

Special Specification 7245

Sanitary Sewers



1. DESCRIPTION

Furnish labor, materials, and equipment necessary to provide a complete sanitary sewer system in accordance and compliance with AWWA, ASTM, ANSI, ACI, and NSF standards, the plans, specifications, and in compliance with the City of Colleyville.

The abbreviations AWWA, ASTM, ANSI, AASHTO, ACI, and NSF, used in this specification, refer to the following organizations or technical societies:

- AWWA American Water Works Association,
- ASTM American Society for Testing and Materials,
- ANSI American National Standards Institute,
- AASHTO American Association of State Highway and Transportation Officials,
- ACI American Concrete Institute, and
- NSF National Sanitation Foundations.

References to specifications of the above organizations mean the latest standard or tentative standard in effect on the date of the proposal.

The size and location of utility lines shown on the plans were obtained from field surveys and from the various utility companies. The Department does not assume responsibility for the accuracy of the information presented, nor does it warrant that every utility line is shown.

2. MATERIALS

2.1. **General.** Provide new and unused materials for this project unless otherwise stated on the plans or proposal. The type of pipe to be supplied should be as shown on the plans or in the special provisions for each project.

2.2. C 1.9 Ductile Iron Pipe

All ductile iron pipe will be asphaltic coated outside and manufactured in accordance with the latest revision of ANSI/AWWA C151/A21.51.

All pipe will be new.

All ductile iron pipe for water service should be cement mortar lined in accordance with the latest revision ANSI/AWWA C104/A21.4 and must be approved by the National Sanitation Foundation.

Ductile iron pipe should be designed in accordance with the latest revision of ANSI/AWWA C150/A21.50, for a minimum 150 psi (or project requirements, whichever is greater) rated water working pressure plus a 100 psi minimum surge allowance and a 2:1 factor of safety and a service allowance of 0.08 in. Minimum external earth load should be calculated assuming a prism load and a minimum soil density of 120 pcf, or project requirements, whichever is greater. Minimum external live load should be the AASHTO H-20, or project requirements, whichever is greater. Laying condition and depth of cover should be in accordance with the plans.

Ductile iron pipe should have either push-on joints, flanged, or mechanical joints in accordance with ANSI A21.11 (AWWA C111) entitled "American National Standard for Rubber-Gasket Joints for Cast-Iron and

Ductile-Iron Pressure Pipe and Fittings."

Bolts, nuts, and washers used in flange and mechanical joint connections should be high strength, low alloy steel similar to CORTEN or equal.

Dimensions, coatings, linings, joint types, etc., should conform to Section C 1.19, Ductile Iron Fittings, of these specifications. Only ductile iron fittings should be used on ductile iron pipe. All fittings must be approved by the National Sanitation Foundation.

Ductile iron pipe should be approved by the Underwriters' Laboratory and should be accepted by the State Fire Insurance Commission for use in fire protection systems without penalty.

All ductile iron pipe and fittings should be tested in accordance with the applicable provisions of the specifications relating thereto.

Ductile iron pipe and fittings may be rejected for failure to meet any of the requirements of this specification.

2.3. **C 1.10 Polyvinyl Chloride (PVC) Gravity Sewer Pipe**

This specification governs the manufacture of unplasticized polyvinyl chloride (PVC,) plastic gravity sewer pipe with integral wall bell, and spigot joints for the conveyance of domestic sewage.

Four-inch (4") through Fifteen (15") Diameter: Pipe and fittings four-inch (4") through fifteen-inch (15") in diameter shall comply in all respects to ASTM D 3034 SDR 26 pipe and ASTM D 2412 with pipe stiffness of 115 psi.

Eighteen-inch (18") through 36-inch Diameter: Pipe and fittings eighteen- inch (18") through 36- inch in diameter shall comply in all respects to ASTM F 679 and ASTM D 2412 with pipe stiffness of 115 psi.

Joints for the piping system shall be sealed with a rubber ring gaske and shall comply with ASTM D 3212. Gasket shall comply with ASTM F 477 and shall be of a composition and texture resistant to common ingredients of sewage and industrial waste, including oils and ground water, and which will endure permanently under the conditions imposed by this use.

Fittings and accessories shall be manufactured and furnished by the pipe supplier or approved equal and have bell and/or spigot configuration identical to that of the pipe.

Minimum pipe stiffness at five (5%) percent deflection shall be 115 when calculated in accordance with ASTM D 2412.

At manholes, rubber gasket water stops or Kor-N-Seal connectors as manufactured by NDC, Inc., Milford, New Hampshire, or equal will be used to provide a positive watertight connection. Fernco coupling devices, or approved equal, will be used to connect to existing pipelines.

