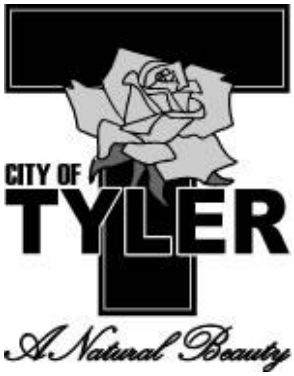

City of Tyler

Standard Specifications

Revision Date
May 14, 2021

City of Tyler Standard Specifications

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City of Tyler Standard Specifications

DUCTILE IRON PIPE (DIP) FOR WATER MAINS

PART 1 - GENERAL

1.1 SCOPE: This specification covers the requirements for ductile iron pipe (DIP) and fittings to be used for potable water mains.

1.2 APPROVALS: Ductile iron water pipe shall conform to ANSI/NSF Standard No. 61.

1.3 QUALITY ASSURANCE: Finished pipe 16" in diameter and larger shall be the product of one (1) manufacturer which has had not less than 10 years successful experience manufacturing pipe of the types and sizes indicated, unless otherwise approved by Tyler Water Utilities.

1.4 HANDLING AND STORAGE: Handling and storage shall be in accordance with the pipe manufacturer's recommendations. The **CONTRACTOR** shall inspect each load of pipe upon delivery to verify that the load is intact and in good condition. During handling the **CONTRACTOR** shall minimize impacts to the pipe. Care shall be taken to insure the pipe is not dropped or damaged.

If possible, pipe shall be stored in packages provided by the manufacturer. Care shall be taken to avoid compression, damage or deformation to ends of pipe. Pipe should be supported to prevent damage to the bottom of the pipe. The interior of the pipe shall be kept free from dirt or other foreign matter.

1.5 REJECTION: Ductile-iron pipe and fittings may be rejected for failure to meet any or all of the requirements of this specification.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE: Ductile iron water pipe shall be designed in accordance with the latest revision of ANSI/AWWA C150/A21.50 using 60,000 pounds per square inch tensile strength, 42,000 pounds per square inch yield strength and 10 percent elongation. The minimum pressure class shall be as follows:

Pipe Size	Working Pressure	Surge Allowance
3" through 12"	350 psi	100 psi
14" through 20"	250psi	100 psi
24" and larger	200 psi	100 psi

Ductile iron pipe shall be manufactured in metal or sand lined molds in accordance with the latest revision of ANSI/AWWA C151/A21.51. Each pipe shall be subjected to a hydrostatic pressure test of at least 500 psi at the point of manufacture.

Ductile iron thickness shall conform in all respects to AWWA/ANSI C150/A21.50, latest revision, based on the minimum working pressure, given above, for the diameter of pipe. For larger diameters or deeper cover, special design shall be provided in accordance with the Standard Thickness for Earth Load plus Truck Load, Type 2 Ditch per ANSI/AWWA C151/A21.51.

The pressure rating, metal thickness, weight of pipe without lining, length of pipe, and name of manufacturer shall be clearly marked on each joint of pipe.

Ductile iron pipe shall be new and shall be manufactured by American, U.S. Pipe, McWane, Griffin Pipe or approved equal.

2.2 JOINTS: All ductile-iron water pipe shall be furnished with one of the following types of joints and as described in the plans and specifications or in the bid proposal:

Type Joint	**ANSI/AWWA Standard**
Push-on	ANSI/AWWA C111/A21.11
Mechanical Joint	ANSI/AWWA C111/A21.11
Flanged Ends	ANSI/AWWA C115/A21.15
Restrained Joints	As provided by the pipe manufacturer

Joints shall be in accordance with the latest revision of the appropriate ANSI/AWWA standard or as provided by the manufacturer's recommendation, and shall be furnished complete with all necessary accessories.

All screwed flanges shall be ductile iron.

Bolts and nuts for mechanical joints or flanged ends (if used underground) shall be of high-strength low-alloy corrosion-resistant steel and shall conform to ASTM A325 (Type 3), latest revision.

2.3 FITTINGS: Fittings for ductile iron water pipe shall be new, shall be ductile iron and shall conform to the latest revision of either ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53 using 70,000 pounds per square inch minimum tensile strength, 50,000 pounds per square inch minimum yield strength and 5 percent minimum elongation. The minimum pressure class shall be as follows:

Pipe Size	Working Pressure	Surge Allowance
3" through 24"	350 psi	100 psi
30" through 48"	250psi	100 psi

Fittings and accessories shall be furnished with either push-on or mechanical type joints in accordance with ANSI/AWWA C111/A21.11, latest revision, flanged type joints in accordance with ANSI/AWWA C115/A21.15, latest revision or restrained type joints as provided by the manufacturer.

Bolts and nuts for mechanical joints or flanged ends shall be of a high-strength corrosion-resistant low-allow steel and shall conform to ASTM A325 (Type 3), latest revision.

The pressure rating, nominal diameters of openings, manufacturer's identification, country where cast and number of degrees or fraction of the circle shall be cast distinctly on each fitting.

Fittings shall have a cement mortar lining in accordance with ANSI/AWWA C104/A21.4, latest revision and a standard asphaltic coating on the exterior surfaces.

2.4 PIPE COATING AND LINING: Pipe shall have a cement mortar lining on the interior in accordance with ANSI/AWWA C104/A21.4, latest revision, and a standard asphaltic coating on the exterior surfaces.

2.5 POLYETHYLENE ENCASEMENT FOR DUCTILE IRON PIPE, VALVES, FITTINGS AND OTHER APPURTENANCES: Polyethylene encasement shall be required for all ductile iron pipe, valves, fittings and other appurtenances in accordance with ANSI/AWWA C105/A21.05, latest revision.

The polyethylene film shall be manufactured of virgin polyethylene material conforming to requirements of ASTM D1248, latest revision. Class Grade C (Black) shall be utilized. Sunlight will eventually deteriorate polyethylene film. Exposure to sunlight should be kept to a minimum.

Tube width for each pipe diameter shall be as listed in the following table:

Nominal Pipe Size (inches)	Minimum Polyethylene Tube Width (inches)
3	14
4	14
6	16
8	20
10	24
12	27
14	30
16	34
18	37
20	41
24	54
30	67
36	81
42	81
48	95
54	108
60	108
64	121

All widths shall be 8 mils thick.

PART 3 - EXECUTION

3.1. SITE PREPARATION: The construction site shall be prepared for construction operations by the removal and disposal of all obstructions and objectionable materials from the designated construction area. It is the intent of this specification to provide for the removal and disposal of all objectionable material not specifically provided for elsewhere in the plans or specifications. This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for clearing and removing from the site of the work wherever located, all obstructions, designated trees, stumps, brush vegetation, miscellaneous stone, brick, concrete, scrap iron and all rubbish and debris whether above or below ground level. Such items shall be included in such contract pay item as provided in the bid proposal.

3.2 EXCAVATION: This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for the furnishing, placing and maintaining of all sheeting, shoring and bracing necessary to protect the work and adjacent properties; to support the sides and ends of the excavation and to support all adjacent structures above and below the ground; the installation and operation of all pumping, bailing and draining necessary to keep the excavation free from seepage water, water from sewers, drains, ditches, creeks and other sources; to provide for the uninterrupted flow of the removal, after the completion of the work, of all sheeting, shoring and bracing not necessary to support the sides of the excavation; and the satisfactory disposal of excess and unsuitable materials not required or which cannot be used for backfilling.

Prior to commencing any excavation, the **CONTRACTOR** shall provide ample labor, equipment, shoring materials and such other safety equipment as required to insure that the work shall be carried on without interruption or damage to existing installations; and to provide the least interruption of traffic commensurate with the project requirements. Blasting is prohibited; alternate methods shall be utilized.

In general, all excavation shall be made in open cut from the surface of the ground and shall be no greater in width or depth than is necessary to permit the proper construction of the work in accordance with the plans and these specifications. All excavation shall be to the line and grade as provided by the Engineer. The **CONTRACTOR** shall abide by all applicable federal, state and/or local laws governing excavation work. The entire foundation area in the bottom of all excavation shall be firm, stable and at uniform density as nearly as practicable. Unless necessary, materials shall not be disturbed. The final cleaning and preparing of the foundation area shall be done immediately prior to the placing of the embedment materials or structures.

A. PROGRESS: The **CITY** shall have the right to limit the amount of trenches that shall be opened, or partly opened, in advance of or following the pipe laying operation. Unless otherwise directed by the **CITY**, the completion of backfill shall immediately follow the pipe laying. In the event the **CONTRACTOR** fails to comply with this requirement, the **CITY** may stop the pipe laying until the requirements are met.

B. TRENCH BOTTOM ELEVATION: All trenches for installation of water lines shall be excavated to a point below the barrel of the pipe for the type of embedment specified.

C. TRENCH OVERCUT: Should the **CONTRACTOR** excavate below the plan trench bottom for water lines, the **CONTRACTOR** shall backfill to trench bottom grade shown on the plan with approved aggregate, consolidated and compacted to meet the **CITY'S** approval, at no additional cost to the **CITY**. See paragraph 3.2.H "Stabilization" of this specification.

D. EXCAVATION CLASSIFICATIONS: All excavation is “unclassified” and involves removal of all materials necessary to permit carrying on the completion of the work.

Bidders must satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location, and sizes of pipe or conduits of various kinds in place.

E. SHORING AND SHEETING: When necessary to prevent caving or unduly hazardous working conditions, or to comply with existing laws, trench walls shall be appropriately braced, or sheeted and braced. Where bracing, or sheeting and bracing, is used, the trench width shall be increased accordingly and shall be paid for per linear foot of bracing or sheeting and bracing. Sheeting and shoring shall be in accordance with the City of Tyler Standard Specification for Trench Safety Systems.

In wet, saturated or flowing materials where it is necessary to install tight sheeting or cofferdams, wood or steel sheet piling shall be used. All sheeting, shoring and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and to maintain the sides of the excavation properly from injury or damage. When excavations are made adjacent to existing buildings or to other structures or in paved streets, particular care shall be taken to adequately sheet, shore and brace the sides of the excavation to prevent undermining of, or settlement beneath the structures or pavement. Unless otherwise established in the pay items, underpinning of adjacent structures or pavement shall be done by the **CONTRACTOR** at his own cost and expense and in a manner satisfactory to the **CITY**; or, when required by the **CITY**, the pavement or structure shall be removed, the void satisfactorily refilled and compacted and the pavement or structure replaced by the **CONTRACTOR**. Wooden sheeting, shoring, and bracing shall be left in place where it is adjacent to the pipe embedment for the initial lift of backfill.

The removal of all sheeting, shoring and bracing shall be done in such manner as not to endanger or damage either new or existing structures, private or public properties; and so as to avoid cave-ins, or sliding of the banks. All holes or voids left by the removal of the sheeting, shoring or bracing shall be immediately and completely filled and compacted with suitable materials. If, for any reason, the **CONTRACTOR**, with the approval of the **CITY**, elects to leave in place the sheeting, shoring or bracing, no payment shall be allowed for such material left in place unless ordered by the **CITY** to be left in place.

F. DISPOSAL OF EXCAVATED MATERIALS: Suitable excavated materials may be piled adjacent to the work to be used for backfilling. Excavated materials unsuitable for backfilling, or in excess of that required for backfilling, shall be disposed of by the **CONTRACTOR**. Desirable topsoil, sod, etc., shall be carefully removed and piled separately adjacent to the work when required.

Excavated materials shall be handled at all times in such manner as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to private and public property adjacent to or along the line of work. The excavated material in rock which is not suitable material for bedding or backfill shall be disposed of by the **CONTRACTOR**. Suitable selected bedding or backfill material from the trench excavation shall be provided at no additional cost to the **CITY** or **OWNER**.

G. DEWATERING: The **CONTRACTOR** shall remove all water from any source which may accumulate in the excavation. The embedment or pipe shall not be installed in water. No water shall be allowed to flow through or over unset concrete or through the completed line. All water removed from excavations shall be disposed of in an approved manner, so as not to create unsanitary conditions; nor to cause injury to persons or property; nor damage to the work in progress, and/or not to interfere unduly with the use of streets, private driveways or entrances. Pumping or bailing and draining, underdrains, ditches, etc., shall be considered as incidental work and shall not be paid for as separate items; but their cost shall be included in such contract prices as are provided for in the contract.

H. STABILIZATION: In the event the **CONTRACTOR** is preventing water from interfering with the work and the trench bottom is too unstable in the opinion of the Engineer or the Engineer's representative for proper grading and pipe installation, the **CONTRACTOR** shall stabilize the bottom of the trench as instructed by the Engineer or the Engineer's representative. To stabilize the trench bottom, the **CONTRACTOR** shall undercut the trench bottom as required and place a layer of washed crushed stone or concrete mix in the trench bottom. In general, the crushed stone or concrete mix is to be 6" thick unless a greater thickness is specified by the Engineer or the Engineer's representative. When used, the crushed rock shall meet the requirements of paragraph 3.3.B.1 “Crushed Stone” of this specification, except the gradation shall be:

	Percent
Passing 5" sieve	100%
Retained on 2" sieve	100%

The concrete mix, if used, is to be mixed as specified for concrete encasement with the exception that the water is to be omitted from the mix and the dry mix placed in the trench bottom. The dry concrete mix is to be placed only in short sections at a time and then immediately fine graded and the pipe installed over it without delay before the dry concrete mix is placed in the next section of trench.

Stabilization will be paid for as specified in the pay items but shall not be used except with the approval of the Engineer or **CITY.** In cases of disagreement between the Engineer and the **CITY**, the decision of the **CITY** shall be final.

3.3 BACKFILL: This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for the furnishing, placing and maintaining of all embedment, backfill materials, compaction, refilling any settlement of all excavated areas, the replacement of topsoil after backfill is completed and the restoration of all other lands, private or public, damaged or occupied by the **CONTRACTOR** in the performance of the contract to the same (or improved) condition as they were prior to the beginning of the work.

A. BACKFILL PROCEDURE: Backfill procedure is that procedure required to return trenches or excavated areas to a condition satisfactory to the **CITY**. Such backfilling occurs in two general areas. They are: 1) areas not subject to vehicular traffic; and 2) areas subjected directly to, or influenced by, vehicular traffic.

The methods of backfilling to be used shall vary with the width of trench, the character of the materials excavated, the methods of excavation, the type of conduit and the degree of compaction required. The placing of backfill shall not begin until the **CITY** has been notified. The excavation shall be backfilled only with approved materials, in accordance with the plans and these specifications. Backfill is divided into two major categories: (1) embedment; and (2) final backfill material, as follows:

1. Embedment is the material upon which the pipe rests and which covers the pipe.

2. Final backfill material is the material required to fill the trench from the top of the embedment to ground elevation or subgrade of a street.

B. EMBEDMENT: The type of embedment to be used for ductile iron water mains shall be as follows:

1. Crushed Stone:

a. Description: The aggregates shall consist of durable particles of crushed stone; free from frozen material or injurious amounts of salt, alkali, vegetable matter or other material either free or as adherent coating; and its quality shall be reasonably uniform throughout. It shall have a wear of not more than 40 percent when tested in accordance with TxDOT Test Method Tex-410-A.

b. Test: When tested by standard laboratory methods, crushed rock embedment for each gradation shall meet the following requirements for percentage by weight as stated in the TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, latest edition.

Standard Crushed Rock – Aggregate Grade 4:

	Percent
Retained on 1-½" sieve	0%
Retained on 1" sieve	0-5%
Retained on ½" sieve	40-75%
Retained on No. 4 sieve	90-100%
Retained on No. 8 sieve	95-100%

Fine Crushed Rock – Aggregate Grade 8:

	Percent
Retained on ½" sieve	0%
Retained on 3/8" sieve	0-5%
Retained on No. 4 sieve	35-60%
Retained on No. 8 sieve	90-100%

Coarse Crushed Rock:

	Percent
Passing 1-½" sieve	100%
Retained on ¾" sieve	100%

2. Granular Material: Granular material shall be free flowing, such as sand or hydraulically graded crushed stone fines, or mixed sand and gravel, or sandy loam. The material shall be free from lumps, stones over 2" in diameter, clay and organic matter.

3. Select Material: Select material shall be gravel, fine rock cuttings, clayey sand, sand, sandy loam or loam free from excessive clay. Rock cuttings shall have no dimension greater than 2". Soil materials shall have a PI ranging between 0 and 15. Select material shall meet all requirements of paragraph 3.3.C “Select Backfill – Special Circumstances” of this specification.

4. Natural Gravel: Natural gravel shall consist of uncrushed stones meeting the requirements for wear as outlined in paragraph 3.3.B.1 “Crushed Stone” of this specification. The material shall be washed and screened and not have by weight more than one percent organic matter, clays or loam and not more than five percent by weight of any one of or combination of slate, shale, schist or soft particles of sandstones. The gradation shall be:

	Percent
Passing 1-½" sieve	100%
Retained on ¾" sieve	100%

5. Sand: Sand shall consist of clean, hard, durable, uncoated grains, free from lumps and organic material. All particles must pass a No. 8 sieve.

C. SELECT BACKFILL – SPECIAL CIRCUMSTANCES: During planning work, the Engineer may recognize that a majority of the ditchline material may not be suitable for backfill and provide for select backfill material placement, the use of which shall be approved by the **CITY**. In cases where ditchline material is not suitable for backfill, select backfill material as approved by the Engineer shall be required.

These backfill materials may fall into one of two categories: 1) select backfill obtained onsite or 2) select backfill obtained offsite. Generally, select backfill obtained onsite would relate to utilities installation in subdivisions.

Should the provision for the necessity of major select backfill be required, the plans and specifications will address and provide a bid item for the same.

1. Select Backfill Obtained Onsite: The Engineer shall designate select backfill material from a point within the project limits. Unsuitable excavated material designated by the Engineer will be removed and disposed of by the **CONTRACTOR** as approved by the Engineer. The unsuitable material shall be spread and bladed as needed. All stockpiled material shall have adequate erosion control. For the unit price bid, the **CONTRACTOR** shall load and haul select backfill to the project and install it in the trench according to these specifications. Select backfill will be made for the full depth of the trench above the embedment. Payment will be for the linear foot of trench for a given size pipe to be installed in that trench. Payment includes furnishing all labor and equipment to remove, haul and spread unsuitable excavated material on sites designated by the Engineer and to load, haul, and install select backfill in the trenches.

2. Select Backfill Obtained Offsite: The **CONTRACTOR** will be responsible for locating suitable sources of select backfill material, advise the Engineer of the availability of the sources, and obtain the Engineer's approval of the sources before any commitment is made to use the material. The **CONTRACTOR** will be responsible for the payment of any royalties necessary for the materials. Unsuitable excavated material designated by the Engineer will be removed and disposed of by the **CONTRACTOR** as approved by the Engineer. The unsuitable material shall be spread and bladed as needed. All stockpiled material shall have

adequate erosion control. For the unit price bid, the **CONTRACTOR** shall pay royalties, load and haul select backfill material to the project and install in the trench according to these specifications. Payment will be for the linear foot of trench for a given size pipe to be installed in that trench. Payment includes furnishing all labor and equipment to remove, haul and spread unsuitable excavated material on sites designated by the Engineer, pay royalties and to load, haul, and install select backfill material in the trenches.

D. COMPACTION: Compaction of all backfill material shall be performed in a manner that shall not crack or crush the pipe and/or cause the installed pipe to be moved from the established grade and/or alignment, as shown on the plans. Wet ground conditions following rainfall may preclude the opening of ditch lines that cannot be properly backfilled and tamped.

1. Densities In Areas Subjected To or Influenced By Vehicular Traffic: The trench backfill shall be mechanically compacted to the top of the subgrade in 6" lifts by the method selected by the **CONTRACTOR**, to a density of 95% as determined by ASTM D698, latest revision.

2. Densities In Areas Not Subjected To or Influenced By Vehicular Traffic: The trench backfill shall be placed in layers not more than 10" in depth (loose measurement) and shall be compacted by whatever means the **CONTRACTOR** chooses, subject to the restrictions outlined, to a density of 90% as determined by ASTM D698, latest revision.

   The embedment shall be compacted by a method approved by the **CITY**.

3. Special Situations: In areas specifically designated in the plans and specifications, the entire backfill shall be compacted.

4. Compaction Methods: The method of compaction shall be left to the discretion of the **CONTRACTOR** with the following exception, unless otherwise specified, provided that the proper degree of compaction is obtained and provided that the pipe is not damaged in the process. If any potential damage to the pipe due to a proposed method of compaction exists, in the opinion of the Engineer, that method of compaction shall not be allowed.

   Compaction of any backfill material by flooding or jetting shall not be permitted for soils with a PI in excess of 5, unless authorized by **CITY**.

   Hand-operated mechanical tampers may be used with approval of the **CITY** for compacting backfill.

5. Rejection: If the backfill does not meet the proper degree of compaction throughout its depth, the **CITY** shall require its removal and replacement to meet the requirements at the **CONTRACTOR'S** expense.

   In areas with vehicular traffic or for future improvements, all ditch lines after backfill and compaction shall be sealed with oiled dirt to preclude drainage water from entering the ditch line. The oiled dirt seal shall be maintained until road construction commences. Compensation for oil dirt seal shall be included in the unit price for the improvements if no separate bid item is provided in the proposal.

6. Means and methods to complete installation in accordance with the specifications shall be the responsibility of the **CONTRACTOR**. **CITY** shall provide quality assurance testing as deemed necessary.

E. INCLEMENT WEATHER: The **CITY** shall require work to cease due to inclement weather which saturates the existing soil to be removed and utilized as backfill material. Wet soil conditions, particularly in areas of proposed street improvements do not allow the proper compaction to be attained in cases of high moisture content.

3.4 TESTING AND STERILIZATION:

A. PRESSURE AND LEAKAGE TESTS: A hydrostatic test in accordance with AWWA C600, latest revision, shall be performed on all ductile iron water lines installed under this contract. Unless authorized by the **CITY**, a separate hydrostatic test shall be performed on each valved section of the new water line. Waterline stub-outs measuring 200 lineal feet and less shall be incorporated into other test sections.

The test procedure called for in AWWA C600 is paraphrased below for the **CONTRACTOR'S** reference. Pressure and leakage tests shall be conducted concurrently.

1. Test Restrictions:
   a. Test pressure shall be 150 psi or be not less than 1.25 times the working pressure at the highest point along the test section.

   b. Test pressure shall not exceed pipe or thrust-restraint design pressures.

   c. The hydrostatic test shall be a 2-hour duration.

   d. Test pressure shall not vary by more than 5 psi for the duration of the test.

e. Tests shall be made on sections having a valve on each end. The use of test plugs is not permitted.

f. The test pressure shall not exceed twice the rated pressure of the valves or hydrants when the pressure boundary of the test section includes closed gate valves or hydrants. Valves shall not be operated in either direction at differential pressure exceeding the rated valve working pressure. Use of a test pressure greater than the rated valve pressure can result in trapped test pressure between the gates of a double disc gate valve. For tests at these pressures, the test setup should include a provision, independent of the valve, to reduce the line pressure to the rated valve pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or fully opened if desired.

g. The test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.

2. Pressurization: After the pipe has been laid, all newly laid pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 150 psi or not less than 1.25 times the working pressure at the point of testing. Each valved section of pipe shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure. It is a good practice to allow the system to stabilize at the test pressure before conducting the leakage test.

3. Air Removal: Before applying the specified test pressure, air shall be expelled completely from the section of pipeline under test. If permanent air vents are not located at all high points, corporation stops shall be installed at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation stops shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation stops shall be removed and plugged or left in place as required by the specifications. No extra payment will be made for the tapping, furnishing, and installing of the corporation stop.

4. Examination: All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, hydrants, or joints that are discovered following the

pressure test shall be repaired or replaced with sound material, and the test shall be repeated until satisfactory results are obtained.

5. Leakage Defined: Leakage shall be 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 air has been expelled and the pipe has been filled with water. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

6. Allowable Leakage: No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

Equation 1: $$L = \frac{SD\sqrt{P}}{133{,}200}$$

Where: L = allowable leakage, in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in pounds per square inch (gauge)

These formulas are based on an allowable leakage of 11.65 gpd/mi./in. of nominal diameter at a pressure of 150 psi.

Allowable leakage at various pressures is shown in the Table 1, which follows.

When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/h/in. of nominal valve size shall be allowed.

When hydrants are in the test section, the test shall be made against the closed hydrant.

7. Acceptance of Installation: Acceptance shall be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than that allowed by this test procedure, repairs, or replacements shall be accomplished in accordance with the specifications.

All visible leaks are to be repaired regardless of the amount of leakage.

The **CONTRACTOR** shall provide means for measuring the quantity of water pumped during the test.

B. STERILIZATION: Potable water lines shall be thoroughly disinfected in accordance with the latest revision of AWWA C651 and then flushed and sampled before being placed into service. A minimum of one sample for each 1,000 feet of completed main is required for bacteriological analysis. The **CONTRACTOR** shall furnish sampling taps and sterile bottles and shall deliver them to the local Texas Department of Health or county health unit laboratory. No line may be placed into service until negative bacteriological tests results (no bacteria found) are obtained. No hose or fire hydrant shall be used for sampling. Raw water lines shall not be sterilized.

Table 1																		
Allowable Leakage per 1,000 Ft. of Ductile Iron Pipeline*																		
(gal/hour)**																		
Avg. Test Pressure (psi)	**Nominal Pipe Diameter (inches)**																	
	3	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**24**	**30**	**36**	**42**	**48**	**54**	**60**	**64**
450	0.48	0.64	0.95	1.27	1.59	1.91	2.23	2.55	2.87	3.18	3.82	4.78	5.73	6.69	7.64	8.60	9.56	10.19
400	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60	4.50	5.41	6.31	7.21	8.11	9.01	9.61
350	0.42	0.56	0.84	1.12	1.40	1.69	1.97	2.25	2.53	2.81	3.37	4.21	5.06	5.90	6.74	7.58	8.43	8.99
300	0.39	0.52	0.78	1.04	1.30	1.56	1.82	2.08	2.34	2.60	3.12	3.90	4.68	5.46	6.24	7.02	7.80	8.32
275	0.37	0.50	0.75	1.00	1.24	1.49	1.74	1.99	2.24	2.49	2.99	3.73	4.48	5.23	5.98	6.72	7.47	7.97
250	0.36	0.47	0.71	0.95	1.19	1.42	1.66	1.90	2.14	2.37	2.85	3.56	4.27	4.99	5.70	6.41	7.12	7.60
225	0.34	0.45	0.68	0.90	1.18	1.35	1.58	1.80	2.03	2.25	2.70	3.38	4.05	4.73	5.41	6.03	6.76	7.21
200	0.32	0.43	0.64	0.85	1.06	1.28	1.48	1.70	1.91	2.12	2.55	3.19	3.82	4.46	5.09	5.73	6.37	6.80
175	0.30	0.40	0.59	0.80	0.99	1.19	1.39	1.59	1.79	1.98	2.38	2.98	3.58	4.17	4.77	5.36	5.96	6.36
150	0.28	0.37	0.55	0.74	0.92	1.10	1.29	1.47	1.66	1.84	2.21	2.76	3.31	3.86	4.41	4.97	5.52	5.88
125	0.25	0.34	0.50	0.67	0.84	1.01	1.18	1.34	1.51	1.68	2.01	2.52	3.02	3.53	4.03	4.53	5.04	5.37
100	0.23	0.30	0.45	0.60	0.75	0.90	1.05	1.20	1.35	1.50	1.80	2.25	2.70	3.16	3.60	4.05	4.50	4.80

* If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

** Calculated on the basis of Equation 1.

3.5 INSTALLATION OF POLYETHYLENE ENCASEMENT: The polyethylene encasement shall prevent contact between the pipe and fittings and surrounding backfill and bedding material but is not intended to be a completely airtight and watertight enclosure. Overlaps shall be secured by the use of adhesive tape, plastic string, or any other material capable of holding the polyethylene encasement in place until backfilling operations are completed.

Polyethylene encasement shall be installed in accordance with the latest revision of ANSI/AWWA C105/A21.5 and as follows:

METHOD A: Cut polyethylene tube to a length approximately 2' longer than that of the pipe section. Slip the tube around the pipe, centering it to provide a 1' overlap on each adjacent pipe section, and bunching it accordion-fashion lengthwise until it clears the pipe ends.

Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe. A shallow bell hole must be made at joints to facilitate installation of the polyethylene tube.

After assembling the pipe joint, make the overlap of the polyethylene tube. Pull the bunched polyethylene from the preceding length of pipe, slip it over the end of the new length of pipe, and secure it in place. Then slip the end of the polyethylene from the new pipe section over the end of the preceding length of pipe. Secure the overlap in place. Take up the slack width to make a snug, but not tight, fit along the barrel of the pipe, securing the fold at quarter points.

Repair any rips, punctures, or other damage to the polyethylene with adhesive tape or with a short length of polyethylene tube cut open, wrapped around the pipe and secured in place. Proceed with installation of the next section of pipe in the same manner.

METHOD B: Cut polyethylene tube to a length approximately 1' shorter than that of the pipe section. Slip the tube around the pipe, centering it to provide 6" of bare pipe at each end. Make polyethylene snug, but not tight.

Before making up a joint, slip a 3' length of polyethylene tube over the end of the preceding pipe section, bunching it accordion-fashion length-wise. After completing the joint, pull the 3' length of polyethylene over the joint, overlapping the polyethylene previously installed on each adjacent section of pipe by at least 1'; make snug and secure each end as described in Method A.

Repair any rips, punctures, or other damage to the polyethylene as described in Method A. Proceed with installation of the next section of pipe in the same manner.

A. PIPE-SHAPED APPURTENANCES: Cover bends, reducers, offsets, and other pipe shaped appurtenances with polyethylene in the same manner as the pipe.

B. ODD-SHAPED APPURTENANCES: When valves, tees, crosses, and other odd-shaped pieces cannot be wrapped practically in a tube, wrap with a flat sheet or split length of polyethylene tube by passing the sheet under the appurtenance and bringing it up around the body. Make seams by bringing the edged together, folding over twice, and taping down. Handle width and overlaps at joints as described in Method A. Tape polyethylene securely in place at valve stem and other penetrations.

C. OPENINGS IN ENCASEMENT: Provide openings for branches, service taps, blow-offs, air valves, and similar appurtenances by making an X-shaped cut in the polyethylene and temporarily folding back the film. After the appurtenance is installed, tape the slack securely to the appurtenance and repair the cut, as well as any other damaged areas in the polyethylene, with tape.

D. JUNCTIONS BETWEEN WRAPPED AND UNWRAPPED PIPE: Where polyethylene-wrapped pipe joins an adjacent pipe that is not wrapped, extend the polyethylene wrap to cover the adjacent pipe for a distance of at least 2'. Secure the end with circumferential turns of tape.

E. BACKFILL FOR POLYETHYLENE WRAPPED PIPE: Use the same backfill materials as that specified for pipe without polyethylene wrapping, exercising care to prevent damage to the polyethylene wrapping when placing backfill. Backfill material shall be free from cinders, refuse, boulders, rocks, stones, or other material that could damage polyethylene.

PART 4 – MEASUREMENT AND PAYMENT

4.1. WATER LINES: Payment for installing ductile iron pipe for water lines shall be by the lineal foot. The measurement shall be made from end to end of the lines, including through all valves and fittings. This payment shall be the complete payment for site preparation, excavating the trench, furnishing and installing the pipe and joint materials, installing the backfill including compaction, performing all necessary tests and sterilization, and providing all clean up and restoration not specifically included in other bid items.

4.2. FITTINGS: Fittings shall be paid for by their weights, according to the latest list of standard weights as published for compact ductile iron fittings in the Tyler Pipe Catalogue. This measurement shall include the bare fitting plus the gaskets, glands and bolts for mechanical joint fittings. The payment for fittings shall be the complete payment for making the excavation, cutting the pipe line where necessary to install the fitting, furnishing and installing the fitting and all required joint materials, installing the backfill including compaction and providing all clean up and restoration not specifically included in other items (excluding special fittings required in fire hydrant installations).

4.3 THRUST BLOCKING: Furnishing materials for and installation of thrust blocking shall be subsidiary to the installation of pipe and fittings, and shall not be considered as a separate pay item.

4.4. POLYETHYLENE ENCASEMENT: Furnishing materials for and installing polyethylene encasement shall be subsidiary to the installation of pipe and fittings and shall not be considered a separate pay item.

City of Tyler Standard Specifications

POLYVINYL CHLORIDE (PVC) PIPE FOR WATER MAINS

PART 1 - GENERAL

1.1 SCOPE: This specification covers the requirements for polyvinyl chloride (PVC) pressure pipe and ductile iron fittings to be used for potable water mains.

1.2 APPROVALS: PVC water pipe shall be accepted by the State Fire Insurance Commission for use in water distribution systems in cities and towns of Texas. PVC water pipe shall conform to ANSI/NSF Standard No. 61 and must bear the National Sanitation Foundation Seal of Approval (NSF-pw).

1.3 QUALITY ASSURANCE: Pipe shall be the product of one (1) manufacturer which has had not less than 10 years successful experience manufacturing pipe of the types and sizes indicated, unless otherwise approved by Tyler Water Utilities.

1.4 HANDLING AND STORAGE: Handling and storage shall be in accordance with the pipe manufacturer's recommendations. The **CONTRACTOR** shall inspect each load of pipe upon delivery to verify that the load is intact and in good condition. During handling the **CONTRACTOR** shall minimize impacts to the pipe. Care shall be taken to insure the pipe is not dropped or damaged.

If possible, pipe shall be stored in packages provided by the manufacturer. Avoid storage in direct sunlight for periods longer than 90 days. Care shall be taken to avoid compression, damage or deformation to bell ends of pipe. Pipe should be supported to prevent damage to the bottom of the pipe. The interior of the pipe shall be kept free from dirt or other foreign matter.

1.5 REJECTION: PVC water pipe and ductile iron fittings may be rejected for failure to meet any or all of the requirements of this specification.

PART 2 - PRODUCTS

2.1 PVC PIPE: Polyvinyl chloride (PVC) water pipe shall meet the requirements of AWWA C900, latest revision. All PVC water pipe shall have a dimension ratio (DR) of 14 unless the design engineer submits surge calculations in accordance with AWWA C900 Appendix B, latest revision, that demonstrate that pipe with a dimension ration of 18 is adequate for the design conditions. In no case will pipe with a dimension ration of 25 be allowed.

