square inch. The bidder shall furnish a complete description of brass goods with his bid.

415.2 Copper tubing shall be Type "K" soft annealed seamless tubing and shall conform to Federal Specifications Number WW-T-799a of December 23, 1943 and Amendment 1 of June 27, 1946.

The coils of copper tubing shall be in individual packages. The contractor shall furnish an affidavit that the copper tubing furnished complies with all specifications.

416. TYPE PSM POLYVINYL CHLORIDE (PVC) SEWER PIPE AND FITTINGS

416.1 Pipe and Fittings:

416.1.1: Where Type PSM polyvinyl chloride (PVC) sewer pipe is specified or required, it shall conform to ASTM Standard D3034-94 "Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings". Nominal pipe diameter may be from 4 inches to 15 inches in size. All PVC sewer pipe shall have a minimum pipe stiffness of 115 psi and shall have a Standard Thermoplastic Pipe Dimension Ratio (SDR) of 26. The pipe shall be made of PVC plastic having a cell classification of 12454-B or 12454-C or 12364-C or 13364-B (with minimum tensile modulus of 3450 Mpa (500,000 psi) as defined in ASTM Standard D1784. The pipe shall be clearly marked at intervals of 1.5m (5 ft) or less, and the markings shall indicate manufacturer's name or trademark and code, nominal pipe size, the cell classification, the designation "Type PSM SDR-26 PVC Sewer Pipe", and the designation "Specification D3034". The fittings shall be marked with manufacturer's name or trademark, nominal size, the material designation "PVC", PSM, and the designation "Specification D3034".

416.2 Joints:

416.2.1: Jointing of plastic pipe shall be accomplished by push-on type joint, with an elastomeric seal conforming to ASTM Standard D3212-92 "Standard Specification for Joint for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals". The contractor shall furnish to the Engineer details of proposed joint in triplicate for approval before any such jointing material is delivered to the job site.