PART 800

WATER AND SEWER

TABLE OF CONTENTS

SECTION	TITLE
801	Trench Excavation, Pipe Bedding, Backfilling, and Compaction
802	Encasement of Water or Sewer Pipe by Jacking or Tunneling
803	Water Line Construction
804	Sewer Line Construction

SECTION 801
TRENCH EXCAVATION, BACKFILLING, AND COMPACTION

801.1 DESCRIPTION
The work covered by this specification consists of all material and labor to perform all work necessary in connection with the excavation and backfilling of trenches in accordance with the plans.

Excavation, backfilling and compaction for appurtenance structures, such as manholes, inlets, vaults, valve boxes, etc., shall conform to the applicable requirements as specified for pipe trenches.

801.2 MATERIALS
Pipe Bedding:

a) Type 1 Pipe Bedding Material shall be crushed rock conforming to ASTM C-33, Gradation No. 67, and will meet all requirements for Portland Cement Concrete Pavement Coarse Aggregate, section 406.2, City of Bel Aire Standard Specifications.

b) Type 2 Pipe Bedding Material shall be a sand-gravel mix conforming to KDOT Standard Specifications for Type UD-2 underdrain aggregate.

c) Type 3 Pipe Bedding Material may, at the option of the Contractor, be the same as Type 1 or Type 2; or it may be pit-run sand; or it may be select earth material which is free from stones larger than two inches in the longest dimension or trash and contains proper moisture content for compaction.

d) Sand used as bedding material shall be clean washed sand with one-hundred percent (100%) passing the 3/4" sieve, not more than twenty-five percent (25%) retained on a No. 4 sieve and not more than ten percent (10%) passing the No. 200 sieve.

Excavatable Flowable Fill:
Excavatable flowable fill shall be in accordance with Section 306.

Flowable mortar fill shall be used in sewer, water, and utility trenches under the pavement or at other locations as shown on the plans, or as specified.

The mix design for flowable fill mortar shall be approved by the Engineer, and shall meet the following minimum requirements:

Material	**Proportion**
Cement / Fly Ash	350 lbs/cy
Fine Aggregate	2,600 lbs/cy
Air Content	15 - 20%

It is intended that the mix design produce a maximum 150-psi compressive strength at 28 days.

Cement / Fly Ash shall be in accordance with Subsection 306.2.

Fine Aggregate for flowable mortar shall be natural sand consisting of mineral aggregate particles. The gradation of this material shall be as follows:

Sieve Size	**Percent Passing**
3/4	100
200	0 - 10

801.3 PAVEMENT REMOVAL
Pavement removal shall be in accordance with Subsection 202.4 "Pavement Removal".

801.4 TRENCH EXCAVATION
General:
The Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths indicated on the plans, and including excavation ordered by the Engineer of compacted backfill for the purpose of making density tests on any portion of the backfill.

All excavation shall be done by Open Cut, except where necessary to tunnel under existing sewers or other underground utilities and/or locations where tunneling is expressly permitted or directed by the Engineer.

Trench Width:
Trenches for other than cast-in-place pipe shall conform to the following dimensions, unless otherwise specified in the Special Provisions, indicated on the plans and/or approved by the Engineer.

Table 801-1 **Size of Pipe (ID)**	**Max Width at Top of Pipe Greater Than O. D. of Barrel**	**Min Width at Springline Each Side of Pipe**
Less than 18"	16"	6"
18" to 24" inclusive	19"	7-1/2"
27" to 39" inclusive	22"	9"
42" to 60" inclusive	½ O.D.	12"
Over 60"	36"	12"

Trench Grading:
Trenches shall be graded to allow for specified bedding requirements and to conform to the pipe alignment and elevation shown on the plan. The Engineer will provide offset line and grade stakes as necessary to facilitate the construction. The Contractor shall preserve all stakes and benchmarks.

Trench Stabilization:
The Contractor shall make adequate subsurface soil explorations to be satisfied as to the character of the work prior to submitting his bid.

The Engineer may direct that trench stabilization be installed when groundwater or unstable soil conditions are encountered. Trench stabilization for sanitary/storm pipe shall consist of over-excavation and placement of additional compacted type 1 pipe bedding material. Any trench stabilization required as a result of surface water entering the trench or to correct inadvertent over-depth trenching shall be installed at the Contractor's expense.

The Contractor shall install dewatering systems as necessary to keep trenches free of water. In no circumstance will pipe be laid in standing water. Dewatering systems shall remain in operation until the trench has been backfilled. The cost for this work will be included in the unit price bid per foot of pipe.

Trench Shoring:
The Contractor shall do such trench bracing, sheathing, or shoring necessary to perform and protect the excavation as required for safety and conformance to governing laws. Approved trench boxes may be used in place of shoring.

All shoring deemed necessary to protect the excavation and to safeguard employees, shall be installed. See Section 6.13 of the General Conditions.

Open Trenches:

Except when approved by the Engineer, trenches shall not be opened more than two hundred feet (200') in advance of laying pipe.

Trenches across streets shall be backfilled as soon as possible after pipe laying.

Substantial steel plates with adequate trench bracing shall be used to bridge across trenches at street crossings where trench backfill and temporary patches have not been completed during regular work hours. Safe passage for pedestrians shall be provided.

Grading and Stockpiling:
The Contractor shall strip and save the top six inches (6") of topsoil in unpaved developed areas. After the utility is installed, the topsoil will be replaced by the Contractor.

All grading in the vicinity of trench excavation shall be controlled to prevent surface water from flowing into the trenches. Any water accumulated in the trenches shall be removed by pumping or by other approved methods.

During excavation, material suitable for backfilling shall be piled in an orderly manner, a sufficient distance back from the edges of trenches, to avoid overloading and to prevent slides or cave-ins. Material unsuitable for backfilling, or excess material, shall be hauled from the job site and disposed of by the Contractor.

801.5 IMPROVED BEDDING
General:
Improved bedding shall be defined as the initial pipe backfill to a depth of twelve inches (12") above the top of the pipe. All pipe bedding shall be improved bedding, except where flowable fill is specified or required, and shall be hand placed and tamped under the haunches and around the pipe in uniform, maximum six-inch (6") lifts. The improved bedding shall be worked simultaneously on each side of the pipe to insure equal fill heights at all times. Particular care shall be taken to obtain uniform bearing along the length of pipe without causing joint damage or displacement.

All bedding shall be brought to proper moisture content and compacted to not less than ninety percent (90%) of maximum dry density as determined by AASHTO Method T99.

Sanitary/Storm Pipe:

a) **Improved bedding for rigid pipe** shall consist of Type 1 or 2 Pipe Bedding Material under the barrel of the pipe extending up to a level equal to one-sixth (1/6) the outside pipe diameter. Type 3 Pipe Bedding Material shall be used from this level to a level twelve inches (12") above the top of the pipe.

b) **Improved bedding for flexible pipe** shall consist of Type 1 or 2 Pipe Bedding Material under the barrel of the pipe extending up to a level twelve inches (12") above the top of the pipe.

c) **Improved bedding for semi-rigid pipe** shall consist of Type 1 or 2 Pipe Bedding Material under the barrel of the pipe extending up to a level equal to one-half (½) the outside pipe diameter. Type 3 Pipe Bedding Material shall be used from this level to a level twelve inches (12") above the top of the pipe.

Waterline Pipe:
Improved bedding for waterline pipe shall consist of sand placed from six inches (6") under the barrel of the pipe extending to a level twelve inches (12") above the top of the pipe.

Improved bedding for Prestressed Concrete Steel Cylinder Pipe (PCCP) shall conform to the bedding recommended by the manufacturer, as approved by the Engineer.

Structures:

All sanitary, storm sewer, and water structures, including but not limited to Reinforced Concrete Box Culverts, Curb Inlets, Area Inlets, Manholes, Water Vaults, and Air Release Vaults must have a minimum of 6” of Type 1 bedding material placed under the structure, to the limits of excavation. Improved bedding material for these structures will not be paid for separately, but will be considered subsidiary to the bid item for the structure itself.

801.6 BACKFILLING AND COMPACTION

General:

All trenches and excavations shall be backfilled immediately after the installation of improved bedding. Trench backfill, beginning twelve inches (12") above the top of the pipe shall be as described herein, unless shown otherwise on the plans and/or directed by the Engineer.

Trenches under existing or proposed pavement, or where shown elsewhere on the plan, shall be backfilled with flowable fill to an elevation of two feet (2') below the bottom of the existing or proposed pavement. The Engineer may waive the requirement for flowable fill when the distance between the top of the pipe and the bottom of the existing or proposed pavement is less than four feet (4'). Jetted sand may be used when approved by the Engineer.

Trenches not under existing or proposed pavement and having less than seven (7') of cover over the pipe shall be backfilled with excavated material mechanically compacted to a density equal to or greater than ninety percent (90%) of standard density. Such trenches with cover over the pipe equal to or greater than seven feet (7') may be either backfilled with excavated material compacted to ninety percent (90%) of standard density or consolidated by flushing and vibrating, upon approval of the Engineer.

The top two feet (2') of trenches within alley or street right-of-way shall be backfilled with excavated material mechanically compacted to a density equal to or greater than ninety-five percent (95%) of standard density. The Contractor will be required to furnish other approved backfill material suitable for mechanical compaction when laboratory tests indicate the Contractor is not able to obtain the required density by mechanical compaction of the material excavated from the trench.

Trenches to be consolidated by flushing shall be sand backfilled when the excavated material is not suitable for backfill material as determined by the Engineer. The top one foot (1') of trenches to be flushed shall be earth backfill compacted to a density equal to or greater than the existing adjacent undisturbed material. Backfill material to be flushed shall be placed in six-foot (6') maximum lifts when the trench is within alley or street right-of-way, and in twelve-foot (12') maximum lifts when the trench is outside of alley or street right-of-way. Each lift shall be thoroughly consolidated by using water jets and vibrators. Consolidation of backfill by flushing and vibrating shall result in a final density, which equals or exceeds ninety percent (90%) of the standard density. Water shall be applied so that effective settlement is obtained with a minimum amount of water. Trenches shall not be permitted to overflow. Special care must be taken during backfilling, flushing, and compacting operations to prevent pipe from floating. Water shall be introduced into the layer being flushed through a long pipe nozzle and in such a manner that the granular fill, tamped material or the previously placed layer will not be disturbed, and in no case shall the nozzle end be inserted closer than three feet (3') above the top of the pipe.

County Right-of-Way:

Unless shown otherwise on the plans and/or directed by the Engineer, backfill within County Right-of-Way shall be as follows:

The top two feet (2') shall be compacted to one hundred percent (100%) of standard density and the backfill from twelve inches (12") above the pipe to within two feet (2') of the surface shall be compacted to ninety-five percent (95%) of standard density, where the pipe is crossing a paved surface, including driveways. Jetted sand may be used when approved by the Engineer.

Testing:

All utility trenches shall be tested for compaction by an Independent Testing Laboratory on behalf of the Contractor and is considered to be subsidiary to items for which direct payment is made. Copies of all test results shall be immediately made available to both the City and the Engineer. Utility trenches shall have, at a minimum, one (1) field density test per street crossing.

801.7 PAVEMENT REPLACEMENT

All pavement or driveway repair shall extend a minimum of one foot (1') beyond the edge of the trench. No. 6 deformed reinforcing steel bars shall be placed across the ditch on two-foot (2') centers with the bars extending a minimum of eleven inches (11") past the edges of the trench. Two No. 6 longitudinal reinforcing steel bars shall be placed parallel with the centerline of the trench for the full width of the pavement. All bar crossings shall be securely fastened using wire ties. The pavement repair shall be two inches (2") thicker than the original pavement in an area of one foot (1') beyond either side of the trench. The dimensions of pavement, curb, gutter, driveways and sidewalk shall conform to City Standards for that type of work even though those structures removed may not have originally conformed to such standards. Reconstruction of asphaltic concrete pavement shall conform to requirements in Section 405. Reconstruction of concrete pavement shall conform to requirements in Section 406.

SECTION 802
ENCASEMENT OF WATER OR SEWER PIPE BY JACKING OR TUNNELING OPERATION

802.1 DESCRIPTION

The Contractor shall furnish all labor, material, and equipment as required to perform the jacking or tunneling operation in accordance with the plans and specifications.

In the performance of the work, the Contractor shall comply with the lawful requirements of the affected Contracting Agencies, owners of public utilities and any other facilities, which might be endangered by jacking or tunneling operations.