Outside diameter shall be cast-iron compatible. Pipe shall be new and furnished in standard lengths of 20'. Pipe in conformance with this standard shall be permanently and legibly marked at intervals of 5 feet or less, as follows:

A. Manufacturers name or trademark and production code
B. Nominal pipe size
C. PVC
D. Dimension Ratio (DR)
E. AWWA/UL Pressure Class
F. AWWAC900, latest edition
G. Seal or mark of the testing agency verifying the suitability of the pipe material for water service

Manufacturers shall be Certainteed, J&M or approved equal.

2.2 JOINTS: PVC water pipe shall be furnished with gasketed joints meeting the requirements of ASTM D3139, latest revision. Gaskets shall be part of a complete pipe section and purchased as such. Lubricant used for pipe and fittings assembly shall be as recommended by the pipe or fitting manufacturer and shall have no detrimental effect to the potable qualities of the water being transported or to either the gasket or pipe.

2.3 FITTINGS: Fittings for PVC water pipe shall be new, shall be ductile iron and shall conform to the latest revision of ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53, unless otherwise specified.

Fittings joints shall be push-on or mechanical joints. Bolts and nuts for mechanical joints shall be of a high-strength, corrosion-resistant, low-alloy steel and shall conform to ASTM A325 (Type 3), latest revision.

Fittings shall have a cement mortar lining in accordance with ANSI/AWWA C104/A21.4, latest revision and a standard asphaltic coating on the exterior surfaces.

2.4 POLYETHYLENE ENCASEMENT FOR DUCTILE IRON VALVES, FITTINGS AND OTHER APPURTENANCES: Polyethylene encasement shall be required for all ductile iron valves, fittings and other appurtenances in accordance with ANSI/AWWA C105/A21.05, latest revision.

The polyethylene film shall be manufactured of virgin polyethylene material conforming to requirements of ASTM D1248, latest revision. Class Grade C (Black) shall be utilized. Sunlight will eventually deteriorate polyethylene film. Exposure to sunlight should be kept to a minimum.

Tube width for each pipe diameter shall be as listed in the following table:

Nominal Pipe Size (inches)	Minimum Polyethylene Tube Width (inches)
3	14
4	14
6	16
8	20
10	24
12	27
14	30
16	34
18	37
20	41
24	54
30	67
36	81
42	81
48	95
54	108
60	108
64	121

All widths shall be 8 mils thick.

2.5 TRACER WIRE: Inductive tracer detection wire shall be placed directly above the centerline of all non-metallic pipe for the full length of the pipe a minimum of 12" below subgrade or, in areas outside the limits of pavement, a minimum of 18" below finished grade. The tracer wire shall be a solid copper conductor, 14 gauge, insulated by a high molecular weight polyethylene jacket and color coded according to American Public Works Association Uniform Color Code, i.e. blue for potable water.

PART 3 - EXECUTION

3.1. SITE PREPARATION: The construction site shall be prepared for construction operations by the removal and disposal of all obstructions and objectionable materials from the designated construction area. It is the intent of this specification to provide for the removal and disposal of all objectionable material not specifically provided for elsewhere in the plans or specifications. This work shall include the furnishing of all

labor, materials, tools, equipment and the work necessary for clearing and removing from the site of the work wherever located, all obstructions, designated trees, stumps, brush vegetation, miscellaneous stone, brick, concrete, scrap iron and all rubbish and debris whether above or below ground level. Such items shall be included in such contract pay item as provided in the bid proposal.

3.2 EXCAVATION: This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for the furnishing, placing and maintaining of all sheeting, shoring and bracing necessary to protect the work and adjacent properties; to support the sides and ends of the excavation and to support all adjacent structures above and below the ground; the installation and operation of all pumping, bailing and draining necessary to keep the excavation free from seepage water, water from sewers, drains, ditches, creeks and other sources; to provide for the uninterrupted flow of the removal, after the completion of the work, of all sheeting, shoring and bracing not necessary to support the sides of the excavation; and the satisfactory disposal of excess and unsuitable materials not required or which cannot be used for backfilling.

Prior to commencing any excavation, the **CONTRACTOR** shall provide ample labor, equipment, shoring materials and such other safety equipment as required to insure that the work shall be carried on without interruption or damage to existing installations; and to provide the least interruption of traffic commensurate with the project requirements. Blasting is prohibited; alternate methods shall be utilized.

In general, all excavation shall be made in open cut from the surface of the ground and shall be no greater in width or depth than is necessary to permit the proper construction of the work in accordance with the plans and these specifications. All excavation shall be to the line and grade as provided by the Engineer. The **CONTRACTOR** shall abide by all applicable federal, state and/or local laws governing excavation work. The entire foundation area in the bottom of all excavation shall be firm, stable and at uniform density as nearly as practicable. Unless necessary, materials shall not be disturbed. The final cleaning and preparing of the foundation area shall be done immediately prior to the placing of the embedment materials or structures.

A. PROGRESS: The **CITY** shall have the right to limit the amount of trenches that shall be opened, or partly opened, in advance of or following the pipe laying operation. Unless otherwise directed by the **CITY**, the completion of backfill shall immediately follow the pipe laying. In the event the **CONTRACTOR** fails to comply with this requirement, the **CITY** may stop the pipe laying until the requirements are met.

B. TRENCH BOTTOM ELEVATION: All trenches for installation of water lines shall be excavated to a point below the barrel of the pipe for the type of embedment specified.

C. TRENCH OVERCUT: Should the **CONTRACTOR** excavate below the plan trench bottom for water lines, the **CONTRACTOR** shall backfill to trench

bottom grade shown on the plan with approved aggregate, consolidated and compacted to meet the **CITY'S** approval, at no additional cost to the **CITY**. See paragraph 3.2.H "Stabilization" of this specification.

If the **CONTRACTOR** elects to overcut the trench and use gravel and drain pipe as an underdrain in lieu of or in conjunction with plumbing, draining, or well pointing, the additional work shall be considered as incidental work; and additional compensation shall not be allowed.

D. EXCAVATION CLASSIFICATIONS: All excavation is "unclassified" and involves removal of all materials necessary to permit carrying on the completion of the work.

Bidders must satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location, and sizes of pipe or conduits of various kinds in place.

E. SHORING AND SHEETING: When necessary to prevent caving or unduly hazardous working conditions, or to comply with existing laws, trench walls shall be appropriately braced, or sheeted and braced. Where bracing, or sheeting and bracing, is used, the trench width shall be increased accordingly and shall be paid for per linear foot of bracing or sheeting and bracing. Sheeting and shoring shall be in accordance with the City of Tyler Standard Specification for Trench Safety Systems.

In wet, saturated or flowing materials where it is necessary to install tight sheeting or cofferdams, wood or steel sheet piling shall be used. All sheeting, shoring and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and to maintain the sides of the excavation properly from injury or damage. When excavations are made adjacent to existing buildings or to other structures or in paved streets, particular care shall be taken to adequately sheet, shore and brace the sides of the excavation to prevent undermining of, or settlement beneath the structures or pavement. Unless otherwise established in the pay items, underpinning of adjacent structures or pavement shall be done by the **CONTRACTOR** at his own cost and expense and in a manner satisfactory to the **CITY**; or, when required by the **CITY**, the pavement or structure shall be removed, the void satisfactorily refilled and compacted and the pavement or structure replaced by the **CONTRACTOR**. Wooden sheeting, shoring, and bracing shall be left in place where it is adjacent to the pipe embedment for the initial lift of backfill.

The removal of all sheeting, shoring and bracing shall be done in such manner as not to endanger or damage either new or existing structures, private or public properties; and so as to avoid cave-ins, or sliding of the banks. All holes or voids left by the removal of the sheeting, shoring or bracing shall be immediately and completely filled and compacted with suitable materials. If, for any reason, the

CONTRACTOR, with the approval of the **CITY**, elects to leave in place the sheeting, shoring or bracing, no payment shall be allowed for such material left in place unless ordered by the **CITY** to be left in place.

F. DISPOSAL OF EXCAVATED MATERIALS: Suitable excavated materials may be piled adjacent to the work to be used for backfilling. Excavated materials unsuitable for backfilling, or in excess of that required for backfilling, shall be disposed of by the **CONTRACTOR**. Desirable topsoil, sod, etc., shall be carefully removed and piled separately adjacent to the work when required. Excavated materials shall be handled at all times in such manner as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to private and public property adjacent to or along the line of work. The excavated material in rock which is not suitable material for bedding or backfill shall be disposed of by the **CONTRACTOR**. Suitable selected bedding or backfill material from the trench excavation shall be provided at no additional cost to the **CITY** or **OWNER**.

G. DEWATERING: The **CONTRACTOR** shall remove all water from any source which may accumulate in the excavation. The embedment or pipe shall not be installed in water. No water shall be allowed to flow through or over unset concrete or through the completed line. All water removed from excavations shall be disposed of in an approved manner, so as not to create unsanitary conditions; nor to cause injury to persons or property; nor damage to the work in progress, and/or not to interfere unduly with the use of streets, private driveways or entrances. Pumping or bailing and draining, underdrains, ditches, etc., shall be considered as incidental work and shall not be paid for as separate items; but their cost shall be included in such contract prices as are provided for in the contract.

H. STABILIZATION: In the event the **CONTRACTOR** is preventing water from interfering with the work and the trench bottom is too unstable in the opinion of the Engineer or the Engineer's representative for proper grading and pipe installation, the **CONTRACTOR** shall stabilize the bottom of the trench as instructed by the Engineer or the Engineer's representative. To stabilize the trench bottom, the **CONTRACTOR** shall undercut the trench bottom as required and place a layer of washed crushed stone or concrete mix in the trench bottom. In general, the crushed stone or concrete mix is to be 6" thick unless a greater thickness is specified by the Engineer or the Engineer's representative. When used, the crushed rock shall meet the requirements of paragraph 3.3.B.1 “Crushed Stone” of this specification, except the gradation shall be:

	Percent
Passing 5" sieve	100%
Retained on 2" sieve	100%

The concrete mix, if used, is to be mixed as specified for concrete encasement with the exception that the water is to be omitted from the mix and the dry mix placed in the trench bottom. The dry concrete mix is to be placed only in short sections at a time and then immediately fine graded and the pipe installed over it without delay before the dry concrete mix is placed in the next section of trench.

Stabilization will be paid for as specified in the pay items but shall not be used except with the approval of the Engineer or **CITY.** In cases of disagreement between the Engineer and the **CITY**, the decision of the **CITY** shall be final.

3.3 BACKFILL: This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for the furnishing, placing and maintaining of all embedment, backfill materials, compaction, refilling any settlement of all excavated areas, the replacement of topsoil after backfill is completed and the restoration of all other lands, private or public, damaged or occupied by the **CONTRACTOR** in the performance of the contract to the same (or improved) condition as they were prior to the beginning of the work.

A. BACKFILL PROCEDURE: Backfill procedure is that procedure required to return trenches or excavated areas to a condition satisfactory to the **CITY**. Such backfilling occurs in two general areas. They are: 1) areas not subject to vehicular traffic; and 2) areas subjected directly to, or influenced by, vehicular traffic.

The methods of backfilling to be used shall vary with the width of trench, the character of the materials excavated, the methods of excavation, the type of conduit and the degree of compaction required. The placing of backfill shall not begin until the **CITY** has been notified. The excavation shall be backfilled only with approved materials, in accordance with the plans and these specifications. Backfill is divided into two major categories: (1) embedment; and (2) final backfill material, as follows:

1. Embedment is the material upon which the pipe rests and which covers the pipe.

2. Final backfill material is the material required to fill the trench from the top of the embedment to ground elevation or subgrade of a street.

B. EMBEDMENT: The type of embedment to be used for PVC water mains shall be as follows:

1. Crushed Stone:

a. Description: The aggregates shall consist of durable particles of crushed stone; free from frozen material or injurious amounts of salt, alkali, vegetable matter or other material either free or as adherent coating; and its quality shall be reasonably uniform

throughout. It shall have a wear of not more than 40 percent when tested in accordance with TxDOT Test Method Tex-410-A.

b. Test: When tested by standard laboratory methods, crushed rock embedment for each gradation shall meet the following requirements for percentage by weight as stated in the TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, latest edition.

Standard Crushed Rock – Aggregate Grade 4:

	Percent
Retained on 1-½" sieve	0%
Retained on 1" sieve	0-5%
Retained on ½" sieve	40-75%
Retained on No. 4 sieve	90-100%
Retained on No. 8 sieve	95-100%

Fine Crushed Rock – Aggregate Grade 8:

	Percent
Retained on ½" sieve	0%
Retained on 3/8" sieve	0-5%
Retained on No. 4 sieve	35-60%
Retained on No. 8 sieve	90-100%

Coarse Crushed Rock:

	Percent
Passing 1-½" sieve	100%
Retained on ¾" sieve	100%

2. Natural Gravel: Natural gravel shall consist of uncrushed stones meeting the requirements for wear as outlined in paragraph 3.3.B.1 “Crushed Stone” of this specification. The material shall be washed and screened and not have by weight more than one percent organic matter, clays or loam and not more than five percent by weight of any one of or combination of slate, shale, schist or soft particles of sandstones. The gradation shall be:

	Percent
Passing 1-½" sieve	100%
Retained on ¾" sieve	100%

3. Sand: Sand shall be clean, granular and homogenous material composed mainly of mineral matter, free of mud, silt, clay lumps or clods, vegetation or debris. Sand shall meet the specifications of the Uni-Bell "Handbook of PVC Pipe", latest revision, for Class II sand. The gradation shall be as follows:

	Percent
Retained on 1-1/2" sieve	0%
Retained on No. 4 sieve	<50%
Retained on No. 200 sieve	88-95%

C. SELECT BACKFILL – SPECIAL CIRCUMSTANCES: During planning work, the Engineer may recognize that a majority of the ditchline material may not be suitable for backfill and provide for select backfill material placement, the use of which shall be approved by the **CITY**. In cases where ditchline material is not suitable for backfill, select backfill material as approved by the Engineer shall be required.

These backfill materials may fall into one of two categories: 1) select backfill obtained onsite or 2) select backfill obtained offsite. Generally, select backfill obtained onsite would relate to utilities installation in subdivisions.

Should the provision for the necessity of major select backfill be required, the plans and specifications will address and provide a bid item for the same.

1. Select Backfill Obtained Onsite: The Engineer shall designate select backfill material from a point within the project limits. Unsuitable excavated material designated by the Engineer will be removed and disposed of by the **CONTRACTOR** as approved by the Engineer. The unsuitable material shall be spread and bladed as needed. All stockpiled material shall have adequate erosion control. For the unit price bid, the **CONTRACTOR** shall load and haul select backfill to the project and install it in the trench according to these specifications. Select backfill will be made for the full depth of the trench above the embedment. Payment will be for the linear foot of trench for a given size pipe to be installed in that trench. Payment includes furnishing all labor and equipment to remove, haul and spread unsuitable excavated material on sites designated by the Engineer and to load, haul, and install select backfill in the trenches.

2. Select Backfill Obtained Offsite: The **CONTRACTOR** will be responsible for locating suitable sources of select backfill material, advise the Engineer of the availability of the sources, and obtain the Engineer's approval of the sources before any commitment is made to use the material. The **CONTRACTOR** will be responsible for the payment of any royalties necessary for the materials. Unsuitable excavated material designated by the Engineer will be removed and disposed of by the **CONTRACTOR** as approved by the Engineer. The unsuitable material shall be spread and bladed as needed. All stockpiled material shall have adequate erosion control. For the unit price bid, the **CONTRACTOR** shall pay royalties, load and haul select backfill material to the project and install in the trench according to these specifications. Payment will be for the linear foot of trench for a given size pipe to be installed in that trench. Payment includes furnishing all labor and equipment to remove, haul and spread unsuitable excavated material on sites designated by the Engineer, pay royalties and to load, haul, and install select backfill material in the trenches.

D. COMPACTION: Compaction of all backfill material shall be performed in a manner that shall not crack or crush the pipe and/or cause the installed pipe to be moved from the established grade and/or alignment, as shown on the plans. Wet ground conditions following rainfall may preclude the opening of ditch lines that cannot be properly backfilled and tamped.

1. Densities In Areas Subjected To or Influenced By Vehicular Traffic: The trench backfill shall be mechanically compacted to the top of the subgrade in 6" lifts by the method selected by the **CONTRACTOR**, to a density of 95% as determined by ASTM D698, latest revision.

2. Densities In Areas Not Subjected To or Influenced By Vehicular Traffic: The trench backfill shall be placed in layers not more than 10" in depth (loose measurement) and shall be compacted by whatever means the **CONTRACTOR** chooses, subject to the restrictions outlined, to a density of 90% as determined by ASTM D698, latest revision.

   The embedment shall be compacted by a method approved by the **CITY**.

3. Special Situations: In areas specifically designated in the plans and specifications, the entire backfill shall be compacted.

4. Compaction Methods: The method of compaction shall be left to the discretion of the **CONTRACTOR** with the following exception, unless otherwise specified, provided that the proper degree of compaction is obtained and provided that the pipe is not damaged in the process. If any potential damage to the pipe due to a proposed method of compaction

exists, in the opinion of the Engineer, that method of compaction shall not be allowed.

Compaction of any backfill material by flooding or jetting shall not be permitted for soils with a PI in excess of 5, unless authorized by the **CITY**.

Hand-operated mechanical tampers may be used with approval of the **CITY** for compacting backfill.

5. Rejection: If the backfill does not meet the proper degree of compaction throughout its depth, the **CITY** shall require its removal and replacement to meet the requirements at the **CONTRACTOR'S** expense.

   In areas with vehicular traffic or for future improvements, all ditch lines after backfill and compaction shall be sealed with oiled dirt to preclude drainage water from entering the ditch line. The oiled dirt seal shall be maintained until road construction commences. Compensation for oil dirt seal shall be included in the unit price for the improvements if no separate bid item is provided in the proposal.

6. Means and methods to complete installation in accordance with the specifications shall be the responsibility of the **CONTRACTOR**. **CITY** shall provide quality assurance testing as deemed necessary.

7. Extreme groundwater conditions in the ditch line may require French drain installation prior to utilities installation.

E. INCLEMENT WEATHER: The **CITY** shall require work to cease due to inclement weather which saturates the existing soil to be removed and utilized as backfill material. Wet soil conditions, particularly in areas of proposed street improvements do not allow the proper compaction to be attained in cases of high moisture content.

3.4 TESTING AND STERILIZATION:

A. PRESSURE AND LEAKAGE TESTS: A hydrostatic test in accordance with the latest revision of AWWA Manual M23 shall be performed on all PVC water lines installed under this contract. Unless authorized by the **CITY**, a separate hydrostatic test shall be performed on each valved section of the new water line. Waterline stub-outs measuring 200 lineal feet and less shall be incorporated into other test sections.

The test procedure called for in AWWA Manual M23 is paraphrased below for the **CONTRACTOR'S** reference.

1. Testing Procedure: The following procedure is based on the assumption that the pressure and leakage tests will be performed at the same time. Separate tests may be made if desired, in which case the pressure test should be performed first. The specified test pressure should be applied by means of a pump connected to the pipe. The test pressure should be maintained (by additional pumping if necessary) for the specified time. While the line is under pressure, the system and all exposed pipe, fittings, valves, and hydrants should be carefully examined for leakage. All defective elements should be repaired or replaced and the test repeated until all visible leakage has been stopped and the allowable leakage requirements have been met.

   If pressure and leakage tests are performed separately on the installed system, they shall be performed at test durations and pressures specified in Table 1.

Table 1
System Test Methods

Procedure	Pressure	Test Duration
Simultaneous pressure and leakage tests	150% of working pressure at point of test, but not less than 125% of normal working pressure at highest elevation.	2 hr
Separate pressure test	150% of working pressure at point of test, but not less than 125% of normal working pressure at highest elevation.	1 hr
Separate leakage test	150% of normal average working pressure of segment tested.	2 hr

   When hydrants are in the test section, the test shall be made against the closed hydrant.

2. Allowable Leakage: The duration of each leakage test should be 2 hours, unless otherwise specified, and during the test the main should be subjected to the pressure required in Table 2. Leakage should be defined as the quantity of water that must be supplied in to the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified leakage test pressure after the pipe has been filled with water and the air in the pipeline has been expelled. No installation should be accepted if the leakage is greater than that determined by the following formula and as shown in Table 2, below:

   Equation 1: $$L = \frac{ND\sqrt{P}}{7{,}400}$$

Where: L = allowable leakage, in gallons per hour
N = number of joints in the tested line (pipe and fittings)
D = nominal diameter of the pipe, in inches
P = average test pressure during the leakage test, in pounds per square inch (gauge)

Table 2
Allowable Leakage for PVC Pipe

Nominal Pipe Size (inches)	Average Test Pressure in Line, psi				
	50	100	150	200	250
	Allowable Leakage Per 1000 Ft or 50 Joints, gal/h				
4	.19	0.27	0.33	.38	.43
6	.29	0.41	.050	.57	.64
8	.38	0.54	.066	.76	.85
10	.48	0.68	0.83	.96	1.07
12	.57	0.81	.099	1.15	1.28
14	.67	.95	1.16	1.34	1.50
16	.76	1.08	1.32	1.53	1.71
18	.86	1.22	1.49	1.72	1.92
20	.96	1.35	1.66	1.91	2.14
24	1.15	1.62	1.99	2.29	2.56
30	1.43	2.03	2.48	2.87	3.20
36	1.72	2.43	2.98	3.44	3.85

B. STERILIZATION: Potable water lines shall be thoroughly disinfected in accordance with AWWA C651, latest revision, and then flushed and sampled before being placed into service. A minimum of one sample for each 1,000 feet of completed main is required for bacteriological analysis. The **CONTRACTOR** shall furnish sampling taps and sterile bottles, and shall deliver them to the local Texas Department of Health or county health unit laboratory. No line may be placed into service until negative bacteriological tests results (no bacteria found) are obtained. No hose or fire hydrant shall be used for sampling. Raw water lines shall not be sterilized.

3.5 INSTALLATION OF POLYETHYLENE ENCASEMENT: The polyethylene encasement shall prevent contact between the valves and fittings and surrounding backfill and bedding material but is not intended to be a completely airtight and watertight enclosure. Overlaps shall be secured by the use of adhesive tape, plastic string, or any other material capable of holding the polyethylene encasement in place until backfilling operations are completed.

A. PIPE-SHAPED APPURTENANCES: Cover bends, reducers, offsets, and other pipe shaped appurtenances with polyethylene in the same manner as pipe.

B. ODD-SHAPED APPURTENANCES: When valves, tees, crosses, and other odd-shaped pieces cannot be wrapped practically in a tube, wrap with a flat sheet or split length of polyethylene tube by passing the sheet under the appurtenance and bringing it up around the body. Make seams by bringing the edged together, folding over twice, and taping down. Tape polyethylene securely in place at valve stem and other penetrations.

C. JUNCTIONS BETWEEN WRAPPED AND UNWRAPPED PIPE: Where polyethylene-wrapped valves and fittings join an adjacent pipe that is not wrapped, extend the polyethylene wrap to cover the adjacent pipe for a distance of at least 2 ft. Secure the end with circumferential turns of tape.

D. BACKFILL FOR POLYETHYLENE WRAPPED FITTINGS: Use the same backfill materials as that specified for pipe without polyethylene wrapping, exercising care to prevent damage to the polyethylene wrapping when placing backfill. Backfill material shall be free from cinders, refuse, boulders, rocks, stones, or other material that could damage polyethylene.

PART 4 – MEASUREMENT AND PAYMENT

4.1. WATER LINES: Payment for installing PVC pipe for water lines shall be by the lineal foot. The measurement shall be made from end to end of the lines, including through all valves and fittings. This payment shall be the complete payment for site preparation, excavating the trench, furnishing and installing the pipe and joint materials, installing the backfill including compaction, performing all necessary tests and sterilization, and providing all clean up and restoration not specifically included in other bid items.

4.2. FITTINGS: Fittings shall be paid for by their weights, according to the latest list of standard weights as published for compact ductile iron fittings in the Tyler Pipe Catalogue. This measurement shall include the bare fitting plus the gaskets, glands and bolts for mechanical joint fittings. The payment for fittings shall be the complete payment for making the excavation, cutting the pipe line where necessary to install the fitting, furnishing and installing the fitting and all required joint materials, furnishing and installing polyethylene encasement for fittings, installing the backfill including compaction and providing all clean up and restoration not specifically included in other items (excluding special fittings required in fire hydrant installations).

4.3 THRUST BLOCKING: Furnishing materials for and installation of thrust blocking shall be subsidiary to the installation of pipe and fittings, and shall not be considered as a separate pay item.

4.4 TRACER WIRE: Furnishing materials for and installation of tracer wire shall be subsidiary to the installation of pipe and fittings, and shall not be considered as a separate pay item.

4.5. POLYETHYLENE ENCASEMENT: Furnishing materials for and installing polyethylene encasement shall be subsidiary to the installation of valves and fittings and shall not be considered a separate pay item.

City of Tyler Standard Specifications

BAR-WRAPPED CONCRETE PRESSURE PIPE FOR WATER MAINS

PART 1 - GENERAL

1.1 SCOPE: This specification covers the requirements for bar-wrapped concrete pressure pipe and fittings to be used for potable water mains. This type of pipe shall be used only when specifically designated in the project plans or specifications.

1.2 APPROVALS: Bar-wrapped concrete pressure pipe shall conform to AWWA C303 and shall be NSF 61 Certified. All pipe and fittings shall be new.

1.3 QUALITY ASSURANCE:

A. EXPERIENCE REQUIREMENTS: Finished pipe shall be the product of one (1) manufacturer who has fabricated no less than 100,000 feet of Bar-Wrapped Concrete Cylinder Pipe to the AWWA Standard, and has had not less than 10 years successful experience manufacturing pipe of the types and sizes indicated, unless authorized by Tyler Water Utilities.

B. FACTORY TESTING: The **CITY** may require the manufacturer to furnish mill test certificates on reinforcing steel or wire, steel plate, and cement. The manufacturer shall perform the tests described in AWWA C303, latest revision, for all pipe, fittings, and specials.

1.4 SUBMITTALS: Submittals shall include:

A. Prior to the fabrication of the pipe, submit fabrication and laying drawings to the Engineer for record purposes. Record drawings shall include a complete description of the pipe offered, including cuts, tabulated layout and pertinent design data. Record drawings shall reference stationing on the plan profile sheets and shall incorporate changes necessary to avoid conflicts with existing utilities and structures. Details for the design and fabrication of all fittings and specials and provisions for thrust shall be included.

B. Prior to delivery of the pipe to the project site, the manufacturer shall furnish an affidavit certifying that all pipe, fittings, and specials, and other products and materials furnished, comply with this specification. Copies of results of factory tests and mill certificates for steel and cement shall be provided, if requested.

1.5 HANDLING AND STORAGE: Handling and storage shall be in accordance with the pipe manufacturer's recommendations. The **CONTRACTOR** shall inspect each load of pipe upon delivery to verify that the load is intact and in good condition. During handling

the **CONTRACTOR** shall minimize impacts to the pipe. Care shall be taken to insure the pipe is not dropped or damaged.

Care shall be taken to avoid compression, damage or deformation to ends of pipe. Pipe should be supported to prevent damage to the bottom of the pipe. The interior of the pipe shall be kept free from dirt or other foreign matter.

1.6 REJECTION: Bar-wrapped pipe and fittings may be rejected for failure to meet any or all of the requirements of this specification.

PART 2 - PRODUCTS

2.1 PIPE: Except as modified or supplemented herein, bar- wrapped concrete cylinder pipe, fittings and specials shall conform to the applicable requirements of the following standard specifications, latest edition:

AWWA C303	Concrete Pressure Pipe, Bar-Wrapped, Steel- Cylinder Type
AWWA M9	Concrete Pressure Pipe

Sizes and pressure classes (working pressure) shall be 150 psi minimum or in accordance with project specifications, whichever is greater. For the purposes of pipe design, working pressure plus transient pressure shall be equal to 1.5 times the pressure class specified. Fittings, specials and connections shall be same class as the associated pipe. Pipe and fittings shall be clearly marked with the pressure class and piece number to permit easy identification in the field. Pipe design shall be based on trench conditions and design pressure class specified. Pipe shall be designed using the following parameters:

1. Unit Weight of Fill (w) = 120 pcf
2. Live Load (where applicable) = AASHTO HS 20
3. Trench Depth = as indicated
4. Coefficient Ku' = 0.150
5. Trench Width (Bd) = as indicated
6. Bedding Conditions = as indicated
7. Soil Reaction Modulus (E') = 1000 psi
8. Coefficient k = 0.085

Trench depths indicated shall be verified after existing utilities are located. Vertical alignment changes required because of existing utility or other conflicts shall be accommodated by an appropriate change in pipe design depth. In no case shall pipe be installed deeper than its design allows.

The inside diameter, including the cement mortar lining, shall be a minimum of the nominal diameter of the pipe specified.

Bar-wrapped concrete pipe shall be new and shall be manufactured by Hanson or approved equal.

2.2. JOINTS: The standard pipe end shall include steel joint ring and a continuous solid rubber ring gasket as per the latest revision of AWWA Manual M9.

Flanges shall have ANSI drilling of class equal to or greater than the pipe class, unless otherwise specified, and shall match class of valves or appurtenances which are attached. Nuts and bolts shall conform to ASTM A307, Grade B, latest revision.

Joint wrappers shall be Mar-Mac Manufacturing Company or approved equal.

Flexible joint couplings shall be Dresser Style 38, Rockwell Style 411, or approved equal.

2.3 MIXES; CEMENT MORTAR: Cement mortar used for pouring joints shall consist of one (1) part Portland Cement to two and one-half (2-1/2) parts clean, fine, sharp silica sand, mixed with water. Exterior joint mortar shall be mixed to the consistency of thick cream. Interior joint mortar shall be mixed with as little water as possible so that the mortar is very stiff, but workable. Cement shall conform to the latest revision of ASTM C150, Type I or Type II. Sand shall conform to ASTM C33, latest revision.

2.4 FINE AGGREGATES: Fine aggregates for concrete lining and coating shall conform to ASTM C33, latest revision.

2.5 SPECIAL COATING: Pipe to be laid in casing shall have two (2) built-up rings or mortar each approximately 2' long and slightly higher than the pipe bell to prevent pipe being supported by the bell. Rings to be at the quarter points of the pipe section.

2.6 BRASS REDUCING BUSHINGS: Where outlets or taps are threaded, furnish and install brass reducing bushings for the outlet size indicated.

2.7 PROVISIONS FOR THRUST: Thrusts at bends, tees, plugs, or other fittings shall be resisted by thrust blocking or restrained joints as indicated on the drawings. Thrust blocking or anchors shall be used to restrain thrust at bends, fittings, etc. adjacent to casing pipe and where indicated.

Restrained joints, where identified on the drawings, shall be used for a sufficient distance from each side of the bend, tee, plug, or other fitting to resist thrust which will be developed at the design pressure of the pipe. Restrained joints shall consist of welded joints or harnessed joints. Harnessed joints shall be clamp or snap ring type in accordance with AWWA Manual M9, latest revision.

The length of pipe with welded joints to resist thrust forces shall be determined by the pipe manufacturer in accordance with AWWA Manual M9, latest revision, utilizing TRDP and the following:

1. Soil Type = Type III

The above applies to unsaturated soil conditions. In locations where ground water is encountered, the soil density shall be reduced to its buoyant weight for the backfill below the water table, and the coefficient of friction shall be reduced to 0.25.

PART 3 - EXECUTION

3.1. SITE PREPARATION: The construction site shall be prepared for construction operations by the removal and disposal of all obstructions and objectionable materials from the designated construction area. It is the intent of this specification to provide for the removal and disposal of all objectionable material not specifically provided for elsewhere in the plans or specifications. This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for clearing and removing from the site of the work wherever located, all obstructions, designated trees, stumps, brush vegetation, miscellaneous stone, brick, concrete, scrap iron and all rubbish and debris whether above or below ground level. Such items shall be included in such contract pay item as provided in the bid proposal.

3.2 EXCAVATION: This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for the furnishing, placing and maintaining of all sheeting, shoring and bracing necessary to protect the work and adjacent properties; to support the sides and ends of the excavation and to support all adjacent structures above and below the ground; the installation and operation of all pumping, bailing and draining necessary to keep the excavation free from seepage water, water from sewers, drains, ditches, creeks and other sources; to provide for the uninterrupted flow of the removal, after the completion of the work, of all sheeting, shoring and bracing not necessary to support the sides of the excavation; and the satisfactory disposal of excess and unsuitable materials not required or which cannot be used for backfilling.

Prior to commencing any excavation, the **CONTRACTOR** shall provide ample labor, equipment, shoring materials and such other safety equipment as required to insure that the work shall be carried on without interruption or damage to existing installations; and to provide the least interruption of traffic commensurate with the project requirements. Blasting is prohibited; alternate methods shall be utilized.

In general, all excavation shall be made in open cut from the surface of the ground and shall be no greater in width or depth than is necessary to permit the proper construction of the work in accordance with the plans and these specifications. All excavation shall be to the line and grade as provided by the Engineer. The **CONTRACTOR** shall abide by all applicable federal, state and/or local laws governing excavation work. The entire foundation area in the bottom of all excavation shall be firm, stable and at uniform density as nearly as practicable. Unless necessary, materials shall not be disturbed. The

final cleaning and preparing of the foundation area shall be done immediately prior to the placing of the embedment materials or structures.

A. PROGRESS: The **CITY** shall have the right to limit the amount of trenches that shall be opened, or partly opened, in advance of or following the pipe laying operation. Unless otherwise directed by the **CITY**, the completion of backfill shall immediately follow the pipe laying. In the event the **CONTRACTOR** fails to comply with this requirement, the **CITY** may stop the pipe laying until the requirements are met.

B. TRENCH BOTTOM ELEVATION: All trenches for installation of water lines shall be excavated to a point below the barrel of the pipe for the type of embedment specified.

C. TRENCH OVERCUT: Should the **CONTRACTOR** excavate below the plan trench bottom for water lines, the **CONTRACTOR** shall backfill to trench bottom grade shown on the plan with approved aggregate, consolidated and compacted to meet the **CITY'S** approval, at no additional cost to the **CITY**. See paragraph 3.2.H "Stabilization" of this specification.

D. EXCAVATION CLASSIFICATIONS: All excavation is "unclassified" and involves removal of all materials necessary to permit carrying on the completion of the work.

Bidders must satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location, and sizes of pipe or conduits of various kinds in place.

E. SHORING AND SHEETING: When necessary to prevent caving or unduly hazardous working conditions, or to comply with existing laws, trench walls shall be appropriately braced, or sheeted and braced. Where bracing, or sheeting and bracing, is used, the trench width shall be increased accordingly and shall be paid for per linear foot of bracing or sheeting and bracing. Sheeting and shoring shall be in accordance with the City of Tyler Standard Specification for Trench Safety Systems.