Each pipe shall be identified with the name of the manufacturer, nominal size, cell classification, ASTM designation, SDR ratio or pipe stiffness designation and manufacturer code.

PVC gravity sewer pipe and fittings may be rejected for failure to meet any of the requirements of this specification.

2.4. **C 1.11 Reinforced Concrete Pipe with Rubber Gasket Joint**

2.4.1. **General.**

This specification governs the manufacture of reinforced concrete pipe with rubber gasket joints used for the conveyance of domestic sewage.

Reinforced concrete pipe manufactured under these specifications shall conform to ASTM C 76 or ASTM C

655 with modifications set forth in this specification. Rubber gasket joints shall conform to ASTM C 443.

Aggregates for the concrete shall comply with the requirements of ASTM C 33 with the additional requirement that aggregate shall have a minimum of fifty (50%) percent of calcium carbonate equivalent.

Pipe furnished under this specification shall be designed for the required "D-Load" in accordance with ASTM C 655. Proof of design will be required if requested. Calculations shall be submitted for approval and shall be done in accordance with accepted ultimate strength design procedures or generally accepted empirical design procedures accepted by the City.

All pipe shall be machine made by a process which will provide for uniform placement of zero slump concrete in the form and compaction by mechanical devices which will assure a dense concrete in the finished product.

The minimum laying length of each joint shall be six (6') feet for sizes up to and including fifteen- inch (15") through 78-inch. Laying length requirements do not apply to bends, wyes, and other special fittings which may be required or for special radius pipe.

Pipe and fittings shall be steam cured in accordance with methods prescribed in ASTM C 76 or any other method or combination of methods approved by the City.

All steel reinforcement shall be in accordance with ASTM C 76 and shall be circular. The maximum permissible absorption shall be six and one-half (6.5%) percent.

The basic physical pipe dimensional design for thickwall pipe shall be identical to the next larger three- inch (3") increment for standard pipe size, up through and including 51-inch diameter.

It shall be the next six-inch (6") increment for size 54-inch and larger. The pipe shall be reduced internally to the inside diameter as specified on the plans.

The reinforcing steel shall be placed as required on the next larger size to provide an additional sacrificial lining of either one and one-half inches (1½") or three inches (3") of concrete cover over the reinforcing steel.

Proof of design in accordance with Section 6 of ASTM C 655 must be submitted to the City.

Connecting joints shall be made using a flexible watertight rubber-type compression gasket in accordance with ASTM C 361. The rubber gasket shall be the sole element of the joint depended upon to provide watertightness and shall be required to meet and be tested in accordance with ASTM C 443.

- **Joint Design.** The joint design shall consist of a bell or groove on one end of a unit of pipe and a spigot or tongue on the conic surfaces of the inside of the bell or groove, and the outer surfaces of the spigot or tongue shall be parallel and shall not be more than three (3) degrees for pipe sizes through fifteen (15) diameter nor more than two (2) degrees for larger sizes. The spigot or tongue shall be so shaped as to provide a groove within which the gasket will be largely confined when compressed. The joint shall be designed such that the gasket is not required to support the weight of the pipe.
- **Rubber Gaskets.** All rubber-type gaskets shall be of the round O-ring design and shall be extruded or molded and cured in such a manner that any cross-section will be dense, homogeneous, and free of porosity, blisters, pitting and other imperfections.

The rubber gasket shall be fabricated from a high grade rubber-like compound. All gaskets shall meet and be tested in accordance with ASTM C 443.

The gasket shall be a continuous ring which, when in position in the gasket seat on the spigot or tongue end of the pipe, shall not be stretched more than twenty-five (25%) percent of its original circumference.

- **Tolerances.** The joint design shall be such that the parallel surfaces upon which the gasket may bear during closure shall extend a distance of not less than one (1") inch from the edge of the gasket seat toward the outer edge of the bell when the joint is in a normal fully closed position.
- **Deflection.** The joint design shall provide for the deflection of a pipe unit by opening one side of the

outside perimeter of the joint 1 / 2 - inch wider than the full "home" position without reducing its watertightness. Where greater deflections are required than provided by the joint design, beveled joints or elbows shall be provided.

- **Approval.** Joint designs and type of rubber gaskets shall be subject to approval by the Engineer before installation.

All fittings and specials including all bends, tees, etc., shall be manufactured on machines and in the same manner as straight joint concrete pipe under these specifications except that joint lengths may be shorter than the minimum listed. The quality of the concrete, workmanship, and bell and spigot joint detail for rubber gasket joints will be subjected to the same requirements as straight joints of pipe.