802.2 GENERAL

The inside diameter of the liner plate or casing shall be a minimum of six inches (6") larger than the outside diameter of the bell section of the carrier pipe, unless shown otherwise on the plans or directed by the Engineer.

The approach pit for jacking or tunneling operations shall be secured to safeguard existing sub-structure and surface improvements and to protect against ground movement.

802.3 PIPE INSTALLATION BY BORING AND JACKING METHODS

Water pipe shall not be installed directly by boring or jacking methods unless approved by the Engineer.

Steel casing or sewer pipes shall be installed by boring and jacking methods where specified by the plans. Pipe to be bored and jacked shall be as specified by the plans. Steel casing for bored and jacked construction shall be steel pipe conforming to ASTM A-139 with a minimum diameter as shown on the plans. Steel shall be Grade B under railroads and Grade A on all other uses. Steel pipe shall have welded joints in accordance with AWWA C-206 and shall have minimum wall thickness as indicated in the following table:

Diameter of	**Nominal Wall Thickness -------inches**	
Casing - inches	**Under Railroads**	**All Other Uses**
12	0.282	0.188
14	0.313	0.188
16	0.313	0.188
18	0.313	0.250
20	0.375	0.281
22	0.375	0.281
24	0.438	0.281
26	0.438	0.312
28	0.500	0.312
30	0.500	0.312
32	0.500	0.344.
34	0.563	0.344
36	0.563	0.344
42	0.563	0.375
48	0.625	0.375

For casing diameters larger than 48", plans shall specify minimum diameter and wall thickness to be used.

Excavation shall be completed by approved methods applicable to the materials encountered. The sewer in the area to be bored and jacked shall be completed before the construction of adjacent portions of the same sewer so minor adjustments can be made in the adjacent sewer to compensate for slight discrepancies in alignment or grade, which may occur in the boring and jacking process. Boring and jacking operations shall be performed by experienced crews using a rotary type-boring machine designed

especially for this purpose. The casing or pipe shall be jacked as the boring proceeds. Boring without simultaneous jacking of the casing or pipe will not be permitted.

The steel casing or carrier pipe shall be cleaned of all debris after its installation is complete. Redwood or other approved preservative treated wood skids shall be secured to the barrel of the carrier pipe with metal bands in such a manner to support the weight of the pipe along its full barrel length on the wood skids without any of the weight supported by the pipe bell and in such a manner as required to properly position the carrier pipe to the specified elevations and alignment. The casing spacers must be located as recommended by the spacer manufacturer and approved by the Engineer. Only approved casing spacers may be used. Casing spacers may be used in lieu of treated wood skids. The casing spacers must be located as recommended by the spacer manufacturer and approved by the Engineer. Only approved casing spacers may be used. The annular space between the steel casing and the carrier pipe shall be filled with sand from end seal to end seal after the carrier pipe has been permanently placed in the casing, and approved, in such a manner such as not to disturb the alignment or grade of the carrier pipe. Excavatable flowable fill may be used on sewers when approved by the Engineer.

End seals shall be constructed on each end of the casing as shown on the plan or directed by the Engineer.

The unit price named in the Proposal for steel casing bored and jacked shall cover all costs for completion of this item including excavation, steel casing, sand fill, end seals, skids, bands, fittings, backfill and compaction of backfill. Sewer and water line pipe installed in the steel casing will be paid for separately at the unit price stated in the Proposal.

SECTION 803
WATER LINE CONSTRUCTION

803.1 DESCRIPTION
The construction of all water lines shall conform to applicable standard specifications and details, except as otherwise required on the plans or as modified in the special provisions.

803.2 GENERAL
All pipe shall be delivered, handled and installed in accordance with the manufacturer recommendations and/or applicable provisions of AWWA standards for installation of the various types of water mains specified, insofar as such recommendations and provisions are not in variance with the standard specifications and details.

803.3 MATERIALS
General:
Used pipe shall not be allowed for construction of waterline projects.

Unless otherwise shown on the plans, all materials for waterlines shall be of the type shown for the size pipe specified:

a) 2-inch through 3-inch (2" through 3") diameter pipe shall be Polyvinyl Chloride (PVC) or High Density Polyethylene Pipe (HDPE).

b) 4-inch through 12-inch (4" through 12") diameter pipe shall be either Polyvinyl Chloride (PVC) or Ductile Iron Cement Lined (DICL) or High Density Polyethylene Pipe (HDPE).

c) 16-inch (16") and larger pipe shall be Ductile Iron Cement Lined (DICL) pipe, Polyvinyl Chloride (PVC) pipe or Prestressed Concrete Steel Cylinder pipe (PCCP).

d) Fittings to be used with water line installation include: PVC fittings for 3-inch (3") or smaller pipe; compact ductile iron fittings for 4-inch (4") and larger pipe; and DICL or PCCP fittings with PCCP pipe, as designed for the project. All fittings must meet the pressure rating of the pipe used for the project.

Polyethylene Wrap:
The polywrap shall be of virgin polyethylene, not less than 8 mils in thickness, formed into tubes or sheets as required. Material shall be pigmented with 2 to 2-1/2 percent (2 - 2 ½%) of well- dispersed carbon black with stabilizers. In the event 8-mil polywrap is not available, additional layers of lighter material may be used as allowed by the Engineer. The lighter material shall in no case be thinner than 6 mils.

The polywrap shall be secured with two-inch (2") wide pressure sensitive plastic tape not less than 10 mils thick. The tape shall be Scotchrap No. 50, Polyken No. 900, Tapecoat CT, Johns-Manville No. V-10 Trantex, or approved equal.

Polytube shall be used along lengths of pipe and be sized in accordance with pipe manufacturer recommendations.

Water Pipe/Fittings:

a) Ductile Iron Cement Lined Pipe (DICL) - Ductile iron cement lined pipe shall be constructed in accordance with all requirements of ANSI A 21.51 (AWWA C151 or the latest revision).

All ductile iron cement lined pipe shall meet the requirements of Pressure Class 350 pipe for sizes 12" and smaller, and pressure Class 250 for all pipe 16" and larger, unless otherwise indicated by the plans. The exterior of the pipe shall be coated with a bituminous coating of coal-tar or asphalt base

at least one mil thick. The interior of the pipe shall have a cement lining in accordance with ANSI A21.4 (AWWA C104) with a Bituminous Seal-Coat. Joints shall be slip type with single rubber gasket in accordance with ANSI A21.11 (AWWA C111). All DICL pipe and fittings shall be wrapped in accordance with Subsection 803.6. Ductile iron cement lined fittings shall conform to ANSI/AWWA C110. The fittings shall have standard mechanical joint ends conforming to ANSI A21.11 (AWWA C111). The fittings shall have interior and exterior coatings as specified above for DICL pipe.

b) Polyvinyl Chloride Pipe (PVC) - 3" or Smaller PVC Pipe: The polyvinyl chloride pipe shall be made in accordance with and shall conform to ASTM 1784, Type 1, Grade 1 for PVC compounds; ASTM 2241 for PVC pipe; commercial standard CS-256 for PVC pipe; and NSF Standard Number 14. The PVC pipe shall be class 200, suited for working pressure of 200 psi at 73 degrees F. Joints for the pipe shall be push-on using rubber ringed couplings conforming to ASTM D-1869 requirements.

4" or Larger PVC Pipe: The polyvinyl chloride pipe shall be made in accordance with and conforming to AWWA Standard Specifications for polyvinyl chloride pipe, C-900 or C-905 depending on pipe diameter, or the latest revisions thereof. The pipe shall be DR-18, unless otherwise shown on the plans, and be cast iron outside diameter. The pipe shall use couplings or have bell ends manufactured integral to the pipe. Couplings shall be push-on using rubber rings. The rings shall consist of properly vulcanized rubber compounds, free from porosity. All surfaces shall be smooth and free from pitting, blisters, air checks and other imperfections. The thickness shall be uniform throughout.

c) Polyvinyl Chloride Pipe, Molecular Oriented (PVCO) – 4" to 12" PVC Pipe: The polyvinyl chloride pipe shall be made in accordance with and shall conform to AWWA Standard Specification for polyvinyl chloride pipe C-909, or the latest revision thereof; ASTM F1483 for manufacturing; ASTM D1784, Type I, Grade 1 for PVC compounds; and NSF Standard Number 61. The PVC pipe shall be class 200, suited for a working pressure of 200 psi at 73 degrees F. The pipe shall use couplings or have bell ends manufactured integral to the pipe. Couplings shall be push-on using rubber ringed couplings conforming to ASTM D3139 requirements. All surfaces shall be smooth and free from pitting, blisters, air checks and other imperfections. The thickness shall be uniform throughout.

d) Prestressed Concrete Steel Cylinder Pipe (PCCP) –Prestressed concrete steel cylinder pipe l be as set forth by AWWA C301 or the latest revision thereof, for pre-stressed concrete pressure pipe, steel cylinder type.

Prestressed steel cylinder pipe shall be designed for 150 psi working pressure and shall be properly pre-stressed to accommodate the trench backfill loads at the depths shown on the drawings.

All specials and fittings shall conform to requirements of AWWA C301 and shall be designed and fabricated to accommodate pressure and backfill load stresses equal to or greater than the connecting piping.

Each length of pipe and all specials and fittings shall be marked to show the proper location in the line. Schedules and drawings shall be submitted to the Engineer for approval prior to manufacture or shipment as required in section 1.5 of AWWA C301.

Installation of PCCP, shall conform to both the requirements of the project specifications and the recommendations by the manufacturer as approved by the Engineer. Joint grouting will be required depending on pipe diameter and as recommended by the manufacturer, as approved by the Engineer.

e) High Density Polyethylene Pipe (HDPE) –High Density Polyethylene Pipe shall conform to AWWA Specification C906-90, or the latest revision thereof. All HDPE pipe shall be DR-11, and

have a working pressure rating of 160 psi, unless otherwise stated on the plans. As the pipe inside diameter (I.D.) is critical to the project, the HDPE pipe to be used, shall have an I.D. equivalent to the pipe size specified by the project plans. Due to the pipe wall thickness of HDPE pipe, it may be necessary to upsize the HDPE pipe to have an equivalent I.D. of the type of pipe material shown on the plans. Such increase of HDPE pipe sizing shall be considered subsidiary to providing equivalent pipe and not be bid or paid for separately.

All fittings to be used with HDPE pipe shall be typical cast iron or ductile iron mechanical joint fittings, adapters shall be used as necessary to connect to such fittings. Harvey connectors are approved for use with HDPE pipe for making connections to cast iron or ductile iron fittings. The cost of such adapters shall be considered subsidiary to the use of HDPE pipe and not be bid or paid for separately. HDPE fittings have not been approved for use on water projects.
All HDPE pipe shall be joined using butt fusion. The Contractor shall provide the appropriate butt fusion equipment to join the pipe. Joints shall conform to the manufacturer's recommendations and be water tight at the test pressure. The bead, which forms during the fusion process, shall be uniform, indicating a proper fusion. Joints not meeting these requirements shall be cut out and remade. Cost of joint fusion shall be considered subsidiary to the pipe installation and not bid or paid for separately.

Pipe bedding shall conform to the requirements for other types of pipe material, including sand backfilling and compaction as specified by these plans. If installed by directional drilling, the pipe manufacturer recommendations shall be followed as approved by the Construction Engineer for the City of Wichita.

Installation of HDPE pipe shall be by methods approved by the Construction Engineer. Methods other than approved shall not be allowed. Any installation of HDPE pipe by methods, which are not approved, shall be removed and reinstalled at the expense of the Contractor.

Water Valves:

a) General - Valves for water line projects shall include Mechanical Joint Gate Valves, Mechanical point Butterfly Valves, and Flanged Valves as required by the water line project. All buried valve installations shall include the installation of a valve box.

b) Mechanical Joint Gate Valves - Gate valves shall be used on water lines 12-inch (12") and smaller. The valves shall be resilient seat wedge type gate, with non-rising stem, and shall conform to AWWA Standard Specification C-509 or C-515, or the latest revision thereof.