In wet, saturated or flowing materials where it is necessary to install tight sheeting or cofferdams, wood or steel sheet piling shall be used. All sheeting, shoring and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and to maintain the sides of the excavation properly from injury or damage. When excavations are made adjacent to existing buildings or to other structures or in paved streets, particular care shall be taken to adequately sheet, shore and brace the sides of the excavation to prevent undermining of, or settlement beneath the structures or pavement. Unless otherwise established in the pay items, underpinning of adjacent structures or pavement shall be done by the **CONTRACTOR** at his own cost and expense and in a manner satisfactory to the

CITY; or, when required by the **CITY**, the pavement or structure shall be removed, the void satisfactorily refilled and compacted and the pavement or structure replaced by the **CONTRACTOR**. Wooden sheeting, shoring, and bracing shall be left in place where it is adjacent to the pipe embedment for the initial lift of backfill.

The removal of all sheeting, shoring and bracing shall be done in such manner as not to endanger or damage either new or existing structures, private or public properties; and so as to avoid cave-ins, or sliding of the banks. All holes or voids left by the removal of the sheeting, shoring or bracing shall be immediately and completely filled and compacted with suitable materials. If, for any reason, the **CONTRACTOR**, with the approval of the **CITY**, elects to leave in place the sheeting, shoring or bracing, no payment shall be allowed for such material left in place unless ordered by the **CITY** to be left in place.

F. DISPOSAL OF EXCAVATED MATERIALS: Suitable excavated materials may be piled adjacent to the work to be used for backfilling. Excavated materials unsuitable for backfilling, or in excess of that required for backfilling, shall be disposed of by the **CONTRACTOR**. Desirable topsoil, sod, etc., shall be carefully removed and piled separately adjacent to the work when required. Excavated materials shall be handled at all times in such manner as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to private and public property adjacent to or along the line of work. The excavated material in rock which is not suitable material for bedding or backfill shall be disposed of by the **CONTRACTOR**. Suitable selected bedding or backfill material from the trench excavation shall be provided at no additional cost to the **CITY** or **OWNER**.

G. DEWATERING: The **CONTRACTOR** shall remove all water from any source which may accumulate in the excavation. The embedment or pipe shall not be installed in water. No water shall be allowed to flow through or over unset concrete or through the completed line. All water removed from excavations shall be disposed of in an approved manner, so as not to create unsanitary conditions; nor to cause injury to persons or property; nor damage to the work in progress, and/or not to interfere unduly with the use of streets, private driveways or entrances. Pumping or bailing and draining, underdrains, ditches, etc., shall be considered as incidental work and shall not be paid for as separate items; but their cost shall be included in such contract prices as are provided for in the contract.

H STABILIZATION: In the event the **CONTRACTOR** is preventing water from interfering with the work and the trench bottom is too unstable in the opinion of the Engineer or the Engineer's representative for proper grading and pipe installation, the **CONTRACTOR** shall stabilize the bottom of the trench as instructed by the Engineer or the Engineer's representative. To stabilize the trench bottom, the **CONTRACTOR** shall undercut the trench bottom as required and place a layer of washed crushed stone or concrete mix in the trench bottom. In

general, the crushed stone or concrete mix is to be 6" thick unless a greater thickness is specified by the Engineer or the Engineer's representative. When used, the crushed rock shall meet the requirements of paragraph 3.4.B.1 “Crushed Stone” of this specification, except the gradation shall be:

	Percent
Passing 5" sieve	100%
Retained on 2" sieve	100%

The concrete mix, if used, is to be mixed as specified for concrete encasement with the exception that the water is to be omitted from the mix and the dry mix placed in the trench bottom. The dry concrete mix is to be placed only in short sections at a time and then immediately fine graded and the pipe installed over it without delay before the dry concrete mix is placed in the next section of trench.

Stabilization will be paid for as specified in the pay items but shall not be used except with the approval of the Engineer or **CITY.** In cases of disagreement between the Engineer and the **CITY**, the decision of the **CITY** shall be final.

3.3 INSTALLATION: Install pipe, fittings, specials, and appurtenances as specified herein, as specified in AWWA Manual M9, latest revision, and in accordance with the pipe manufacturer's recommendations.

Lay pipe to the lines and grades, as indicated.

A. PIPE JOINTING: Thoroughly clean the bell and spigot rings before laying each joint of pipe by brushing and wiping. If any damage to the protective coating on the metal has occurred, repair the damage before laying the pipe. Lubricate the gasket and the inside surface of the bell with an approved lubricant (flax soap) which will facilitate the telescoping of the joint. Tightly fit together sections of pipe and exercise care to secure true alignment and grade. When a joint of pipe is being laid, place the gasket on the spigot ring and enter the spigot end of the pipe into the bell of the adjoining pipe and force into position. The inside joint space between ends of the pipe sections shall have an opening within the tolerances as recommended by the pipe manufacturer. No “blocking up” of pipe or joints will be permitted, and if the pipe is not uniformly supported or the joint not made up properly, remove the joint and properly prepare the trench. After joining, check the position of the gasket with a feeler gauge. If the gasket is out of position, disassemble the joint and repeat the joint laying procedure.

1. EXTERIOR JOINTS: Make the exterior joint by placing a joint wrapper around the pipe and secure in place with two (2) metal straps. The wrapper shall be 9" wide for pipe 36" and larger, and 7" wide for smaller pipe, hemmed on each side. The wrapper shall be fiberglass reinforced or burlap cloth, with lengths encircling the pipe, leaving enough opening between

ends to allow the mortar to be poured inside the wrapper into the joint. Fill the joint with mortar from one side in one (1) continuous operation until the grout has flowed entirely around the pipe. During the filling of the joint, pat or manipulate the sides of the wrapper to settle the mortar and expel any entrapped air. Leave wrappers in place undisturbed until the mortar has set-up.

2. INTERIOR JOINTS: Upon completion of backfilling of the pipe trench, fill the inside joint recess with a stiff cement mortar. Prior to placing of mortar, clean out dirt or trash which has collected in the joint, and moisten the concrete surfaces of the joint space by spraying or brushing with a wet brush. Ram or pack the stiff mortar into the joint space and take extreme care to insure that no voids remain in the joint space. After the joint has been filled, level the surfaces of the joint mortar with the interior surfaces of the pipe with a steel trowel so that the surface is smooth. Interior joints of pipe smaller than 21" shall have the bottom of the bell buttered with mortar prior to inserting the spigot, such that when the spigot is pushed into position it will extrude surplus mortar from the joint. The surplus mortar shall be struck off flush with the inside of the pipe by pulling a filled burlap bag or an inflated ball through the pipe with a rope.

3. WELDED JOINTS: Telescope together the joints to be welded with a rubber gasket as specified above and align perfectly with the adjacent section of pipe. Accomplish welding by laying a filler rod between the steel bell of one (1) section and the steel spigot of the other, and welding the bell to the outside of the spigot. Use no less than three (3) complete passes to make the weld. When the joint weld is completed, pour the exterior joint with mortar as specified above. After all sections are in final position, fill the interior joint as specified above. Welded joints shall meet the requirements of AWWA Manual M9, latest revision.

B. PROTECTION OF EXPOSED METAL: Protect exposed ferrous metal by a minimum 1" coating of cement mortar as previously specified for inside joints. Exposed large flat surfaces such as flanges, bolts, caulked joints, threaded outlets, closures, etc., shall have coating reinforced with galvanized wire mesh.

Thoroughly clean and wet the surface receiving cement mortar coating with water just prior to placing the cement mortar coating. After placing, take care to prevent cement mortar from drying out too rapidly by covering with damp earth or burlap. Cement mortar coating shall not be applied during freezing weather.

C. PATCHING: Excessive field-patching of lining or coating shall not be permitted. Patching of lining or coating will be allowed where area to be repaired does not exceed 10 square feet and has no dimensions greater than 24"

Wherever necessary to patch the pipe, make patch with cement mortar as previously specified for interior joints. Do not install patched pipe until the patch has been properly and adequately cured and approved for laying by the Engineer. Promptly remove rejected pipe from the site.

3.4 BACKFILL: This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for the furnishing, placing and maintaining of all embedment, backfill materials, compaction, refilling any settlement of all excavated areas, the replacement of topsoil after backfill is completed and the restoration of all other lands, private or public, damaged or occupied by the **CONTRACTOR** in the performance of the contract to the same (or improved) condition as they were prior to the beginning of the work.

A. BACKFILL PROCEDURE: Backfill procedure is that procedure required to return trenches or excavated areas to a condition satisfactory to the **CITY**. Such backfilling occurs in two general areas. They are: 1) areas not subject to vehicular traffic; and 2) areas subjected directly to, or influenced by, vehicular traffic.

The methods of backfilling to be used shall vary with the width of trench, the character of the materials excavated, the methods of excavation, the type of conduit and the degree of compaction required. The placing of backfill shall not begin until the **CITY** has been notified. The excavation shall be backfilled only with approved materials, in accordance with the plans and these specifications. Backfill is divided into two major categories: (1) embedment; and (2) final backfill material, as follows:

1. Embedment is the material upon which the pipe rests and which covers the pipe.

2. Final backfill material is the material required to fill the trench from the top of the embedment to ground elevation or subgrade of a street.

B. EMBEDMENT: The type of embedment to be used for bar-wrapped concrete water mains shall be as follows:

1. Crushed Stone:

a. Description: The aggregates shall consist of durable particles of crushed stone; free from frozen material or injurious amounts of salt, alkali, vegetable matter or other material either free or as adherent coating; and its quality shall be reasonably uniform throughout. It shall have a wear of not more than 40 percent when tested in accordance with TxDOT Test Method Tex-410-A.

b. Test: When tested by standard laboratory methods, crushed rock embedment for each gradation shall meet the following

requirements for percentage by weight as stated in the TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, latest edition.

Standard Crushed Rock – Aggregate Grade 4:

	Percent
Retained on 1-½" sieve	0
Retained on 1" sieve	0-5%
Retained on ½" sieve	40-75%
Retained on No. 4 sieve	90-100%
Retained on No. 8 sieve	95-100%

Fine Crushed Rock – Aggregate Grade 8:

	Percent
Retained on ½" sieve	0%
Retained on 3/8" sieve	0-5%
Retained on No. 4 sieve	35-60%
Retained on No. 8 sieve	90-100%

Coarse Crushed Rock:

	Percent
Passing 1-½" sieve	100%
Retained on ¾" sieve	100%

2. Granular Material: Granular material shall be free flowing, such as sand or hydraulically graded crushed stone fines, or mixed sand and gravel, or sandy loam. The material shall be free from lumps, stones over 2" in diameter, clay and organic matter.

3. Select Material: Select material shall be gravel, fine rock cuttings, clayey sand, sand, sandy loam or loam free from excessive clay. Rock cuttings shall have no dimension greater than 2". Soil materials shall have a PI ranging between 0 and 15. Select material shall meet all requirements of paragraph 3.4.C “Select Backfill – Special Circumstances” of this specification.

4. Natural Gravel: Natural gravel shall consist of uncrushed stones meeting the requirements for wear as outlined in paragraph 3.4.B.1 “Crushed Stone” of this specification. The material shall be washed and screened and not have by weight more than one percent organic matter, clays or

loam and not more than five percent by weight of any one of or combination of slate, shale, schist or soft particles of sandstones. The gradation shall be:

	Percent
Passing 1 ½" sieve	100%
Retained on ¾" sieve	100%

5. Sand: Sand shall consist of clean, hard, durable, uncoated grains, free from lumps and organic material. All particles must pass a No. 8 sieve.

C. SELECT BACKFILL – SPECIAL CIRCUMSTANCES: During planning work, the Engineer may recognize that a majority of the ditchline material may not be suitable for backfill and provide for select backfill material placement, the use of which shall be approved by the **CITY**. In cases where ditchline material is not suitable for backfill, select backfill material as approved by the **CITY** shall be required.

These backfill materials may fall into one of two categories: 1) select backfill obtained onsite or 2) select backfill obtained offsite. Generally, select backfill obtained onsite would relate to utilities installation in subdivisions.

Should the provision for the necessity of major select backfill be required, the plans and specifications will address and provide a bid item for the same.

1. Select Backfill Obtained Onsite: The Engineer shall designate select backfill material from a point within the project limits. Unsuitable excavated material designated by the Engineer will be removed and disposed of by the **CONTRACTOR** as approved by the Engineer. The unsuitable material shall be spread and bladed as needed. All stockpiled material shall have adequate erosion control. For the unit price bid, the **CONTRACTOR** shall load and haul select backfill to the project and install it in the trench according to these specifications. Select backfill will be made for the full depth of the trench above the embedment. Payment will be for the linear foot of trench for a given size pipe to be installed in that trench. Payment includes furnishing all labor and equipment to remove, haul and spread unsuitable excavated material on sites designated by the Engineer and to load, haul, and install select backfill in the trenches.

2. Select Backfill Obtained Offsite: The **CONTRACTOR** will be responsible for locating suitable sources of select backfill material, advise the Engineer of the availability of the sources, and obtain the Engineer's approval of the sources before any commitment is made to use the material. The **CONTRACTOR** will be responsible for the payment of any

royalties necessary for the materials. Unsuitable excavated material designated by the Engineer will be removed and disposed of by the **CONTRACTOR** as approved by the Engineer. The unsuitable material shall be spread and bladed as needed. All stockpiled material shall have adequate erosion control. For the unit price bid, the **CONTRACTOR** shall pay royalties, load and haul select backfill material to the project and install in the trench according to these specifications. Payment will be for the linear foot of trench for a given size pipe to be installed in that trench. Payment includes furnishing all labor and equipment to remove and spread unsuitable excavated material on sites designated by the Engineer, pay royalties and to load, haul, and install select backfill material in the trenches.

D. COMPACTION: Compaction of all backfill material shall be performed in a manner that shall not crack or crush and/or cause the installed pipe to be moved from the established grade and/or alignment, as shown on the plans. Wet ground conditions following rainfall may preclude the opening of ditch lines that cannot be properly backfilled and tamped.

1. Densities In Areas Subjected To or Influenced By Vehicular Traffic: The trench backfill shall be mechanically compacted to the top of the subgrade in 6" lifts by the method selected by the **CONTRACTOR**, to a density of 95% as determined by ASTM D698, latest revision.

2. Densities In Areas Not Subjected To or Influenced By Vehicular Traffic: The trench backfill shall be placed in layers not more than 10" in depth (loose measurement) and shall be compacted by whatever means the **CONTRACTOR** chooses, subject to the restrictions outlined, to a density of 90% as determined by ASTM D698, latest revision.

   The embedment shall be compacted by a method approved by the **CITY**.

3. Special Situations: In areas specifically designated in the plans and specifications, the entire backfill shall be compacted.

4. Compaction Methods: The method of compaction shall be left to the discretion of the **CONTRACTOR** with the following exception, unless otherwise specified, provided that the proper degree of compaction is obtained and provided that the pipe is not damaged in the process. If any potential damage to the pipe due to a proposed method of compaction exists, in the opinion of the Engineer, that method of compaction shall not be allowed.

   Compaction of any backfill material by flooding or jetting shall not be permitted for soils with a PI in excess of 5, unless authorized by **CITY**.

Hand-operated mechanical tampers may be used with approval of the **CITY** for compacting backfill.

5. Rejection: If the backfill does not meet the proper degree of compaction throughout its depth, the **CITY** shall require its removal and replacement to meet the requirements at the **CONTRACTOR'S** expense.

   In areas with vehicular traffic or for future improvements, all ditch lines after backfill and compaction shall be sealed with oiled dirt to preclude drainage water from entering the ditch line. The oiled dirt seal shall be maintained until road construction commences. Compensation for oil dirt seal shall be included in the unit price for the improvements if no separate bid item is provided in the proposal.

6. Means and methods to complete installation in accordance with the specifications shall be the responsibility of the **CONTRACTOR**. **CITY** shall provide quality assurance testing as deemed necessary.

E. INCLEMENET WEATHER: The **CITY** shall require work to cease due to inclement weather which saturates the existing soil to be removed and utilized as backfill material. Wet soil conditions, particularly in areas of proposed street improvements do not allow the proper compaction to be attained in cases of high moisture content.

3.5 TESTING AND STERILIZATION:

A. PRESSURE AND LEAKAGE TESTS: A hydrostatic test in accordance with AWWA M9, latest revision, shall be performed on all bar-wrapped concrete water lines installed under this contract. Unless authorized by the **CITY**, a separate hydrostatic test shall be performed on each valved section of the new water line. Waterline stub-outs measuring 200 lineal feet and less shall be incorporated into other test sections.

   The test procedure called for in AWWA M9 is paraphrased below for the **CONTRACTOR'S** reference:

1. Test Pressures: Test pressure shall be 150 psi or not be less than 1.25 times the working pressure at the highest point along the test section. The test pressure shall not exceed pipe or thrust-restraint design pressures.

2. Testing After Backfilling: Pipes shall be backfilled prior to testing. When harnessing is used as the method of thrust restraint, the harnessed sections must be backfilled prior to the test in order to develop necessary soil friction.

3. Preparation of Line: Air valves shall be located and checked to ensure they are operational. Small taps and corporation stops shall be installed at all high and low points to bleed air while the line is being filled. All outlets shall be plugged prior to testing.

4. Pretest Soaking: The line shall be filled at a slow rate to prevent air entrapment and shall be left with a low pressure for 24 hours prior to testing. This will saturate the concrete lining and reduce the apparent leakage attributable to absorption by the pipe walls. Before testing, equipment shall be checked to ensure they are in satisfactory condition.

5. Leakage Allowances and Test Duration: Allowable leakage shall be no greater than 50 gallons per inch of diameter per mile of per pipe per 24 hours. Any observed leaks shall be promptly repaired. The hydrostatic test shall be a 2-hour duration.

6. Bulkheads and Thrust Restraints: Bulkheads for use in conducting a hydrostatic test are available from pipe manufacturers. A system of thrust restraint is required at the bulkheads. When bracing against a flat type bulkhead against a thrust block, special care shall be taken if timber is used to avoid a crushing type failure in the wood. The thrust block must be adequately sized and cast against undisturbed soil. For a harnessed type bulkhead there must be enough pipe harnessed to hold the thrust.

B. STERILIZATION: Potable water lines shall be thoroughly disinfected in accordance with the latest revision of AWWA C651 and then flushed and sampled before being placed into service. A minimum of one sample for each 1,000 feet of completed main is required for bacteriological analysis. The **CONTRACTOR** shall furnish sampling taps and sterile bottles and shall deliver them to the local Texas Department of Health or county health unit laboratory. No line may be placed into service until negative bacteriological tests results (no bacteria found) are obtained. No hose or fire hydrant shall be used for sampling. Raw water lines shall not be sterilized.

PART 4 – MEASUREMENT AND PAYMENT

4.1. WATER LINES: Payment for installing bar-wrapped concrete water pipe shall be by the lineal foot. The measurement shall be made from end to end of the lines, including through all valves and fittings. This payment shall be the complete payment for site preparation, excavating the trench, furnishing and installing the pipe and joint materials, installing the backfill including compaction, performing all necessary tests and sterilization, and providing all clean up and restoration not specifically included in other bid items.

4.2 THRUST BLOCKING: Furnishing materials for and installation of thrust blocking shall be subsidiary to the installation of pipe and fittings, and shall not be considered as a separate pay item.

City of Tyler Standard Specifications

SERVICE LINES, TAPS AND OTHER APPURTENANCES

PART 1 - GENERAL

1.1 SCOPE: This specification covers the requirements for copper tubing, polyethylene (PE) pipe, tapping sleeves and valves, curb stops, clamps, fittings and other miscellaneous appurtenances for the installation of water service lines.

1.2 QUALITY ASSURANCE:

A. TAPPING SLEEVES AND VALVES: Tapping valves shall be tested by the manufacturer in accordance with AWWA C509. Any leaking at the test pressure through any casting or between the bronze ring and the cast iron body shall cause the said casting to be rejected. No plugging or patching to stop any leakage shall be allowed.

B. BRASS STOPS AND FITTINGS: All brass stops and fittings included in this section shall be tested in accordance with the applicable provisions of Section 2.2 relating thereto.

C. SERVICE CLAMPS: All products not previously approved for use shall be subject to a hydrostatic test. Service clamps shall not leak or show any structural deformation under a hydrostatic pressure of 300 psi for 30 consecutive days.

D. COPPER TUBING: The vendor shall be responsible for submission of a laboratory analysis of the products supplied. The manufacturer's own laboratory analysis is acceptable. The certificate of analysis shall state size and type of analysis and results obtained. A statement shall be made and validated that tests confirm compliance with the requirements of this specification.

The **CITY** reserves the right to conduct or cause to have conducted independent laboratory tests. Where the results of such tests prove the quality requirements have not been met:

1. The costs of tests shall be charged to the vendor's account, and
2. The entire shipment may be rejected on the basis of such tests.

E. POLYETHYLENE (PE) PIPE: The vendor shall be responsible for submission of a laboratory analysis of the products supplied. The manufacturer's own laboratory analysis is acceptable. The certificate of analysis shall state size and type of analysis and results obtained. A statement shall be made and validated that tests confirm compliance with the requirements of this specification.

The **CITY** reserves the right to conduct or cause to have conducted independent

laboratory tests. Where the results of such tests prove the quality requirements have not been met:

1. The costs of tests shall be charged to the vendor's account, and
2. The entire shipment may be rejected on the basis of such tests.

1.3 REJECTION: Products furnished under this specification may be rejected for failure to meet any or all of the requirements of this specification.

PART 2 - PRODUCTS

2.1 TAPPING SLEEVES AND VALVES:

A. TAPPING SLEEVES: The material for tapping sleeve bodies shall be Grade C carbon steel in accordance with ASTM A285, latest revision, in two sections or halves to be bolted together with high-strength corrosion-resistant low-alloy steel bolts conforming to ANSI/AWWA C111/A21.11, latest revision. Manufacturer shall be Smith-Blair Model 622 or approved equal.

Size-on-size taps must be approved by the City of Tyler prior to installation. All size-on-size taps, when approved, shall use stainless steel, full circle tapping sleeves. Manufacturer shall be Smith-Blair Model 665 or approved equal.

Carbon steel sleeves shall be subject to the following additional specifications:

1. Flange shall conform to AWWA C207, latest revision, Class D, ANSI 150 lb. drilling. Gasket shall be affixed around the recess of the tap opening in such a manner as to preclude rolling or binding during installation.
2. All carbon steel sleeves shall be fusion bonded epoxy coated to an average of 12 mil thickness. Finished epoxy coat shall be free of laminations and blisters, shall not peel and shall remain pliable and resistant to impact.
3. Carbon steel sleeves shall be provided with a ¾" NPT test opening so that test can be made prior to tapping. Opening shall be provided with a ¾" bronze plug.
4. All carbon steel sleeves shall be crated so as to provide protection from damage to epoxy coating during transport and storage.
5. Branch outlet of tapping sleeves shall be flanged, with a machined projection or recess to mate with tapping valve inlet flange to assure correct alignment.

B. TAPPING VALVES: Tapping valves shall conform to the requirements of C509, latest revision, and the other requirements of this section with the following exceptions:

1. Tapping valves shall have oversized seat rings to permit entry of standard tapping machine cutters.
2. In the open position, valve gates shall be clear of the ports, so that the cutter shall pass through without making contact with the gates.

3. Valves may have an inlet flange conforming to the latest revisions of ANSI/AWWA C110/A21.10, Class 125 and MSS-SP-60, with a machined projection or recess to mate with tapping sleeve outlet flange to assure correct alignment.
4. Valves shall have standard mechanical joint outlets and bolt holes drilled per ANSI B16.1 Class 125 and shall fit any standard tapping machine.

Tapping valves shall be manufactured by Mueller, M&H, Clow, AVK, or approved equal.

2.2 BRASS STOPS AND FITTINGS: Stops and fittings furnished under these specifications shall conform to the requirements of AWWA C800, latest revision, and shall be of the size and type specified, with all parts of brass, conforming to alloy 85-5-5-5, ASTM B62 - Table 1, latest revision, except cast solder-joint fittings shall conform to alloy 83-4-6-7, ASTM B584, latest revision. Brass used shall have a tensile strength (as determined from test bars) of not less than 30,000 psi when tested as prescribed by ASTM B208, latest revision. Stops containing brass parts shall be shipped prelubricated with a light fluid lubricant between key and body. Lubrication shall remain fluid indefinitely, either in storage or in service. All stops fittings shall be full size throughout the size specified.

A. CORPORATION STOPS: Corporation stops shall be of the ground key or plug type and shall have a maximum working pressure of 100 psi for sizes up to 1". Manufacturer shall be Ford F 1000, Mueller H-15008, or approved equal.

Seating surfaces shall be tapered and shall be accurately fitted together by turning the key and reaming the body. Seating surfaces shall be lapped together using suitable abrasives to insure accurate fit. The large end to the tapered surface of the key shall be reduced in diameter for a distance that shall bring the largest end of the seating surface of the key into the largest diameter of the seating surface of the body, and the taper seat in the body shall be relieved on the small end, so that the small end of the key may extend through to prevent wearing of a shoulder and to facilitate proper seating of the key. The stem end of the key, key nut and washer shall be so designed that if the key nut is tightened to failure point the stem of the key shall not fracture. The nut and the stem shall withstand a torque on the nut of at least three times the necessary effort to properly seat the key without failure in any manner.

Inlets shall have AWWA taper or iron pipe threads and shall be protected in shipment by a plastic coating or other equally satisfactory means. Outlets shall have pack joint or compression connections. If used, coupling nuts shall have a baring skirt machined to fit the outside diameter of the pipe for a length at least equal to the outside diameter of the pipe.

Corporation stops shall be so designed as to rotate about the axis of the flow passageway within a circle of rotation small enough to properly clear the inside of any standard tapping machine of appropriate size.

B. CURB STOPS: Curb stops shall be of the ball valve type and shall have a maximum working pressure of 300 psi for sizes up to 2". Manufacturer shall be Ford B 43, Mueller B-25170 or approved equal.

The ball stop shall have a full-size round-way opening with straight-through flow and a teflon coated bronze ball with a minimum of 0.5 mil thickness coating. Stops shall have EPDM or nitrile rubber seats and double O-rings made of rubber. The stop must be so constructed that it may be disassembled and the ball removed without special tools.

End connections shall be female iron pipe, pack joint or compression connections.

C. FITTINGS: All castings shall be smooth, free from burrs, scales, sand holes and defects of every nature which would make them unfit for the use for which they are intended.

Nuts shall be smooth cast and shall have symmetrical hexagonal wrench flats.

Flare-joint fittings shall be smooth cast. Seating surfaces for metal-to-metal seal shall be machined to proper taper or curve, free from any pits or protrusions.

Solder-joint fittings shall be smooth cast. Inside surfaces of solder-joint ends shall be machined smooth to proper inside diameter.

All thread fittings, of all types, shall have N.P.T. threads, and male threaded ends shall be protected in shipment by a plastic coating or other equally satisfactory means.

Compression tube fittings shall have a Buna-N beveled gasket or equal. Compression nuts shall have:

1. For copper pipe, an approved restraining device must be provided.
2. For iron pipe, a stainless steel set screw to bite in and lock on the pipe.

2.3 BRONZE SERVICE CLAMPS: Service clamps shall be designed for tapping water pipe under normal service pressure. PVC pipe shall be limited to 1" or 2" taps, while ductile iron pipe shall be limited to 2" taps only.

The clamp shall consist of a contoured saddle fastened to the pipe by two U-bolts and double strapped clamps, or shall consist of two sections or halves which shall be fastened together with a minimum of two bolts and nuts. The saddle shall be sealed against the pipe with a rubber gasket and shall have a heavy hub tapped with a corporation stop thread. The clamp shall be designed for 150 psi water working pressure.

Repair clamps and tapping saddles shall be manufactured by Smith-Blair or approved equal.

A. SADDLES: The saddles shall be shaped so as to provide approximately 180-degrees coverage around the pipe.

1. Saddle Hubs: The saddle hub for double strap clamps shall have a wall thickness of not less than 1/2" including threads. The hub shall be tapped with a corporation stop thread of the size specified. The thread shall have a taper and pitch in accordance with AWWA C800, latest revision. The hub shall be reinforced so that threads shall not be distorted by bending movements. Open slots for bolts shall not be allowed.
2. Clamps: Double strapped clamps 4" through 12" shall have not less than the following specified thickness from the point of the built-up hub segment to the segment immediately adjoining the holes for the saddle straps.

Clamp Size (inches)	**Minimum Thickness (inches)**
4	.190
6	.195
8	.195
10	.195
12	.215

3. Markings: Saddles shall be distinctly marked with cast letters showing manufacturer's name, type pipe saddle as designed for (cast iron, ductile, etc.) and minimum/maximum o.d. ranges.

B. STRAPS: Straps shall be formed flat on one side to fit uniformly against the wall of pipe. Rod diameter shall not be less than 5/8" flattened to ¾" on one side.

C. GASKET: Gasket shall be of O-ring type, 3/16" thick and securely fastened to the saddle to facilitate installation.

D. MATERIAL:

1. Saddle: Saddle shall be bronze, conforming to ASTM B62, latest revision.
2. Straps: Straps shall be of materials conforming to latest revisions of ASTM B124 and ASTM B98.
3. Nuts: Nuts shall be of the same materials as saddles or straps.
4. Gaskets: Gaskets shall be of neoprene rubber. Shore hardness shall be 65, plus or minus five.

2.4 METER RESETTERS: Meter resetters shall be constructed of no-lead brass alloy and shall have the letters "NL" cast into the main body for lead-free identification. Resetters shall be assembled with lead-free solder. Resetters shall conform to AWWA C800.

A. NO BYPASS: Inlet valve shall be flanged angle key valve and outlet shall be a

meter nut. Inlet and outlet shall be threaded. Manufacturer shall be Ford V42-xxW-NL or approved equal.

B. BYPASS: Inlet and outlet valves shall be flanged angle ball valves. Inlet and outlet shall be flanged. Bypass shall be a ball valve and be equipped with a padlock wing. Manufacturer shall be Ford VBB46-xxB-NL or approved equal.

2.5 SEAMLESS COPPER TUBING: This specification pertains only to Type K, Class 1, annealed (soft) copper water tubing for use with solder, flared, or compression-type fittings. The copper tubing shall conform to ASTM B88, latest revision.

Manufacturers shall be Cerro, Cambridge-Lee Ind., Wolverine, Kobe Weiland or approved equal.

2.6 POLYETHYLENE (PE) PIPE: Polyethylene (PE) pipe shall meet the requirements of AWWA C901, latest revision. PE pipe shall be made with 10 AWG, single strand tracer wire held to the pipe with two independent spiral-wound polypropylene continuous tape layers. Manufacturers shall be Endot Industries, Inc. ENDOTRACE or approved equal.

Pipe end shall be fitted with stainless steel inserts to prevent pipe from losing rigidity. Inserts shall be Ford Stainles Steel Inserts for Polyethylene Pipe or approved equal.

2.7 WATER METER VAULTS: Vaults may be precast or poured in place concrete structures, equipped with a diamond plate steel lid. All vaults shall be constructed to encompass required by-passes and shall be designed and constructed in accordance with the City of Tyler Standard Specification “Concrete Vaults” and the City of Tyler Standard Details.

PART 3 - INSTALLATION

3.1 WATER SERVICE LINES: Water service lines shall be made by tapping the water main under pressure (no dry taps permitted) at points as designated on the plans or as directed by the Engineer. The work shall be performed by experienced workmen with a suitable tapping machine, tools and materials. Generally water taps are designated to be installed in the center of the lot frontage to be served.

Service connections shall consist of a tap on the water main, installation of a corporation stop and polyethylene pipe extended to the point designated and terminated with a curb stop. The water service line shall be extended from the water main to a point immediately beyond the back of curb at the same depth as the main pipeline. Upon clearing the back of proposed curb, the service line pipe shall be raised to a point 12" below finished ground elevation. Water service lines shall terminate 3 feet behind back of curb and be marked with a “W” on the curb where the service line crosses the curb.

Magnetic tracer shall be installed directly above the service line, either as an integral part

of the piping or separately and immediately above the pipe.

Improper bending of the service pipe will injure or reduce the cross section of the pipe and will not be permitted. Upon installation and testing, the **CONTRACTOR** shall insure that all corporations are turned on and the installation is serviceable.

PART 4 - MEASUREMENT AND PAYMENT

4.1 TAPPING SLEEVES AND VALVES: Payment for tapping sleeves and valves shall be paid for per each at the unit price bid. This payment shall include furnishing and attaching the tapping sleeve (including furnishing joint materials, tapping sleeve, tapping valve, valve box and concrete) for furnishing the tapping machine, making the tap in the water main and for all necessary excavation, backfill and cleanup.

4.2 WATER SERVICE LINES: Payment for water service lines shall be paid for either per each service line (long service versus short service) or by the linear foot at the unit price bid. This payment shall include the tap on the main, corporation, copper or polyethylene service line and curb stop. Such payment shall be full compensation for all materials, equipment and labor necessary for installation and cleanup.

4.3 SERVICE LINE ADJUSTMENTS: Payment for adjustments needed to bring water service lines to 3’ back of curb shall be paid for per each service line. Such payment shall be full compensation for all materials, equipment and labor necessary for adjustments.

4.4 WATER METER VAULTS: Water meter vaults shall be paid for per each at the unit price bid. This payment shall be the complete payment for excavating the vault location, furnishing and installing the vault, complete in place if precast or the concrete, rebar and forms if cast in place, sump and drain line, vault covers, inspection plates, and all other miscellaneous appurtenances and materials to form a complete vault, the backfill including compaction, all necessary tests and sterilization, and all clean up and restoration not specifically included in other bid items.

City of Tyler Standard Specifications

VALVES FOR WATER SERVICE

PART 1 - GENERAL

1.1 SCOPE: This specification covers the requirements for gate valves, air valves and butterfly valves to be used in potable water systems.

1.2 SUBMITTALS: Prior to beginning the Work, the **CONTRACTOR** shall submit to the **CITY**, a list of all valves to be installed as part of the Work that includes the number used, the manufacturer and model, and the location installed of each valve. If requested by the **CITY**, the **CONTRACTOR** shall also submit manufacturer's product data for each valve.

1.3 REJECTION: Products furnished under this specification may be rejected for failure to meet any or all of the requirements of this specification.

PART 2 – PRODUCTS

2.1 RESILIENT WEDGE GATE VALVES: All resilient-seated gate valves shall conform to AWWA C509, latest revision or to AWWA C515, latest revision. Gate valves larger than 48" shall be a special consideration. Tests and design data may be as designated on the plans and contract specifications.