Exterior surface of the valve is to be epoxy coated. The coating shall be 8 mils thick and of an approved epoxy. Gate valves shall open left, shall have all bronze disc assemblies, and all bronze internal working parts, or shall have an approved epoxy coating to provide a corrosion resistant barrier between the base metal and the surroundings. The coating shall be factory applied using a process consisting of grit blasting and chemical cleaning to provide the best surface for fusion-bonding and heat curing, and shall be holiday free with a minimum thickness of 8-mils. Valves shall also have a 2-inch square operating nut, "O" ring seals, and mechanical joint ends with Corten material mechanical joint bolts and nuts or approved equal. Resilient seat wedge-type gate valves shall have a replaceable internally reinforced specially contoured molded rubber disc seat ring attached to the face of the disc with self-locking stainless steel screws or shall consist of a gate with a bonded elastomer seat which in the closed position, is fully encapsulated and effects a bubble-tight seal across the disc at a full differential of 200 psi. The stem and stem nut shall be of all bronze material. All gate valves provided shall have a history of at least three years service. All valves supplied under these specifications shall conform to a minimum working pressure of 175 psi and a test pressure of 300 psi.

c) Mechanical Joint Butterfly Valves - Mechanical joint butterfly valves shall be used for pipe larger than 12", unless otherwise directed or approved by the Engineer or the project plans. The valve

and related equipment shall consist of tight closing rubber seat butterfly valves, Class 150. Except as modified or supplemented herein, all valves shall be in accordance with AWWA Standard for Rubber-Seated Butterfly Valves, C-504-80, or the latest revision thereof.

d) Valve Description - The valves shall be designed for an operating pressure of 150 psi. The valve shall give bubble-tight shutoff against a pressure of 150 psi, and the body shall be capable of withstanding a hydrostatic test pressure of 300 psi. All valves shall be satisfactory for throttling application and suitable for operation after long periods in a static position. The outside diameter of the valve body of wafer type valves shall be such that the pipeline bolts accurately "center up" the valve in relation to pipe flanges. The valve shall be such as to provide for full opening of the disc in a pipeline of the same nominal diameter as the valve. The pipeline shall consist of cement lined cast iron pipe (or fittings) made in conformance with ASA A21.4 - 1953, A21.6 - 1953, A21.8 - 1953 or the latest revisions thereof, or pipeline of equal inside diameter. The port diameter of each valve shall not be more than 1" less than the nominal valve diameter.

e) Valve Bodies and Coatings - Valve bodies shall have mechanical joint ends with gaskets, follower rings, T-head bolts made of Corten material or approved equal, as designated by ASA A21.11. The body material shall be close-grained cast iron, complying with Specification ASTM A28-48 Class 40, or ASTM A126, Class B, or the latest revisions thereof. The interior of the water way of the valve body, including any area in contact with water flow, must be epoxy coated with either AL-CLAD or Mueller HP or an approved equal. The interior of the valve body shall be fully epoxy coated with either AL-CLAD, or Mueller HP, or an approved equal if the rubber valve seat is mounted on the valve disc. If the rubber valve seat is mounted on the valve body, then an approved non-epoxy coating will be allowed as approved by the Engineer.

f) Valve Disc - The valve disc shall be constructed of a cast or fabricated design with no external ribs transverse to the flow. The thickness of the disc through the center hub section of the valve disc shall be 1 3/4 to 2 1/4 times the shaft diameter to ensure structural strength. The disc shall be designed for 125 lb. shutoff with a stress less than 1/5th of the ultimate strength of the material. The disc shall be Ni-Resist, Type 1, cast bronze meeting ASTM B-143- 1A of B61, or cast iron with AL-CLAD epoxy coating as provided by Dresser Manufacturing, Mueller HP epoxy coating as provided by the Mueller company, or any other coating which is approved by the Engineer. All coatings shall be suitable for potable water service, and factory applied using a process consisting of grit blasting and chemical cleaning to provide the best surface for fusion-bonding and heat curing, and has a minimum thickness of 8 mils.

g) Valve Shaft - The valve shaft shall be not less than the minimum diameter listed for valves in Table 4 of AWWA Specification C-504-80, or the latest revision thereof. The valve shaft material shall be one of the following: (a) Stainless steel 18-8, type 302, 303, 304, 316, or Monel; (b) Steel - if sealed from contact with internal liquids.

h) Valve Seat - The valve seat shall be applied to either the valve body or the valve disc. The valve seat design shall be such that under a prolonged pressure test at 150 psi differential, the seat shall not bulge or deform or show any signs of water leakage. Any signs of such design deficiency shall be cause for rejection of the valve. Valve seats shall be made of Hycar, Buna N, or approved equal. Clamps, screws, and other appurtenances used for securing the rubber seat shall be stainless steel 18-8, Type 302, 303, 304, 316, 317, or approved equal.

i) Operators - Operators for butterfly valves shall be in accordance with AWWA Specifications C-504-80, or the latest revisions thereof. The operators shall be direct bury type. The operators shall be as manufactured by Henry Pratt Company, Philadelphia Gear Corporation, Dresser Mfg., or approved equal, and shall be in accordance with specified requirements.

All working parts within the operator shall be completely bathed in an oil or suitable grease for lifetime operation. The manufacturer shall state the type of grease used in the operator. The input

shaft shall be furnished with a 2-inch (2") square AWWA operating nut which shall turn clockwise to close the valve.

Tracer Wire:

a) General – Conductive type pipe locator/tracer wire shall be installed to locate all waterline pipe and all long services that cross streets regardless of the pipe material. The wire shall extend the entire length of the proposed pipe. The wire shall be taped to the waterline and pulled with the pipe. Split-bolt connectors shall be used at splice locations. Electrical tape shall cover all splices so no bare wire is exposed. Test stations shall be installed adjacent to all fire hydrants along the waterline and at blow offs or valves near the ends of the waterlines. Any exceptions to the location of test stations shall be approved by the Engineer. At each test station, the tracer wire shall be connected to a 1 lb. zinc or magnesium anode. Anodes shall also be attached to the tracer wire at both the beginning and the end of the proposed waterline. A typical layout of the tracer wire and test station is provided on “Standard Water Assembly Details” plan sheet.

b) Wire – The tracer wire shall be Blue No. 12 THHN annealed soft copper wire with thermal plastic insulation. The insulation shall be heat, oil, and gasoline resistant as manufactured by Temple Electric or approved equal. To allow for grade adjustment, a minimum 12” of excess wire shall be coiled at the bottom of the test station for all wires. The insulation sheathing shall be removed such that 1” bare copper wire is exposed at all points of connection. Contractor shall attach wire being installed with proposed water main to any tracer wire installed with adjacent waterline projects.

c) Test Stations - The test station for fire hydrant applications shall be a 1 inch galvanized conduit style test station as manufactured by AGRA Industries with a removable solid cover having two leads extending from the face or approved equal. The test station for valve applications shall be 2 inch flush style test station T2PS3B as manufactured by HANDLEY Industries or approved equal. The conduit style shall be attached to 1 inch rigid galvanized conduit with a minimum length of 36” and plastic end bushing. The flush style shall have the word “WATER” stamped or molded into the lid. All test stations shall be manufactured using molded blue tops or sufficiently coated with blue enamel paint. The tracer wire and the anode wire shall be installed to allow 10 inches of wire within the test station. In concrete environments such as sidewalks or in the downtown area, the contractor shall use the flush style test station. The location of all test stations shall be approved by the Engineer, recorded, and shown in the as-built drawing.

d) Anodes - The anodes shall be 1 lb. bare zinc or magnesium. The anodes shall be buried at the same elevation as the waterline of each test station. The anodes shall be connected to Black No. 12 THHN annealed soft copper wire which shall be extended to the test station.

Fire Hydrants:

a) General - The fire hydrants supplied under these specifications shall meet in every way the AWWA and New England Water Works Association Standard Specifications for Fire Hydrants for Ordinary Water Works Service, AWWA C502-54 or the latest revision thereof, except as modified herein. Direct reference to the above AWWA Specification is made by Section number in most instances.

b) Traffic Type Fire Hydrant - Fire hydrants shall be of the traffic accident type, so that in the event of a traffic accident, the barrel will not become broken, nor the main operating stem become broken or bent. Only the safety flange or safety breaker bolts joining the upper and lower barrel sections can be damaged in the event of a traffic accident, which parts shall be easily and quickly replaceable.

c) Fire Hydrant Requirements - The fire hydrant shall meet the following requirements:

1. Shutoff shall be with pressure by compression.

2. The inlet connection shall be 6" mechanical joint. Required glands, gaskets, bolts and nuts required shall be supplied with the fire hydrant and tee head bolts and nuts shall be of Corten material, or approved equal.
3. **Provisions shall be made for lengthening the hydrant without the necessity of excavation.**
4. All working parts of the valve shall be removable through the top of the hydrant without the necessity of excavation. Removal of parts shall be accomplished with the use of a small hydrant hand tool.
5. All parts entering into the manufacture of the fire hydrants shall be interchangeable.
6. The top of the hydrant shall be so constructed that the operating threads are immersed in a sealed oil or grease reservoir. "O" ring seals shall be used to prevent water and oil leakage. The stem shall be bronze lined where it passes through the "O" rings. The operating nut shall be provided with seal or shield.
7. The interior of the shoe shall be coated with a cement mortar lining in accordance with AWWA C-104-53, or the latest revision thereof, or with a catalyst cured or electro fused epoxy having a minimum thickness of 10 mils.

d) Fire Hydrant Valve - The fire hydrant valve shall meet the following requirements:

1. The main valve assembly shall be seated in a sub-seat of all bronze material so as to provide bronze to bronze engagement of the valve seat ring and to provide a drainage channel of non-ferrous material.
2. The valve assembly, including the lower valve plate, shall be bronze or stainless steel. The lower stem, that is that portion below the lower valve plate, shall be completely enclosed with bronze cap nut or nuts.
3. Valve facing - The main valve shall be faced with balata, hycar rubber, or approved equal.
4. The fire hydrant main valves shall move from full closed to full open in not less than 12 complete turns and not more than 18 complete turns of the operating nut.
5. Operating mechanism - Any spring assembly, between the stem and the main valve, used by the manufacturer to facilitate operations, shall be composed of either bronze or stainless steel.
6. The fire hydrant shall open left (counter clockwise).
7. The hydrant shall have two drain valves for automatic draining of the barrel when the main valve is loosed.
8. The main valve shall be designed to provide for flushing at the drain valves during the first four turns of opening the main valve.
9. The main valve opening shall be 4.5 inches unless otherwise specified.
10. The operating nut and cap nuts shall be a 1-½ inch pentagon.

e) Nozzles - The fire hydrant shall have the following:

1. Two 2 ½ inch nominal nozzles with 2 ½ inch national standard thread.
2. One 5-inch Storz pumper nozzle.

3. The 2.5-inch nozzles with national standard thread shall be joined to the barrel by either a threaded or twist-lock type joint. The threads provided shall match threads now in service with other fire hydrants in use in the City of Bel Aire.
4. The hydrant pumper nozzle shall be of one-piece design compatible with 5” Storz hose coupling. The nozzle shall be an integral part of the fire hydrant and must be furnished by the manufacturer. An acceptable option would be the installation of a Herrington Permanent Hydrant Adapter™.
5. Nozzle cap chains or cables shall not be installed or included.

f) Fire Hydrant Materials - The materials used in the manufacturing of the fire hydrant shall be as follows:

1. Cast Iron - All iron castings shall be made from a superior quality iron and of even grain and shall possess a tensile strength of not less than 32,000 pounds per square inch.
2. Bolts and Nuts - Flange bolts and nuts shall be of Everdur, stainless steel, or Corten for that type of fire hydrant employing drainage between flanges of the shoe and barrel.
3. Packing - Stuffing box packing shall have "O" ring seals for upper stem.
4. Gaskets - Gasket material shall be rubber composition.
5. Epoxy Coating - The epoxy coating shall be applied to the interior of the hydrant as follows. The casting shall be grit or sand blasted to bare metal, blown free of dust, and cured by heating to 135 degrees F. The coating shall be applied in a dust free area with a minimum of three (3) applications of equal thickness.

g) Fire Hydrant Color - The fire hydrant shall be painted. The nozzles and bonnet of the hydrant shall be painted red, all other parts above ground shall be aluminum.

h) Approved Fire Hydrants - The fire hydrants listed below may be used on water projects:
Clow Medallion
M & H 929
Mueller Super Centurion 250
U.S. Pipe Metropolitan 5-1/4"
American Darling 5-1/4” B-84-B

The City of Bel Aire may accept other hydrants if they have received approval prior to solicitation of bids.

Water Service Materials:

a) General - Service materials shall include corporation stops, service saddles, plastic or copper service tubing, unions and couplings, copper meter setters, meter boxes, and meter rings and lids. All services 1" or smaller shall use 1" service material and adapters as necessary to install the meter or connect to the property side service line. Material in this specification is for 1" services, larger service material must be approved by the Engineer.

b) Corporation Stops - All corporation stops used for installation of services shall be 1 inch unless directed otherwise by the Engineer or indicated by the project plans. The corporation stops shall have AWWA standard inlet threads. The corporation outlet shall be compression type for copper tubing or copper tubing size polyethylene plastic tubing. Each corporation stop shall be furnished with a stainless steel insert for style 3406 polyethylene plastic tubing, copper tubing size O.D.

All corporation stops shall be Ford F1000, Hays 5200, Mueller H-15008, or approved equal.

c) Service Saddles - Service saddles are required on all service taps. All service saddles shall be bronze with silicon bronze straps and bronze nuts, or 18-8 stainless steel and shall be Jones, McDonald, Mueller, or approved equal.

d) Service Tubing - Plastic tubing shall be polyethylene style 3406, 3408, polybutylene class 250, or approved equal, shall have ultra high molecular weight and shall be furnished in copper tubing size, unless otherwise specified. ProCare, ClearCor or Yardley brand polyethylene pipe are not acceptable.

Plastic tubing shall have a working pressure of 160 psi with a minimum burst pressure of 630 psi at 23 degrees C. Plastic tubing shall meet or exceed the requirements of ASTM D2737- SDR9, and must be N.S.F. approved.

Copper tubing shall conform to AWWA specifications 7-S-CR and must be manufactured within the continental limits of the United States. All copper tubing shall be 1" type K, soft copper tubing.

e) Unions and Couplings - Copper flange fitting ends shall be compression type and each end shall be furnished with stainless steel inserts for style 3306 polyethylene tubing. Threads for 1" unions and couplings shall be AWWA threads.

All unions and couplings shall conform to the sizes, ends and manufacturers listed or approved equal:

One-inch (1") unions, 3 part copper compression to copper compression; Hays 5615, ford C44-44, Mueller 15403.

One-inch (1") couplings, copper compression to outside I.P.T.; Hays 5600; Ford C84-44, Mueller H-15451.

f) Copper Meter Setters - All meter setters for installation of water services shall be 1", unless larger setters are required. Meter yokes shall be furnished with Mueller saddle nuts and with plain stop. Inlet and outlet connection shall be compression type fitting for copper tubing or copper tubing size polyethylene style 3406. Meter yokes shall be furnished with stainless steel insert for each fitting.

One inch (1") Copper Meter yokes shall be Ford V84, Hays 5615, Mueller H1408 McDonald or approved equal.

g) Meter Boxes - Meter boxes shall be installed for all water services that are 1" or smaller. The meter box shall be unslotted, 30" in height, and be 21" in diameter for a 1" service. The meter box shall constructed of PVC.

1. **PVC Meter Boxes** - The boxes shall be made of Class 12454 polyvinyl chloride which conforms to the current ASTM D1784 standard, formed into a seamless tube. The 21" diameter box shall have a minimum inside diameter of 21.00", and a minimum wall thickness of 0.432". The ends of the boxes must be smooth and even. All surfaces of the boxes must be white in color.

h) Meter Rings and Lids - Meter Rings and Lids shall be cast of good gray cast iron free from impurities and foreign bodies insofar as is customary in the industry. The rings and lids shall be painted on all surfaces with an asphaltic base paint or approved equal. The meter rings and lids shall be: Ford C32, ***or*** Ford C4. Lids shall have a 1 ⅞" or 1 ¾" hole to accept T.R.P.L.

i) Meter Coupling Plugs - Inlet and outlet meter coupling nuts on the meter yokes are to be plugged with PVC plugs. The 1" meter yokes use 1 ¼" I.P.T. plugs.

Couplings, Gaskets, and Flanges:

a) Couplings: The couplings used to join pipe of the same type shall be a mechanical joint sleeve (long) or a coupling manufactured for the pipe. The couplings used to join a pipe of one type to pipe of another type may be a Smith-Blair, or Dresser style coupling, or an approved equal. Couplings manufactured by the pipe manufacturer for use with their pipe, such as PVC collars or couplers may be used as approved by the Engineer. Cost of joint collars or couplers shall be subsidiary to the pipe installation and not bid or paid for separately.

b) Bolts and Nuts: The bolts and nuts to be used with ductile iron fittings shall be tee head and made of Corten, US alloy or approved equal and be sized ⅛" smaller than the bolt hole. They shall be manufactured from low alloy, high-strength steel bar stock.

Bolts and nuts shall be made from the same proprietary material. The mechanical joints, flanges, and other locations where the bolts and nuts are used, shall be wrapped with 8 mil polywrap to protect them from corrosion. Cost of bolts and nuts shall be considered subsidiary to the fitting for which they will be used and not bid or paid for separately.

c) Gaskets: Where flanged fittings are used, gaskets shall be used. All gaskets for use with pipelines or flanged valves shall be one piece, full-faced, and made from one-ply cloth inserted SBR rubber material. For flanges 20-inches (20") and smaller, the gasket thickness shall be 1/16-inch (1/16") material, for flanges larger than 20 inches (20"), the gasket shall be 1/8-inch (1/8") material. Inspection of gasket material prior to installation will be required. Cost of gaskets shall be considered subsidiary to the installation of the fitting for which it is required and not bid or paid for separately.

d) Flanges: Cast iron flanges shall conform to AWWA C-110 as to material, diameter, thickness, drilling, etc. Steel flanges shall be ring or hub type and shall conform to AWWA C-207, Class D. All flanges shall be drilled to AWWA C-110, except that bolt holes shall be 1/8- inch (1/8") larger than the bolts for the size flange. Bolts for flanges shall be as specified above and all flanges shall have flat faces. Where flanges are required, cost of such flanges shall be considered subsidiary to the fitting or pipe on which it used.

803.4 SEPARATION OF POTABLE WATER MAINS FROM SANITARY SEWERS AND POLLUTION SOURCES

Separation of Water Mains and Sewers:

a) Gravity/pressure sanitary sewers - When potable water pipes and sanitary sewers are laid parallel to each other, the horizontal distance between them shall be not less than 10 feet. The distance shall be measured from edge to edge. The laying of water pipes and sanitary sewers shall be in separate trenches with undisturbed earth between them. In cases where it is not practical to maintain a 10-foot separation, equivalent protection shall be required. Reinforced concrete encasement of the sanitary sewer is one such protective measure that may be used.

When a water pipe and a sanitary sewer cross and the sewer is 2 feet or more (clear space) below the water pipe, no special requirements or limitations are provided herein. At all other crossings, the sanitary sewer is to be constructed of Ductile Iron**,** PVC, or Reinforced Concrete pipe, meeting the requirements specified in Subsection 804.2, and pressure tested to assure water tightness pursuant to Chapter VIII of KDHE's Minimum Standard of Design of Water Pollution Control Facilities, latest revision.

Joints in the sewer pipe shall be located as far as practical from the intersected water main. A minimum distance of 10 feet is to be maintained as the distance of a sewer joint to the water line.

Where a water main is laid across or through an area where there is an existing sanitary sewer, which is not constructed of one of the above specified materials, and is two feet (2') or less below the water pipe, the existing sanitary sewer shall be encased with reinforced concrete with a minimum six (6") thickness for a ten-foot (10') distance on each side of the crossing or the crossed section of sewer replaced to meet the above specified construction requirements. If the water pipe is below the sanitary sewer, regardless of clear space, the sanitary sewer shall be concrete encased for a distance or replaced to meet the above requirements.

b) Sewer connections - There are to be no physical connections between any parts of the potable water system with building sewers, sanitary sewers, or wastewater treatment facilities.

c) Sewer manholes - No water pipe shall pass through or come in contact with any part of a sewer manhole. Required horizontal separation distances between water mains and manholes are equivalent to those required for water mains and gravity sanitary sewers.

d) Storm Sewers - The separation distance between a storm sewer (which is not a combined storm/sanitary sewer) and a water main should be based on geotechnical considerations. Required separation distances between water mains and combined storm/sanitary sewers are equivalent to those for water mains and gravity sanitary sewers.

e) **Drains** - Underground drains from fire hydrants or valve pits should not be directly connected to sanitary or storm drains.

Separation of Water Mains and Other Pollution Sources:
It is of the utmost importance that potable water lines be protected from any source of pollution. The following shall pertain to instances where septic tanks, absorption fields, waste stabilization ponds, feedlots, or other sources of pollution are encountered.

a) A minimum distance of 25 ft (7.6 m) shall be maintained between all potable water lines and all septic tanks or waste stabilization ponds.

b) Under no circumstances shall a water line extend through a septic tank absorption field or feedlot. All water lines shall be located a minimum of 25 ft (7.6 m) from the farthest known extent of any sewage contamination. Under no condition will it be considered that encasement of the water main through an area of real or potential pollution would provide the protection needed to the water supply.

c) Under no conditions shall the encasement of a water line be considered as adequate protection of a water line or a water supply for the purpose of extending the water line through a real or potential source of contamination.

Cross Connections:
There shall be no physical connection between the public water supply system and any pipes, pumps, hydrants, tanks, or non-potable water supplies whereby unsafe water or other contaminating materials may be discharged or drawn into the system. KDHE does not approve the interconnection of municipal water lines and individual or independent water supply sources such as home wells. Neither steam condensation nor cooling from engine jacket or other heat exchange devices shall be returned to the potable water supply.

803.5 CONSTRUCTION METHODS
Water mains shall be installed according to applicable AWWA Standards (including AWWA C600 for PVC pipe and AWWA C605 for DICL), AWWA Manuals of Water Supply Practices and/or the manufacturers recommended procedures.

All water mains shall have the minimum cover as shown below, unless shown otherwise on the project plans:

a) 42" of cover for 8" pipe and smaller
b) 48" of cover for 12" and 16" pipe
c) 60" of cover for pipe 20" and larger

The cover is measured from the top of pipe to the proposed finish grade or proposed top of curb.

No water pipe shall be deflected, either vertically or horizontally. Deflections may be made only at couplings, joints, or fittings. Under no circumstance shall deflections at joints or couplings exceed that recommended by the manufacturer.

Every precaution shall be taken to prevent foreign matter from entering the pipe that is being laid or has been placed in the line. When pipe laying is not in progress, the open ends of the pipe shall be closed with a watertight plug or by other means approved by the Engineer.

Except as otherwise required by this specification, by the special provisions, or by the Engineer, trench excavation, backfill, and compaction shall be in accordance with the requirements of Section 801. Backfilling may commence as soon as approved by the Engineer, subject to testing.

All corporation stops used for testing and chlorination shall be left in the pipeline with the stop closed and all connecting pipe removed.

Two inch (2") blowoff assemblies shall be installed at the end of each main to clear the line, unless otherwise shown on the project plans. Fire hydrants may also be used to flush the mains. The blowoff assembly detail is shown on the standard water detail sheet for the project.

803.6 POLYETHYLENE CORROSION PROTECTION

General:

Where ductile iron pipe, ductile iron or cast iron fittings, valves, fire hydrants, or other metallic items are installed as part of the water line project, such items shall be wrapped with 8-mil polyethylene wrap (polywrap) to prevent corrosion. The polywrap shall be continuous, securely taped, and provide a continuous barrier between the pipe and surrounding bedding and backfill. Installation of polywrap shall be considered subsidiary to pipe installation.

Polytube shall be used along lengths of pipe and be sized in accordance with pipe manufacturer recommendations.

Materials:

Material requirements for Polyethylene wrap and securing tape are provided in Subsection 803.3.

Installation:

The polyethylene tubing shall be cut into lengths approximately two feet longer than the pipe sections. With the pipe suspended from the center, the tube shall be slipped over the spigot end and bunched up between the point of support and the spigot end. After the pipe is installed into the bell of the adjacent pipe, the pipe shall be lowered to the trench bottom and the supporting sling removed from the center of the pipe. The pipe shall then be raised at the bell end enough to allow the polytube tube to be slipped along the full length of the barrel with enough left at each end to overlap the adjoining pipe about one foot. A shallow bell hole must be made at each joint to facilitate installation of the polywrap. The bunched up polywrap from the preceding length of pipe shall be slipped over the end of the new length of pipe, and secured in place with one circumferential turn of tape plus enough overlap to assure firm adhesion. All lengths of polywrap are to be secured together with the approved tape. Rips or punctures of the wrap are to be repaired using wrap material secured with tape. Bends and reducers shall be wrapped using polytube.