All gate valves shall be iron body, nonrising stem, fully encapsulated wedge type with a 250 psi maximum working pressure. Manufacturer shall be Mueller, M & H, Clow, American Flow Control, AVK or approved equal shall be furnished. Periodic reviews are made on other name brand valves for innovative improvements.

A. BODY AND BONNET: Valve bodies and bonnets shall be cast iron or ductile iron and shall be coated on the inside and outside with a fusion body epoxy coating. Bonnets shall have a rubber O-ring. All exterior valve body bolting shall be stainless steel.

B. ENDS: Valves shall have flanged, push-on, or mechanical-joint ends, or any combination of these as may be specified.

Mechanical-joint ends shall conform to ANSI/AWWA C111/A21.11, latest revision.

Flanged ends shall conform to ANSI B16.1, latest revision, Class 125.

Bolts and nuts for mechanical joints shall be of high-strength low-alloy corrosion-resistant steel conforming to ASTM A325 (Type 3), latest revision. All

mechanical-joint glands shall be cast iron.

C. WEDGING DEVICES: Wedges shall be cast iron or ductile iron and shall be fully encapsulated with rubber.

D. VALVE STEMS AND NUTS: Valve stems and valve nuts shall be bronze. The stem shall be provided with three rubber O-ring seals. The two O-rings above the thrust collar shall be replaceable with the valve fully open and while subject to its full rated working pressure.

E. STUFFING BOXES: The stuffing box shall be cast iron or ductile iron and shall have a rubber O-ring gasket.

F. HAND WHEELS AND/OR OPERATING NUTS: All valves 2" in diameter and larger shall be nut operated unless otherwise ordered. All operating nuts shall be cast iron, ductile iron or bronze.

Handwheels shall be furnished only when called for on plans or in the contract specifications. The handwheel shall be constructed of cast iron or ductile iron.

All valves shall open by turning counterclockwise.

G. BY-PASS VALVES: By-pass valves, when required, shall conform to the requirements of AWWA C509 or AWWA C515.

Properties, construction and design requirements herein specified are applicable to by-pass valves, except stems on by-pass valves over 4" shall have the same physical qualities as for 30" and larger.

H. VALVES FOR INSTALLATION IN HORIZONTAL PIPELINE: Valves for installation in horizontal pipelines shall be designed for vertical installation unless otherwise shown on the plans.

2.2 AIR RELEASE VALVES: Unless otherwise indicated in the plans or contract specifications, air valves shall meet the requirements specified herein.

A. TYPES: Air valves shall be of two types as follows:

1. An air valve called for on the plans shall mean an air and vacuum valve of the ball type designed to permit the escape of air from a pipeline when the line is being filled and to permit air to enter the pipeline when the line is being emptied.
2. A combination air valve called for on the plans shall mean a combination air and vacuum and air release valve designed to fulfill the functions of an air and vacuum valve and also designed to permit the escape of air accumulated in the line at the high point when the line is under pressure while in operation. Air valves 3" and smaller shall be self-contained in one

unit. Air valves larger than 3" shall be a combination of two valves, unless otherwise shown on the plans.

B. MATERIAL: The valves shall be stainless steel or iron body, stainless steel, brass or bronze fulcrum levers and links, stainless steel ball floats and pins, steel flange bolts and nuts, Buna-N synthetic rubber seats against bronze or stainless steel, and brass for other parts.

C. INLETS AND OUTLETS: Inlets shall be threaded for 2" and smaller and flanged for 3" and larger. Outlets shall be threaded through 4".

D. OPERATING PRESSURE AND TESTING: The valves shall be designed to operate under an operating pressure of 200 psi and shall be tested to 1-1/2 times that pressure.

E. COATING: Air valves shall be coated with an epoxy coating such as Tnemec Pota-Pox Series N140, or approved equal.

2.3 BUTTERFLY VALVES:

A. GENERAL: Butterfly valves and operators shall conform to AWWA C504, latest revision, and to these specifications:
1. Type of body shall be short body, flanged.
2. Body material shall be cast iron or ductile iron.
3. Class shall be specified on the plans or contract specifications.
4. Shafts shall be Type 304 or 316 stainless steel.
5. Flange holes shall be drilled full size.
6. Valve seats shall be natural rubber or Buna-N and polished stainless steel, Type 304 or 316, 90 seating angle only, with a 360-degree uninterrupted seating surface.
7. Shaft seals shall be standard split-V packing or double O-ring seal cartridges.
8. Discs shall be ductile iron, cast iron, or fabricated steel.
9. Operating nuts shall be ductile iron.

B. ENDS: Valves shall have flanged, push-on or mechanical joint ends or any combination of these as may be specified:
1. Mechanical joint ends shall conform to ANSI/AWWA C111/A21.1l, latest revision. Bolts and nuts for mechanical joints shall be of high-strength low-alloy corrosion-resistant steel conforming to ASTM A325 (Type 3), latest revision.
2. Push-on joint ends shall conform to ANSI/AWWA C111/A21.1l, latest revision.
3. Flanged ends shall conform to ANSI/AWWA C110/A21.10, latest revision, class 250 lb.

C. VALVES FOR INSTALLATION IN HORIZONTAL PIPELINE: Valves for installation in horizontal pipelines shall be designed for vertical installation unless otherwise shown on the plans.

D. MANUAL OPERATORS: All operators shall be located as follows, unless otherwise noted, looking in the direction of flow:
1. At the right end of a horizontal shaft.
2. Input shaft vertical and upward.

The valve shall close by turning the input shaft clockwise. All handwheels shall turn clockwise to close the valve.

All manual operators shall be totally enclosed worm gear type, or rack and pinion type.

All operators shall be equipped with a disc position indicator with each valve. The indicator shall be highly visible, clearly showing the legends “Open” and “Closed” at the ends of a 90-degree arc, with a pointer to show the disc position (Closed – 0-degrees and Open – 90-degrees). The arc shall be graduated in degrees.

All manual worm gear type operators shall be Limitorque, Type HBC, or approved equal.

Each valve operator shall be sized for maximum valve torque requirement based on the operating pressures and flow rates as specified.

E. ELECTRIC MOTOR OPERATOR: Each electric motor operator shall conform to AWWA C504, latest revision, and shall be of sufficient size to open and close the valve against maximum differential pressure and maximum required torque conditions when voltage at motor terminals is 90% of nominal voltage; and shall have totally enclosed worm gear reducer with spur gear attached. Limit switches shall be for the four train-gear with switches adjustable to operate at any point in the opening or closing cycle of the valve.

Limit switches and torque switches shall be located in a special compartment that is an integral part of the operator and shall be readily accessible. Each limit switch shall have two normal closed contacts. Limit switch gearing shall be in step at all times whether in power or manual operation. Limit switch gearing shall be stainless steel or high-grade bronze. Two torque switches shall be furnished, one for opening direction and one for closing direction. The torque switches shall be connected in series, so that they shall operate regardless of the phasing of the power.

Torque and thrust loads in both closing and opening directions shall be limited by torque switches. Each torque switch shall be provided with a micrometer

adjustment and reference setting indicator. The adjustment shall permit a variation of approximately 40 percent in torque setting. Switches shall have a rating of not less than six amperes at 120 volts ac and 2.2 amperes at 115 dc. The torque switches shall be in series with the opening and closing coils of the starter.

The torque switches shall be factory adjusted by the manufacture for this application.

A handwheel for manual operation shall be provided. Motor shall not rotate when handwheel is in use. A fused motor shall not interfere with manual operation. For valve control, furnish for each valve a reversing starter in watertight enclosure which is integral with the operator housing. Furnish a push-button station, NEMA-4, with red and green indicating lights separate from the valve operator. Space heaters shall be provided to protect the motor, reversing starter and limit switch compartments from moisture condensation. Valve control wiring diagrams shall be furnished with submittal data.

Valve operators shall conform to latest revision of AWWA C504, latest revision, and shall be designed to hold the valve in any intermediate position between fully opened and fully closed without creeping and fluttering.

F. OTHER OPERATORS: Other types of operators shall conform to AWWA C504, latest revision.

G. SHIPMENT AND STORAGE REQUIREMENTS: Electric motor operated valves shall be shipped to bonded covered warehouse storage to be designated by the **CITY**. Valves shall be stored indoors and shall have space heaters energized.

Full face flange protectors of waterproof plywood shall be at least 1" thick.

H. TESTS: All butterfly valves shall be tested by the manufacturer in accordance with AWWA C504, latest revision. Test results shall be furnished to the **CITY**.

2.4 AUTOMATIC FLUSHING VALVES: Portable flushing station shall be removable with inlet threads capable of being used on any standard 3/4" or 3/4"x5/8" meter setter sampling station. All operational parts and water shall be PVC or stainless steel. The flushing valve shall automatically flush up to 65 gallons per minute, control the flow of water through the hydrant and its diaphragm with the extension and retraction of a DC latching solenoid and have a 150 psi rating. Each unit shall be furnished with a stand-along valve controller. The valve controller shall not require a second hand-held device for programming. Controller must have a minimum of 12 possible flushing cycles per day at up to 6 hours of flush time per cycle. Controller shall be submersible to 12 feet, operate with a 9-volt battery and have resin-sealed electrical components. The solenoid shall have no loose parts when removed from the valve. The flushing station shall be installed on a 2-inch water service line in a concrete meter box and be plumbed to flush away from neighboring properties (i.e., to an inlet box, curb or street). A meter gasket will be used to

prevent leaking. Valves shall be Kupferle Foundry Company Model 9497A Meter Pit Automatic Flushing Station.

2.5 STANDARD VALVE BOXES: Valve boxes shall be cast iron telescoping type and shall be Bass & Hayes Foundry, Inc. 340-1, Tyler Pipe 562-S or approved equal. Valve boxes for valves used to define controlled pressure zones shall be painted red to designate that they should be closed. Valve boxes installed outside proposed travel-ways shall include a concrete pad at least 2' x 2' and 4" thick placed at finished ground level.

PART 3 - INSTALLATION

3.1 AIR/VACUUM VALVES: Air valve installation shall include a corporation projected from either a tap or outlet provided on the pipeline; brass piping; two (2) each 90-degree bends; valve placement on the pipe run in a horizontal position; air/vacuum valve placement; and a box constructed of PVC or concrete of sufficient size to house the valve for maintenance purposes.

PART 4 - MEASUREMENT AND PAYMENT

4.1 GATE VALVES: Payment for gate valves shall be paid for per each at the unit price bid. Payment for gate valves shall include furnishing and installing the valve, including the valve box and concrete, plus all incidentals for installation and clean-up.

4.2 AIR VALVES: Payment for air valves or combination air vacuum shall be paid for per each at the unit price bid. Payment shall include either a tap on the main pipeline or adaptation to an existing pipe outlet including a corporation, sufficient brass or copper piping, two (2) each 90-degree pipe bends if required, and a valve placed in a horizontal position. Installation shall include a metal or concrete box of sufficient size to house the air valve for maintenance purposes. Such payment shall include full compensation for all labor, material, and equipment for installation.

4.3 BUTTERFLY VALVES: Payment for butterfly valves shall be paid for per each at the unit price bid. Payment for butterfly valves shall include furnishing and installing the valve, including the valve box and concrete, plus all incidentals for installation and clean-up.

City of Tyler Standard Specifications

FIRE HYDRANTS

PART 1 - GENERAL

1.1 SCOPE: This specification covers the requirements for fire hydrants used in the water distribution system. Except for supplementary details, changes, or additions set forth herein, fire hydrants shall comply with AWWA C502, latest revision.

1.2 APPROVAL: Only those manufacturers whose hydrants have been specifically approved by the Director of Utilities and Public Works will be approved for use in the **CITY'S** water system. This approval will be based in part, but not limited to, the following:

A. DRAWINGS: Each manufacturer of fire hydrants manufactured under these specifications shall have on file with the **CITY** certified assembly drawings of the hydrant proposed to be furnished. Any proposed exceptions, changes, or modifications of design must be accompanied by new detailed drawings and statement of changes made. Failure to meet this requirement is sufficient cause for disqualification. Drawings furnished shall show principal dimensions, including metal thickness, construction details, and materials used.

B. EXPERIENCE RECORD: No hydrant will be considered which has not been regularly manufactured and in current production.

C. AFFIDAVIT OF COMPLIANCE: An affidavit of compliance to the effect that the hydrant complies in all respects to these specifications shall accompany each request for approval.

1.3 TESTS: All fire hydrants shall fully meet and comply with the hydrostatic tests set forth in AWWA C502.

1.4 SUBMITTALS: Prior to beginning the Work, the **CONTRACTOR** shall submit to the **CITY**, a list of all hydrants to be installed as part of the Work that includes the number used, the manufacturer and model, and the location installed of each hydrant. If requested by the **CITY**, the **CONTRACTOR** shall also submit manufacturer's product data for each hydrant.

1.5 REJECTION: Fire hydrants and other appurtenances may be rejected for failure to meet any or all of the requirements of this specification.

PART 2 - PRODUCTS

2.1 FIRE HYDRANTS: Fire hydrants shall be post type with compression main valve closing with the line pressure. All hydrants shall be of the “Traffic” type with easily replaceable frangible parts designed to break on traffic impact. Hydrants shall be designed for a working pressure of 150 psi, and shall be new and unused and of current manufacture.

Fire hydrants shall be Mueller Super Centurion 423, Clow Medallion, American Darling B48B or AVK 2780.

2.2 MAIN VALVE SIZE: 5-1/4" valve outlet minimum.

2.3 INLET CONNECTION: 6" mechanical joint or as otherwise shown on the contract drawings. All bolts used in mechanical joints shall be high-strength low-alloy, corrosion-resistant material such as USS Cor-Ten, Bethlehem Mayari, or equal.

2.4 DEPTH OF BURY: Normally 5 feet unless otherwise shown on the plans or called for in the contract documents. The maximum permissible depth of bury is 6 feet, unless otherwise approved. If fire hydrants are set off water lines with depths greater than 6 feet, offsets, bends, and fittings as required shall be used to reduce the hydrant depth of bury to no more than 6 feet.

2.5 BARREL SECTIONS: Hydrants shall have upper and lower barrel sections with the joint designed to be at least 2" above finished grade. The union between the upper and lower barrels shall be made by a traffic safety device such as a two-part safety flange, four-part segmental coupling, or breakable lugs in combination with breakable bolts. The design will permit rotation of the upper barrel to position the nozzles in any direction. Upper and lower barrel flanges shall be integrally cast.

2.6 NOZZLES: The upper barrel shall include two (2) hose nozzles and one (1) pumper nozzle located on the same plane. All nozzles shall be equipped with cap chains and gaskets for all nozzle caps.

2.7 HOSE NOZZLES: The two hose nozzles shall be 2-1/2" I.D. with National Standard threads.

2.8 STEAMER NOZZLE: The steamer nozzle shall be 4-1/2" I.D. with National Standard threads.

2.9 DIRECTION TO OPEN: Turn to left (counter clockwise).

2.10 OPERATING NUT: The operating nut shall be pentagon, 1-1/2" measured point to flat.

2.11 FINISHES: The body of the fire hydrant above ground shall be painted two coats of perma-coat quick dry gloss enamel in Safety Red, or approved equal. The bonnet and caps shall be painted with two coats of Silver Chrome Aluminum, or approved equal

Exposed exterior surfaces below the ground line, exposed interior surfaces below the ground line and interior surfaces above the main valve shall be coated with two coats of asphalt varnish or primer. Asphalt varnish shall meet the requirements of Federal Specification TT-V-51 or Military Specification Mil-C-450. The prime coat from the ground up shall be Federal Specification TT-P-86 (type IV), Federal Specification TT-P-636 or equal.

2.12 STEM: The union between the upper and lower stems shall be made by a breakable coupling. The design shall be such that excessive turning torque on the stems in either the opening or closing cycle is not transmitted to the weakened section of the coupling.

2.13 DRAINWAY: The drainway shall be all bronze. Drain water shall not come in contact with the internal cast iron parts of the shoe while exiting the hydrant through the drainway.

2.14 MAIN VALVE: The main valve and seat ring shall be removable through the upper barrel from above ground.

2.15 RINGS: O-rings shall be furnished in lieu of stem packing.

PART 3 - INSTALLATION

3.1 INSTALLING FIRE HYDRANTS AND VALVES: Fire hydrants and valves shall be installed at points shown on the plans and at such other locations as the Engineer shall direct. Changes to the plans shall be approved by the Director of Utilities and Public Works. A gate valve shall be installed on each fire hydrant branch between the main line and hydrant. Generally hydrants shall be placed at intersections and shall be installed at the end of the curb radius, with a minimum back of curb clearance of 1-1/2 feet measured from the steamer nozzle cap. Hydrants placed between blocks shall be placed in line with a property line between individual lots. Fire hydrants shall stand plumb, with the steamer nozzle facing the street. The Engineer shall furnish the location of each hydrant and furnish a grade for installation.

The shoe of each hydrant shall be placed on a concrete slab 4" thick and 15" square. The side of the hydrant opposite the steamer nozzle shall rest firmly against the face of the trench. All hydrants shall be positively restrained, with use of retainer glands, long swivel hydrant adapters and swivel fittings or bridle rods and collars if unstable ground conditions are encountered.

In the event the **CONTRACTOR** makes excessive excavation around a fire hydrant location, the **CONTRACTOR** shall furnish and install concrete backing behind the

hydrant at no extra payment. Washed gravel consisting of 6 cubic feet shall be placed around the base of each hydrant to serve as a drain field when the hydrant is closed.

The length of the barrel of the hydrant shall be sufficient for the depth of bury at the particular location in which the hydrant is to be installed. The joint between the upper and lower barrel sections shall be at least 2" above finished grade for each location. The minimum bury of the fire hydrant is 5 feet. The maximum bury permissible is 6 feet unless otherwise approved. If fire hydrants are installed at points where the main pipeline is a greater depth than 6 feet, offsets, bends and fittings are required to reduce the bury to no more than 6 feet. No extra payment shall be made for hydrants requiring barrels longer than 3-1/2 feet of bury.

3.2 REFLECTIVE FIRE HYDRANT MARKERS Before final acceptance will be issued, 4” by 4” raised blue reflective markers shall be installed in the street at a point adjacent to the fire hydrant. At corner locations, buttons must be installed in both streets. On unstriped roads, markers shall be placed in the center of the road. On striped or divided roads, markers shall be placed 6” from the stripe or divider on the side closest to the hydrant. Markers shall be applied with a bituminous adhesive on asphalt streets and with an epoxy adhesive on concrete streets.

PART 4 - MEASUREMENT AND PAYMENT

4.1 FIRE HYDRANTS: Fire hydrants shall be paid for at the unit price bid for each and shall include all fittings and specials necessary for installation to the proper grade and location. Branch line valves and pipe utilized in the branch extension shall be considered separate from the hydrant and retainer glands or specials required. Payment for fire hydrants shall include the concrete slab, drain gravel, bridle rods and collars where required and retainer glands utilized in the installation. Payment for fire hydrants shall also include painting as described in paragraph 2.11 “Finishes”.

City of Tyler Standard Specifications

CONCRETE VAULTS

PART 1 - GENERAL

1.1 SCOPE: This specification covers the requirements for concrete vaults for compound water meters sized 3" and larger and detector check valves in non-traffic installations.

Separate vaults shall be used for each water meter, detector check valve and backflow device.

Concrete vaults may be either precast or cast-in-place.

1.2 REJECTION: Concrete vaults may be rejected for failure to meet any or all of the requirements of this specification.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE VAULTS: Precast concrete vaults shall be constructed in accordance with ASTM C915, latest revision, with a minimum compressive strength of 3,000 psi at 28 days. Vaults shall be constructed with minimum 6" thick walls, top and base.

The bottom of the vault shall be in one direction to a 12" square sump 6" in depth. The sump shall be connected to the **CITY'S** storm drain system where possible. Where it is not possible to connect to the storm drain system, 4", schedule 40 PVC pipe shall be installed at the lower edge of the sump and graded to drain away from the vault. The 4" PVC pipe shall be solid to a point outside the vault wall. Perforated 4" PVC pipe shall be installed from the outside wall for a distance of seven (7') feet to serve as a field drain. The 4" perforated pipe shall be encased in drain gravel at least 6" completely around the pipe and geotextile fabric in accordance with the City of Tyler Detail for Underdrain.

Vaults shall be sized to provide proper inside clearance from fittings, valves, and meter bypass connections to allow sufficient space for a minimum 18" interior clearance. The depth of the vault above the top of the meter shall not exceed five (5') feet. The top of the vault shall be installed to match area landscape elevation with sufficient rise that soil will slope away from the top and drain surface water off the vault lid. Vault dimensions shall generally be as follows:

Meter Size	**Vault Dimensions (minimum)**
Less than or equal to 8”	8’ long x 3’ wide
10”	9’ long x 7’ wide

Exact dimensions may need to be coordinated with the City.

Manufacturer shall be Del Zotto Concrete Products or approved equal.

2.2 CAST-IN-PLACE CONCRETE VAULTS: Cast-in-place concrete vaults shall be constructed of Class A Concrete - 5 Sack Mix, with #3 Bar Steel on 12" centers, vertical and horizontal. All forms shall be inspected by the Project Representative prior to beginning the pour. Vaults may be poured in stages with steel stubbed a minimum of 12" out of each pour. Concrete pours shall be made within 45 minutes of truck arrival, and each pour shall be sufficiently vibrated.

Vaults shall be grouted to a smooth broom finish with all leavouts grouted around the inlet and outlet pipe.

The bottom of the vault shall be constructed of concrete, 6" thickness and graded in one direction to a 12" square sump 6" in depth. The sump shall be connected to the **CITY’S** storm drain system where possible. Where it is not possible to connect to the storm drain system, 4", schedule 40 PVC pipe shall be installed at the lower edge of the sump and graded to drain away from the vault. The 4" PVC pipe shall be solid to a point outside the vault wall. Perforated 4" PVC pipe shall be installed from the outside wall for a distance of seven (7') feet to serve as a field drain. The 4" perforated pipe shall be encased in drain gravel at least 6" completely around the pipe and geotextile fabric in accordance with the City of Tyler Detail for Underdrain.

Vault walls shall be formed for 6" thickness with a minimum of 18" interior clearance from the bottom and sides of the pipe fittings, meters, valves, and bypass connections.

Exact vault dimensions shall be obtained from actual field measurements for proper inside clearance from fittings, valves, and meter bypass connections to allow sufficient space for a minimum 18" interior clearance. The depth of the vault above the top of the meter shall not exceed five (5') feet. The top of the vault shall be installed to match area landscape elevation with sufficient rise that soil will slope away from the top and drain surface water off the vault lid.

2.3 VAULT COVER: The vault cover shall be constructed of 1/4" diamond plate steel, skid resistant, with 300 pounds per square feet load weight. The cover shall have a 1-7/8” hole drilled into it and shall be equipped with a restraint chain that limits the lid opening to a maximum angle of 120 degrees. The vault cover shall be counter sunk in the concrete wall 3/8" to 1/2" deep, with no deflections up or down along the edges of the vault cover.

The counter sunk section for the vault cover shall be a minimum of 2" width for the entire perimeter of the inside box wall and sides.

The vault cover shall be reinforced on the bottom completely around the perimeter; less 2" and on both ends of the inspection plate, with 1-1/2" x 1-1/2" x 3/16" angle iron by welding. Placement of the angle iron shall be installed to allow 1-1/2" angle iron to protrude downward into inside diameter walls and ends of the vault to secure the vault cover.

The vault cover shall be equipped with two 3/8" steel rods for handling. The rods shall be constructed to protrude through the vault cover in holes of slightly larger diameter than the rod with a welded plate on the bottom of the 3/8" rods. The length of the rod between holes shall be 4", centered in each end of the cover and 6" from the edge of the vault cover. The rods for handling of the cover shall drop through the plate steel at both ends and rest evenly on the cover in a slightly counter sunk groove.

The inspection plate shall be equipped with one 3/8" rod handle as described above, to be placed at the edge of the plate, opposite the hinged area. The rod handle shall rest evenly on the covering in a slightly counter sunk groove.

The vault cover shall finally be painted with two coats of Structural Steel Shopcoat Primer, Red Oxide No. E-61 R25, Sherwin Williams, or approved equal.

2.4 INSPECTION PLATE: The inspection plate shall be constructed of the same material as the vault cover with dimensions as follows. The inspection plate shall be placed on the cover in such a location as to facilitate reading of the water meter.

Compound Meters		**Detector Check Valves**	
Meter Size	**Plate Size**	**Valve Size**	**Plate Size**
3"	28" x 24"	3" or 4"	28" x 24"
4"	28" x 24"	6"	28" x 24"
6"	28" x 24"	8"	28" x 24"
8"	28" x 24"	10"	36" x 24"
		12"	36" x 24"

Inspection plates shall be securely held in place with heavy duty steel, tight pin, reversible butt hinges, 4" x 4" size, attached to bottom of the inspection plate and the bottom of the vault cover on continuous weld. The number of hinges required on the installation shall be determined as follows:

Inspection Plate Size	**Number Hinges Required**
28" x 24"	3
36" x 24"	4

PART 3 - EXECUTION

3.1 GENERAL: Prior to construction, contact the Project Representative to schedule inspections.

The **CONTRACTOR** shall comply with the traffic control requirements as required in the City of Tyler General Conditions and furnish barricades, cones, and flares maintained on the job from commencement of the work to final completion and acceptance.

Concrete vaults shall not be installed in sidewalk areas or in areas subjected to vehicular traffic, unless special approval is given by the **CITY**.

Backfill around the vault shall be mechanically tamped. In the event the spoil removed from the vault is unsuitable for backfill, the **CONTRACTOR** shall furnish backfill suitable for the installation. Backfill shall be granular, free of rocks and debris. Water soaking may be utilized to attain proper compaction upon approval of the Project Representative.

The area disturbed by construction shall be replaced to original or better condition as existed prior to construction. Seeding or grass sod shall be utilized to replace damaged landscape.

When construction is complete, the installation shall be free of hazardous obstructions which would contribute to injuries to pedestrians or the public in general.

The complete installation shall be finally inspected by the Project Representative or his appointed representative.

Buildings which require Fire Sprinkler Systems shall comply with State law on plan approval. Local codes and ordinances shall apply per normal routine.

Installation from the required Detector Check Valve, to and including building, shall be performed under the oversight of a Registered Fire Sprinkler Company representative, along with regulatory inspection and tests.

In cases where a building does not require a fire sprinkler system, the inspection by a Registered Fire Sprinkler Company will not be required for approach lines and onsite fire hydrants.

Inspection of underground pressure tests will be made under the supervision of the City of Tyler Fire Marshall and observed by the Project Representative.

PART 4 – MEASUREMENT AND PAYMENT

4.1 CONCRETE VAULTS: Concrete vaults shall be paid for per each at the unit price bid. This payment shall be the complete payment for excavating the vault location, furnishing and installing the vault complete in place if precast or furnishing and installing the concrete, rebar, forms, sump and field drain, vault covers, inspection plates, and all other miscellaneous appurtenances and materials to form a complete cast-in-place vault, the backfill including compaction, all necessary tests and sterilization, and all clean up and restoration not specifically included in other bid items.

City of Tyler Standard Specifications

VITRIFIED CLAY PIPE (VCP) FOR GRAVITY SEWER MAINS

PART 1 - GENERAL

1.1 SCOPE: This specification covers the requirements for vitrified clay pipe and fittings to be used for sanitary sewer gravity mains.

1.2 QUALITY ASSURANCE: Pipe shall be the product of one (1) manufacturer which has had not less than 10 years successful experience manufacturing pipe of the types and sizes indicated, unless approved by Tyler Water Utilities.

1.3 CERTIFICATION: Written certification by the manufacturer indicating compliance with the requirements of ASTM C425 and ASTM C700 shall be submitted to the Engineer for approval prior to delivery of the pipe. The certification shall include the test result data.

1.4 HANDLING AND STORAGE: Handling and storage shall be in accordance with the pipe manufacturer's recommendations. The **CONTRACTOR** shall inspect each load of pipe upon delivery to verify that the load is intact and in good condition. During handling the **CONTRACTOR** shall minimize impacts to the pipe. Care shall be taken to insure the pipe is not dropped or damaged.

If possible, pipe shall be stored in packages provided by the manufacturer. Care shall be taken to avoid compression, damage or deformation to ends of pipe. Pipe should be supported to prevent damage to the bottom of the pipe. The interior of the pipe shall be kept free from dirt or other foreign matter.

1.5 REJECTION: Vitrified clay pipe may be rejected for failure to meet any or all of the requirements of this specification.

PART 2 - PRODUCTS

2.1 VITRIFIED CLAY PIPE: Gravity sewer pipe sized 4" through 42" shall be Extra Strength Vitrified Clay Pipe. Pipe shall conform to all the requirements of ASTM C700, latest revision. Maximum lengths produced by the manufacturer shall be furnished except for fittings, closures and specials.

All pipe and fittings shall be clearly marked with the name or trademark of the manufacturer, the location of manufacturing plant, and strength designation.

2.2 JOINTS: Clay pipe joints 15" and larger shall conform to the requirements of ASTM C425, latest revision, for bell and spigot pipe.

Clay pipe joints 12" and smaller shall conform to the requirements of ASTM C425, latest revision, for compression couplings for plain-end pipe. The collar material for compression couplings of plain-end pipe shall conform to the requirements of ASTM D1784, latest revision.

Pipe joints shall be new and shall be Can Clay "CanOLok", Mission Clay Pipe/Building Products Company "JCP Polyurethane Compression Joints" or approved equal.

2.3 FITTINGS: Fittings in vitrified clay pipe for all sizes shall be of the same strength, and conform to the same specifications, as the pipe. Fittings shall be made to such dimensions as will accommodate the joint system specified. Wye and Tee branch fittings shall be furnished with spurs securely fastened by the manufacturer to the barrel of the fitting. There shall be no projection on the inner surface of the barrel.

PART 3 - EXECUTION

3.1. SITE PREPARATION: The construction site shall be prepared for construction operations by the removal and disposal of all obstructions and objectionable materials from the designated construction area. It is the intent of this specification to provide for the removal and disposal of all objectionable material not specifically provided for elsewhere in the plans or specifications. This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for clearing and removing from the site of the work wherever located, all obstructions, designated trees, stumps, brush vegetation, miscellaneous stone, brick, concrete, scrap iron and all rubbish and debris whether above or below ground level. Such items shall be included in such contract pay item as provided in the bid proposal.

3.2 EXCAVATION: This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for the furnishing, placing and maintaining of all sheeting, shoring and bracing necessary to protect the work and adjacent properties; to support the sides and ends of the excavation and to support all adjacent structures above and below the ground; the installation and operation of all pumping, bailing and draining necessary to keep the excavation free from seepage water, water from sewers, drains, ditches, creeks and other sources; to provide for the uninterrupted flow of the removal, after the completion of the work, of all sheeting, shoring and bracing not necessary to support the sides of the excavation; and the satisfactory disposal of excess and unsuitable materials not required or which cannot be used for backfilling.

Prior to commencing any excavation, the **CONTRACTOR** shall provide ample labor, equipment, shoring materials and such other safety equipment as required to insure that the work shall be carried on without interruption or damage to existing installations; and to provide the least interruption of traffic commensurate with the project requirements. Blasting is prohibited; alternate methods shall be utilized.

In general, all excavation shall be made in open cut from the surface of the ground and shall be no greater in width or depth than is necessary to permit the proper construction of the work in accordance with the plans and these specifications. All excavation shall be to the line and grade as provided by the Engineer. The **CONTRACTOR** shall abide by all applicable federal, state and/or local laws governing excavation work. The entire foundation area in the bottom of all excavation shall be firm, stable and at uniform density as nearly as practicable. Unless necessary, materials shall not be disturbed. The final cleaning and preparing of the foundation area shall be done immediately prior to the placing of the embedment materials or structures.

A. PROGRESS: The **CITY** shall have the right to limit the amount of trenches that shall be opened, or partly opened, in advance of or following the pipe laying operation. Unless otherwise directed by the **CITY**, the completion of backfill shall immediately follow the pipe laying. In the event the **CONTRACTOR** fails to comply with this requirement, the **CITY** may stop the pipe laying until the requirements are met.

B. TRENCH BOTTOM ELEVATION: All trenches for installation of gravity sewer lines shall be excavated to a point below the barrel of the pipe for the type of embedment specified.

C. TRENCH OVERCUT: Should the **CONTRACTOR** excavate below the plan trench bottom for gravity sewer lines, the **CONTRACTOR** shall backfill to trench bottom grade shown on the plan with approved aggregate, consolidated and compacted to meet the **CITY'S** approval, at no additional cost to the **CITY**. See paragraph 3.2.H "Stabilization" of this specification.

Trenches shall be excavated to a width that will provide adequate working space but not more than the maximum design width. Trench walls shall not be undercut.

The trench walls may be sloped. The measured width at the top of the pipe shall not exceed the maximum design trench width.

Uniform support shall be provided along the length of the barrel. Bell holes shall be excavated to prevent point loading of the bells.

D. EXCAVATION CLASSIFICATIONS: All excavation is "unclassified" and involves removal of all materials necessary to permit carrying on the completion of the work.

Bidders must satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location, and sizes of pipe or conduits of various kinds in place.

E. SHORING AND SHEETING: When necessary to prevent caving or unduly hazardous working conditions, or to comply with existing laws, trench walls shall

be appropriately braced, or sheeted and braced. Where bracing, or sheeting and bracing, is used, the trench width shall be increased accordingly and shall be paid for per linear foot of bracing or sheeting and bracing. Sheeting and shoring shall be in accordance with the City of Tyler Standard Specification for Trench Safety Systems.

In wet, saturated or flowing materials where it is necessary to install tight sheeting or cofferdams, wood or steel sheet piling shall be used. All sheeting, shoring and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and to maintain the sides of the excavation properly from injury or damage. When excavations are made adjacent to existing buildings or to other structures or in paved streets, particular care shall be taken to adequately sheet, shore and brace the sides of the excavation to prevent undermining of, or settlement beneath the structures or pavement. Unless otherwise established in the pay items, underpinning of adjacent structures or pavement shall be done by the **CONTRACTOR** at his own cost and expense and in a manner satisfactory to the **CITY**; or, when required by the **CITY**, the pavement or structure shall be removed, the void satisfactorily refilled and compacted and the pavement or structure replaced by the **CONTRACTOR**. Wooden sheeting, shoring, and bracing shall be left in place where it is adjacent to the pipe embedment for the initial lift of backfill.