Valves, tees, crosses, fire hydrants, and outlets, shall be wrapped with flat sheets of the same polywrap material. The sheets shall be passed under valves and brought up around the body to the stem. Edges shall be brought together, folded twice and secured with the approved adhesive tape.

803.7 VALVES

Valves shall be installed in accordance with AWWA C-600 or AWWA C-603, modified as follows:

All tapping sleeves, gate valves, butterfly valves, air release and vacuum valves, and corporation stops shall be in accordance with Subsection 803.3.

All three-inch (3") and smaller valves used shall be IPT gate valves as manufactured by Clow or Mueller. Valves which are to be used on the project that are12-inch (12") and smaller shall be mechanical joint gate valves; valves which are larger than 12-inch (12") shall be mechanical joint butterfly valves. As approved by the Engineer, 16 and 24-inch (16 and 24") Mechanical Joint Resilient Seat Wedge Gate Valves with non-rising stems, as manufactured by American Flow Control, may be used in place of 16 and 24-inch (16 and 24") butterfly valves. The valve operator may be either a top or side operator as approved by the Engineer. The use of ball valves or globe valves for use with the connection of 3-inch (3") and smaller water lines will not be allowed.

Concrete supports shall be provided under valves in vaults. The support shall be constructed one inch (1") low and the void between the valve and the support shall be filled with non-shrink grout. Buried valves shall be supported on poured concrete blocks.

Valve boxes are to be installed on all valves in accordance with the standard detail drawings. Valve boxes shall be held vertical and plumb during backfill operations.

Valve operator extensions shall be installed on all valves where the operator stem is in excess of seven feet (7') or more below proposed grade. The operator extension shall bring the operating nut to within five feet (5') of the proposed surface. All valves shall be installed in accordance with these specifications. The valve installation shall include excavation, concrete support blocking, valve box, and any other material to provide the item complete and in place at the unit price bid.

803.8 VAULTS
Valve vaults shall be required only as indicated by the project plans. The vault shall be constructed of reinforced concrete conforming to Subsection 406.2 of these specifications.

The Contractor shall be required to provide all materials and labor to provide the item complete and in place at the unit price bid.

803.9 FIRE HYDRANTS
The Contractor shall furnish all labor, materials, and equipment necessary to install fire hydrants complete and in place at locations shown on the plans in accordance with the standard details and special revisions. Fire hydrants furnished by the Contractor shall conform to the requirements of Subsection 803.3.

Paint that has been damaged, chipped, or scraped, shall be repaired as directed by the Engineer.

All fire hydrants shall be faced away from the street and/or bagged, until such time as the hydrant is placed in service. The hydrant shall be turned to face the street, at the proper grade, plumb, fully flushed, and in good working order before it will be accepted. The fire hydrant control valve at the main shall be left open. The Contractor shall provide the fire hydrant bid item complete and in place at the unit price bid.

803.10 CONNECTIONS TO EXISTING MAINS
The Contractor shall be required to fully excavate the existing main for any adjustment of the line and grade of the new main. Such adjustment shall be as directed by the Engineer and approved prior to construction and shall be considered subsidiary to the installation of the water main project.

All connections to existing mains shall be in accordance with the project plans.

Valves connecting new mains to the existing mains shall remain closed at all times. If it is necessary to obtain water from the existing water system, the Engineer shall be contacted for approval. After approval has been granted, valves may be operated only if the Engineer or his representative is present. After the valve has been operated, it shall be closed and left in the closed position until the line is to be flushed and cleared. After disinfection and testing is completed, the new water line may be released for service upon completion of project documentation.

When an existing water line must be shut down to make a connection, the Contractor, Engineer, and the Owner, shall discuss the timing of the shut down and make any necessary arrangements to make the shutdown. The shutdown time shall be held to a minimum to avoid disruption of service to the water customers. The Contractor shall make the necessary notification to those affected by the proposed shutdown. Such notice shall be in writing and given a minimum of 48 hours ahead of the proposed shutdown. The Contractor shall notify the Engineer who will then notify the Owner when the main is returned to service.

803.11 TAPPING SLEEVES, VALVES AND VALVE BOXES ON WATER LINES
Description:
Tapping sleeves are to be installed by the Contractor at all locations where indicated by the project plans. The Contractor shall contact the Engineer to arrange for the installation of the tapping sleeve.

Installation:

The Contractor shall perform all excavation and backfill for the installation. The Contractor shall expose the existing pipe prior to the installation of the tapping sleeve so that the Water and Sewer Department may determine the type of tapping sleeve required for the installation. After the installation of the tapping sleeve and valve, the Contractor shall extend the new water line from the connection, construct the thrust block behind the tapping sleeve and valve, and install the valve box during the backfilling operation. The valve box is to be vertical and plumb.

When tapping the main is required by the project plans for the connection of the new main to the existing main, the Contractor shall contact the Engineer, who will make the necessary arrangements for having the main tapped by the Water and Sewer Department. The Contractor shall not tap the existing main unless authorized in writing by the Water and Sewer Department and the Engineer.

The connection to the existing main shall be considered subsidiary to the pipe installation unless otherwise indicated by the bid proposal. If part of the bid proposal, the item shall be provided complete and in place.

803.12 METER SERVICE CONNECTIONS

On projects where the Contractor will be installing water services and meter setters, the water services shall be installed as directed by the City. The following items shall be included in the water service and meter setter bid items shown in the bid proposal. The Contractor shall provide all material and labor to provide the item complete and in place at the unit price bid for the item.

Water Services:

For projects requiring the installation of water services or replacement of water services, the Contractor shall be required to install a new water service line from the new main and connect the service line to the existing water meter setter. New water service lines shall be one inch (1") where replacement of existing ⅝", ¾", or 1" water service lines is required. Where existing water service lines are larger than one inch (1"), the new service line shall be the same size as found and connected to existing meter setter, using adapters as required. When replacement of the existing meter setter is required, a minimum of three feet (3') of one inch (1") copper tubing shall be installed on the consumer's side of the setter. The contractor shall provide the inspector with a list of materials used in the meter box assembly. The one inch (1") water service bid items shall include the following: installation of a one inch (1") service saddle, installation of new one inch (1") service line, connection of the new service line to the existing meter setter, adapters as necessary for the connection, new 36" PVC meter boxes, new meter rings, new meter lids, and all other material an labor to furnish the bid item complete and in place. The Contractor may reuse 36" meter boxes that are made of PVC that has not been damaged, as approved by the City. The Contractor shall be paid for only those services installed or replaced, regardless of the number of services bid, at the unit price bid for the appropriate bid item.

Water Meter Setters:

Water meter setters shall be replaced as approved and directed by the City. The existing water meter setter shall be used if it is in satisfactory condition and of suitable material. If the existing meter setter is not usable, a new one inch (1") meter setter shall be installed. The existing water meter shall be reused and reinstalled using the appropriate adapters. An existing water meter setter that may not be reused, shall be abandoned by removing the old meter setter, crimping the existing service line shut, removing the existing meter ring, lid, and box, and filling the hole with sand. Such abandoning shall be considered subsidiary to the meter setter bid item and not bid or paid for separately. The Contractor shall be paid for the actual number of water meter setters installed, regardless of the number of meter setters bid, at the unit price bid for the meter setter bid item. The old meter rings and lids shall be returned to the Owner at no additional cost to the bid item.

803.13 FIRE SERVICE LINE CONNECTIONS

Fire service line connections shall be made in accordance with the plans and the standard details.

The fire service line from the control valve at the main to the detector check valve shall be constructed of ductile iron pipe regardless of length.

Fire service lines shall be constructed in accordance with plans that have been approved by the Owner.

803.14 BLOCKING

All pipe lines, fire hydrants, valves, and fittings are to be blocked with concrete thrust blocks in accordance with standard details. Horizontal thrust block bearing area calculations are to be based on a test pressure of 150 psi, and undisturbed soil bearing of 1,000 psf in clay soils, and 2,000 psf in sand-gravel soils. Vertical thrust blocks shall be sized to resist thrust with an equal weight of concrete if the block is above the fitting. The concrete for thrust blocking shall conform to Subsection 406.2. Cost for the installation of concrete thrust blocks shall be considered subsidiary to the pipe installation and not bid or paid for separately.

803.15 TESTING

General:

All sizes of water lines, including all fittings and connections to the water mains will be tested for watertightness by subjecting each section of water line to hydrostatic tests in accordance with applicable provisions of AWWA C-600, except as modified below. The tests shall include both pressure and leakage testing. The Contractor shall provide all equipment, material, and labor to perform the required testing.

Pressure Tests:

Water lines, including all fittings and connections to the water mains shall be tested for watertightness by subjecting each section to pressure test. The pressure shall be measured at the lowest end of the section under test. The pipe is to be tested at a test pressure of 150 psi. The duration of the test is to be two hours unless otherwise directed by the Engineer. Each section of the project is to be tested separately as per AWWA Standards (AWWA C600 for ductile iron mains or AWWA C605 for PVC mains, or their most recent revision) or per Appendix C of KDHE's *Minimum Design Standards*. A section of less than 500 feet may be tested with the next adjacent section, however, testing of sections longer than ½ mile in total pipe length shall not be allowed unless written approval from the Engineer has been provided.

Pressure testing may begin only after appropriate backfilling has been completed and the last concrete thrust block has set for seven days, unless high early strength concrete was used, in which case the block must set for 36 hours prior to testing. The pipe to be tested shall be filled slowly with water and allowed to stand for 24 hours to allow for absorption. After the 24-hour period, the test may begin. Any exposed valves, fittings, pipe sections, and fire hydrants, etc., shall be examined during the pressure test for cracks, leaks, or other signs of leakage. The pipe section is to be pumped to 150 psi and the pressure gages observed for the duration of the test. The pressure shall not vary more than 5 psi during the testing period. The pipe sections that do not pass testing, shall be repaired or replaced with sound material as directed by the Engineer, at the expense of the Contractor. The test shall be repeated after repairs have been made. Only after the section has passed the test shall the section be accepted.

Leakage Test:

Leakage is defined as the quantity of water that must be supplied into the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

The duration of the leakage test shall be 2 hours unless otherwise directed by the Engineer. The leakage test is to be performed **after** the pressure test. The specified pressure during the leakage test is to be the same as for the pressure test. The test shall be conducted per AWWA Standards (AWWA C600 for ductile iron mains or AWWA C605 for PVC mains, or their most recent revision), or per Appendix C of KDHE's *Minimum Design Standards*.

Permissible leakage for PVC and DICL is determined by the following formula:

$$L = \frac{SD\sqrt{P}}{148{,}000}$$

In which

L = Allowable leakage, in gallons per hour
S = Length of pipe tested, in feet
D = Nominal pipe diameter, in inches
P = Average test pressure during leakage test, in pounds per square inch

The above equation is based on a leakage rate of 10.5 gallons per day per mile per inch of nominal diameter of pipe. Leakage values determined by the above formula for 1,000 feet of pipe are presented in table 803-1, below.

A table showing allowable leakage is shown below.

Table 803-1
Allowable leakage per 1000 feet of pipeline in gallons/hour (GPH)

Avg. Test Pressure	Normal Pipe Diameter							
PSI	4	6	8	12	16	20	24	36
250	0.43	0.64	0.85	1.28	1.71	2.14	2.56	3.85
225	0.41	0.61	0.81	1.22	1.62	2.03	2.43	3.65
200	0.38	0.57	0.76	1.15	1.53	1.91	2.29	3.44
175	0.36	0.54	0.72	1.07	1.43	1.79	2.15	3.22
150	0.33	0.50	0.66	0.99	1.32	1.66	1.99	2.98
125	0.30	0.45	0.60	0.91	1.21	1.51	1.81	2.72
100	0.27	0.41	0.54	0.81	1.08	1.35	1.62	2.43
75	0.23	0.35	0.47	0.70	0.94	1.17	1.40	2.11
50	0.19	0.29	0.38	0.57	0.76	0.96	1.15	1.72

Should any section have leakage greater than shown in the table or calculated by the above formula, the section shall be repaired or material replaced with sound material and the test repeated. Only after the section has passed the test shall the section be accepted.

Testing and the associated repair and retesting of the water line shall be considered subsidiary to the pipe installation and not paid for separately.