The removal of all sheeting, shoring and bracing shall be done in such manner as not to endanger or damage either new or existing structures, private or public properties; and so as to avoid cave-ins, or sliding of the banks. All holes or voids left by the removal of the sheeting, shoring or bracing shall be immediately and completely filled and compacted with suitable materials. If, for any reason, the **CONTRACTOR**, with the approval of the **CITY**, elects to leave in place the sheeting, shoring or bracing, no payment shall be allowed for such material left in place unless ordered by the **CITY** to be left in place.

If a movable shield is used in the pipe zone, it is imperative that pipe already laid be securely blocked or braced to prevent opening of pipe joints when the shield is advanced in the trench.

F. DISPOSAL OF EXCAVATED MATERIALS: Suitable excavated materials may be piled adjacent to the work to be used for backfilling. Excavated materials unsuitable for backfilling, or in excess of that required for backfilling, shall be disposed of by the **CONTRACTOR**. Desirable topsoil, sod, etc., shall be carefully removed and piled separately adjacent to the work when required. Excavated materials shall be handled at all times in such manner as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to private and public property adjacent to or along the line of work. The excavated material in rock which is not suitable material for bedding or backfill shall be disposed of by the **CONTRACTOR**. Suitable selected bedding or

backfill material from the trench excavation shall be provided at no additional cost to the **CITY** or **OWNER**.

G. DEWATERING: The **CONTRACTOR** shall remove all water from any source which may accumulate in the excavation. The embedment or pipe shall not be installed in water. No water shall be allowed to flow through or over unset concrete or through the completed line. All water removed from excavations shall be disposed of in an approved manner, so as not to create unsanitary conditions; nor to cause injury to persons or property; nor damage to the work in progress, and/or not to interfere unduly with the use of streets, private driveways or entrances. Pumping or bailing and draining, underdrains, ditches, etc., shall be considered as incidental work and shall not be paid for as separate items; but their cost shall be included in such contract prices as are provided for in the contract.

H STABILIZATION: In the event the **CONTRACTOR** is preventing water from interfering with the work and the trench bottom is too unstable in the opinion of the Engineer or the Engineer's representative for proper grading and pipe installation, the **CONTRACTOR** shall stabilize the bottom of the trench as instructed by the Engineer or the Engineer's representative. To stabilize the trench bottom, the **CONTRACTOR** shall undercut the trench bottom as required and place a layer of washed crushed stone or concrete mix in the trench bottom. In general, the crushed stone or concrete mix is to be 6" thick unless a greater thickness is specified by the Engineer or the Engineer's representative. When used, the crushed rock shall meet the requirements of paragraph 3.3.B “Pipe Bedding” of this specification, except the gradation shall be:

	Percent
Passing 5" sieve	100%
Retained on 2" sieve	100%

The concrete mix, if used, is to be mixed as specified for concrete encasement with the exception that the water is to be omitted from the mix and the dry mix placed in the trench bottom. The dry concrete mix is to be placed only in short sections at a time and then immediately fine graded and the pipe installed over it without delay before the dry concrete mix is placed in the next section of trench.

Stabilization will be paid for as specified in the pay items but shall not be used except with the approval of the Engineer or **CITY.** In cases of disagreement between the Engineer and the **CITY**, the decision of the **CITY** shall be final.

3.3 BACKFILL: This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for the furnishing, placing and maintaining of all embedment, backfill materials, compaction, refilling any settlement of all excavated areas, the replacement of topsoil after backfill is completed and the restoration of all

other lands, private or public, damaged or occupied by the **CONTRACTOR** in the performance of the contract to the same (or improved) condition as they were prior to the beginning of the work.

A. BACKFILL PROCEDURE: Backfill procedure is that procedure required to return trenches or excavated areas to a condition satisfactory to the **CITY**. Such backfilling occurs in two general areas. They are: 1) areas not subject to vehicular traffic; and 2) areas subjected directly to, or influenced by, vehicular traffic.

The methods of backfilling to be used shall vary with the width of trench, the character of the materials excavated, the methods of excavation, the type of conduit and the degree of compaction required. The placing of backfill shall not begin until the **CITY** has been notified. The excavation shall be backfilled only with approved materials, in accordance with the plans and these specifications. Backfill is divided into two major categories: (1) embedment; and (2) trench backfill material, as follows:

1. Embedment is the material upon which the pipe rests and which may cover the pipe. Embedment is divided into two categories: (1) pipe bedding; and (2) initial backfill.

2. Trench backfill material is the material required to fill the trench from the top of the embedment to ground elevation or subgrade of a street. Backfill materials shall be shovel-sliced into the haunch areas to fill and support the haunch areas.

B. PIPE BEDDING: The bedding shall be placed on a flat undisturbed or restored trench bottom with a minimum thickness beneath the pipe barrel of 4-inches or one-eighth of the outside diameter of the pipe, whichever is greater. Carefully placed material shall be sliced in the haunches of the pipe with a flattened shovel or other suitable tool. The pipe barrel shall be placed so that it is true to line and grade and to provide uniform and continuous support.

Standard size for bedding materials shall be in accordance with ASTM D448, latest revision, as follows:

Nominal Pipe Size	ASTM D 448 Aggregate Size
Less than 15 inches	#57, #67, #7 or #8
15 inches to 30 inches	#57, #6 or #67
Greater than 30 inches	#57, #6 or #67

Sieve Analysis - Percent Passing								
Aggregate Size	Sieve Size							
	1 1/2"	1"	3/4"	1/2"	3/8"	No. 4	No.8	No.16
#57	100	95-100	---	25-60	---	0-10	0-5	---
#6	---	100	90-100	20-55	0-15	0-5	---	---
#67	---	100	90-100	---	20-55	0-10	0-5	---
#7	---	---	100	90-100	40-70	0-15	0-5	---
#8	---	---	---	100	85-100	10-30	0-10	0-5

Crushed stone and/or gravel shall have at least one fractured face on each stone. Other suitable bedding materials may be approved by the Engineer.

Materials for stabilization may be required if soft, spongy, unstable, or other similar material is encountered upon which bedding material or pipe is to be placed. Unstable material shall be removed to a depth ordered by the Engineer and replaced with foundation material suitably densified.

C. INITIAL BACKFILL

1. Native Material: Finely divided material free of debris, organic material, and large stones.

2. Granular Material: Granular material shall be free flowing, such as sand or hydraulically graded crushed stone fines, or mixed sand and gravel, or sandy loam. The material shall be free from lumps, stones over 2" in diameter, clay and organic matter.

3. Select Material: Select material shall be gravel, fine rock cuttings, clayey sand, sand, sandy loam or loam free from excessive clay. Rock cuttings shall have no dimension greater than 2". Soil materials shall have a PI ranging between 0 and 15. Select material shall meet all requirements of paragraph 3.3.C “Select Backfill – Special Circumstances” of this specification.

4. Natural Gravel: Natural gravel shall consist of uncrushed stones meeting the requirements for wear as outlined in paragraph 3.3.B.1 “Crushed Stone” of this specification. The material shall be washed and screened and not have by weight more than one percent organic matter, clays or loam and not more than five percent by weight of any one of or combination of slate, shale, schist or soft particles of sandstones. The gradation shall be:

	Percent
Passing 1-½" sieve	100%
Retained on ¾" sieve	100%

5. Sand: Sand shall consist of clean, hard, durable, uncoated grains, free from lumps and organic material. All particles must pass a No. 8 sieve.

D. SELECT BACKFILL – SPECIAL CIRCUMSTANCES: During planning work, the Engineer may recognize that a majority of the ditchline material may not be suitable for backfill and provide for select backfill material placement, the use of which shall be as approved by the **CITY**. In cases where ditchline material is not suitable for backfill, select backfill material as approved by the Engineer shall be required.

These backfill materials may fall into one of two categories: 1) select backfill obtained onsite or 2) select backfill obtained offsite. Generally, select backfill obtained onsite would relate to utilities installation in subdivisions.

Should the provision for the necessity of major select backfill be required, the plans and specifications will address and provide a bid item for the same.

1. Select Backfill Obtained Onsite: The Engineer shall designate select backfill material from a point within the project limits. Unsuitable excavated material designated by the Engineer will be removed and disposed of by the **CONTRACTOR** as approved by the Engineer. The unsuitable material shall be spread and bladed as needed. All stockpiled material shall have adequate erosion control. For the unit price bid, the **CONTRACTOR** shall load and haul select backfill to the project and install it in the trench according to specifications. Select backfill will be made for the full depth of the trench above the embedment. Payment will be for the linear foot of trench for a given size pipe to be installed in that trench. Payment includes furnishing all labor and equipment to remove, haul and spread unsuitable excavated material on sites designated by the Engineer and to load, haul, and install select backfill in the trenches.

2. Select Backfill Obtained Offsite: The **CONTRACTOR** will be responsible for locating suitable sources of select backfill material, advise the Engineer of the availability of the sources, and obtain the Engineer's approval of the sources before any commitment is made to use the material. The **CONTRACTOR** will be responsible for the payment of any royalties necessary for the materials. Unsuitable excavated material designated by the Engineer will be removed and disposed of by the **CONTRACTOR** as approved by the Engineer. The unsuitable material shall be spread and bladed as needed. All stockpiled material shall have adequate erosion control. For the unit price bid, the **CONTRACTOR** shall pay royalties, load and haul select backfill material to the project and install in the trench according to these specifications. Payment will be for the linear foot of trench for a given size pipe to be installed in that trench. Payment includes furnishing all labor and equipment to remove, haul and

spread unsuitable excavated material on sites designated by the Engineer, pay royalties and to load, haul, and install select backfill material in the trenches.

E. COMPACTION: Compaction of all backfill material shall be performed in a manner that shall not crack or crush the pipe and/or cause the installed pipe to be moved from the established grade and/or alignment, as shown on the plans. Wet ground conditions following rainfall may preclude the opening of ditch lines that cannot be properly backfilled and tamped.

1. Densities In Areas Subjected To or Influenced By Vehicular Traffic: The trench backfill shall be mechanically compacted to the top of the subgrade in 6" lifts by the method selected by the **CONTRACTOR**, to a density of 95% as determined by ASTM D698, latest revision.

2. Densities In Areas Not Subjected To or Influenced By Vehicular Traffic: The trench backfill shall be placed in layers not more than 10" in depth (loose measurement) and shall be compacted by whatever means the **CONTRACTOR** chooses, subject to the restrictions outlined, to a density of 90% as determined by ASTM D698, latest revision.

   The embedment shall be compacted by a method approved by the **CITY**.

3. Special Situations: In areas specifically designated in the plans and specifications, the entire backfill shall be compacted.

4. Compaction Methods: The method of compaction shall be left to the discretion of the **CONTRACTOR** with the following exception, unless otherwise specified, provided that the proper degree of compaction is obtained and provided that the pipe is not damaged in the process. If any potential damage to the pipe due to a proposed method of compaction exists, in the opinion of the Engineer, that method of compaction shall not be allowed.

   Compaction of any backfill material by flooding or jetting shall not be permitted for soils with a PI in excess of 5, unless authorized by the **CITY**.

   Hand-operated mechanical tampers may be used with approval of the **CITY** for compacting backfill.

5. Rejection: If the backfill does not meet the proper degree of compaction throughout its depth, the **CITY** shall require its removal and replacement to meet the requirements at the **CONTRACTOR'S** expense.

In areas with vehicular traffic or for future improvements, all ditch lines after backfill and compaction shall be sealed with oiled dirt to preclude drainage water from entering the ditch line. The oiled dirt seal shall be maintained until road construction commences. Compensation for oil dirt seal shall be included in the unit price for the improvements if no separate bid item is provided in the proposal.

6. Means and methods to complete installation in accordance with the specifications shall be the responsibility of the **CONTRACTOR**. **CITY** shall provide quality assurance testing as deemed necessary.

7. Extreme groundwater conditions in the ditch line may require French drain installation prior to utilities installation.

F. INCLEMENT WEATHER: The **CITY** shall require work to cease due to inclement weather which saturates the existing soil to be removed and utilized as backfill material. Wet soil conditions, particularly in areas of proposed street improvements do not allow the proper compaction to be attained in cases of high moisture content.

3.4 TESTING: The **CONTRACTOR** shall be required to perform a Ball Test and a Low Pressure Air Test on each section of VCP gravity sewer line installed. In addition, all new sewer main will be TV inspected.

A. BALL TEST: Upon the completion of laying each sewer line, the **CONTRACTOR** shall thoroughly flush each sewer line with a sufficient quantity of fresh water at a sufficiently high velocity to clean each line. The **CONTRACTOR** shall continue flushing until the water from each sewer line runs clear and clean.

After this has been completed, the **CONTRACTOR** shall make a test of the cleanliness and flow through each line by running a large quantity of clean fresh water through the lines. This may be applied from a fire hydrant near the end of the line or may have to be hauled by water trucks. In any event, the flow through each line during this test shall not be less than 200 gallons per minute. For the purpose of the test, the **CONTRACTOR** shall furnish rubber balls which shall be run through each line in the presence of the Project Representative. The size of the rubber balls shall be as follows:

Line Size	**Ball Diameter**
6"	4-1/2" to 5"
8"	6" to 7"
10" and larger	8" and larger

The ball shall be inserted at the high point of each line and flushed through the entire length of the line with inspection made of each manhole as the ball passes through it. Every sewer line on the project is designed so that the minimum velocity through the sewer line exceeds 2 feet per second. During the ball test, the ball shall travel from manhole to manhole at not less than one-half this velocity or one foot per second.

B. LOW PRESSURE AIR TEST:

Leakage Allowance: The leakage allowance requirements of the air test shall be considered satisfied if the time required in seconds for the pressure to decrease from 3.5 pounds per square inch (psi) to 2.5 psi is not less than that shown in the following table:

Table 1
Minimum Testing Times for Low-Pressure Air Test

Pipe Diameter (inches)	Minimum Test Time (25% of Test Period)	Minimum Test Time (100% of Test Period)	Maximum Pipe Length for Minimum Test Time (feet)	Time for Longer Pipe Length (seconds/foot)
6	85 sec (1 min, 25 sec)	340 sec (5 min, 40 sec)	398	0.855
8	114 sec (1 min, 54 sec)	454 sec (7 min, 34 sec)	298	1.520
10	142 sec (2 min, 22 sec)	567 sec (9 min, 27 sec)	239	2.374
12	170 sec (2 min, 50 sec)	680 sec (11 min, 20 sec)	199	3.419
15	213 sec (3 min, 33 sec)	850 sec (14 min, 10 sec)	159	5.342
18	255 sec (4 min, 15 sec)	1020 sec (17 min, 0 sec)	133	7.693
21	298 sec (4 min, 58 sec)	1190 sec (19 min, 50 sec)	114	10.471
24	340 sec (5 min, 40 sec)	1360 sec (22 min, 40 sec)	100	13.676
27	383 sec (6 min, 23 sec)	1530 sec (25 min, 30 sec)	88	17.309
30	425 sec (7 min, 5 sec)	1700 sec (28 min, 20 sec)	80	21.369
33	468 sec (7 min, 48 sec)	1870 sec (31 min, 10 sec)	72	25.856

Testing Procedure:

1. The section of pipe to be tested is to be plugged at each end. The ends of all branches, laterals, and wyes which are to be included in the test are to be sealed or plugged. All plugs shall be carefully braced to prevent slippage and blowout due to internal pressure. One of the plugs provided must have an inlet tap or other provision for connecting an air hose.

2. Connect one end of the air hose to the inlet tap on the plug and connect the other end of the hose to portable air control equipment. The air control equipment shall consist of pressure gages and valves used to control the rate at which the air flows to the test section and to monitor the air pressure inside the pipe. The air control equipment can then be connected to a source of air supply such as a portable air compressor.

3. After the air hoses are properly connected, inject air into the test section. Monitor the air pressure so that pounds per square inch, gage (psig) may be recorded.

4. When the pressure inside the test section reaches 4.0 psig, throttle the air supply so that the internal pressure is maintained between 4.0 and 3.5 psig for at least two minutes. These two minutes allow time for the temperature of the air to come to equilibrium within the pipe walls.

5. After the temperature has been allowed to stabilize for the two minute period, the air supply should be disconnected and the pressure be allowed to decrease to 3.5 psig. At 3.5 psig, a stopwatch is to be started to determine the time required for the pressure to drop to 2.5 psig. The section of pipeline being tested shall be considered acceptable if the time required in seconds for the pressure to decrease from 3.5 to 2.5 psig is equal to or greater than that shown in Table 3.4-1 (above) in these specifications.

6. The test may stop if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of a testing period, then the test must continue for the entire test duration as outlined above or until failure.

7. Pipes with a 27 inch or larger average inside diameter may be air tested at each joint instead of following the procedure outlined in this section.

8. Groundwater will be measured where it is known to exist and a correction made to increase test pressure to 3.5 pounds per square inch greater than the pressure exerted by the groundwater above the pipe.

   At the time the sewer line is installed, the **CONTRACTOR** shall install a 1" to 1-1/2" diameter standpipe from the top of the sewer line to a point at

or above ground level to be used to measure the groundwater. The bottom of the standpipe shall be perforated for one foot and enclosed with loose gravel to allow the groundwater to seek its natural level within the standpipe. The top of the standpipe shall be capped to prevent foreign material from entering. Generally, a 1" to 1-1/2" monitor standpipe shall be installed in each run of pipeline between manholes.

Immediately prior to the line acceptance test, the groundwater shall be determined by removing the cap and measuring the height in feet of water over the invert of the sewer line. This height in feet shall be multiplied by 0.43 to establish the pounds of pressure that will be added to the wall readings. For example, if the height of water is 7', then the added pressure will be 3 psig. This increases the 3.5 psig to 6.5 psig, and the 2.5 psig to 5.5 psig. The allowable drop of 1 pound in the timing remains the same. If possible, the standpipe should be removed after the sewer line is accepted.

3.5 FINAL INSPECTION: On each section of sewer line, inspection shall be made on that line at the same time the ball test and air test is performed. Before the required tests are made, the **CONTRACTOR** shall complete all work on the portion of line to be tested and dress up the ditches, remove all debris, and complete the work in every way except for the required tests. When these tests are being performed, the Project Representative shall inspect the line including manhole, grout, and structure defects. Defects that are noted during this final inspection shall be repaired by the **CONTRACTOR** without additional payment. All work and testing shall be performed in the presence of the Project Representative and be finally approved by the Director of Utilities and Public Works.

PART 4 – MEASUREMENT AND PAYMENT

4.1 SEWER LINES: Payment for installing vitrified clay pipe for gravity sewer lines shall be by the lineal foot according to the depth of the line. The measurement of the length shall be from end to end, including through all fittings and manholes. The measurement of the depth shall be from the original ground level at the centerline of the ditch before the construction was begun to the invert of the sewer line. This payment shall be the complete payment for site preparation, excavating the trench, furnishing and installing the pipe and joint materials, installing the backfill including compaction, performing all necessary tests and sterilization, and providing all clean up and restoration not specifically included in other bid items.

4.2. FITTINGS: Fittings shall be paid for per each at the unit price bid. This measurement shall include the fitting and all accessories. The payment for fittings shall be the complete payment for making the excavation, cutting the pipe line where necessary to install the fitting, furnishing and installing the fitting and all required joint materials, installing the backfill including compaction and providing all clean up and restoration not specifically included in other items.

City of Tyler Standard Specifications

DUCTILE IRON PIPE (DIP) FOR GRAVITY SEWER MAINS

PART 1 - GENERAL

1.1 SCOPE: This specification covers the requirements for ductile iron (DI) pipe and fittings to be used for sanitary sewer gravity mains. Ductile iron pipe shall be used where shown on the plans, for stream crossings, for installation in bore holes under highways and railroads, where sewer lines cross water lines, and where the sewer line is installed in shallow locations.

1.2 QUALITY ASSURANCE: Pipe shall be the product of one (1) manufacturer which has had not less than 10 years successful experience manufacturing pipe of the types and sizes indicated, unless otherwise approved by Tyler Water Utilities.

1.3 HANDLING AND STORAGE: Handling and storage shall be in accordance with the pipe manufacturer's recommendations. The **CONTRACTOR** shall inspect each load of pipe upon delivery to verify that the load is intact and in good condition. During handling the **CONTRACTOR** shall minimize impacts to the pipe. Care shall be taken to insure the pipe is not dropped or damaged.

If possible, pipe shall be stored in packages provided by the manufacturer. Care shall be taken to avoid compression, damage or deformation to ends of pipe. Pipe should be supported to prevent damage to the bottom of the pipe. The interior of the pipe shall be kept free from dirt or other foreign matter.

1.4 REJECTION: Ductile iron pipe and fittings may be rejected for failure to meet any or all of the requirements of this specification.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE: Ductile iron gravity sewer pipe shall be designed in accordance with the latest revision of ANSI/AWWA C150/A21.50 using 60,000 pounds per square inch tensile strength, 42,000 pounds per square inch yield strength and 10 percent elongation. The minimum pressure class shall be as follows:

Pipe Size	Working Pressure	Surge Allowance
3" through 12"	350 psi	100 psi
14" through 20"	250psi	100 psi
24" and larger	200 psi	100 psi

Ductile iron pipe shall be manufactured in metal or sand lined molds in accordance with the latest revision of ANSI/AWWA C151/A21.51. Each pipe shall be subjected to a hydrostatic pressure test of at least 500 psi at the point of manufacture.

Ductile iron thickness shall conform in all respects to AWWA/ANSI C150/A21.50, latest revision, based on the minimum working pressure, given above, for the diameter of pipe. For larger diameters or deeper cover, special design shall be provided in accordance with the Standard Thickness for Earth Load plus Truck Load, Type 2 Ditch per ANSI/AWWA C151/A21.51.

The pressure rating, metal thickness, weight of pipe without lining, length of pipe, and name of manufacturer shall be clearly marked on each joint of pipe.

Ductile iron pipe shall be new and shall be manufactured by American, U.S. Pipe, McWane, Griffin Pipe or approved equal.

2.2 JOINTS: All ductile-iron gravity sewer pipe shall be furnished with one of the following types of joints and as described in the plans and specifications or in the bid proposal:

Type Joint	**ANSI/AWWA Standard**
Push-on	ANSI/AWWA C111/A21.11
Mechanical Joint	ANSI/AWWA C111/A21.11
Flanged Ends	ANSI/AWWA C115/A21.15
Restrained Joints	As provided by the pipe manufacturer

Joints shall be in accordance with the latest revision of the appropriate ANSI/AWWA standard or as provided by the manufacturer's recommendation, and shall be furnished complete with all necessary accessories.

All screwed flanges shall be ductile iron.

Bolts and nuts for mechanical joints or flanged ends (if used underground) shall be of high-strength low-alloy corrosion-resistant steel and shall conform to ASTM A325 (Type 3), latest revision.

2.3 FITTINGS: Fittings for ductile iron gravity sewer pipe shall be new, shall be ductile iron and shall conform to the latest revision of either ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53 using 70,000 pounds per square inch minimum tensile strength, 50,000 pounds per square inch minimum yield strength and 5 percent minimum elongation. The minimum pressure class shall be as follows:

Pipe Size	Working Pressure	Surge Allowance
3" through 24"	350 psi	100 psi
30" through 48"	250psi	100 psi

Fittings and accessories shall be furnished with either push-on or mechanical type joints in accordance with ANSI/AWWA C111/A21.11, latest revision, flanged type joints in accordance with ANSI/AWWA C115/A21.15, latest revision or restrained type joints as provided by the manufacturer.

Bolts and nuts for mechanical joints or flanged ends shall be of a high-strength corrosion-resistant low-allow steel and shall conform to ASTM A325 (Type 3), latest revision.

The pressure rating, nominal diameters of openings, manufacturer's identification, country where cast and number of degrees or fraction of the circle shall be cast distinctly on each fitting.

Fittings shall have a cement mortar lining on the interior in accordance with ANSI/AWWA C104/A21.4, latest revision, and a standard asphaltic coating on the exterior surfaces. Fittings for pipes 12" and larger shall have an interior coating of Protecto 401 or approved equal, in lieu of the cement mortar lining.

2.4 PIPE COATING AND LINING: Pipe shall have a cement mortar lining on the interior in accordance with ANSI/AWWA C104/A21.4, latest revision, and a standard asphaltic coating on the exterior surfaces. Pipes 12" and larger shall have an interior coating of Protecto 401 or approved equal, in lieu of the cement mortar lining.

2.5 POLYETHYLENE ENCASEMENT FOR DUCTILE IRON PIPE, VALVES, FITTINGS AND OTHER APPURTENANCES: Polyethylene encasement shall be required for all ductile iron pipe, valves, fittings and other appurtenances in accordance with ANSI/AWWA C105/A21.05, latest revision.

The polyethylene film shall be manufactured of virgin polyethylene material conforming to requirements of ASTM D1248, latest revision. Class Grade C (Black) shall be utilized. Sunlight will eventually deteriorate polyethylene film. Exposure to sunlight should be kept to a minimum.

Tube width for each pipe diameter shall be as listed in the following table:

Nominal Pipe Size (inches)	Minimum Polyethylene Tube Width (inches)
6	16
8	20
10	24
12	27
14	30
16	34
18	37
20	41
24	54
30	67
36	81
42	81
48	95
54	108
60	108
64	121

All widths shall be 8 mils thick.

PART 3 - EXECUTION

3.1. SITE PREPARATION: The construction site shall be prepared for construction operations by the removal and disposal of all obstructions and objectionable materials from the designated construction area. It is the intent of this specification to provide for the removal and disposal of all objectionable material not specifically provided for elsewhere in the plans or specifications. This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for clearing and removing from the site of the work wherever located, all obstructions, designated trees, stumps, brush vegetation, miscellaneous stone, brick, concrete, scrap iron and all rubbish and debris whether above or below ground level. Such items shall be included in such contract pay item as provided in the bid proposal.

3.2 EXCAVATION: This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for the furnishing, placing and maintaining of all sheeting, shoring and bracing necessary to protect the work and adjacent properties; to support the sides and ends of the excavation and to support all adjacent structures above

and below the ground; the installation and operation of all pumping, bailing and draining necessary to keep the excavation free from seepage water, water from sewers, drains, ditches, creeks and other sources; to provide for the uninterrupted flow of the removal, after the completion of the work, of all sheeting, shoring and bracing not necessary to support the sides of the excavation; and the satisfactory disposal of excess and unsuitable materials not required or which cannot be used for backfilling.

Prior to commencing any excavation, the **CONTRACTOR** shall provide ample labor, equipment, shoring materials and such other safety equipment as required to insure that the work shall be carried on without interruption or damage to existing installations; and to provide the least interruption of traffic commensurate with the project requirements. Blasting is prohibited; alternate methods shall be utilized.

In general, all excavation shall be made in open cut from the surface of the ground and shall be no greater in width or depth than is necessary to permit the proper construction of the work in accordance with the plans and these specifications. All excavation shall be to the line and grade as provided by the Engineer. The **CONTRACTOR** shall abide by all applicable federal, state and/or local laws governing excavation work. The entire foundation area in the bottom of all excavation shall be firm, stable and at uniform density as nearly as practicable. Unless necessary, materials shall not be disturbed. The final cleaning and preparing of the foundation area shall be done immediately prior to the placing of the embedment materials or structures.

A. PROGRESS: The **CITY** shall have the right to limit the amount of trenches that shall be opened, or partly opened, in advance of or following the pipe laying operation. Unless otherwise directed by the **CITY**, the completion of backfill shall immediately follow the pipe laying. In the event the **CONTRACTOR** fails to comply with this requirement, the **CITY** may stop the pipe laying until the requirements are met.

B. TRENCH BOTTOM ELEVATION: All trenches for installation of gravity sewer lines shall be excavated to a point below the barrel of the pipe for the type of embedment specified.

C. TRENCH OVERCUT: Should the **CONTRACTOR** excavate below the plan trench bottom for gravity sewer lines, the **CONTRACTOR** shall backfill to trench bottom grade shown on the plan with approved aggregate, consolidated and compacted to meet the **CITY'S** approval, at no additional cost to the **CITY**. See paragraph 3.2.H "Stabilization" of this specification.

D. EXCAVATION CLASSIFICATIONS: All excavation is "unclassified" and involves removal of all materials necessary to permit carrying on the completion of the work.

Bidders must satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location, and sizes of pipe or conduits of various kinds in place.

E. SHORING AND SHEETING: When necessary to prevent caving or unduly hazardous working conditions, or to comply with existing laws, trench walls shall be appropriately braced, or sheeted and braced. Where bracing, or sheeting and bracing, is used, the trench width shall be increased accordingly and shall be paid for per linear foot of bracing or sheeting and bracing. Sheeting and shoring shall be in accordance with the City of Tyler Standard Specification for Trench Safety Systems.

In wet, saturated or flowing materials where it is necessary to install tight sheeting or cofferdams, wood or steel sheet piling shall be used. All sheeting, shoring and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and to maintain the sides of the excavation properly from injury or damage. When excavations are made adjacent to existing buildings or to other structures or in paved streets, particular care shall be taken to adequately sheet, shore and brace the sides of the excavation to prevent undermining of, or settlement beneath the structures or pavement. Unless otherwise established in the pay items, underpinning of adjacent structures or pavement shall be done by the **CONTRACTOR** at his own cost and expense and in a manner satisfactory to the **CITY**; or, when required by the **CITY**, the pavement or structure shall be removed, the void satisfactorily refilled and compacted and the pavement or structure replaced by the **CONTRACTOR**. Wooden sheeting, shoring, and bracing shall be left in place where it is adjacent to the pipe embedment for the initial lift of backfill.

The removal of all sheeting, shoring and bracing shall be done in such manner as not to endanger or damage either new or existing structures, private or public properties; and so as to avoid cave-ins, or sliding of the banks. All holes or voids left by the removal of the sheeting, shoring or bracing shall be immediately and completely filled and compacted with suitable materials. If, for any reason, the **CONTRACTOR**, with the approval of the **CITY**, elects to leave in place the sheeting, shoring or bracing, no payment shall be allowed for such material left in place unless ordered by the **CITY** to be left in place.

F. DISPOSAL OF EXCAVATED MATERIALS: Suitable excavated materials may be piled adjacent to the work to be used for backfilling. Excavated materials unsuitable for backfilling, or in excess of that required for backfilling, shall be disposed of by the **CONTRACTOR**. Desirable topsoil, sod, etc., shall be carefully removed and piled separately adjacent to the work when required. Excavated materials shall be handled at all times in such manner as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to private and public property adjacent to or along the line of work. The excavated material in rock which is not suitable material for bedding or backfill

shall be disposed of by the **CONTRACTOR**. Suitable selected bedding or backfill material from the trench excavation shall be provided at no additional cost to the **CITY** or **OWNER**.

G. DEWATERING: The **CONTRACTOR** shall remove all water from any source which may accumulate in the excavation. The embedment or pipe shall not be installed in water. No water shall be allowed to flow through or over unset concrete or through the completed line. All water removed from excavations shall be disposed of in an approved manner, so as not to create unsanitary conditions; nor to cause injury to persons or property; nor damage to the work in progress, and/or not to interfere unduly with the use of streets, private driveways or entrances. Pumping or bailing and draining, underdrains, ditches, etc., shall be considered as incidental work and shall not be paid for as separate items; but their cost shall be included in such contract prices as are provided for in the contract.

H STABILIZATION: In the event the **CONTRACTOR** is preventing water from interfering with the work and the trench bottom is too unstable in the opinion of the Engineer or the Engineer's representative for proper grading and pipe installation, the **CONTRACTOR** shall stabilize the bottom of the trench as instructed by the Engineer or the Engineer's representative. To stabilize the trench bottom, the **CONTRACTOR** shall undercut the trench bottom as required and place a layer of washed crushed stone or concrete mix in the trench bottom. In general, the crushed stone or concrete mix is to be 6" thick unless a greater thickness is specified by the Engineer or the Engineer's representative. When used, the crushed rock shall meet the requirements of paragraph 3.3.B.1 “Crushed Stone” of this specification, except the gradation shall be:

	Percent
Passing 5" sieve	100%
Retained on 2" sieve	100%

The concrete mix, if used, is to be mixed as specified for concrete encasement with the exception that the water is to be omitted from the mix and the dry mix placed in the trench bottom. The dry concrete mix is to be placed only in short sections at a time and then immediately fine graded and the pipe installed over it without delay before the dry concrete mix is placed in the next section of trench.

Stabilization will be paid for as specified in the pay items but shall not be used except with the approval of the Engineer or **CITY.** In cases of disagreement between the Engineer and the **CITY**, the decision of the **CITY** shall be final.

3.3 BACKFILL: This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for the furnishing, placing and maintaining of all embedment, backfill materials, compaction, refilling any settlement of all excavated areas, the replacement of topsoil after backfill is completed and the restoration of all

other lands, private or public, damaged or occupied by the **CONTRACTOR** in the performance of the contract to the same (or improved) condition as they were prior to the beginning of the work.

A. BACKFILL PROCEDURE: Backfill procedure is that procedure required to return trenches or excavated areas to a condition satisfactory to the **CITY**. Such backfilling occurs in two general areas. They are: 1) areas not subject to vehicular traffic; and 2) areas subjected directly to, or influenced by, vehicular traffic.

The methods of backfilling to be used shall vary with the width of trench, the character of the materials excavated, the methods of excavation, the type of conduit and the degree of compaction required. The placing of backfill shall not begin until the **CITY** has been notified. The excavation shall be backfilled only with approved materials, in accordance with the plans and these specifications. Backfill is divided into two major categories: (1) embedment; and (2) final backfill material, as follows:

1. Embedment is the material upon which the pipe rests and which covers the pipe.

2. Final backfill material is the material required to fill the trench from the top of the embedment to ground elevation or subgrade of a street.

B. EMBEDMENT: The type of embedment to be used for ductile iron sewer mains shall be as follows:

1. Crushed Stone:

a. Description: The aggregates shall consist of durable particles of crushed stone; free from frozen material or injurious amounts of salt, alkali, vegetable matter or other material either free or as adherent coating; and its quality shall be reasonably uniform throughout. It shall have a wear of not more than 40 percent when tested in accordance with TxDOT Test Method Tex-410-A.

b. Test: When tested by standard laboratory methods, crushed rock embedment for each gradation shall meet the following requirements for percentage by weight as stated in the TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, latest edition.

Standard Crushed Rock – Aggregate Grade 4:	
	Percent
Retained on 1-½" sieve	0%
Retained on 1" sieve	0-5%
Retained on ½" sieve	40-75%
Retained on No. 4 sieve	90-100%
Retained on No. 8 sieve	95-100%

C. SELECT BACKFILL – SPECIAL CIRCUMSTANCES: During planning work, the Engineer may recognize that a majority of the ditchline material may not be suitable for backfill and provide for select backfill material placement, the use of which shall be approved by the **CITY**. In cases where ditchline material is not suitable for backfill, select backfill material as approved by the Engineer shall be required.

These backfill materials may fall into one of two categories: 1) select backfill obtained onsite or 2) select backfill obtained offsite. Generally, select backfill obtained onsite would relate to utilities installation in subdivisions.

Should the provision for the necessity of major select backfill be required, the plans and specifications will address and provide a bid item for the same.

1. Select Backfill Obtained Onsite: The Engineer shall designate select backfill material from a point within the project limits. Unsuitable excavated material designated by the Engineer will be removed and disposed of by the **CONTRACTOR** as approved by the Engineer. The unsuitable material shall be spread and bladed as needed. All stockpiled material shall have adequate erosion control. For the unit price bid, the **CONTRACTOR** shall load and haul select backfill to the project and install it in the trench according to these specifications. Select backfill will be made for the full depth of the trench above the embedment. Payment will be for the linear foot of trench for a given size pipe to be installed in that trench. Payment includes furnishing all labor and equipment to remove, haul and spread unsuitable excavated material on sites designated by the Engineer and to load, haul, and install select backfill in the trenches.

2. Select Backfill Obtained Offsite: The **CONTRACTOR** will be responsible for locating suitable sources of select backfill material, advise the Engineer of the availability of the sources, and obtain the Engineer's approval of the sources before any commitment is made to use the material. The **CONTRACTOR** will be responsible for the payment of any royalties necessary for the materials. Unsuitable excavated material designated by the Engineer will be removed and disposed of by the

CONTRACTOR as approved by the Engineer. The unsuitable material shall be spread and bladed as needed. All stockpiled material shall have adequate erosion control. For the unit price bid, the **CONTRACTOR** shall pay royalties, load and haul select backfill material to the project and install in the trench according to these specifications. Payment will be for the linear foot of trench for a given size pipe to be installed in that trench. Payment includes furnishing all labor and equipment to remove, haul and spread unsuitable excavated material on sites designated by the Engineer, pay royalties and to load, haul, and install select backfill material in the trenches.

D. COMPACTION: Compaction of all backfill material shall be performed in a manner that shall not crack or crush the pipe and/or cause the installed pipe to be moved from the established grade and/or alignment, as shown on the plans. Wet ground conditions following rainfall may preclude the opening of ditch lines that cannot be properly backfilled and tamped.

1. Densities In Areas Subjected To or Influenced By Vehicular Traffic: The trench backfill shall be mechanically compacted to the top of the subgrade in 6" lifts by the method selected by the **CONTRACTOR**, to a density of 95% as determined by ASTM D698, latest revision.

2. Densities In Areas Not Subjected To or Influenced By Vehicular Traffic: The trench backfill shall be placed in layers not more than 10" in depth (loose measurement) and shall be compacted by whatever means the **CONTRACTOR** chooses, subject to the restrictions outlined, to a density of 90% as determined by ASTM D698, latest revision.

   The embedment shall be compacted by a method approved by the **CITY**.

3. Special Situations: In areas specifically designated in the plans and specifications, the entire backfill shall be compacted.

4. Compaction Methods: The method of compaction shall be left to the discretion of the **CONTRACTOR** with the following exception, unless otherwise specified, provided that the proper degree of compaction is obtained and provided that the pipe is not damaged in the process. If any potential damage to the pipe due to a proposed method of compaction exists, in the opinion of the Engineer, that method of compaction shall not be allowed.

   Compaction of any backfill material by flooding or jetting shall not be permitted for soils with a PI in excess of 5, unless authorized by **CITY**.

   Hand-operated mechanical tampers may be used with approval of the **CITY** for compacting backfill.

5. Rejection: If the backfill does not meet the proper degree of compaction throughout its depth, the **CITY** shall require its removal and replacement to meet the requirements at the **CONTRACTOR'S** expense.

   In areas with vehicular traffic or for future improvements, all ditch lines after backfill and compaction shall be sealed with oiled dirt to preclude drainage water from entering the ditch line. The oiled dirt seal shall be maintained until road construction commences. Compensation for oil dirt seal shall be included in the unit price for the improvements if no separate bid item is provided in the proposal.

6. Means and methods to complete installation in accordance with the specifications shall be the responsibility of the **CONTRACTOR**. **CITY** shall provide quality assurance testing as deemed necessary.

E. INCLEMENT WEATHER: The **CITY** shall require work to cease due to inclement weather which saturates the existing soil to be removed and utilized as backfill material. Wet soil conditions, particularly in areas of proposed street improvements do not allow the proper compaction to be attained in cases of high moisture content.

3.4 TESTING: The **CONTRACTOR** shall be required to perform a Ball Test, a Low Pressure Air Test on each section of ductile iron gravity sewer line installed, and a Deflection Test on each section of ductile iron gravity sewer line installed with an inside diameter of 27" or less. For pipes with an inside diameter greater than 27", other test methods shall be used to determine deflection. In addition, all new sewer main will be TV inspected.

A. BALL TEST: Upon the completion of laying each sewer line, the **CONTRACTOR** shall thoroughly flush each sewer line with a sufficient quantity of fresh water at a sufficiently high velocity to clean each line. The **CONTRACTOR** shall continue flushing until the water from each sewer line runs clear and clean.

   After this has been completed, the **CONTRACTOR** shall make a test of the cleanliness and flow through each line by running a large quantity of clean fresh water through the lines. This may be applied from a fire hydrant near the end of the line or may have to be hauled by water trucks. In any event, the flow through each line during this test shall not be less than 200 gallons per minute. For the purpose of the test, the **CONTRACTOR** shall furnish rubber balls which shall be run through each line in the presence of the Project Representative. The size of the rubber balls shall be as follows:

Line Size	Ball Diameter
6"	4-1/2" to 5"
8"	6" to 7"
10" and larger	8" and larger

The ball shall be inserted at the high point of each line and flushed through the entire length of the line with inspection made of each manhole as the ball passes through it. Every sewer line on the project is designed so that the minimum velocity through the sewer line exceeds 2 feet per second. During the ball test, the ball shall travel from manhole to manhole at not less than one-half this velocity or one foot per second.

B. LOW PRESSURE AIR TEST:

Leakage Allowance: The leakage allowance requirements of the air test shall be considered satisfied if the time required in seconds for the pressure to decrease from 3.5 pounds per square inch (psi) to 2.5 psi is not less than that shown in the following table:

Table 1 Minimum Testing Times for Low-Pressure Air Test				
Pipe Diameter (inches)	**Minimum Test Time (25% of Test Period)**	**Minimum Test Time (100% of Test Period)**	**Maximum Pipe Length for Minimum Test Time (feet)**	**Time for Longer Pipe Length (seconds/foot)**
6	85 sec (1 min, 25 sec)	340 sec (5 min, 40 sec)	398	0.855
8	114 sec (1 min, 54 sec)	454 sec (7 min, 34 sec)	298	1.520
10	142 sec (2 min, 22 sec)	567 sec (9 min, 27 sec)	239	2.374
12	170 sec (2 min, 50 sec)	680 sec (11 min, 20 sec)	199	3.419
15	213 sec (3 min, 33 sec)	850 sec (14 min, 10 sec)	159	5.342
18	255 sec (4 min, 15 sec)	1020 sec (17 min, 0 sec)	133	7.693
21	298 sec (4 min, 58 sec)	1190 sec (19 min, 50 sec)	114	10.471
24	340 sec (5 min, 40 sec)	1360 sec (22 min, 40 sec)	100	13.676
27	383 sec (6 min, 23 sec)	1530 sec (25 min, 30 sec)	88	17.309
30	425 sec (7 min, 5 sec)	1700 sec (28 min, 20 sec)	80	21.369
33	468 sec (7 min, 48 sec)	1870 sec (31 min, 10 sec)	72	25.856

Testing Procedure:

1. The section of pipe to be tested is to be plugged at each end. The ends of all branches, laterals, and wyes which are to be included in the test are to be sealed or plugged. All plugs shall be carefully braced to prevent slippage and blowout due to internal pressure. One of the plugs provided must have an inlet tap or other provision for connecting an air hose.

2. Connect one end of the air hose to the inlet tap on the plug and connect the other end of the hose to portable air control equipment. The air control equipment shall consist of pressure gages and valves used to control the rate at which the air flows to the test section and to monitor the air pressure inside the pipe. The air control equipment can then be connected to a source of air supply such as a portable air compressor.

3. After the air hoses are properly connected, inject air into the test section. Monitor the air pressure so that pounds per square inch, gage (psig) may be recorded.

4. When the pressure inside the test section reaches 4.0 psig, throttle the air supply so that the internal pressure is maintained between 4.0 and 3.5 psig for at least two minutes. These two minutes allow time for the temperature of the air to come to equilibrium within the pipe walls.

5. After the temperature has been allowed to stabilize for the two minute period, the air supply should be disconnected and the pressure be allowed to decrease to 3.5 psig. At 3.5 psig, a stopwatch is to be started to determine the time required for the pressure to drop to 2.5 psig. The section of pipeline being tested shall be considered acceptable if the time required in seconds for the pressure to decrease from 3.5 to 2.5 psig is equal to or greater than that shown in Table 2 (above) in these specifications.

6. The test may stop if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of a testing period, then the test must continue for the entire test duration as outlined above or until failure.

7. Pipes with a 27 inch or larger average inside diameter may be air tested at each joint instead of following the procedure outlined in this section.

8. Groundwater will be measured where it is known to exist and a correction made to increase test pressure to 3.5 pounds per square inch greater than the pressure exerted by the groundwater above the pipe.

   At the time the sewer line is installed, the **CONTRACTOR** shall install a 1" to 1-1/2" diameter standpipe from the top of the sewer line to a point at or above ground level to be used to measure the groundwater. The bottom of the standpipe shall be perforated for one foot and enclosed with loose gravel to allow the groundwater to seek its natural level within the standpipe. The top of the standpipe shall be capped to prevent foreign material from entering. Generally, a 1" to 1-1/2" monitor standpipe shall be installed in each run of pipeline between manholes.

   Immediately prior to the line acceptance test, the groundwater shall be determined by removing the cap and measuring the height in feet of water over the invert of the sewer line. This height in feet shall be multiplied by 0.43 to establish the pounds of pressure that will be added to the wall readings. For example, if the height of water is 7', then the added pressure will be 3 psig. This increases the 3.5 psig to 6.5 psig, and the 2.5 psig to

5.5 psig. The allowable drop of 1 pound in the timing remains the same. If possible, the standpipe should be removed after the sewer line is accepted.

C. DEFLECTION TEST: No sooner than 30 days, or later than 12 months, after the pipe has been installed and backfilling is complete, tests for deflection shall be made for complete sections of ductile iron pipe (i.e. sections from manhole-to-manhole). A deflection of more than 5% of the inside diameter of the pipe shall be cause for rejection and the line will be removed and replaced at the **CONTRACTOR'S** expense. The replacement line will again be tested not less than 30 days after the pipe has been installed and backfilling is complete. Pipe with an inside diameter of less than 27" shall be tested using a rigid mandrel. For pipe with an inside diameter of 27" or greater, other test methods may be used to determine vertical deflection.

The street surface course shall not be completed until after the deflection test is performed and passed.

Mandrel Design: The mandrel shall be designed in accordance with current TCEQ requirements.

Testing Procedure:

1. Completely flush the line, if required, to make sure the pipe is free of any mud or other debris that would hinder passage of the mandrel.

2. During the final flushing of the pipe, attach a floating block or ball to the end of the mandrel pull rope and float the rope through the pipe.

3. After the rope is threaded through the pipe, connect the pull rope to the mandrel and place the mandrel in the entrance of the pipe.

4. Connect a retrieval rope to the back of the mandrel to pull it back if necessary.

5. Remove all slack in the pull rope and place a tape marker on the rope at the ends of the pipe where the mandrel will exit, determining the location of the mandrel in the pipe.

6. Using manhole guide pulleys, draw the mandrel through the sewer pipe. If any irregularity or pipe deformation which exceeds the allowable 5% is encountered, the pipe shall be uncovered at that point.

7. If an obstructed or over deflected section is found, locate the problem within the pipe, uncover the pipe and replace it.

8. Re-test the pipe section for deflection not less than 30 days after the pipe is installed and after backfilling is complete.

9. Any pipe removed shall be replaced by use of gasketed repair couplings.

10. The mandrel test shall be performed without the use of mechanical pulling devices.

3.5 INSTALLATION OF POLYETHYLENE ENCASEMENT: The polyethylene encasement shall prevent contact between the pipe and fittings and surrounding backfill and bedding material but is not intended to be a completely airtight and watertight enclosure. Overlaps shall be secured by the use of adhesive tape, plastic string, or any other material capable of holding the polyethylene encasement in place until backfilling operations are completed.

Polyethylene encasement shall be installed in accordance with the latest revision of ANSI/AWWA C105/A21.5 and as follows:

METHOD A: Cut polyethylene tube to a length approximately 2' longer than that of the pipe section. Slip the tube around the pipe, centering it to provide a 1' overlap on each adjacent pipe section, and bunching it accordion-fashion lengthwise until it clears the pipe ends.

Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe. A shallow bell hole must be made at joints to facilitate installation of the polyethylene tube.

After assembling the pipe joint, make the overlap of the polyethylene tube. Pull the bunched polyethylene from the preceding length of pipe, slip it over the end of the new length of pipe, and secure it in place. Then slip the end of the polyethylene from the new pipe section over the end of the preceding length of pipe. Secure the overlap in place. Take up the slack width to make a snug, but not tight, fit along the barrel of the pipe, securing the fold at quarter points.

Repair any rips, punctures, or other damage to the polyethylene with adhesive tape or with a short length of polyethylene tube cut open, wrapped around the pipe and secured in place. Proceed with installation of the next section of pipe in the same manner.

METHOD B: Cut polyethylene tube to a length approximately 1' shorter than that of the pipe section. Slip the tube around the pipe, centering it to provide 6" of bare pipe at each end. Make polyethylene snug, but not tight.

Before making up a joint, slip a 3' length of polyethylene tube over the end of the preceding pipe section, bunching it accordion-fashion length-wise. After completing the joint, pull the 3' length of polyethylene over the joint, overlapping the polyethylene previously installed on each adjacent section of pipe by at least 1'; make snug and secure each end as described in Method A.

Repair any rips, punctures, or other damage to the polyethylene as described in Method A. Proceed with installation of the next section of pipe in the same manner.

A. PIPE-SHAPED APPURTENANCES: Cover bends, reducers, offsets, and other pipe shaped appurtenances with polyethylene in the same manner as the pipe.

B. ODD-SHAPED APPURTENANCES: When valves, tees, crosses, and other odd-shaped pieces cannot be wrapped practically in a tube, wrap with a flat sheet or split length of polyethylene tube by passing the sheet under the appurtenance and bringing it up around the body. Make seams by bringing the edged together, folding over twice, and taping down. Handle width and overlaps at joints as described in Method A. Tape polyethylene securely in place at valve stem and other penetrations.

C. OPENINGS IN ENCASEMENT: Provide openings for branches, service taps, blow-offs, air valves, and similar appurtenances by making an X-shaped cut in the polyethylene and temporarily folding back the film. After the appurtenance is installed, tape the slack securely to the appurtenance and repair the cut, as well as any other damaged areas in the polyethylene, with tape.

D. JUNCTIONS BETWEEN WRAPPED AND UNWRAPPED PIPE: Where polyethylene-wrapped pipe joins an adjacent pipe that is not wrapped, extend the polyethylene wrap to cover the adjacent pipe for a distance of at least 2'. Secure the end with circumferential turns of tape.

E. BACKFILL FOR POLYETHYLENE WRAPPED PIPE: Use the same backfill materials as that specified for pipe without polyethylene wrapping, exercising care to prevent damage to the polyethylene wrapping when placing backfill. Backfill material shall be free from cinders, refuse, boulders, rocks, stones, or other material that could damage polyethylene.

3.6 FINAL INSPECTION: On each section of sewer line, inspection shall be made on that line at the same time the ball test, air test, and deflection test is performed. Before the required tests are made, the **CONTRACTOR** shall complete all work on the portion of line to be tested and dress up the ditches, remove all debris, and complete the work in every way except for the required tests. When these tests are being performed, the Project Representative shall inspect the line including manhole, grout, and structure defects. Defects that are noted during this final inspection shall be repaired by the **CONTRACTOR** without additional payment. All work and testing shall be performed in the presence of the Project Representative and be finally approved by the Director of Utilities and Public Works.

PART 4 – MEASUREMENT AND PAYMENT

4.1. SEWER LINES: Payment for installing ductile iron pipe for gravity sewer lines shall be by the lineal foot according to the depth of the line. The measurement shall be made from end to end of the lines, including through all fittings and manholes. The measurement of the depth shall be from the original ground level at the centerline of the ditch before the construction was begun to the invert of the sewer line. This payment shall be the complete payment for site preparation, excavating the trench, furnishing and installing the pipe and joint materials, installing the backfill including compaction, performing all necessary tests, and providing all clean up and restoration not specifically included in other bid items.

The payment for ductile iron pipe in shallow trenches and under water lines shall by the linear foot of pipe. Where piers are required, they shall be paid for separately.

Payment of ductile iron pipe in bore holes under highways and/or railroads shall be by the foot of pipe installed, and shall be the complete payment for making the necessary excavation, making the bore hole, for furnishing and installing the ductile iron pipe, installing the backfill and providing cleanup.

Payment for ductile iron pipe in casing under railroads shall be by the foot of pipe installed, and shall be the complete payment for making the necessary excavation, making the bore hole, for furnishing and installing the ductile iron pipe, installing the backfill and providing cleanup. Payment for the casing shall be a separate item.

4.2. FITTINGS: Fittings shall be paid for by their weights, according to the latest list of standard weights as published for compact ductile iron fittings in the Tyler Pipe Catalogue. This measurement shall include the bare fitting plus the gaskets, glands and bolts for mechanical joint fittings. The payment for fittings shall be the complete payment for making the excavation, cutting the pipe line where necessary to install the fitting, furnishing and installing the fitting and all required joint materials, installing the backfill including compaction and providing all clean up and restoration not specifically included in other items.

4.3 POLYETHYLENE ENCASEMENT: Payment for polyethylene encasement shall be paid per linear feet of pipe installed.

4.4 CONCRETE PIERS: Payment for concrete piers and for concrete cradle and encasement shall be by the cubic yard of concrete in place. This shall be the total payment for furnishing all concrete and reinforcement materials, for mixing and placing the concrete, for any forming required and for wrecking the forms. This payment shall include furnishing, bending and cutting the reinforcement, as required, and for placing and tying the reinforcement.

City of Tyler Standard Specifications

POLYVINYL CHLORIDE (PVC) PIPE FOR GRAVITY SEWER MAINS

PART 1 - GENERAL

1.1 SCOPE: This specification covers requirements for unplasticized polyvinyl chloride (PVC) pipe and fittings for gravity sanitary sewer mains.

1.2 QUALITY ASSURANCE: Pipe shall be the product of one (1) manufacturer which has had not less than 10 years successful experience manufacturing pipe of the types and sizes indicated, unless otherwise approved by Tyler Water Utilities.

1.3 HANDLING AND STORAGE: Handling and storage shall be in accordance with the pipe manufacturer's recommendations. The **CONTRACTOR** shall inspect each load of pipe upon delivery to verify that the load is intact and in good condition. During handling the **CONTRACTOR** shall minimize impacts to the pipe. Care shall be taken to insure the pipe is not dropped or damaged.

If possible, pipe shall be stored in packages provided by the manufacturer. Avoid storage in direct sunlight for periods longer than 90 days. Care shall be taken to avoid compression, damage or deformation to bell ends of pipe. Pipe should be supported to prevent damage to the bottom of the pipe. The interior of the pipe shall be kept free from dirt or other foreign matter.

1.4 REJECTION: PVC gravity sewer pipe may be rejected for failure to meet any or all of the requirements of this specification.

PART 2 - PRODUCTS

2.1 PVC PIPE: All pipe shall meet the requirements of ASTM D3034, latest revision, Type PSM Polyvinyl Chloride (PVC) sewer pipe for a standard dimension ratio (SDR) of 26. The color shall be green. Nominal outside pipe diameters and wall thicknesses shall conform to the requirements of the latest revision of ASTM D3034. Gravity sewer pipe shall be new and shall be furnished in standard lengths of 14' or 20'. Pipe shall be permanently and legibly marked at intervals of 5' or less, as follows:

A. Manufacturers name or trademark and production code
B. Nominal pipe size
C. PVC Cell classification
D. The legend "SDR 26 PVC Pipe ASTM D3034".

Manufacturers shall be Certainteed, J&M or approved equal.

2.2 JOINTS: Joint bells shall be formed integrally with the pipe and shall have single rubber sealing gasket conforming to ASTM F477, latest revision, permanently locked in during the production process. Pipe joints shall conform to ASTM D3212, latest revision.

The pipe spigot shall have an insertion stop-mark. The assembled joint shall be designed so the gasket shall be radially compressed to assure a positive water-tight seal for all installation conditions recommended by the manufacturer and under all combinations of production tolerances for the joint components. Each size joint shall be qualified to have no leakage under various test conditions in conformance with ASTM D3212, latest revision.

2.3 FITTINGS: All fittings, such as saddle outlets, ells, tees and others, shall be PVC, shall have elastomeric seals and shall be compatible with the pipe. Adapters shall be provided for transition to other types of pipe.

2.4 TRACER TAPE: Tracer tape shall be required for PVC sewer service lines only. Inductive tracer detection tape shall be placed directly above the centerline of all non-metallic pipe for the full length of the pipe a minimum of 18" below finished grade. The tracer tape shall be encased in a protective, inert, plastic jacket and color coded according to American Public Works Association Uniform Color Code, i.e. green for wastewater.

PART 3 - EXECUTION

3.1. SITE PREPARATION: The construction site shall be prepared for construction operations by the removal and disposal of all obstructions and objectionable materials from the designated construction area. It is the intent of this specification to provide for the removal and disposal of all objectionable material not specifically provided for elsewhere in the plans or specifications. This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for clearing and removing from the site of the work wherever located, all obstructions, designated trees, stumps, brush vegetation, miscellaneous stone, brick, concrete, scrap iron and all rubbish and debris whether above or below ground level. Such items shall be included in such contract pay item as provided in the bid proposal.

3.2 EXCAVATION: This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for the furnishing, placing and maintaining of all sheeting, shoring and bracing necessary to protect the work and adjacent properties; to support the sides and ends of the excavation and to support all adjacent structures above and below the ground; the installation and operation of all pumping, bailing and draining necessary to keep the excavation free from seepage water, water from sewers, drains, ditches, creeks and other sources; to provide for the uninterrupted flow of the removal, after the completion of the work, of all sheeting, shoring and bracing not necessary to support the sides of the excavation; and the satisfactory disposal of excess and unsuitable materials not required or which cannot be used for backfilling

Prior to commencing any excavation, the **CONTRACTOR** shall provide ample labor, equipment, shoring materials and such other safety equipment as required to insure that the work shall be carried on without interruption or damage to existing installations; and to provide the least interruption of traffic commensurate with the project requirements. Blasting is prohibited; alternate methods shall be utilized.

In general, all excavation shall be made in open cut from the surface of the ground and shall be no greater in width or depth than is necessary to permit the proper construction of the work in accordance with the plans and these specifications. All excavation shall be to the line and grade as provided by the Engineer. The **CONTRACTOR** shall abide by all applicable federal, state and/or local laws governing excavation work. The entire foundation area in the bottom of all excavation shall be firm, stable and at uniform density as nearly as practicable. Unless necessary, materials shall not be disturbed. The final cleaning and preparing of the foundation area shall be done immediately prior to the placing of the embedment materials or structures.

A. PROGRESS: The **CITY** shall have the right to limit the amount of trenches that shall be opened, or partly opened, in advance of or following the pipe laying operation. Unless otherwise directed by the **CITY**, the completion of backfill shall immediately follow the pipe laying. In the event the **CONTRACTOR** fails to comply with this requirement, the **CITY** may stop the pipe laying until the requirements are met.

B. TRENCH BOTTOM ELEVATION: All trenches for installation of gravity sewer lines shall be excavated to a point below the barrel of the pipe for the type of embedment specified.

C. TRENCH OVERCUT: Should the **CONTRACTOR** excavate below the plan trench bottom for gravity sewer lines, the **CONTRACTOR** shall backfill to trench bottom grade shown on the plan with approved aggregate, consolidated and compacted to meet the **CITY'S** approval, at no additional cost to the **CITY**. See paragraph 3.2.H "Stabilization" of this specification.

   If the **CONTRACTOR** elects to overcut the trench and use gravel and drain pipe as an underdrain in lieu of or in conjunction with plumbing, draining, or well pointing, the additional work shall be considered as incidental work; and additional compensation shall not be allowed.

D. EXCAVATION CLASSIFICATIONS: All excavation is "unclassified" and involves removal of all materials necessary to permit carrying on the completion of the work.

   Bidders must satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location, and sizes of pipe or conduits of various kinds in place.

E. SHORING AND SHEETING: When necessary to prevent caving or unduly hazardous working conditions, or to comply with existing laws, trench walls shall be appropriately braced, or sheeted and braced. Where bracing, or sheeting and bracing, is used, the trench width shall be increased accordingly and shall be paid for per linear foot of bracing or sheeting and bracing. Sheeting and shoring shall be in accordance with the City of Tyler Standard Specification for Trench Safety Systems.

In wet, saturated or flowing materials where it is necessary to install tight sheeting or cofferdams, wood or steel sheet piling shall be used. All sheeting, shoring and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and to maintain the sides of the excavation properly from injury or damage. When excavations are made adjacent to existing buildings or to other structures or in paved streets, particular care shall be taken to adequately sheet, shore and brace the sides of the excavation to prevent undermining of, or settlement beneath the structures or pavement. Unless otherwise established by the pay items, underpinning of adjacent structures or pavement shall be done by the **CONTRACTOR** at his own cost and expense and in a manner satisfactory to the **CITY**; or, when required by the **CITY**, the pavement or structure shall be removed, the void satisfactorily refilled and compacted and the pavement or structure replaced by the **CONTRACTOR**. Wooden sheeting, shoring, and bracing shall be left in place where it is adjacent to the pipe embedment for the initial lift of backfill.

The removal of all sheeting, shoring and bracing shall be done in such manner as not to endanger or damage either new or existing structures, private or public properties; and so as to avoid cave-ins, or sliding of the banks. All holes or voids left by the removal of the sheeting, shoring or bracing shall be immediately and completely filled and compacted with suitable materials. If, for any reason, the **CONTRACTOR**, with the approval of the **CITY**, elects to leave in place the sheeting, shoring or bracing, no payment shall be allowed for such material left in place unless ordered by the **CITY** to be left in place.

F. DISPOSAL OF EXCAVATED MATERIALS: Suitable excavated materials may be piled adjacent to the work to be used for backfilling. Excavated materials unsuitable for backfilling, or in excess of that required for backfilling, shall be disposed of by the **CONTRACTOR**. Desirable topsoil, sod, etc., shall be carefully removed and piled separately adjacent to the work when required. Excavated materials shall be handled at all times in such manner as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to private and public property adjacent to or along the line of work. The excavated material in rock which is not suitable material for bedding or backfill shall be disposed of by the **CONTRACTOR**. Suitable selected bedding or backfill material from the trench excavation shall be provided at no additional cost to the **CITY** or **OWNER**.

G. DEWATERING: The **CONTRACTOR** shall remove all water from any source which may accumulate in the excavation. The embedment or pipe shall not be installed in water. No water shall be allowed to flow through or over unset concrete or through the completed line. All water removed from excavations shall be disposed of in an approved manner, so as not to create unsanitary conditions; nor to cause injury to persons or property; nor damage to the work in progress, and/or not to interfere unduly with the use of streets, private driveways or entrances. Pumping or bailing and draining, underdrains, ditches, etc., shall be considered as incidental work and shall not be paid for as separate items; but their cost shall be included in such contract prices as are provided for in the contract.

H STABILIZATION: In the event the **CONTRACTOR** is preventing water from interfering with the work and the trench bottom is too unstable in the opinion of the Engineer or the Engineer's representative for proper grading and pipe installation, the **CONTRACTOR** shall stabilize the bottom of the trench as instructed by the Engineer or the Engineer's representative. To stabilize the trench bottom, the **CONTRACTOR** shall undercut the trench bottom as required and place a layer of washed crushed stone or concrete mix in the trench bottom. In general, the crushed stone or concrete mix is to be 6" thick unless a greater thickness is specified by the Engineer or the Engineer's representative. When used, the crushed rock shall meet the requirements of paragraph 3.3.B.1 "Crushed Stone" of this specification, except the gradation shall be:

	Percent
Passing 5" sieve	100%
Retained on 2" sieve	100%

The concrete mix, if used, is to be mixed as specified for concrete encasement with the exception that the water is to be omitted from the mix and the dry mix placed in the trench bottom. The dry concrete mix is to be placed only in short sections at a time and then immediately fine graded and the pipe installed over it without delay before the dry concrete mix is placed in the next section of trench.

Stabilization will be paid for as specified in the pay items but shall not be used except with the approval of the Engineer or **CITY.** In cases of disagreement between the Engineer and the **CITY**, the decision of the **CITY** shall be final.

3.3 BACKFILL: This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for the furnishing, placing and maintaining of all embedment, backfill materials, compaction, refilling any settlement of all excavated areas, the replacement of topsoil after backfill is completed and the restoration of all other lands, private or public, damaged or occupied by the **CONTRACTOR** in the performance of the contract to the same (or improved) condition as they were prior to the beginning of the work.

A. BACKFILL PROCEDURE: Backfill procedure is that procedure required to return trenches or excavated areas to a condition satisfactory to the **CITY**. Such backfilling occurs in two general areas. They are: 1) areas not subject to vehicular traffic; and 2) areas subjected directly to, or influenced by, vehicular traffic.

The methods of backfilling to be used shall vary with the width of trench, the character of the materials excavated, the methods of excavation, the type of conduit and the degree of compaction required. The placing of backfill shall not begin until the **CITY** has been notified. The excavation shall be backfilled only with approved materials, in accordance with the plans and these specifications. Backfill is divided into two major categories: (1) embedment; and (2) final backfill material, as follows:

1. Embedment is the material upon which the pipe rests and which covers the pipe.

2. Final backfill material is the material required to fill the trench from the top of the embedment to ground elevation or subgrade of a street.

B. EMBEDMENT: The type of embedment to be used for PVC sewer mains shall be as follows:

1. Crushed Stone:

a. Description: The aggregates shall consist of durable particles of crushed stone; free from frozen material or injurious amounts of salt, alkali, vegetable matter or other material either free or as adherent coating; and its quality shall be reasonably uniform throughout. It shall have a wear of not more than 40 percent when tested in accordance with TxDOT Test Method Tex-410-A.

b. Test: When tested by standard laboratory methods, crushed rock embedment for each gradation shall meet the following requirements for percentage by weight as stated in the TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, latest edition.

Standard Crushed Rock – Aggregate Grade 4:	
	Percent
Retained on 1-½" sieve	0%
Retained on 1" sieve	0-5%
Retained on ½" sieve	40-75%
Retained on No. 4 sieve	90-100%
Retained on No. 8 sieve	95-100%

C. SELECT BACKFILL – SPECIAL CIRCUMSTANCES: During planning work, the Engineer may recognize that a majority of the ditchline material may not be suitable for backfill and provide for select backfill material, the use of which shall be approved by the **CITY**. In cases where ditchline material is not suitable for backfill, select backfill material as approved by the Engineer shall be required.

These backfill materials may fall into one of two categories: 1) select backfill obtained onsite or 2) select backfill obtained offsite. Generally, select backfill obtained onsite would relate to utilities installation in subdivisions.

Should the provision for the necessity of major select backfill be required, the plans and specifications will address and provide a bid item for the same.

1. Select Backfill Obtained Onsite: The Engineer shall designate select backfill material from a point within the project limits. Unsuitable excavated material designated by the Engineer will be removed and disposed of by the **CONTRACTOR** as approved by the Engineer. The unsuitable material shall be spread and bladed as needed. All stockpiled material shall have adequate erosion control. For the unit price bid, the **CONTRACTOR** shall load and haul select backfill to the project and install it in the trench according to these specifications. Select backfill will be made for the full depth of the trench above the embedment. Payment will be for the linear foot of trench for a given size pipe to be installed in that trench. Payment includes furnishing all labor and equipment to remove, haul and spread unsuitable excavated material on sites designated by the Engineer and to load, haul, and install select backfill in the trenches.

2. Select Backfill Obtained Offsite: The **CONTRACTOR** will be responsible for locating suitable sources of select backfill material, advise the Engineer of the availability of the sources, and obtain the Engineer's approval of the sources before any commitment is made to use the material. The **CONTRACTOR** will be responsible for the payment of any royalties necessary for the materials. Unsuitable excavated material designated by the Engineer will be removed and disposed of by the **CONTRACTOR** as approved by the Engineer. The unsuitable material

shall be spread and bladed as needed. All stockpiled material shall have adequate erosion control. For the unit price bid, the **CONTRACTOR** shall pay royalties, load and haul select backfill material to the project and install in the trench according to these specifications. Payment will be for the linear foot of trench for a given size pipe to be installed in that trench. Payment includes furnishing all labor and equipment to remove, haul and spread unsuitable excavated material on sites designated by the Engineer, pay royalties and to load, haul, and install select backfill material in the trenches.

D. COMPACTION: Compaction of all backfill material shall be performed in a manner that shall not crack or crush the pipe and/or cause the installed pipe to be moved from the established grade and/or alignment, as shown on the plans. Wet ground conditions following rainfall may preclude the opening of ditch lines that cannot be properly backfilled and tamped.

1. Densities In Areas Subjected To or Influenced By Vehicular Traffic: The trench backfill shall be mechanically compacted to the top of the subgrade in 6" lifts by the method selected by the **CONTRACTOR**, to a density of 95% as determined by ASTM D698, latest revision.

2. Densities In Areas Not Subjected To or Influenced By Vehicular Traffic: The trench backfill shall be placed in layers not more than 10" in depth (loose measurement) and shall be compacted by whatever means the **CONTRACTOR** chooses, subject to the restrictions outlined, to a density of 90% as determined by ASTM D698, latest revision.

   The embedment shall be compacted by a method approved by the **CITY**.

3. Special Situations: In areas specifically designated in the plans and specifications, the entire backfill shall be compacted.

4. Compaction Methods: The method of compaction shall be left to the discretion of the **CONTRACTOR** with the following exception, unless otherwise specified, provided that the proper degree of compaction is obtained and provided that the pipe is not damaged in the process. If any potential damage to the pipe due to a proposed method of compaction exists, in the opinion of the Engineer, that method of compaction shall not be allowed.