803.16 DISINFECTION
After pressure and leakage testing has been performed and the sections found acceptable, the entire water line, including valves, fittings, fire hydrants, etc., shall be disinfected. All valves in the line, including fire hydrants, shall be operated during the disinfection procedure.

Cost of disinfection shall be considered subsidiary to the pipe installation and not bid or paid for separately.

Disinfection of water mains shall conform to the current requirements of the Kansas Department of Health and Environment (KDHE). The disinfection procedures shall be followed to ensure the water in the new water system being installed is free from bacteria. The KDHE disinfection procedures are located in Appendix D of the *KDHE Minimum Design Standards*. Cost for the disinfection of the water line shall be considered subsidiary to the pipe installation and not paid for separately.

SECTION 804
SEWER LINE CONSTRUCTION

804.1 DESCRIPTION
The construction of sewer lines shall conform to the applicable standard specifications and details, except as otherwise modified in the special provisions.

804.2 MATERIALS
Concrete:
Concrete and materials for concrete shall conform to the, Subsection 406.2, except as modified herein. Cement used in concrete for sanitary sewer manholes shall be Type II. Cement used in all other concrete shall be Type I/II. All cement shall comply with the requirements of the latest revisions of ASTM C-150.

The Engineer shall have the authority to instruct the Contractor to substitute high early strength (Type lll) cement for Type I/II cement. In this event, the Contractor will be allowed as an extra the difference in cost between standard Portland cement and high early strength (Type III) cement.

Reinforcing Steel:
Reinforcing steel shall conform to the same requirements as specified in the Subsection 406.2.

Mortar (Grout):
Mortar used in constructing brick masonry structures shall contain eight (8) sacks of Type II Portland cement per cubic yard, fine aggregate, and sufficient water to produce mortar of desired consistency. Fine aggregate for mortar shall conform to the requirements specified for concrete pavement, except that it shall have a gradation factor not less than 2.75 and shall be free from dust, loam or dirt.

Manhole Castings:
Manhole castings shall be made of good quality gray iron, free from cracks, holes, swells and cold shuts. Manhole castings shall be manufactured to conform to the shape and dimensions and other requirements as shown on standard manhole detail. Manhole castings shall conform to Class 30 of ASTM A-48.

Stormwater/Sanitary Pipes:

a) Clay Pipe *(Sanitary)* - All clay pipes shall be extra strength vitrified clay pipe conforming to the requirements of the latest revision of ASTM C-700. Individual pieces shall not be less than five feet (5') in length, except that shorter pieces may be used to facilitate connections at manholes.

Clay pipe shall be installed with an improved bedding conforming to the standard drawing.

All pipe shall be subject to inspection at the factory, on the job site, or at any other location prior to construction. Purpose of the inspection shall be to cull and reject pipe which, independent of the strength tests herein specified, fail to comply with the requirements of the specifications. All rejected pipe shall be plainly marked by the inspector and shall be replaced by the Contractor without additional cost. Pipe will be rejected when the allowable variations as specified in the latest revision of ASTM C-700 are exceeded or when pipe fails to give a clear ringing sound when placed on one end and tapped with a light hammer.

Clay pipe may be either bell and spigot pipe or plain end pipe. Bell-and-spigot pipe shall have compression joints which conform to the requirements of the latest revision of ASTM C-425, Type I, except that the sealing element on both the bell and the spigot shall be affixed to the pipe in the factory. Plain end pipe shall have compression couplings which conform to the latest revision of ASTM C-594 for Type B coupling, except that the rigid external sleeve coupling for jointing the pipe shall be affixed to one end of the pipe in the factory. A lubricant shall be used as recommended by the manufacturer to facilitate the joining of the pipe.

b) Polyvinyl Chloride Composite Pipe *(Sanitary)* - Polyvinyl (P.V.C.) Composite Sewer Pipe shall conform to the latest revision of ASTM D-2680. Joints shall be rubber gasketed. All pipe ends shall be sealed with a suitable sealant as recommended by the pipe manufacturer to prevent air intrusion into the pipe wall filler material during the low pressure air testing. PVC Composite Pipe shall be installed in accordance with the manufacturer's recommendations. PVC Composite Pipe shall be installed with an improved bedding in accordance with the standard drawing for composite pipe. PVC Composite Pipe shall have a Certification of Compliance executed by an accredited independent testing laboratory.

c) Polyvinyl Chloride Pipe *(Sanitary)* - Polyvinyl Chloride (P.V.C.) Pipe having diameters of eight inches (8") or greater shall have elastomeric gasketed joints and shall conform to the latest revision of ASTM D-3034 for 15-inch and smaller pipe, and to ASTM F-679 for 18-inch and larger pipe, and shall be rated for SDR-35. All PVC pipe shall be installed in accordance with manufacturer's recommendations. PVC pipe shall be installed with an improved bedding in accordance with the standard detail.

Pipe furnished may be P.V.C. pipe meeting the requirements of the latest revision of ASTM F789, unless otherwise noted on the plans. Such pipe shall have a Certification of Compliance executed by an accredited independent testing laboratory. Pipe joints shall be elastomeric gaskets meeting the requirements of the latest revision of ASTM D-3212. Such pipe shall be installed in conformance with the applicable requirements specified for PVC pipe in the preceding paragraph. Approved waterstop gaskets shall be furnished and installed on the pipe in all manhole walls.

d) Ductile Iron Pipe (Storm) - Ductile iron pipe shall conform to ANSl A21.51 or AWCA C151 and shall be Thickness Class 52, unless otherwise noted on the plans. Joints shall be either push-on joints or mechanical joints manufactured in accordance with Federal Specification WW-P-421C. When specified by the plans, ductile iron pipe shall be furnished with flexible joints capable of deflecting a minimum of twelve and one-half degrees (12-1/2). Flexible joints shall be "Molox" as manufactured by American Cast Iron Pipe Company, "Usiflex" as manufactured by the United States Pipe & Foundry Company, or an approved equal. All exterior surfaces of ductile iron pipe shall be coated with a bituminous coating approximately one mil thick. The inside of ductile iron pipe to be used in constructing storm sewers having diameters of eight inches (8") or larger shall have a one-sixteenth inch (1/16") thick cement lining with a bituminous coating in accordance with ANSI A21 .4 or AWWA C104. Ductile iron pipe shall be used only when specified by plans or proposal. Ductile iron pipe shall be installed with an improved bedding in accordance with the standard drawing.

e) Reinforced Concrete Pipe (Storm) - Reinforced concrete pipe for storm sewers shall be Class Ill pipe, unless specified otherwise by the plans. Circular reinforced concrete storm sewer pipe shall conform to the requirements of the latest revisions of ASTM C-76 for Wall B. Reinforced concrete arch storm sewer pipe shall conform to the latest revision of ASTM C-506. Reinforced concrete elliptical storm sewer pipe shall conform to the latest revision of ASTM Designation C-507. Joints shall be tongue and groove joints sealed with either flexible plastic gaskets or cement mortar. Flexible plastic gaskets shall conform to the requirements of the latest revision of AASHTO M-198 for Type B gaskets. The gasket manufacturer shall certify to the Engineer that he has examined the appropriate detailed joint drawings of the pipe manufacturer and has recommended the specific size and number of wraps of gasket to be employed in the joints of pipe sizes proposed for the project.

f) Corrugated Metal Pipe *(Storm)* - Corrugated steel pipe shall be galvanized steel and shall conform to the applicable provisions of KDOT Standard Specifications, Section 1905.

All corrugated steel pipe furnished up to and including a circular diameter of sixty-six inches (66") or metal pipe arches smaller than 66" x 51" shall have corrugations with a pitch of two and two-thirds inches (2-2/3") and a depth of one-half inch (1/2"). All corrugated steel pipe specified larger than circular diameter of sixty-six inches (66") or metal pipe arch sizes larger than 64" x 43" shall

have corrugations with a pitch of three inches (3") and a depth of one inch (1"). Corrugated steel pipe used in the construction of storm sewers and culverts shall be furnished with the "Hugger" band couplers manufactured by Contect Steel Corporation, or an approved equal, for connecting sections of corrugated steel pipe. The coupling bands shall be furnished and installed with gaskets such that the connection will be tight when completed to preclude entrance of backfill material into the pipe.

Corrugated steel pipe shall be of the size and type as shown on plans, corrugated steel pipe gage requirements shall conform with the minimums as shown in the following table unless otherwise shown on plans:

Circular Pipe Size in Inches	**Arch Pipe Size in Inches**	**Minimum Gage**	**Minimum Sheet Thickness in Inches**
15 (See Note)	17x13 (See Note)	12	0.109
18	21x15	12	0.109
21	24x18	12	0.109
24	28x20	12	0.109
30	35x24	12	0.109
36	42x29	12	0.109
42	49x33	12	0.109
48	57x38	12	0.109
54	64x43	12	0.109
60	66x51	12	0.109
66	73x55	12	0.109
72	81x59	12	0.109
78	87x63	10	0.138
84	95x67	10	0.138
90	103x71	10	0.138
96	112x75	8	0.168

Note: Twelve gage fifteen-inch (15") or 17"x13" CMP may not always be available. RCP may be substituted for these sizes. RCP with a diameter of 12" may be substituted for 17"x13" CMP. Such substitutions can be made with the Engineer's approval.

Circular corrugated steel pipes larger than ninety-six inches (96") and corrugated steel pipe arches larger than 112" x 75" require special consideration, and the requirements for the larger pipes will be specified on the plans.

Any damage to pipe or coating shall be repaired by the Contractor as approved by the Engineer. Scrapes or scratches penetrating the galvanized coating shall be painted with zinc-rich paint. Damaged pipe, which in the opinion of the Engineer cannot be satisfactorily repaired, shall be replaced by the Contractor.

Ungalvanized welds and pipe ends shall be factory painted with zinc-rich paint, and any areas where the galvanizing has been damaged is shipping or installation shall be field painted with zinc rich paint. Zinc-rich paint shall be a one-component material manufactured as a coating for steel and have a minimum of 85% zinc weight in the dried film.

g) Closed Profile PVC Pipe *(Storm)*

1. **Scope:** This specification covers Closed Profile polyvinyl chloride (PVC) pipe and fittings made to a controlled inside diameter in sizes 21" to 48" with an integral bell and elastomeric seal joints which meet the requirements of ASTM D-1784.
2. **Physical Dimensions:** Pipe dimensions shall conform to the requirements in the following table when measured in accordance with ASTM D-2122:

Pipe Dimensions

Normal Size	Average O.D.	Wall Thickness	Average I.D.
21"	22.110"	0.680"	20.76"
24"	25.116"	0.770"	23.50"
27"	28.232"	0.886"	26.50"
30"	31.416"	0.965"	29.50"
36"	37.800"	1.150"	35.50"
42"	44.200"	1.350"	41.60"
48"	50.570"	1.535"	47.50"

3. **Pipe Stiffness:** The minimum pipe stiffness shall be 46 psi when tested in accordance with ASTM D-2412.
4. **Flattening:** Pipe shall show no visual evidence of cracking, splitting or breaking when flattened between parallel plates in a suitable press to 60 percent deflection in accordance with ASTM D-2412.
5. **Fusion Quality:** Pipe shall show no sign of flaking or disintegration when immersed in an anhydrous acetone for 20 minutes as described in ASTM D-2152.
6. **Impact Resistance:** The impact resistance of closed profile PVC sewer pipe shall meet the requirement of 21-24 inch (21-24") 220 foot/pounds when tested in accordance with ASTM D-2444.
7 **Marking:** Each joint of pipe shall be marked with the following information: Size, Company name, PVC Sewer Pipe, ASTM F-794-'88, Manufacturers Code, Cell Classification and Pipe Stiffness.
8. **Workmanship:** The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions and other injurious defects.

h) Ribbed Wall PVC Pipe *(Storm)*

1. **Scope:** This specification covers Ribbed Wall pipe with a smooth interior and a solid cross-sectional rib exterior for use in gravity flow applications as sanitary sewer. Exterior ribs shall be perpendicular to the axis of the pipe. Such pipe may be Extrusion Technologies "Ultra-Rib" or an approved equal. Ribbed PVC sewer pipe shall meet the requirements of ASTM F-794 and Uni-Bell B-9.
2. **Physical Dimensions:** Pipe dimensions shall conform to the requirements of the following table when measured in accordance with ASTM D-2122.

Pipe Dimensions

Normal Size	Average O.D.	Major Wall Min. Thickness	Average I.D.
8"	8.8"	0.105"	7.89"
10"	11.0"	0.105"	9.86"
12"	13.1"	0.105"	11.74"
15"	16.07"	0.118"	14.37"
18"	19.76"	0.150"	17.65"

3. **Pipe Stiffness:** The minimum pipe stiffness at 500 deflection shall be 60 psi for all sizes with ASTM D-2412.
4. **Flattening:** Pipe shall show no visual evidence of cracking, splitting or breaking when flattened to 60 percent deflection in accordance with ASTM D-2412.
5. **Extrusion Quality:** Pipe shall not disintegrate or flake when tested in accordance with ASTM D-2152.
6. **Impact Resistance:** The impact resistance of ribbed PVC sewer pipe shall meet the requirements shown below when tested in accordance with ASTM D-2444:
   8-inch 210 ft/lbs
   10-18-inch 220 ft/lbs

7. **Marking:** Each joint of pipe shall be marked with the following information: Size, Company name, PVC Sewer Pipe, ASTM F-794-'88, Manufacturers Code, Cell Classification and Pipe Stiffness.
8. **Workmanship:** The pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions and other injurious defects.

i) Corrugated High Density Polyethylene Pipe (Storm)

1. Material
   Corrugated High Density Polyethylene (HDPE) pipe for storm water shall conform to ASTM F-2306 and AASHTO M294, or the latest revisions thereof, and shall be Type S or Type SP (Perforated – only when specified) only. All HDPE pipe joints shall consist of integral bell and spigot with rubber gasket that meets specification requirements of ASTM F 477. Bell shall span over three (3) spigot corrugations. All joints shall be soil tight, per ASTM F-2306, paragraph 6.6.3.1, and AASHTO M294.
2. Size
   HDPE pipe shall have an I.D. equivalent to the pipe size specified by the project plans. **The maximum allowable inside diameter for HDPE pipe shall be thirty inches (30").**
3. Connections and Fittings
   Fittings/connections will only be allowed in repair situations, and as approved by the Engineer. No fittings will be allowed between dissimilar materials. Connection to an existing pipe, regardless of the existing pipe material, shall be by means of a structure, to be designed into the project. All fittings to be used for HDPE to HDPE connections shall not reduce or impair the overall integrity or function of the pipeline and shall meet the requirements of AASHTO M294 and ASTM F-2306. Fittings may be either molded or fabricated, and shall be soil tight. Common corrugated fittings include in-line joint fittings such as couplers and reducers, and branch assembly fittings such as bends, tees, wyes and end caps. Only fittings supplied or recommended by the manufacturer, and as approved by the Engineer shall be used. The cost of such fittings, adapters, and connections shall be considered subsidiary to the HDPE pipe bid item, and will not be bid or paid for separately.
4. Allowable Use
   HDPE pipe will only be allowed when specified on the plans or in project specific provisions. HDPE pipe placement within the street right-of-way, including under pavement, shall only be permissible for roadways that carry less than 3,000 vehicles per day.

   The last run of pipe to an end section, headwall, ditch or other such facility must be concrete. HDPE pipe shall always terminate at a manhole or other type structure, and no exposed pipe will be permitted. The use of HDPE pipe as a road or driveway culvert will only be allowed as approved by the Engineer.
5. Installation
   Pipe bedding shall be improved Type 1 or Type 2 per Section 801.2 and 801.5 (Flexible Pipe) of the Standard Specifications, with the following modification. Improved bedding shall be placed a minimum of six inches (6") under the barrel of the pipe to twelve inches (12") above the pipe, or to within two feet (2') of final grade, whichever is higher.

   There is to be a minimum of thirty-six inches (36") of cover above the top of pipe, as measured from the top of curb in street right-of-way, and from proposed ground level in side and back lot easements.

   The minimum trench width shall be 1-1/2 times the pipe diameter plus twelve inches (12").

   Installation of HDPE pipe shall be by methods approved by the Engineer, and per the manufacturer's recommendation. Methods other than the approved shall not be allowed. Any installation of HDPE pipe by methods that are not approved shall be removed and reinstalled at the expense of the Contractor.
6. Testing
   The Contractor shall televise and mandrel the HDPE pipe thirty (30) days after construction. Any barrel deflection of the pipe (reduction of the barrel base inside diameter) greater than 5% will require the reinstallation or replacement of the pipe by the Contractor. Any penetration of the pipe

that is encountered during televising will also be reinstalled or replaced by the Contractor, at no additional cost to the project. Repairs will be made per the manufacturers recommendation and as approved by the Engineer. The cost of all testing shall be considered subsidiary to the HDPE pipe bid item, and will not be paid for separately.

804.3 PIPE INSTALLATION

General:

Trench excavation, pipe bedding, backfilling and compaction shall comply with Section 801.

Sewer pipe shall be installed to line and grade as shown on the plans. Pipe shall bear uniformly along its length with notches excavated where necessary to accommodate pipe.

The sewer pipe shall be laid up grade beginning with the lowest elevation, unless otherwise approved by the Engineer. The sewer pipe shall be installed with the bell end or upstream, unless otherwise approved by the Engineer. When pipe laying is not in progress, the forward end of the pipe shall be kept tightly closed with an approved temporary plug.

Any sewer lines having flow elevations which deviate by more than one inch (1") from a straight line, as determined by the flow line of the two ends of pipe of any one line between the structures, shall be reconstructed by the Contractor at his expense such that the flow elevations will not deviate by more than one inch (1") from a straight line.

Only one kind of pipe may be used on each project unless shown otherwise on the plans or approved by the Engineer.

Joint Gaps:

Maximum allowable gaps measured at the widest point and maximum allowable offsets in the flowline between butting ends of pipe shall be as indicated in the following table. Joint gap requirements shown in the following table shall be applicable only to those types of pipes with joints where the bell socket is designed with an inner face which would normally seat with the butt end of the pipe installed into the bell socket for such pipe as clay pipe, concrete pipe and other such pipe types.

Pipe Size	Joint Gap	Flowline Offset
8"	1/2"	3/16"
10"	1/2"	3/16"
12"	1/2"	1/4"
18"	11/16"	1/4"
21"	7/8"	3/8"
24"	7/8"	3/8"
27"	15/16"	1/2"
30"	15/16"	1/2"
36" or larger	1"	1/2"

Reinforced Concrete Pipe Joints (Storm):

Joints shall be tongue and groove joints sealed with either flexible plastic gaskets or cement mortar.

Tongue and groove joints shall consist of a concrete tongue (spigot) and a concrete groove (bell). The spigot and bell shall be integral parts with the pipe barrel. Joints utilizing collars instead of bells as an integral part with the pipe barrel will not be permitted.

Pipe joints shall be round and true subject to permissible variations specified in Section 11 of ASTM C-76.

The seating surfaces of the concrete bell and spigot shall be parallel to one another and the annular space between the seating surfaces shall not exceed the following dimensions:

Pipe Diameter	Annular Space

12"-18"	7/32"
21"-27"	1/4"
30"	5/16"
33"-48"	3/8"
54"-66"	7"1/6"

For pipe sizes larger than 66", the pipe manufacturer shall submit to the Engineer for approval, prior to pipe manufacture, detailed joint drawing, which specifically indicate annular space.

The seating surfaces shall be free from air holes, chipped or spalled concrete, or other defects which would be harmful to the integrity of the joint.

Gaskets shall be installed in accordance with the manufacturer's recommendations. The Contractor shall submit to the Engineer a copy of these recommended procedures prior to pipe installation for his review and approval. Such procedure shall specifically indicate the number and location of wraps of joint sealant required for pipe sizes proposed for the project.

When mortar joints are used, the annular space in pipe joints shall be filled with cement mortar consisting of one part Portland cement to two parts sand and 6-1/2 to 7 gallons of water per each sack of cement.

Cement mortar sealant shall be installed in accordance with the following procedures:

The joint surfaces shall be thoroughly cleaned immediately before the joint is made. A layer of cement mortar is placed on the lower one-half of the bell end of the installed pipe and on the upper one-half of the spigot end of the pipe section to be installed. The spigot is then inserted into the bell of the installed pipe until the sealant material is squeezed out on the interior and exterior surfaces. Any annular joint space between the adjacent pipe ends shall be filled with mortar and the excess mortar on the inside of the pipe wiped clean and finished smooth. The annular joint space shall be completed, filled with mortar and the abutting joint sections shall be flush and even.

804.4 MANHOLES/INLETS

Manhole Top Elevation:

The intent of this specification is to insure that tops of manholes will be constructed to match proposed finished grade in areas of new development and existing finished grade in areas, which have already developed. The intent is to construct sewer manholes outside of paved or unpaved street, driveway, parking lot or traveled ways to an elevation of 0.4' higher than the proposed finished grade or the existing finished grade. Tops of manholes constructed in proposed or existing paved traveled ways shall be set flush with the proposed or existing pavement. Tops of manholes constructed in proposed or existing unpaved traveled ways shall be constructed to an elevation of six inches (6") below the proposed or existing finished grade.

Plan elevations may need to be adjusted in the field at the time of construction in conformance with the requirements in this specification as approved by the Engineer.

When the plans do not indicate top of manhole elevations, the manhole top elevation shall be ascertained at the time of construction using the best information available in conformance with the requirements of this specification as approved by the Engineer.

Structure Excavation and Backfill:

Excavation for structures, backfill for structures and compaction of such backfill shall conform to the applicable requirements as specified for sewer pipe trenches (Section 801).

Reinforced Concrete Manholes:

Reinforced concrete manholes constructed on sanitary sewers shall have all areas of concrete that would otherwise be exposed to sewer gases, except the floors, protected with plastic lining. The plastic lining may be Amer-Plate T-Lock Liner Plate, B.F. Goodrich Lok-Rib Koroseal, or an approved equal. The plastic liner shall be white or near white in color. Manufacturer's recommendations for installing, sealing joints,

testing and inspection of the plastic lining shall be considered as incorporated in and forming a part of these specifications. The pipe supplier shall furnish to the Engineer three (3) copies of plastic lining manufacturer's recommendations prior to the fabrication of any pipe. Plastic liner shall be white or near white in color. Reinforced concrete manholes shall not be backfilled until a period of seventy-two (72) hours has expired after the removal of the forms.

The floors of the manholes shall be shaped and smoothed so that flow channels will be formed such that the manhole will be self-cleaning and free of areas where solids may be deposited as sewage flows through the manhole from all inlet pipes to the outlet pipe. The floors shall have slopes of three inches (3") per foot on areas outside of the flow channels.

Precast Concrete Manholes Type P:
Precast Concrete Manholes Type P shall be constructed as detailed by standard detail sheet in conformance with the latest revision of ASTM C 478, except for the following modifications:

a) Thickness of precast sections shall be at least one-twelfth (1/12) of the internal shell diameter plus one inch (1"), or five inches (5") total, whichever is greater. The minimum internal diameter of manholes shall be 4 feet.

b) Joints between precast reinforced concrete sections shall provide for the use of mastics or rubber gaskets (natural or synthetic) to prevent leakage or infiltration.

c) Precast sections shall be adequately reinforced with steel to withstand erection and temperature stresses.

d) The bottom sections of all precast reinforced manholes shall extend into the cast-in-place-manhole base a minimum distance of four inches (4"). When cast-in-place bases are used, the bottom section of the reinforced precast manhole shall extend into the base a minimum of four inches (4").

e) Precast reinforced concrete manholes shall conform to the dimensions and requirements of the standard details.

f) All interior surfaces of precast concrete manholes to be connected to sewer pipe shall receive a troweled or broomed grout finish to fill any voids and irregularities prior to applying the epoxy coatings. The interior surfaces shall be painted with two coats of Tnemec Series 66 Hi-build epoxy or other approved equal. When the paint coating is applied by the manufacturer, surfaces which are to be grouted or patched shall not be painted until after assembly of the manhole. The Contractor shall apply epoxy to touch up damaged surfaces and cover patches or grouted areas. Each application of epoxy coating shall have a minimum dry film thickness of 4 mils.

g) The floors of the manholes shall be shaped and smoothed so that flow channels will be formed such that the manhole will be self-cleaning and free of areas where solids may be deposited as sewage flows through the manhole from all inlet pipes to the outlet pipe. The floors shall have slopes of three inches (3") per foot on areas outside of the flow channels.

h) All grout used to close openings around waterstop gaskets and sewer pipes shall contain approved non-metallic shrinkage correcting aggregate.

i) Exterior manhole walls shall be coated with an approved waterproofing membrane system. Approved waterproofing membrane systems are Ultrashield WB, or approved equal.

j) Manholes, when specified, shall have an approved epoxy lining system applied to interior surfaces in lieu of the epoxy paint listed in section (f). Approved epoxy lining systems are: Raven 405, Sauereisen 210S, Warren Environmental S301, Zebron or approved equal.

k) All manhole section joints that will be in groundwater or installed at a depth greater than 12 feet shall be wrapped with an approved External Joint Seal. Approved External Joint Seals are: Cretex, Infrashield, Riserwrap, or approved equal.