   Compaction of any backfill material by flooding or jetting shall not be permitted for soils with a PI in excess of 5, unless authorized by **CITY**.

   Hand-operated mechanical tampers may be used with approval of the **CITY** for compacting backfill.

5. Rejection: If the backfill does not meet the proper degree of compaction throughout its depth, the **CITY** shall require its removal and replacement to meet the requirements at the **CONTRACTOR'S** expense.

   In areas with vehicular traffic or for future improvements, all ditch lines after backfill and compaction shall be sealed with oiled dirt to preclude drainage water from entering the ditch line. The oiled dirt seal shall be maintained until road construction commences. Compensation for oil dirt seal shall be included in the unit price for the improvements if no separate bid item is provided in the proposal.

6. Means and methods to complete installation in accordance with the specifications shall be the responsibility of the **CONTRACTOR**. **CITY** shall provide quality assurance testing as deemed necessary.

E. INCLEMENT WEATHER: The **CITY** shall require work to cease due to inclement weather which saturates the existing soil to be removed and utilized as backfill material. Wet soil conditions, particularly in areas of proposed street improvements do not allow the proper compaction to be attained in cases of high moisture content.

3.4 TESTING: The **CONTRACTOR** shall be required to perform a Ball Test, a Low Pressure Air Test on each section of PVC gravity sewer line installed, and a Deflection Test on each section of PVC gravity sewer line installed with an inside diameter of 27" or less. For pipes with an inside diameter greater than 27", other test methods shall be used to determine deflection. In addition, all new sewer main will be TV inspected.

A. BALL TEST: Upon the completion of laying each sewer line, the **CONTRACTOR** shall thoroughly flush each sewer line with a sufficient quantity of fresh water at a sufficiently high velocity to clean each line. The **CONTRACTOR** shall continue flushing until the water from each sewer line runs clear and clean.

   After this has been completed, the **CONTRACTOR** shall make a test of the cleanliness and flow through each line by running a large quantity of clean fresh water through the lines. This may be applied from a fire hydrant near the end of the line or may have to be hauled by water trucks. In any event, the flow through each line during this test shall not be less than 200 gallons per minute. For the purpose of the test, the **CONTRACTOR** shall furnish rubber balls which shall be run through each line in the presence of the Project Representative. The size of the rubber balls shall be as follows:

Line Size	Ball Diameter
6"	4-1/2" to 5"
8"	6" to 7"
10" and larger	8" or larger

The ball shall be inserted at the high point of each line and flushed through the entire length of the line with inspection made of each manhole as the ball passes through it. Every sewer line on the project is designed so that the minimum velocity through the sewer line exceeds 2 feet per second. During the ball test, the ball shall travel from manhole to manhole at not less than one-half this velocity or one foot per second.

B. LOW PRESSURE AIR TEST:

Leakage Allowance: The leakage allowance requirements of the air test shall be considered satisfied if the time required in seconds for the pressure to decrease from 3.5 pounds per square inch (psi) to 2.5 psi is not less than that shown in the following table:

Table 1 Minimum Testing Times for Low-Pressure Air Test				
Pipe Diameter (inches)	**Minimum Test Time (25% of Test Period)**	**Minimum Test Time (100% of Test Period)**	**Maximum Pipe Length for Minimum Test Time (feet)**	**Time for Longer Pipe Length (seconds/foot)**
6	85 sec (1 min, 25 sec)	340 sec (5 min, 40 sec)	398	0.855
8	114 sec (1 min, 54 sec)	454 sec (7 min, 34 sec)	298	1.520
10	142 sec (2 min, 22 sec)	567 sec (9 min, 27 sec)	239	2.374
12	170 sec (2 min, 50 sec)	680 sec (11 min, 20 sec)	199	3.419
15	213 sec (3 min, 33 sec)	850 sec (14 min, 10 sec)	159	5.342
18	255 sec (4 min, 15 sec)	1020 sec (17 min, 0 sec)	133	7.693
21	298 sec (4 min, 58 sec)	1190 sec (19 min, 50 sec)	114	10.471
24	340 sec (5 min, 40 sec)	1360 sec (22 min, 40 sec)	100	13.676
27	383 sec (6 min, 23 sec)	1530 sec (25 min, 30 sec)	88	17.309
30	425 sec (7 min, 5 sec)	1700 sec (28 min, 20 sec)	80	21.369
33	468 sec (7 min, 48 sec)	1870 sec (31 min, 10 sec)	72	25.856

Testing Procedure:

1. The section of pipe to be tested is to be plugged at each end. The ends of all branches, laterals, and wyes which are to be included in the test are to be sealed or plugged. All plugs shall be carefully braced to prevent slippage and blowout due to internal pressure. One of the plugs provided must have an inlet tap or other provision for connecting an air hose.

2. Connect one end of the air hose to the inlet tap on the plug and connect the other end of the hose to portable air control equipment. The air control equipment shall consist of pressure gages and valves used to control the rate at which the air flows to the test section and to monitor the air pressure inside the pipe. The air control equipment can then be connected to a source of air supply such as a portable air compressor.

3. After the air hoses are properly connected, inject air into the test section. Monitor the air pressure so that pounds per square inch, gage (psig) may be recorded.

4. When the pressure inside the test section reaches 4.0 psig, throttle the air supply so that the internal pressure is maintained between 4.0 and 3.5 psig for at least two minutes. These two minutes allow time for the temperature of the air to come to equilibrium within the pipe walls.

5. After the temperature has been allowed to stabilize for the two minute period, the air supply should be disconnected and the pressure be allowed to decrease to 3.5 psig. At 3.5 psig, a stopwatch is to be started to determine the time required for the pressure to drop to 2.5 psig. The section of pipeline being tested shall be considered acceptable if the time required in seconds for the pressure to decrease from 3.5 to 2.5 psig is equal to or greater than that shown in Table 1 (above) in these specifications.

6. The test may stop if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of a testing period, then the test must continue for the entire test duration as outlined above or until failure.

7. Pipes with a 27 inch or larger average inside diameter may be air tested at each joint instead of following the procedure outlined in this section.

8. Groundwater will be measured where it is known to exist and a correction made to increase test pressure to 3.5 pounds per square inch greater than the pressure exerted by the groundwater above the pipe.

   At the time the sewer line is installed, the **CONTRACTOR** shall install a 1" to 1-1/2" diameter standpipe from the top of the sewer line to a point at or above ground level to be used to measure the groundwater. The bottom of the standpipe shall be perforated for one foot and enclosed with loose gravel to allow the groundwater to seek its natural level within the standpipe. The top of the standpipe shall be capped to prevent foreign material from entering. Generally, a 1" to 1-1/2" monitor standpipe shall be installed in each run of pipeline between manholes.

   Immediately prior to the line acceptance test, the groundwater shall be determined by removing the cap and measuring the height in feet of water over the invert of the sewer line. This height in feet shall be multiplied by 0.43 to establish the pounds of pressure that will be added to the wall readings. For example, if the height of water is 7', then the added pressure will be 3 psig. This increases the 3.5 psig to 6.5 psig, and the 2.5 psig to

5.5 psig. The allowable drop of 1 pound in the timing remains the same. If possible, the standpipe should be removed after the sewer line is accepted.

C. DEFLECTION TEST: No sooner than 30 days, or later than 12 months, after the pipe has been installed and backfilling is complete, tests for deflection shall be made. A deflection of more than 5% of the inside diameter of the pipe shall be cause for rejection and the line will be removed and replaced at the **CONTRACTOR'S** expense. The replacement line will again be tested not less than 30 days after the pipe has been installed and backfilling is complete.

The street surface course shall not be completed until after the deflection test is performed and passed.

Mandrel Design: The mandrel shall be designed in accordance with current TCEQ requirements.

Testing Procedure:

1. Completely flush the line, if required, to make sure the pipe is free of any mud or other debris that would hinder passage of the mandrel.

2. During the final flushing of the pipe, attach a floating block or ball to the end of the mandrel pull rope and float the rope through the pipe.

3. After the rope is threaded through the pipe, connect the pull rope to the mandrel and place the mandrel in the entrance of the pipe.

4. Connect a retrieval rope to the back of the mandrel to pull it back if necessary.

5. Remove all slack in the pull rope and place a tape marker on the rope at the ends of the pipe where the mandrel will exit, determining the location of the mandrel in the pipe.

6. Using manhole guide pulleys, draw the mandrel through the sewer pipe. If any irregularity or pipe deformation which exceeds the allowable 5% is encountered, the pipe shall be uncovered at that point.

7. If an obstructed or over deflected section is found, locate the problem within the pipe, uncover the pipe and replace it.

8. Re-test the pipe section for deflection not less than 30 days after the pipe is installed and after backfilling is complete.

9. Any pipe removed shall be replaced by use of gasketed repair couplings.

10. The mandrel test shall be performed without the use of mechanical pulling devices.

3.5 FINAL INSPECTION: On each section of sewer line, inspection shall be made on that line at the same time the ball test, air test, and deflection test is performed. Before the required tests are made, the **CONTRACTOR** shall complete all work on the portion of line to be tested and dress up the ditches, remove all debris, and complete the work in every way except for the required tests. When these tests are being performed, the Project Representative shall inspect the line including manhole, grout, and structure defects. Defects that are noted during this final inspection shall be repaired by the **CONTRACTOR** without additional payment. All work and testing shall be performed in the presence of the Project Representative and be finally approved by the Director of Utilities and Public Works.

PART 4 – MEASUREMENT AND PAYMENT

4.1 SEWER LINES: Payment for installing PVC pipe for gravity sewer lines shall be by the lineal foot according to the depth of the line. The measurement shall be made from end to end of the lines, including through all fittings and manholes. The measurement of the depth shall be from the original ground level at the centerline of the ditch before the construction was begun to the invert of the sewer line. This payment shall be the complete payment for site preparation, excavating the trench, furnishing and installing the pipe and joint materials, installing the backfill including compaction, performing all necessary tests, and providing all clean up and restoration not specifically included in other bid items.

4.2. FITTINGS: Fittings shall be paid for per each at the unit price bid. This measurement shall include the fitting and all accessories. The payment for fittings shall be the complete payment for making the excavation, cutting the pipe line where necessary to install the fitting, furnishing and installing the fitting and all required joint materials, installing the backfill including compaction and providing all clean up and restoration not specifically included in other items.

4.3 TRACER TAPE: Furnishing materials for and installation of tracer tape shall be subsidiary to the installation of sewer service pipe and fittings, and shall not be considered as a separate pay item.

City of Tyler Standard Specifications

POLYVINYL CHLORIDE (PVC) PIPE FOR SEWER FORCE MAINS

PART 1 - GENERAL

1.1 SCOPE: This specification covers requirements for unplasticized polyvinyl chloride (PVC) pipe and fittings for sanitary sewer force mains.

1.2 QUALITY ASSURANCE: Pipe shall be the product of one (1) manufacturer which has had not less than 10 years successful experience manufacturing pipe of the types and sizes indicated, unless authorized by the Tyler Water Utilities.

1.3 HANDLING AND STORAGE: Handling and storage shall be in accordance with the pipe manufacturer's recommendations. The **CONTRACTOR** shall inspect each load of pipe upon delivery to verify that the load is intact and in good condition. During handling the **CONTRACTOR** shall minimize impacts to the pipe. Care shall be taken to insure the pipe is not dropped or damaged.

If possible, pipe shall be stored in packages provided by the manufacturer. Avoid storage in direct sunlight for periods longer than 90 days. Care shall be taken to avoid compression, damage or deformation to bell ends of pipe. Pipe should be supported to prevent damage to the bottom of the pipe. The interior of the pipe shall be kept free from dirt or other foreign matter.

1.4 REJECTION: PVC pipe for sanitary sewer force mains may be rejected for failure to meet any or all of the requirements of this specification.

PART 2 - PRODUCTS

2.1 PVC PIPE: Polyvinyl chloride (PVC) sewer force main pipe shall meet the requirements of AWWA C900, latest revision. All PVC sewer force main pipe shall have a dimension ratio (DR) of 18. In no case will pipe with a dimension ration of 25 be allowed.

Outside diameter shall be cast-iron compatible. Pipe shall be new and furnished in standard lengths of 20'. Pipe in conformance with this standard shall be permanently and legibly marked at intervals of 5 feet or less, as follows:

A. Manufacturers name or trademark and production code
B. Nominal pipe size
C. PVC
D. Dimension Ratio (DR)
E. AWWA/UL Pressure Class
F. AWWAC900, latest edition

G. Seal or mark of the testing agency verifying the suitability of the pipe material for water service

Manufacturers shall be Certainteed, J&M or approved equal.

2.2 JOINTS: PVC sewer force main pipe shall be furnished with gasketed joints meeting the requirements of ASTM D3139, latest revision. Gaskets shall be part of a complete pipe section and purchased as such. Lubricant used for pipe and fittings assembly shall be as recommended by the pipe or fitting manufacturer and shall have no detrimental effect to the potable qualities of the water being transported or to either the gasket or pipe.

2.3 FITTINGS: Fittings for PVC sewer force main pipe shall be new, shall be ductile iron and shall conform to the latest revision of ANSI/AWWA C110/A21.10, unless otherwise specified.

Fittings joints shall be push-on or mechanical joints. Bolts and nuts for mechanical joints shall be of a high-strength, corrosion-resistant, low-alloy steel and shall conform to ASTM A325 (Type 3), latest revision.

Fittings shall have a cement mortar lining in accordance with ANSI/AWWA C104/A21.4, latest revision and a standard asphaltic coating on the exterior surfaces.

2.4 AIR RELEASE VALVES FOR SEWAGE SERVICE: Unless otherwise indicated in the plans or contract specifications, air valves shall meet the requirements specified herein.

A. TYPE: Air release valve shall be the combination type which allows large volumes of air to escape or enter through a larger diameter air and vacuum orifice when filling or draining a pipeline. When the pipeline is filled under pressure, the large air and vacuum orifice shall stay closed but a smaller diameter air release orifice shall remain open to allow small pockets of air to escape automatically and independently of the large orifice.

B. MATERIAL: The valves shall be cast iron body, stainless steel, stainless steel float and float stem, steel bolts and nuts, Buna-N needle and seat, and brass or stainless steel plug.

C. INLETS AND OUTLETS: Inlets and outlets shall be threaded through 4".

D. COATING: Air valves shall be painted Phenolic Primer Red Oxide, or approved equal.

2.5 TRACER WIRE: Inductive tracer detection wire shall be placed directly above the centerline of all non-metallic pipe for the full length of the pipe a minimum of 12" below subgrade or, in areas outside the limits of pavement, a minimum of 18" below finished grade. The tracer wire shall be a solid copper conductor, 14 gauge, insulated by a high

molecular weight polyethylene jacket and color coded according to American Public Works Association Uniform Color Code, i.e. green for wastewater.

PART 3 - EXECUTION

3.1. SITE PREPARATION: The construction site shall be prepared for construction operations by the removal and disposal of all obstructions and objectionable materials from the designated construction area. It is the intent of this specification to provide for the removal and disposal of all objectionable material not specifically provided for elsewhere in the plans or specifications. This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for clearing and removing from the site of the work wherever located, all obstructions, designated trees, stumps, brush vegetation, miscellaneous stone, brick, concrete, scrap iron and all rubbish and debris whether above or below ground level. Such items shall be included in such contract pay item as provided in the bid proposal.

3.2 EXCAVATION: This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for the furnishing, placing and maintaining of all sheeting, shoring and bracing necessary to protect the work and adjacent properties; to support the sides and ends of the excavation and to support all adjacent structures above and below the ground; the installation and operation of all pumping, bailing and draining necessary to keep the excavation free from seepage water, water from sewers, drains, ditches, creeks and other sources; to provide for the uninterrupted flow of the removal, after the completion of the work, of all sheeting, shoring and bracing not necessary to support the sides of the excavation; and the satisfactory disposal of excess and unsuitable materials not required or which cannot be used for backfilling

Prior to commencing any excavation, the **CONTRACTOR** shall provide ample labor, equipment, shoring materials and such other safety equipment as required to insure that the work shall be carried on without interruption or damage to existing installations; and to provide the least interruption of traffic commensurate with the project requirements. Blasting is prohibited; alternate methods shall be utilized.

In general, all excavation shall be made in open cut from the surface of the ground and shall be no greater in width or depth than is necessary to permit the proper construction of the work in accordance with the plans and these specifications. All excavation shall be to the line and grade as provided by the Engineer. The **CONTRACTOR** shall abide by all applicable federal, state and/or local laws governing excavation work. The entire foundation area in the bottom of all excavation shall be firm, stable and at uniform density as nearly as practicable. Unless necessary, materials shall not be disturbed. The final cleaning and preparing of the foundation area shall be done immediately prior to the placing of the embedment materials or structures.

A. PROGRESS: The **CITY** shall have the right to limit the amount of trenches that shall be opened, or partly opened, in advance of or following the pipe laying

operation. Unless otherwise directed by the **CITY**, the completion of backfill shall immediately follow the pipe laying. In the event the **CONTRACTOR** fails to comply with this requirement, the **CITY** may stop the pipe laying until the requirements are met.

B. TRENCH BOTTOM ELEVATION: All trenches for installation of PVC pipe shall be excavated to a point below the barrel of the pipe for the type of embedment specified.

C. TRENCH OVERCUT: Should the **CONTRACTOR** excavate below the plan trench bottom for sewer force mains, the **CONTRACTOR** shall backfill to trench bottom grade shown on the plan with approved aggregate, consolidated and compacted to meet the **CITY'S** approval, at no additional cost to the **CITY**. See paragraph 3.2.H "Stabilization" of this specification.

If the **CONTRACTOR** elects to overcut the trench and use gravel and drain pipe as an underdrain in lieu of or in conjunction with plumbing, draining, or well pointing, the additional work shall be considered as incidental work; and additional compensation shall not be allowed.

D. EXCAVATION CLASSIFICATIONS: All excavation is "unclassified" and involves removal of all materials necessary to permit carrying on the completion of the work.

Bidders must satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location, and sizes of pipe or conduits of various kinds in place.

E. SHORING AND SHEETING: When necessary to prevent caving or unduly hazardous working conditions, or to comply with existing laws, trench walls shall be appropriately braced, or sheeted and braced. Where bracing, or sheeting and bracing, is used, the trench width shall be increased accordingly and shall be paid for per linear foot of bracing or sheeting and bracing, shall be considered as incidental work and shall not be paid for as a separate item. Sheeting and shoring shall be in accordance with the City of Tyler Standard Specification for Trench Safety Systems.

In wet, saturated or flowing materials where it is necessary to install tight sheeting or cofferdams, wood or steel sheet piling shall be used. All sheeting, shoring and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and to maintain the sides of the excavation properly from injury or damage. When excavations are made adjacent to existing buildings or to other structures or in paved streets, particular care shall be taken to adequately sheet, shore and brace the sides of the excavation to prevent undermining of, or settlement beneath the structures or pavement. Unless otherwise established in the pay items, underpinning of adjacent structures or pavement shall be done by the

CONTRACTOR at his own cost and expense and in a manner satisfactory to the **CITY**; or, when required by the **CITY**, the pavement or structure shall be removed, the void satisfactorily refilled and compacted and the pavement or structure replaced by the **CONTRACTOR**. Wooden sheeting, shoring, and bracing shall be left in place where it is adjacent to the pipe embedment for the initial lift of backfill.

The removal of all sheeting, shoring and bracing shall be done in such manner as not to endanger or damage either new or existing structures, private or public properties; and so as to avoid cave-ins, or sliding of the banks. All holes or voids left by the removal of the sheeting, shoring or bracing shall be immediately and completely filled and compacted with suitable materials. If, for any reason, the **CONTRACTOR**, with the approval of the **CITY**, elects to leave in place the sheeting, shoring or bracing, no payment shall be allowed for such material left in place unless ordered by the **CITY** to be left in place.

F. DISPOSAL OF EXCAVATED MATERIALS: Suitable excavated materials may be piled adjacent to the work to be used for backfilling. Excavated materials unsuitable for backfilling, or in excess of that required for backfilling, shall be disposed of by the **CONTRACTOR**. Desirable topsoil, sod, etc., shall be carefully removed and piled separately adjacent to the work when required. Excavated materials shall be handled at all times in such manner as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to private and public property adjacent to or along the line of work. The excavated material in rock which is not suitable material for bedding or backfill shall be disposed of by the **CONTRACTOR**. Suitable selected bedding or backfill material from the trench excavation shall be provided at no additional cost to the **OWNER**.

G. DEWATERING: The **CONTRACTOR** shall remove all water from any source which may accumulate in the excavation. The embedment or pipe shall not be installed in water. No water shall be allowed to flow through or over unset concrete or through the completed line. All water removed from excavations shall be disposed of in an approved manner, so as not to create unsanitary conditions; nor to cause injury to persons or property; nor damage to the work in progress, and/or not to interfere unduly with the use of streets, private driveways or entrances. Pumping or bailing and draining, underdrains, ditches, etc., shall be considered as incidental work and shall not be paid for as separate items; but their cost shall be included in such contract prices as are provided for in the contract.

H STABILIZATION: In the event the **CONTRACTOR** is preventing water from interfering with the work and the trench bottom is too unstable in the opinion of the Engineer or the Engineer's representative for proper grading and pipe installation, the **CONTRACTOR** shall stabilize the bottom of the trench as instructed by the Engineer or the Engineer's representative. To stabilize the trench bottom, the **CONTRACTOR** shall undercut the trench bottom as required and

place a layer of washed crushed stone or concrete mix in the trench bottom. In general, the crushed stone or concrete mix is to be 6" thick unless a greater thickness is specified by the Engineer or the Engineer's representative. When used, the crushed rock shall meet the requirements of paragraph 3.3.B.1 "Crushed Stone" of this specification, except the gradation shall be:

	Percent
Passing 5" sieve	100%
Retained on 2" sieve	100%

The concrete mix, if used, is to be mixed as specified for concrete encasement with the exception that the water is to be omitted from the mix and the dry mix placed in the trench bottom. The dry concrete mix is to be placed only in short sections at a time and then immediately fine graded and the pipe installed over it without delay before the dry concrete mix is placed in the next section of trench.

Stabilization will be paid for as specified in the pay items but shall not be used except with the approval of the Engineer or **CITY.** In cases of disagreement between the Engineer and the **CITY**, the decision of the **CITY** shall be final.

3.3 BACKFILL: This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for the furnishing, placing and maintaining of all embedment, backfill materials, compaction, refilling any settlement of all excavated areas, the replacement of topsoil after backfill is completed and the restoration of all other lands, private or public, damaged or occupied by the **CONTRACTOR** in the performance of the contract to the same (or improved) condition as they were prior to the beginning of the work.

A. BACKFILL PROCEDURE: Backfill procedure is that procedure required to return trenches or excavated areas to a condition satisfactory to the **CITY**. Such backfilling occurs in two general areas. They are: 1) areas not subject to vehicular traffic; and 2) areas subjected directly to, or influenced by, vehicular traffic.

The methods of backfilling to be used shall vary with the width of trench, the character of the materials excavated, the methods of excavation, the type of conduit and the degree of compaction required. The placing of backfill shall not begin until the **CITY** has been notified. The excavation shall be backfilled only with approved materials, in accordance with the plans and these specifications. Backfill is divided into two major categories: (1) embedment; and (2) final backfill material, as follows:

1. Embedment is the material upon which the pipe rests and which covers the pipe.

2. Final backfill material is the material required to fill the trench from the top of the embedment to ground elevation or subgrade of a street.

B. EMBEDMENT: The type of embedment to be used for PVC sewer force mains shall be as follows:

1. Crushed Stone:

a. Description: The aggregates shall consist of durable particles of crushed stone; free from frozen material or injurious amounts of salt, alkali, vegetable matter or other material either free or as adherent coating; and its quality shall be reasonably uniform throughout. It shall have a wear of not more than 40 percent when tested in accordance with TxDOT Test Method Tex-410-A.

b. Test: When tested by standard laboratory methods, crushed rock embedment for each gradation shall meet the following requirements for percentage by weight as stated in the TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, latest edition.

Standard Crushed Rock – Aggregate Grade 4:

	Percent
Retained on 1-½" sieve	0%
Retained on 1" sieve	0-5%
Retained on ½" sieve	40-75%
Retained on No. 4 sieve	90-100%
Retained on No. 8 sieve	95-100%

Fine Crushed Rock – Aggregate Grade 8:

	Percent
Retained on ½" sieve	0%
Retained on 3/8" sieve	0-5%
Retained on No. 4 sieve	35-60%
Retained on No. 8 sieve	90-100%

Coarse Crushed Rock:

	Percent
Passing 1-½" sieve	100%
Retained on ¾" sieve	100%

2. Granular Material: Granular material shall be free flowing, such as sand or hydraulically graded crushed stone fines, or mixed sand and gravel, or sandy loam. The material shall be free from lumps, stones over 2" in diameter, clay and organic matter.

3. Select Material: Select material shall be gravel, fine rock cuttings, clayey sand, sand, sandy loam or loam free from excessive clay. Rock cuttings shall have no dimension greater than two-inches. Soil materials shall have a PI ranging between 0 and 15. Select material shall meet all requirements of paragraph 3.3.C "Select Backfill – Special Circumstances" of this specification.

4. Natural Gravel: Natural gravel shall consist of uncrushed stones meeting the requirements for wear as outlined in paragraph 3.3.B.1 "Crushed Stone" of this specification. The material shall be washed and screened and not have by weight more than one percent organic matter, clays or loam and not more than five percent by weight of any one of or combination of slate, shale, schist or soft particles of sandstones. The gradation shall be:

	Percent
Passing 1-½" sieve	100%
Retained on ¾" sieve	100%

5. Sand: Sand shall consist of clean, hard, durable, uncoated grains, free from lumps and organic material. All particles must pass a No. 8 sieve.

C. SELECT BACKFILL – SPECIAL CIRCUMSTANCES: During planning work, the Engineer may recognize that a majority of the ditchline material may not be suitable for backfill and provide for select backfill material placement, the use of which shall be as approved by the **CITY**. In cases where ditchline material is not suitable for backfill, select backfill material as approved by the Engineer shall be required.

These backfill materials may fall into one of two categories: 1) select backfill obtained onsite or 2) select backfill obtained offsite. Generally, select backfill obtained onsite would relate to utilities installation in subdivisions.

Should the provision for the necessity of major select backfill be required, the plans and specifications will address and provide a bid item for the same.

1. Select Backfill Obtained Onsite: The Engineer shall designate select backfill material from a point within the project limits. Unsuitable excavated material designated by the Engineer will be removed and

disposed of by the **CONTRACTOR** as approved by the Engineer. The unsuitable material shall be spread and bladed as needed. All stockpiled material shall have adequate erosion control. For the unit price bid, the **CONTRACTOR** shall load and haul select backfill to the project and install it in the trench according to these specifications. Select backfill will be made for the full depth of the trench above the embedment. Payment will be for the linear foot of trench for a given size pipe to be installed in that trench. Payment includes furnishing all labor and equipment to remove, haul and spread unsuitable excavated material on sites designated by the Engineer within the project and to load, haul, and install select backfill in the trenches.

2. Select Backfill Obtained Offsite: The **CONTRACTOR** will be responsible for locating suitable sources of select backfill material, advise the Engineer of the availability of the sources, and obtain the Engineer's approval of the sources before any commitment is made to use the material. The **CONTRACTOR** will be responsible for the payment of any royalties necessary for the materials. Unsuitable excavated material designated by the Engineer will be removed from the roadway and disposed of by the **CONTRACTOR** as approved by the Engineer. The unsuitable material shall be spread and bladed as needed. All stockpiled material shall have adequate erosion control. For the unit price bid, the **CONTRACTOR** shall pay royalties, load and haul select backfill material to the project and install in the trench according to these specifications. Payment will be for the linear foot of trench for a given size pipe to be installed in that trench. Payment includes furnishing all labor and equipment to remove, haul and spread unsuitable excavated material on sites designated by the Engineer, pay royalties and to load, haul, and install select backfill material in the trenches.

D. COMPACTION: Compaction of all backfill material shall be performed in a manner that shall not crack or crush the pipe and/or cause the installed pipe to be moved from the established grade and/or alignment, as shown on the plans. Wet ground conditions following rainfall may preclude the opening of ditch lines that cannot be properly backfilled and tamped.

1. Densities In Areas Subjected To or Influenced By Vehicular Traffic: The trench backfill shall be mechanically compacted to the top of the subgrade in 6" lifts by the method selected by the **CONTRACTOR**, to a density of 95% as determined by ASTM D698, latest revision.

2. Densities In Areas Not Subjected To or Influenced By Vehicular Traffic: The trench backfill shall be placed in layers not more than 10" in depth (loose measurement) and shall be compacted by whatever means the **CONTRACTOR** chooses, subject to the restrictions outlined, to a density of 90% as determined by ASTM D698, latest revision.

The embedment shall be compacted by a method approved by the **CITY**.

3. Special Situations: In areas specifically designated in the plans and specifications, the entire backfill shall be compacted.

4. Compaction Methods: The method of compaction shall be left to the discretion of the **CONTRACTOR** with the following exception, unless otherwise specified, provided that the proper degree of compaction is obtained and provided that the pipe is not damaged in the process. If any potential damage to the pipe due to a proposed method of compaction exists, in the opinion of the Engineer, that method of compaction shall not be allowed.

   Compaction of any backfill material by flooding or jetting shall not be permitted for soils with a PI in excess of 5, unless authorized by the **CITY**.

   Hand-operated mechanical tampers may be used with approval of the **CITY** for compacting backfill.

5. Rejection: If the backfill does not meet the proper degree of compaction throughout its depth, the **OWNER** shall require its removal and replacement to meet the requirements at the **CONTRACTOR'S** expense.

   In areas with vehicular traffic or for future improvements, all ditch lines after backfill and compaction shall be sealed with oiled dirt to preclude drainage water from entering the ditch line. The oiled dirt seal shall be maintained until road construction commences. Compensation for oil dirt seal shall be included in the unit price for the improvements if no separate bid item is provided in the proposal.

6. Means and methods to complete installation in accordance with the specifications shall be the responsibility of the **CONTRACTOR**. **CITY** shall provide quality assurance testing as deemed necessary.

7. Extreme groundwater conditions in the ditch line may require French drain installation prior to utilities installation.

E. INCLEMENT WEATHER: The **CITY** shall require work to cease due to inclement weather which saturates the existing soil to be removed and utilized as backfill material. Wet soil conditions, particularly in areas of proposed street improvements do not allow the proper compaction to be attained in cases of high moisture content.

3.4 TESTING:

A. PRESSURE TEST: A pressure test must be performed at a test pressure of 50 pounds per square inch above the normal operating pressure of the force main. A temporary valve for pressure testing may be installed near the discharge point of the force main and be removed after the test is successfully completed. A pump isolation valve may be used as an opposite termination point. The test must involve filling the force main with water. In order to pass the pressure test, the designated test pressure must be held in the pipe for a minimum of 4 hours and the leakage rate must not exceed 10 gallons per inch of diameter per mile of pipe per day.

The leakage rate shall be calculated using the following formula and shall be as shown in Table 1, below:

Equation 1: $$L = \frac{SD\sqrt{P}}{155{,}400}$$

Where: L = Acceptable leakage rate (gallons/hour/1,000 feet of pipe, based on a leakage rate of 10.0 gallons per inch of diameter per mile of pipe per day)
S = length of pipe (feet)
D = Nominal diameter of pipe (inches)
P = Average test pressure (pounds/square inch)

Table 1
Acceptable Leakage Rate for Pressure Test

Avg. Test Pressure (psi)	Pipe Diameter (inches)								
	4	6	8	10	12	14	16	18	20
450	0.55	0.82	1.09	1.37	1.64	1.91	2.18	2.46	2.73
400	0.51	0.77	1.03	1.29	1.54	1.80	2.06	2.32	2.57
350	0.48	0.72	0.96	1.20	1.44	1.69	1.93	2.17	2.41
300	0.45	0.67	0.89	1.11	1.34	1.56	1.78	2.01	2.23
275	0.43	0.64	0.85	1.07	1.28	1.49	1.71	1.92	2.13
250	0.41	0.61	0.81	1.02	1.22	1.42	1.63	1.83	2.03
225	0.39	0.58	0.77	0.97	1.16	1.35	1.54	1.74	1.93
200	0.36	0.55	0.73	0.91	1.09	1.27	1.46	1.64	1.82
175	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70
150	0.32	0.47	0.63	0.79	0.95	1.10	1.26	1.42	1.58
125	0.29	0.43	0.58	0.72	0.86	1.01	1.15	1.30	1.44
100	0.26	0.39	0.51	0.64	0.77	0.90	1.03	1.16	1.29

PART 4 – MEASUREMENT AND PAYMENT

4.1. SEWER FORCE MAINS: Payment for installing PVC pipe for sanitary sewer force mains shall be by the lineal foot. The measurement shall be made from end to end of the lines, including through all fittings. This payment shall be the complete payment for site preparation, excavating the trench, furnishing and installing the pipe and joint materials, installing the backfill including compaction, performing all necessary tests, and providing all clean up and restoration not specifically included in other bid items.

4.2. FITTINGS: Fittings shall be paid for per each at the unit price bid. This measurement shall include the fitting and all accessories. The payment for fittings shall be the complete payment for making the excavation, cutting the pipe line where necessary to install the fitting, furnishing and installing the fitting and all required joint materials, installing the backfill including compaction and providing all clean up and restoration not specifically included in other items.

4.3 THRUST BLOCKING: Furnishing materials for and installation of thrust blocking shall be subsidiary to the installation of pipe and fittings, and shall not be considered as a separate pay item.

4.4 AIR RELEASE VALVES: Payment for combination air release valves shall be paid for per each at the unit price bid. Payment shall include either a tap on the main pipeline, sufficient brass or copper piping, two (2) each 90-degree pipe bends if required, and a valve placed in a horizontal position. Installation shall include a metal or concrete box of sufficient size to house the air valve for maintenance purposes. Such payment shall include full compensation for all labor, material, and equipment for installation.

4.5 TRACER WIRE: Furnishing materials for and installation of tracer wire shall be subsidiary to the installation of pipe and fittings, and shall not be considered as a separate pay item.

City of Tyler Standard Specifications

MANHOLES

PART 1 - GENERAL

1.1 SCOPE: This specification covers requirements for precast concrete manholes to be used in the gravity sewer collection system.

1.2 REJECTION: Manholes may be rejected for failure to meet any or all of the requirements of this specification.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE: The precast concrete manholes shall be manufactured to meet ASTM C478, latest revision, and shall be made of concrete using at least 75 percent limestone aggregate. The manholes shall have a rubber gasket joint meeting ASTM C443, latest revision, and shall be a trapped O-ring rubber gasket.