Inlets:
Inlets are to be reinforced concrete as indicated by the plans. Inlet cover castings and inlet ring castings shall conform to the same requirements as specified for manhole castings except for weight.
Reinforced concrete inlets shall not be backfilled until a period of seventy-two (72) hours has expired after the removal of the forms.

Inlets with concrete tops shall have rings and covers according to the following schedule.

Inlet Length (Feet)	Number of Rings & Covers
5	1
10	2
15	3
20	4

The rings shall be spaced such that there is a maximum of two and five-tenths feet (2.5') from the inside of the end wall to the center of the ring and a maximum of five feet (5') from center to center between rings. Rings and covers shall be centered between the front and the back of the concrete tops. The number and spacing of rings with covers may vary from this specification only when approved by the Engineer. At least one manhole ring and cover shall be placed such that it is aligned with the centerline of the outfall pipe or pipes.

The floors of the inlets shall be shaped and smoothed so that flow channels will be formed such that the inlets will be self-cleaning and free of areas where solids may be deposited as storm water flows through the inlets from all inlet areas to the outlet pipe. The floors shall have slopes of three inches (3") per foot on areas outside of the flow channels.

Precast Inlets:
When shown on the plans or approved by the Engineer, precast inlets may be used. Precast inlets shall be manufactured in accordance with the detail sheet for the type of inlet to be supplied.

804.5 TESTING
Pipeline Testing and Inspection:
All storm sewers twelve inches (12") or larger and all sanitary sewers larger than six inches (6") shall be inspected visually or with a television camera by the Contractor prior to acceptance by the City. All eight-inch (8") through twenty-four inch (24") sanitary sewers constructed under this contract shall be air tested by the Contractor prior to acceptance. The Contractor will be required to conduct exfiltration tests on sanitary sewers larger than twenty-four inch (24") prior to acceptance by the City. Any infiltration or exfiltration requirements for storm sewers will be set forth on the plans or in supplemental specifications.

Any defects indicated by the visual or television inspection, air testing and/or exfiltration testing shall be corrected by the Contractor without additional compensation prior to final acceptance of the project by the City. The lines shall be retested and reinspected after repairs have been made by the Contractor.

Air testing shall consist of measuring the amount of time required for the pressure to drop one (1) psi from a starting pressure of approximately four (4) psi in the length of sewer being tested between manholes. Permissible elapsed time for a pressure drop of one (1) psi shall be four (4) minutes for eight-inch (8") pipe; five minutes for ten-inch (10") pipe; five and one-half minutes for twelve-inch (12") pipe; seven and one-half minutes for fifteen-inch pipe; eight and one-half minutes for eighteen-inch (18") pipe; ten minutes for twenty-one inch (21") pipe; and eleven and one-half minutes for twenty-four inch (24") pipe.

Exfiltration testing shall be conducted on sewers larger than twenty-four inch (24") under the supervision of the Engineer. The Contractor shall conduct exfiltration testing on each reach of sanitary sewer pipe larger than twenty-four inch (24") between manholes. Exfiltration tests shall be conducted by blocking off manhole openings except those connecting within the reach being tested, filling the line with water and measuring the water required to maintain a constant level in the manholes. Each manhole shall be subjected to at least one exfiltration test. During the exfiltration test, the maximum water depth at the lower end shall not

exceed twenty-five feet (25') and the minimum depth of water at the upper end shall be at least five feet (5') above the top of the pipe or the groundwater elevation on the outside of the pipe, whichever is greater. The total exfiltration shall not exceed two hundred (200) gallons per inch of nominal diameter per mile of pipe per day for each reach tested. Manholes shall be considered as sections of pipe for purposes of determining the maximum allowable leakage. The exfiltration test shall be maintained on each reach of pipe for a minimum of two hours and as much longer as necessary to locate all leaks. The Contractor shall provide at his own expense all necessary equipment, labor and materials required for the test. The methods used and the time of conducting the exfiltration tests shall be subject to the approval of the Engineer. All leaks or other defects shall be repaired to the satisfaction of the Engineer. Any reach which exceeds the allowable maximum shall be retested after the leaks are repaired.

PVC pipe and any other flexible pipe may be subject to testing for deflection after it has been installed and backfilled. Deflection may be tested by a mandrel or by direct measurement of the vertical diameter of the pipe. Pipe that has deflected more than five percent (5%) of its nominal dimension shall be reconstructed, repaired or reconstructed by the Contractor at his expense. The reconstructed pipe shall also be tested for deflection. Testing of pipe with a diameter of thirty-six inches (36") or less shall be by a mandrel, and the Contractor shall be required to furnish all equipment and labor necessary to complete the testing. Testing of pipe with a diameter greater than thirty-six inches (36") shall be by direct measurement by the Engineer's representative.

The cost of all additional testing and inspection in connection with repair work necessary to correct deficiencies in completed work on this project will be charged to the Contractor and may be deducted from the amount due on the final estimate.

Testing of Manholes:
All manholes shall be tested for leaks upon completion of backfill operations. Tests, sealing, and acceptance shall be according to this specification. Prior to testing, all lifting holes and exterior joints shall be filled and pointed with an approved non-shrinking mortar. The completed manhole shall be backfilled before testing of manholes. Manholes shall be tested using the full depth exfiltration or vacuum test method.

a) Full Depth Exfiltration Method - Full depth exfiltration with a water loss of less than 1.14 gallons per foot of depth per day for a 24-hour test period. Testing shall be performed in the presence of a representative of the City.

b) Vacuum Test Method - Vacuum test per the following description:

1. All pipes and other openings into the manhole shall be plugged. All plugs shall be securely braced to prevent the plug from being drawn into the manhole.
2. Air shall then be pumped out of the manhole until a vacuum is created inside of the manhole equal to ten inches (10") of mercury on an approved vacuum gauge. The.800-46 removal of air will then be stopped and the test time will begin.
3. The vacuum must not drop to below 9 inches (9") of mercury within a 60 second test period for a four-foot (4') diameter manhole, 75 seconds for five-foot (5') diameter manhole and 90 seconds for a six-foot (6') diameter manhole. If more than a one-inch (1") drop in vacuum occurs within the test period the manhole shall be considered unacceptable. Contractor shall excavate the manhole and make necessary repairs. Upon completion of repairs the manhole shall be backfilled again and retested.

804.6 INCIDENTAL CONSTRUCTION
Manholes/Inlets Removed:
Manholes/Inlets designated for removal shall be completely removed. All abandoned pipes which remain after the manhole/inlet has been removed shall be plugged. The excavation shall be backfilled in accordance with the requirements as specified for sewer trench backfill.

All castings and covers shall be salvaged, cleaned and delivered to the City Maintenance Yard

Manholes Adjusted:

Manholes designated for adjustment shall be raised or lowered as necessary such that the casting will conform to the required elevation. Construction and material requirements shall conform to the same requirements as specified for new manhole construction. An approved type of flat concrete slab shall be used to support the manhole ring where it is necessary to lower manholes or brick stacks having corbels more than twelve inches (12"). Flat concrete slab manhole tops shall conform to the requirements of A.S.T.M. C-478 in addition to the following requirements.

A minimum six-inch (6") brick collar conforming to the same type of construction as specified for brick manholes shall be installed between the manhole ring and the flat concrete slab to facilitate minor adjustments for elevation unless approved otherwise by the Engineer. All contact surfaces between brick masonry, flat concrete slab and cast iron ring shall be sealed with a layer of mortar. Manholes having corbels which must be raised more than twelve inches (12") will require removing the draw section completely to facilitate reconstruction of a standard draw section. When it is necessary to adjust a reinforced concrete manhole, this work shall conform to the requirements and details as shown by the plans.

Inlets Adjusted:
Inlets designated for adjustment shall be raised or lowered as necessary such that the top of the inlet will conform to the required elevation. Construction and material requirements shall conform to the same requirements as specified for new inlet construction.

Manholes Abandoned:
Manholes designated to be abandoned shall have the top four feet (4') removed and the remaining portion of the manhole shall be filled with sand, flushed and vibrated. All pipes in the manhole which are to be abandoned shall be plugged prior to filling with material similar to the adjacent surface and compacted to a density of ninety percent (90%) of the standard density. Manhole castings shall be salvaged, cleaned and delivered to the City.

Connection to Existing Manholes or Inlets:
When it is necessary to connect a new sewer to an existing inlet or manhole which does not have a stub to facilitate this connection, the Contractor shall core drill into the manhole or inlet unless otherwise approved by the Engineer. All repair work necessary to close the opening made to facilitate the installation of the new pipe shall conform to the requirements for new construction as specified in these specifications for the type of manhole or inlet involved. The floor of the manhole or inlet shall be modified such that smooth channels will be formed from all inlet pipes to the outlet pipe such that the manhole or inlet will be self-cleaning and free of areas where solids could be deposited as water flows through the structure in accordance with such requirements specified for new manhole or inlet construction.

No payment will be made for connecting new sewer pipes to existing manholes or inlets and all costs for completing this work shall be considered as subsidiary to the other items of work except when a bid item appears in the proposal for this work.

Pipe Abandoned in Place:
Both ends of all pipes to be abandoned in place shall be plugged. Pipes abandoned in place having diameters greater than fifteen inches (15") shall be filled with sand or grout and plugged.

Riser Pipe:
Riser pipe shall be installed to serve individual lots or tracts in conjunction with new sanitary sewer construction, unless otherwise ordered by the Engineer, because of groundwater, unstable soil or unusually deep construction. Riser locations shall be as approved by the property owner with the concurrence of the Engineer. Installation of risers on sewers because of unusual depth will be required when the sewer is deeper than twelve (12'). The Contractor will be required to file written documentation with the Engineer on a form approved by the Engineer indicating the locations where risers are to be installed as requested by the property owner or his authorized representative. Riser pipe construction shall conform to the requirements as shown on the standard riser detail sheet. Contract quantities pertaining to riser installation may or may not be utilized on the project, based on the decision of the Engineer with regard to trench conditions. It should be understood by the Contractor that the necessity for installation of risers and the final

pay quantity for such work will largely depend on the job conditions and may vary greatly from contract quantity or may not be utilized at all and the Contractor should prepare his bid accordingly.

Pipe Stub-Outs:
Four-inch (4") and six-inch (6") pipe stubs with temporary pipe plugs shall be installed in manholes when shown on the plans or directed by the Engineer to facilitate connection of building service lines. All four-inch (4") and six-inch (6") clay pipe stubs shall be extra-strength clay pipe conforming to the latest revision of ASTM C-700. Four-inch (4") and six-inch (6") PVC stubs shall be Schedule 40.

Pipe Plugs:
Pipe plugs shall be with masonry with masonry plugs twelve inches (12") thick.

Temporary pipe plugs on the ends of lines, which are to be extended in the future, shall be prefabricated by the manufacturer of the pipe unless approved otherwise by the Engineer. Temporary plugs shall be of such construction that when they are installed, the plug will prevent entrance of any extraneous material into the sewer and such that will facilitate easy removal without undue damage to the sewer pipe when the sewer is extended.

Temporary pipe plugs on sewers to be extended in the future will not be paid for directly and this cost shall be included in the price bid for the pipe.

Reinforced Concrete Encasement:
Reinforced concrete encasement shall be constructed to conform to the standard detail drawing. Concrete and reinforcing steel used in the construction of reinforced concrete encasement shall
conform to the requirements as specified in the Standard Specifications for concrete pavement construction (Subsection 406.2).
Reinforced Concrete Cradle:
Reinforced concrete cradle shall be constructed to conform to the standard detail drawing. Concrete and reinforcing steel used in the construction of reinforced concrete cradle shall conform to the requirements as specified in the Standard Specifications for concrete pavement construction (Subsection 406.2).