2.2 MANHOLE BOTTOMS: Manhole bottoms shall be constructed of Class A, 3000 psi concrete.

2.3 RINGS AND COVERS: Manhole rings and covers shall be smooth close-grained cast iron, free of blisters and blow holes or other imperfections. The ring and lid shall be machined so that the ring fits snugly in the lid. The ring and lid shall weigh a minimum of 250 pounds. The lid shall have cast in it the words “Sanitary Sewer” and the lid shall be constructed with pick bars only. Holes are not allowed. Rings and covers shall be Bass & Hays Foundry, Inc. VRM 30 or approved equal.

2.4 MANHOLE INSERTS: All manholes shall be fitted with an insert to prevent infiltration of water into the manhole. Inserts shall be made of ultra high density polyethylene copolymer material that meets ASTM specifications designation D1248, Class A, Category 5, Type 111 with a minimum impact brittleness temperature of -180° F. The thickness shall be uniform 1/8" or greater. This material shall be corrosion proof from all gases associated with waste water collection systems.

Inserts shall be fitted with a lift strap made of a woven polypropylene web that is attached to the bowl of the dish by a wide head stainless steel rivet and a stainless steel 3/4" backup washer. All cut edges are to be seared to insure against raveling. Ventilation will be provided by a vent hole located on the side of the bowl. The hole will allow a maximum release of 5 gallons of water per 24 hours and will not be affected by debris that might collect in the bottom of the dish.

Manufacturer shall be Sealing Systems, Inc. or approved equal.

PART 3 - EXECUTION

3.1 MANHOLE CONSTRUCTION: Manholes shall be constructed at points shown on the plans or wherever ordered by the Engineer. Each manhole is to be completely built as the work progresses and as each manhole is reached. Manholes shall have the forms and dimensions as shown on the plans, and shall be finished in every respect in a workmanlike manner.

Foundations for manholes shall be constructed of concrete as specified above. Flow channels shall be smoothly formed and of the same dimensions as the connecting pipes. The depth of the flow channel shall be not less than the outside diameter of the pipe. Where flow lines connect at angles, smooth, curve connections shall be formed, and wherever possible, half sewer pipe shall be used to form the channel. Floors of manhole bottoms shall be sloped toward the channels with a fall of one-half inch per foot. Where pipes are laid through the manhole locations and the manhole installed later, the top half of the pipe shall be broken out or cut out.

Rings for covers shall be installed and securely mortared into place and covers placed in position.

Manholes shall be completely finished as the work proceeds and as each is reached. Initial construction shall begin after the line has been laid through that point.

For construction of manholes over existing mains, the precast manholes shall be placed into position on top of the pipe. The walls of the manhole shall be cut out so that the pipe will pass through the walls of the manhole. The bottom of the precast wall shall be lower than the bottom of the lowest pipe entering the manhole. The manhole shall be supported above the bottom of the excavation so that the concrete shall be a minimum of 4" thick under the manhole wall. The pipes entering the manhole shall be blocked into place so that they will not be displaced when the floor is poured. The floor of the manhole and the invert of the manhole shall be poured at the same time and shall be monolithic. After the floor is poured, the **CONTRACTOR** shall break out the tops of the pipe in the manhole and shall pave the remainder of the invert with grout to make a smooth invert.

The height of the precast concrete manholes shall be varied as required by using a top section of 1' – 4' so that the total height of the manhole is either exactly as required, or:

a) not more than 30 inches less than the required height when the manhole is under pavement, or
b) the top shall be a minimum of one foot above finished grade when the manholes is on a cross-country main.

If the height of the manhole does not provide the proper height, a neck or chimney shall be constructed using precast concrete rings set in mortar below the cast iron manhole ring, so that the height of the manhole is correct.

3.2 MANHOLE INSERTS: The manhole frame shall be cleaned of all dirt and debris before placing the manhole insert on the rim. The manhole insert shall be fully seated around the manhole frame rim to prevent water from infiltrating between the cover and the manhole frame rim.

3.3 TESTING: All manholes shall be tested following construction and backfilling for leakage by hydrostatic testing or by vacuum testing, as follows:

A. HYDROSTATIC TESTING: The **CONTRACTOR** shall seal all pipes coming into the manhole with internal pipe plugs. The manhole shall be filled with water and maintained for at least one hour. Concrete manholes may use a 24-hour wetting period before testing to allow saturation of the concrete. The maximum leakage allowed is 0.025 gallons per foot of diameter per foot of manhole depth per hour.

B. VACUUM TESTING: The **CONTRACTOR** shall plug all lift holes and exterior joints with non-shrink grout and plug all pipes entering the manhole. Grout shall not be placed in horizontal joints before testing. Stub-outs, manhole boots and pipe plugs must be secured to prevent movement while a vacuum is drawn. A minimum 60 inch/lb torque wrench shall be used to tighten external clamps to secure a test cover to the top of the manhole. Place a test head at the inside top of the cone section and inflate the seal in accordance with the manufacturer's recommendations. There must be a vacuum of 10" of mercury inside the manhole for the test to be valid. The test does not begin until the pump is turned off. The manhole passes the test if, after 2 minutes and with all valves closed, the vacuum is a t least 9" of mercury.

PART 4 – MEASUREMENT AND PAYMENT

4.1 MANHOLES: The method of payment for manholes and cleanouts shall be by the unit price bid for each item, which shall be the total compensation for furnishing all materials and completing all the construction and cleanup. The bid price in the proposal for manholes shall include all excavation, concrete foundations, manhole ring and covers, inserts and all other appurtenances as shown on the Engineer's plans, and backfilling and tamping. Payment for standard manholes will be made at the unit price bid for each manhole having a depth up to 6 feet from the top of the cover to the lowest invert. Extra payment for additional depth will be made by the foot in excess of 6 feet, each depth being measured to the nearest one-tenth foot and paid for in that manner.

Manholes 4 feet and less in depth, from top of cover to lowest point in the invert, shall be considered as shallow manholes and will be paid for at the unit price submitted by the successful bidder.

Payment for drop manholes shall be made at the unit price submitted on this item, and shall include all fittings, concrete, lumber, plugs, and necessary lengths of pipe needed to complete this unit. Payment for standard drop manholes will be made at the unit price bid for each manhole having a depth up to 6 feet from the top of the cover to the lowest invert. Extra payment for additional depth for drop manholes will be made by the foot in excess of 6 feet, each depth being measured to the nearest one-tenth foot and paid for in that manner.

Where it is necessary to connect new sewer lines to be constructed into existing manholes, payment shall be made at the unit price bid per each connection.

City of Tyler Standard Specifications

HIGH DENSITY POLYETHYLENE (HDPE) CORRUGATED AND SMOOTH LINED THERMOPLASTIC PIPE

PART 1 - GENERAL

1.1 SCOPE: This specification covers the requirements for high density polyethylene (HDPE) corrugated and smooth-lined pipe for the construction of culverts, side road pipes, storm sewers, stubs, and all related connections and fittings.

1.2 QUALITY ASSURANCE: All HDPE Corrugated and Smooth Lined Pipe shall be manufactured at a plant participating in the National Transportation Product Evaluation Program (NTPEP) quality assurance program.

Finished pipe shall be the product of one (1) manufacturer which has had not less than 10 years successful experience manufacturing pipe of the types and sizes indicated, unless otherwise approved by Tyler Water Utilities.

1.3 CONTRACTOR QUALIFICATIONS: All **CONTRACTORS** shall be trained by the manufacturer prior to installing HDPE pipe. Also prior to installation, the **CONTRACTOR** shall be included in the **CITY'S** approved HDPE installer's list. A certificate of training shall be provided to the City prior to beginning work for each specific project.

1.4 HANDLING AND STORAGE: Handling and storage shall be in accordance with the pipe manufacturer's recommendations. The **CONTRACTOR** shall inspect each load of pipe upon delivery to verify that the load is intact and in good condition. During handling the **CONTRACTOR** shall minimize impacts to the pipe. Care shall be taken to insure the pipe is not dropped or damaged.

If possible, pipe shall be stored in packages provided by the manufacturer. Care shall be taken to avoid compression, damage or deformation to ends of pipe. Pipe should be supported to prevent damage to the bottom of the pipe. The interior of the pipe shall be kept free from dirt or other foreign matter.

1.4 REJECTION: High density polyethylene pipe and fittings may be rejected for failure to meet any or all of the requirements of this specification.

PART 2 - PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE PIPE: High Density Polyethylene (HDPE) Corrugated and Smooth Lined Pipe & Fittings shall be manufactured in accordance with ASTM F2306, latest revision. HDPE pipe shall be manufactured from virgin

polyethylene compounds which conform to the requirements of cell class 435400C as defined and described in ASTM D 3350, latest revision.

Minimum Pipe Stiffness (PS) at five percent deflection shall be as described in ASTM F 2306, Section 6.3 when tested in accordance with ASTM D 2412.

Type S pipe shall have a full circular cross section, with an outer corrugated pipe wall and a smooth inner wall.

The sizes, types, and dimensions of pipes shall be as shown on the plans.

2.1 JOINTS: All HDPE pipe shall be furnished with one of the following types of joints and as described in the plans and specifications or in the bid proposal:

A. SOIL TIGHT JOINTS: Soil tight joints shall be as specified in the latest revision of ASTM F2306.

B. WATERTIGHT JOINTS: Watertight joints must meet a 74kPa (10.8 psi) laboratory test per ASTM D3212, latest revision, and utilize a bell and spigot design with a gasket meeting ASTM F477, latest revision.

PART 3 - EXECUTION

3.1. SITE PREPARATION: The construction site shall be prepared for construction operations by the removal and disposal of all obstructions and objectionable materials from the designated construction area. It is the intent of this specification to provide for the removal and disposal of all objectionable material not specifically provided for elsewhere in the plans or specifications. This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for clearing and removing from the site of the work wherever located, all obstructions, designated trees, stumps, brush vegetation, miscellaneous stone, brick, concrete, scrap iron and all rubbish and debris whether above or below ground level. Such items shall be included in such contract pay item as provided in the bid proposal.

3.2 EXCAVATION: This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for the furnishing, placing and maintaining of all sheeting, shoring and bracing necessary to protect the work and adjacent properties; to support the sides and ends of the excavation and to support all adjacent structures above and below the ground; the installation and operation of all pumping, bailing and draining necessary to keep the excavation free from seepage water, water from sewers, drains, ditches, creeks and other sources; to provide for the uninterrupted flow of the removal, after the completion of the work, of all sheeting, shoring and bracing not necessary to support the sides of the excavation; and the satisfactory disposal of excess and unsuitable materials not required or which cannot be used for backfilling.

Prior to commencing any excavation, the **CONTRACTOR** shall provide ample labor, equipment, shoring materials and such other safety equipment as required to insure that the work shall be carried on without interruption or damage to existing installations; and to provide the least interruption of traffic commensurate with the project requirements. Blasting is prohibited; alternate methods shall be utilized.

In general, all excavation shall be made in open cut from the surface of the ground and shall be no greater in width or depth than is necessary to permit the proper construction of the work in accordance with the plans and these specifications. All excavation shall be to the line and grade as provided by the Engineer. The **CONTRACTOR** shall abide by all applicable federal, state and/or local laws governing excavation work. The entire foundation area in the bottom of all excavation shall be firm, stable and at uniform density as nearly as practicable. Unless necessary, materials shall not be disturbed. The final cleaning and preparing of the foundation area shall be done immediately prior to the placing of the embedment materials or structures.

A. PROGRESS: The **CITY** shall have the right to limit the amount of trenches that shall be opened, or partly opened, in advance of or following the pipe laying operation. Unless otherwise directed by the **CITY**, the completion of backfill shall immediately follow the pipe laying. In the event the **CONTRACTOR** fails to comply with this requirement, the **CITY** may stop the pipe laying until the requirements are met.

B. TRENCH BOTTOM ELEVATION: All trenches for installation of HDPE pipe shall be excavated to a point below the barrel of the pipe for the type of embedment specified.

C. TRENCH OVERCUT: Should the **CONTRACTOR** excavate below the plan trench bottom for HDPE pipe, the **CONTRACTOR** shall backfill to trench bottom grade shown on the plan with approved aggregate, consolidated and compacted to meet the **CITY'S** approval, at no additional cost to the **CITY**. See paragraph 3.2.I "Stabilization" of this specification.

D. TRENCH WIDTHS: Trench widths shall be in accordance with the latest revision of ASTM D2321 and shall be sufficient to ensure working room to properly and safely place and compact haunching and other backfill materials. The minimum trench width shall not be less than 1.25 times the pipe outside diameter plus 12 inches. (1.25 x O.D. + 12"). On multiple pipe barrel runs the clear distance between pipes is as follows:

- 18" - 24" Diameters: Clear span =12"

E. EXCAVATION CLASSIFICATIONS: All excavation is "unclassified" and involves removal of all materials necessary to permit carrying on the completion of the work.

Bidders must satisfy themselves as to the actual existing subsurface conditions, including but not limited to the depth, location, and sizes of pipe or conduits of various kinds in place.

F. SHORING AND SHEETING: When necessary to prevent caving or unduly hazardous working conditions, or to comply with existing laws, trench walls shall be appropriately braced, or sheeted and braced. Where bracing, or sheeting and bracing, is used, the trench width shall be increased accordingly and shall be paid for per linear foot of bracing or sheeting and bracing. Sheeting and shoring shall be in accordance with the City of Tyler Standard Specification for Trench Safety Systems.

In wet, saturated or flowing materials where it is necessary to install tight sheeting or cofferdams, wood or steel sheet piling shall be used. All sheeting, shoring and bracing shall have sufficient strength and rigidity to withstand the pressure exerted and to maintain the sides of the excavation properly from injury or damage. When excavations are made adjacent to existing buildings or to other structures or in paved streets, particular care shall be taken to adequately sheet, shore and brace the sides of the excavation to prevent undermining of, or settlement beneath the structures or pavement. Unless otherwise established in the pay items, underpinning of adjacent structures or pavement shall be done by the **CONTRACTOR** at his own cost and expense and in a manner satisfactory to the **CITY**; or, when required by the **CITY**, the pavement or structure shall be removed, the void satisfactorily refilled and compacted and the pavement or structure replaced by the **CONTRACTOR**. Wooden sheeting, shoring, and bracing shall be left in place where it is adjacent to the pipe embedment for the initial lift of backfill.

The removal of all sheeting, shoring and bracing shall be done in such manner as not to endanger or damage either new or existing structures, private or public properties; and so as to avoid cave-ins, or sliding of the banks. All holes or voids left by the removal of the sheeting, shoring or bracing shall be immediately and completely filled and compacted with suitable materials. If, for any reason, the **CONTRACTOR**, with the approval of the **CITY**, elects to leave in place the sheeting, shoring or bracing, no payment shall be allowed for such material left in place unless ordered by the **CITY** to be left in place.

G. DISPOSAL OF EXCAVATED MATERIALS: Suitable excavated materials may be piled adjacent to the work to be used for backfilling. Excavated materials unsuitable for backfilling, or in excess of that required for backfilling, shall be disposed of by the **CONTRACTOR**. Desirable topsoil, sod, etc., shall be carefully removed and piled separately adjacent to the work when required. Excavated materials shall be handled at all times in such manner as to cause a minimum of inconvenience to public travel and to permit safe and convenient access to private and public property adjacent to or along the line of work. The excavated material in rock which is not suitable material for bedding or backfill

shall be disposed of by the **CONTRACTOR**. Suitable selected bedding or backfill material from the trench excavation shall be provided at no additional cost to the **CITY** or **OWNER**.

H. DEWATERING: The **CONTRACTOR** shall remove all water from any source which may accumulate in the excavation. The embedment or pipe shall not be installed in water. No water shall be allowed to flow through or over unset concrete or through the completed line. All water removed from excavations shall be disposed of in an approved manner, so as not to create unsanitary conditions; nor to cause injury to persons or property; nor damage to the work in progress, and/or not to interfere unduly with the use of streets, private driveways or entrances. Pumping or bailing and draining, underdrains, ditches, etc., shall be considered as incidental work and shall not be paid for as separate items; but their cost shall be included in such contract prices as are provided for in the contract.

I STABILIZATION: In the event the **CONTRACTOR** is preventing water from interfering with the work and the trench bottom is too unstable in the opinion of the Engineer or the Engineer's representative for proper grading and pipe installation, the **CONTRACTOR** shall stabilize the bottom of the trench as instructed by the Engineer or the Engineer's representative. To stabilize the trench bottom, the **CONTRACTOR** shall undercut the trench bottom as required and place a layer of washed crushed stone or concrete mix in the trench bottom. In general, the crushed stone or concrete mix is to be 6" thick unless a greater thickness is specified by the Engineer or the Engineer's representative. When used, the crushed rock shall meet the requirements of paragraph 3.4.B.1 “Crushed Stone” of this specification, except the gradation shall be:

	Percent
Passing 5" sieve	100%
Retained on 2" sieve	100%

The concrete mix, if used, is to be mixed as specified for concrete encasement with the exception that the water is to be omitted from the mix and the dry mix placed in the trench bottom. The dry concrete mix is to be placed only in short sections at a time and then immediately fine graded and the pipe installed over it without delay before the dry concrete mix is placed in the next section of trench.

In addition, a soil filter fabric as per manufacturer’s recommendations shall be installed around the initial backfill material unless sufficient fill cover can be provided over the pipe. A water-tight joint shall be used where the hydraulic grade line exceeds the top of the pipe. Perforated pipe with filter fabric may be used where high groundwater is encountered. In flowable fill or high groundwater installations, pipe shall be restrained as per manufacturer’s recommendations as shown in Technical Note 5.05.

Stabilization will be paid for as specified in the pay items but shall not be used except with the approval of the Engineer or **CITY.** In cases of disagreement between the Engineer and the **CITY**, the decision of the **CITY** shall be final.

3.3 INSTALLATION:

A. MINIMUM COVER: Unless authorized by the City of Tyler, the minimum cover is 18-inches for HS-25 Live Loads (18" - 24" diameters). However, care should be taken when heavy construction equipment loads cross the pipe trench during construction. If the passage of construction equipment over an installed pipeline is necessary during project construction, compacted fill in the form of a ramp shall be constructed to a minimum elevation of three feet (3.0') over the top of the pipe. Any damaged pipe shall be replaced at the contractor's expense.

B. HDPE PIPE: Installation of HDPE pipe shall be in accordance with the latest revision of ASTM D2321. Pipe shall be placed in the bed starting at the downstream end. Trenches must be excavated in such a manner as to insure that the sides will be stable under all working conditions. See paragraph 3.2.F "Shoring and Sheeting" of this specification.

C. JOINTS: Joints shall be installed so that the connection of pipe sections will form a continuous line free from irregularities in the flow line.

D. CONNECTIONS TO STRUCTURES: Connections to concrete manholes, headwalls or other structures shall be constructed in accordance with manufacturer's recommendations. For cast-in-place connections, the structure shall be cast around the pipe for a soil-tight connection. For precast connections, a non-shrink grout shall be used for a soil-tight connection. For a water-tight connection, a Water-Stop Gasket connection, or similar type, shall be used.

E. INSTALLATION DEFLECTION: At the **CITY'S** discretion, all pipe exceeding 7.5% deflection (as per AASHTO Section 30) may require replacement or re-compaction at the **CONTRACTOR'S** expense when measured or inspected not less than 30 days following completion of installation. Deflection is defined per ASTM D2321.

3.4 BACKFILL: This work shall include the furnishing of all labor, materials, tools, equipment and the work necessary for the furnishing, placing and maintaining of all embedment, backfill materials, compaction, refilling any settlement of all excavated areas, the replacement of topsoil after backfill is completed and the restoration of all other lands, private or public, damaged or occupied by the **CONTRACTOR** in the performance of the contract to the same (or improved) condition as they were prior to the beginning of the work.

A. BACKFILL PROCEDURE: Backfill procedure is that procedure required to return trenches or excavated areas to a condition satisfactory to the **CITY**.

The methods of backfilling to be used shall vary with the width of trench, the character of the materials excavated, the methods of excavation, the type of conduit and the degree of compaction required. The placing of backfill shall not begin until the **CITY** has been notified. The excavation shall be backfilled only with approved materials, in accordance with the plans and these specifications. Backfill is divided into two major categories: (1) embedment; and (2) final backfill material, as follows:

1. Embedment is the material upon which the pipe rests and which covers the pipe.

2. Final backfill material is the material required to fill the trench from the top of the embedment to ground elevation or subgrade of a street.

B. EMBEDMENT: The type of embedment to be used for HDPE pipe shall be as follows:

1. Crushed Stone:

a. Description: Bedding material shall meet the requirements of ASTM D2321 Class IB material. The aggregates shall consist of durable particles of crushed stone; free from frozen material or injurious amounts of salt, alkali, vegetable matter or other material either free or as adherent coating; and its quality shall be reasonably uniform throughout. It shall have a wear of not more than 40 percent when tested in accordance with TxDOT Test Method Tex-410-A.

b. Test: When tested by standard laboratory methods, crushed stone embedment for each gradation shall meet the following requirements for percentage by weight as stated in the TxDOT Standard Specifications for Construction and Maintenance of Highways, Streets and Bridges, latest edition.

	Percent
Retained on 1-½" sieve	0%
Retained on No. 4 sieve	≥50%
Retained on No. 200 sieve	>95%

C. SELECT BACKFILL – SPECIAL CIRCUMSTANCES: During planning work, the Engineer may recognize that a majority of the ditchline material may not be suitable for backfill and provide for select backfill material placement, the use of which shall be approved by the **CITY**. In cases where ditchline material is not

suitable for backfill, select backfill material as approved by the Engineer shall be required.

These backfill materials may fall into one of two categories: 1) select backfill obtained onsite or 2) select backfill obtained offsite. Generally, select backfill obtained onsite would relate to utilities installation in subdivisions.

Should the provision for the necessity of major select backfill be required, the plans and specifications will address and provide a bid item for the same.

1. Select Backfill Obtained Onsite: The Engineer shall designate select backfill material from a point within the project limits. Unsuitable excavated material designated by the Engineer will be removed and disposed of by the **CONTRACTOR** as approved by the Engineer. The unsuitable material shall be spread and bladed as needed. All stockpiled material shall have adequate erosion control. For the unit price bid, the **CONTRACTOR** shall load and haul select backfill to the project and install it in the trench according to these specifications. Select backfill will be made for the full depth of the trench above the embedment. Payment will be for the linear foot of trench for a given size pipe to be installed in that trench. Payment includes furnishing all labor and equipment to remove, haul and spread unsuitable excavated material on sites designated by the Engineer and to load, haul, and install select backfill in the trenches.

2. Select Backfill Obtained Offsite: The **CONTRACTOR** will be responsible for locating suitable sources of select backfill material, advise the Engineer of the availability of the sources, and obtain the Engineer's approval of the sources before any commitment is made to use the material. The **CONTRACTOR** will be responsible for the payment of any royalties necessary for the materials. Unsuitable excavated material designated by the Engineer will be removed and disposed of by the **CONTRACTOR** as approved by the Engineer. The unsuitable material shall be spread and bladed as needed. All stockpiled material shall have adequate erosion control. For the unit price bid, the **CONTRACTOR** shall pay royalties, load and haul select backfill material to the project and install in the trench according to these specifications. Payment will be for the linear foot of trench for a given size pipe to be installed in that trench. Payment includes furnishing all labor and equipment to remove, haul and spread unsuitable excavated material on sites designated by the Engineer, pay royalties and to load, haul, and install select backfill material in the trenches.

D. COMPACTION: Compaction of all backfill material shall be performed in a manner that shall not crack or crush the pipe and/or cause the installed pipe to be moved from the established grade and/or alignment, as shown on the plans. Wet

ground conditions following rainfall may preclude the opening of ditch lines that cannot be properly backfilled and tamped.

Bedding and backfill materials shall be placed in accordance with the City of Tyler Standard Detail "Trench Cross Section for HDPE Pipe". Bedding shall be loosely compacted. Initial backfill material shall meet the same requirements as the bedding material. Backfill material shall be placed in 6-inch lifts and shall be compacted to a minimum 90% Std. Proctor Density as determined by ASTM D698, latest revision. Final backfill material shall be as directed by the Engineer.

1. Special Situations: In areas specifically designated in the plans and specifications, the entire backfill shall be compacted.

2. Compaction Methods: The method of compaction shall be left to the discretion of the **CONTRACTOR** with the following exception, unless otherwise specified, provided that the proper degree of compaction is obtained and provided that the pipe is not damaged in the process. If any potential damage to the pipe due to a proposed method of compaction exists, in the opinion of the Engineer, that method of compaction shall not be allowed.

   Compaction of any backfill material by flooding or jetting shall not be permitted for soils with a PI in excess of 5, unless authorized by **CITY**.

   Hand-operated mechanical tampers may be used with approval of the **CITY** for compacting backfill.

3. Rejection: If the backfill does not meet the proper degree of compaction throughout its depth, the **CITY** shall require its removal and replacement to meet the requirements at the **CONTRACTOR'S** expense.

   In areas with vehicular traffic or for future improvements, all ditch lines after backfill and compaction shall be sealed with oiled dirt to preclude drainage water from entering the ditch line. The oiled dirt seal shall be maintained until road construction commences. Compensation for oil dirt seal shall be included in the unit price for the improvements if no separate bid item is provided in the proposal.

4. Means and methods to complete installation in accordance with the specifications shall be the responsibility of the **CONTRACTOR**. **CITY** shall provide quality assurance testing as deemed necessary.

E. INCLEMENT WEATHER: The **CITY** shall require work to cease due to inclement weather which saturates the existing soil to be removed and utilized as backfill material. Wet soil conditions, particularly in areas of proposed street

improvements do not allow the proper compaction to be attained in cases of high moisture content.

3.5 INSPECTION: If required by the **CITY**, the **CONTRACTOR** shall provide video camera (CCTV) inspection of a minimum of 10% of the pipelines installed. The sections to be tested will be selected by the **CITY**. The inspection shall be conducted at least 30 days after installation or just prior to paving operations, whichever period is longer. If failures are identified from the video inspection, the **CONTRACTOR** shall provide a CCTV inspection of up to 100% of the pipelines installed as directed by the **CITY**.

3.6 PIPE REPAIRS: If repairs to HDPE pipe are required, refer to manufacturer's recommendations.

PART 4 – MEASUREMENT AND PAYMENT

4.1. HDPE PIPE AND FITTINGS: Payment for installing HDPE pipe and fittings shall be by the lineal foot. The measurement shall be made between the ends of the barrel along its flow line, including through all fittings. This payment shall be the complete payment for site preparation, excavating the trench, furnishing and installing the pipe, joint and fittings materials, installing crushed stone embedment and backfill including compaction and providing all clean up and restoration not specifically included in other bid items.

4.2. SPECIALTY FITTINGS AND CONNECTIONS TO STRUCTUIRES: Specialty fittings and connections to structures shall be paid for per each at the unit price bid. This measurement shall include al specialty fitting and any necessary accessories, as well as each connection to a structure. The payment for specialty fittings and connections to structures shall be the complete payment for making the excavation, furnishing and installing specialty fittings and accessories, making the connection to the structure, installing the backfill including compaction and providing all clean up and restoration not specifically included in other items.

City of Tyler Standard Specifications

BORING AND ENCASEMENT

PART 1 - GENERAL

1.1 SCOPE: This specification covers requirements for boring and encasement. Water and sanitary sewer lines that cross aerial crossings, highways, streets or railroads must be placed in steel casing. Utility line crossings may be made by open cut, dry bore, or wet bore as specified by the Engineer.

1.2 PERMITS: Water or sanitary sewer system installations which require crossing railroads, streets and/or highways may require certain permits. The City of Tyler shall obtain permits for crossing prior to execution of contract. The **CONTRACTOR** shall abide by all requirements stipulated in the permits.

1.3 REJECTION: Pipe casing may be rejected for failure to meet any or all of the requirements of this specification.

PART 2 - PRODUCTS

2.1 CASING: The casing shall be new standard weight steel pipe, having a minimum yield strength of 35,000 psi. Used steel pipe casing will not be acceptable. The exterior shall be coated with 10 – 12 mil thickness of coal tar epoxy. Installation of the casing shall comply with the Engineer's grade requirements. Size of casing and minimum wall thickness will be as follows:

Size of Carrier Pipe (inches)	Minimum Casing Size (inches)	Minimum Wall Thickness (inches)
6	12	0.250
8	14	0.3125
10	18	0.3125
12	20	0.3750
15 or 16	24	0.3750
18	30	0.3750
20 or 24	36	0.3750
24	36	0.3750
27	42	0.500
30	42	0.500
33	48	0.500
36	48	0.500

A larger minimum wall thickness may be required based on the method of construction.

2.2 CASING SPACERS: Casing spacers shall be stainless steel band type or high density polyethylene, as recommended by the Engineer for the application. Manufacturer shall be Advance Products & Systems, Inc., Raci North America or approved equal.

2.3 END SEALS: End seals shall be pull-on or wrap-around styles. Wrap-around styles shall have a mastic seal.

2.4 GROUT MIX FOR WET BORES: Grout mix for wet bores shall be one part of Portland cement to 14 parts of sharp silica sand with sufficient water to make a readily flowable mix.

PART 3 - EXECUTION

3.1 INSTALLATION: When the **CONTRACTOR** is installing the carrier pipe inside the casing, the **CONTRACTOR** shall fasten spacers on the carrier pipe securely so that the carrier pipe can be pulled or pushed into the casing easily and without damage to the casing or carrier pipe. End plugs shall be installed to seal the ends of the casing.

PART 4 – MEASUREMENT AND PAYMENT

4.1 CASING: The method of payment for casing shall be at the unit price bid per lineal foot. This payment shall be the complete payment for site preparation, providing open cuts or bores, furnishing and installing the casing, spacers and end plugs, installing the backfill including compaction if required and providing all clean up and restoration not specifically included in other bid items. The payment for the carrier pipe inside the casing shall be paid for separately, unless otherwise established in the pay items.

City of Tyler Standard Specifications

TRENCH SAFETY SYSTEMS

PART 1 – GENERAL

1.1 RESPONSIBILITIES OF THE CONTRACTOR: The **CONTRACTOR** shall comply with the minimum requirements of this specification. Maintenance and inspection of any shoring and related equipment shall be the responsibility of the **CONTRACTOR**.

These specifications in no way relieve the **CONTRACTOR** of his responsibilities and liability to ensure the safety of the workers or any other party from the hazards of the construction operations. The **CONTRACTOR** is responsible for determining the appropriate trench safety systems necessary for specific locations based on actual subsurface conditions encountered during construction and to detect varying conditions that may be hazardous and take appropriate action. The Trench Safety Plan shall cover the situations that may be encountered during construction and may require revisions during the course of construction due to varying conditions that may be encountered.

1.2 REGULATORY REQUIREMENTS: The **CONTRACTOR'S** trench safety system shall conform to applicable Occupational Safety and Health Administration (OSHA) Standards as contained in 29 CFR, Part 1926, Subpart P - Excavations (as may be amended).

PART 2 – PRODUCTS

2.1 CONSTRUCTION MATERIALS, MAINTENANCE AND INSPECTION: Materials used for sheeting, sheet piping, cribbing, bracing, shoring and underpinning shall be in good serviceable condition, and timbers shall be sound, free from large or loose knots, and of proper dimensions as called for in the Occupational Safety and Health Administration (OSHA) Standards as contained in 29 CFR, Part 1926, Subpart P - Excavations (as may be amended), of which is made a part of these specifications. All materials that are found to be defective in any way shall be immediately removed from the job site. It shall be the responsibility of the **CONTRACTOR** to regularly check all trench safety equipment for soundness and adequacy.

Steel trench shields shall be constructed of steel plate sides, welded to a steel framework. All shields shall be constructed in order to provide protection equivalent to or greater than sheeting of shoring required for the trench. Upon request by the **CITY**, the **CONTRACTOR** shall provide written certification from the manufacturer of adequacy before using any trench shield. Adjustable jacks may be used in order to adjust the shield to varying trench widths. Access ladders shall be provided in accordance with OSHA. Pipe or flat steel runners or wheels shall be installed under the sidewalls for ease of movement of the shield during trenching operations. Substantial lifting eyes and /or rings shall be welded at proper points for moving the shield. For adaptability to deep and

shallow trenches, the shield may be made with top and bottom sections. When the sides of the trench extend above the top of the shield, a reinforced roof with hatches shall be provided. Forced ventilation shall be provided for fully enclosed shields.

All trenches shall be provided with an adequate means of exit at all times with spacings of 25 feet or less. These means of exit shall be anchored in place in order to aid in the event a quick exit is necessary.

During trench excavation, the excavated material shall be placed a minimum of two (2') feet away from the edge of the trench.

Each **CONTRACTOR** shall be responsible and liable for his own trench safety system, including maintenance and self-inspections by a certified "Competent Person" as defined by OSHA, whether or not a Project Representative is present on the job site.

PART 3 – EXECUTION

3.1 TRENCH SAFETY PLAN: Before beginning any excavation the **CONTRACTOR** shall make an inspection of the job site. The **CONTRACTOR** shall pay special attention to the type of soil or soils in which he will be working, any adjacent roads, highways, railroads and any previous excavations. All underground installations shall be located, including utility lines, pipelines, etc., before any excavation begins. The **CONTRACTOR** shall then design a trench safety system in accordance with OSHA Standards as contained in 29 CFR, Part 1926, Subpart P - Excavations (as may be amended). In cases where deviations are made from OSHA standards, special shoring is needed or where trench depths exceed 20 vertical feet, the trench safety system shall be designed by a Registered Professional Engineer in the State of Texas. Prior to issuance of the Notice to Proceed, the **CONTRACTOR** shall submit two (2) copies of a Trench Safety Plan to the **CITY**, which shall be written documentation of the **CONTRACTOR'S** proposed trench safety system.

The **CITY** reserves the right to stop work if the **CONTRACTOR'S** trench safety system is deemed to be not in compliance with the submitted Trench Safety Plan until such time the **CONTRACTOR** achieves compliance or a revised Trench Safety Plan is submitted to the **CITY**.

PART 4 - MEASUREMENT AND PAYMENT

4.1 TRENCH SAFETY SYSTEMS: Payment for trench safety systems shall be by the lineal foot. This payment shall be the complete payment for furnishing all labor, equipment and materials to design and/or install trench safety systems.

4.2 SPECIAL SHORING: Payment for special shoring shall be by the square foot. This payment shall be the complete payment for furnishing all labor, equipment and materials to design and install special shoring.