Each length of pipe shall bear the initials or name of the person, company, or corporation by whom manufactured, date of manufacture, and the class of pipe. The markings shall be indented or stenciled on the exterior or interior of the barrel near the bell and shall be plainly legible for purpose of identification.

The City shall at all times have free access to the manufacturer's plant while production is in progress, and may at any time refuse to accept pipe made when the plant is failing to follow the stipulations of the specifications in regard to workmanship, or failing in provisions to insure a uniform product coming within the permissible variations of the specifications as to size, thickness, position of reinforcing steel, and curing of pipe. The City may reject pipe if adequate means and methods are not provided so as to insure the manufacture of a product of uniform high quality.

The pipe shall be required to meet and be tested in accordance with ASTM C 76 or ASTM C 655 as applicable.

The connecting joints shall be subject to the hydrostatic tests set forth in ASTM C 443.

The rubber gasket shall be required to meet and be tested in accordance with ASTM C 443 or ASTM C 361.

Repairs will be permitted as set forth in ASTM C 76 and/or ASTM C 655 except field repairs will only be allowed upon approval of the City's representative. If, in the opinion of the City's representative, repairs should not be made, the pipe section, fitting, etc., will be rejected and removed from the construction site. Once rejected, the pipe section, fittings, etc., may not be used on a City project.

- The pipe may be rejected with defects or failure to meet requirements as follows:
 - Variations in dimensions exceeding the permissible variations prescribed.
 - A piece broken out of the bell, spigot, or tongue or groove end of such size that the watertightness of the joint should be impaired.
 - Any shattering or flaking of concrete or other conditions indicating any improper concrete mix.
 - Lack of uniformity in placement of steel that might preclude all joints being typical of those tested.
 - Cracks enough to impair the strength, durability, or serviceability of the pipe.
 - Failure to conform to any of the specifications herein set forth or referenced.
 - The complete absence of distinct web-like markings, which may be indicative of a deficiency of water in the concrete mix, from the external surface of the pipe made by any process in which the forms are removed immediately after the concrete has been placed unless specimens submitted for test that do not have such web-like markings shall have passed the physical tests required by these specifications.
 - Failure of the pipe to go completely "home" due to binding of spigot against bell or tongue against groove.
 - Failure to pass any of the tests required by these specifications.
 - Joint sections with spalls, cracks, fractures, or other imperfections that could adversely affect the performance of the joint.

2.5. C 1.20 Polyethylene Wrap for Ductile Iron Pipe and Fittings

2.5.1. **General.** These specifications govern the manufacture of polyethylene film to be used as a wrap to protect buried ductile iron pipe and fittings. Polyethylene wrap shall be used for all pipe, fittings and appurtenances to ductile iron sanitary sewer pipelines.

2.5.2. Polyethylene encasement for ductile iron piping shall conform to ANSI/AWWA C105/A21.5, latest revision. The polyethylene film shall be eight (8) mils thick, with minimum flat tube widths as shown in Table 1 for the specified pipe sizes. The film shall be extracted from polyethylene resin, Type 1, Class C, Grade E-1, and as specified in ASTM D 1248, with the following characteristics:

- Flow Rate - 0.4 maximum
- Tensile Strength - 1,200 psi
- Elongation - 300% minimum
- Dielectric Strength - resistivity 800 volts per mil thickness, minimum

Polyethylene tube seams and overlaps may be wrapped and held in place by means of two-inch (2") wide plastic backed adhesive tape with a minimum thickness of ten (10) mils. Maximum thickness shall be consistent with a pliable installation.

MINIMUM WIDTH OF FILM TUBE (FLAT WIDTH)

Nominal Pipe Size (Inches)	Flat Tube Width (Inches)
4	16
6	20
8	24
10	27
12	30
14	34
16	37
18	41
20	45
24	53

Polyethylene wrap may be rejected for failure to meet any of the requirements of this section.

2.6. C 1.21 Sanitary Sewer Manhole Components

2.6.1. **General.** This specification governs the manufacture of components used for the construction of sanitary sewer manholes.

2.6.2. **Foundation and Inverts.** Concrete for cast-in-place foundations and/or inverts for sanitary sewer manholes shall be Class "A" as defined in Section C 1.24, "Concrete," of these specifications.

Precast bases with formed inverts for watertight connection to precast reinforced concrete manhole sections will be permitted if manufacturing process and resultant product are approved by the City.

2.6.3. **Mortar.** Mortar and/or grout used for invert finishing, grouting of ring and lid, etc., shall be composed of one (1) part cement to two (2) parts sharp sand.

2.6.4. **Precast Reinforced Concrete Manhole Sections.** Precast reinforced concrete manhole sections shall comply with ASTM C 478, "Precast Reinforced Concrete Manhole Sections," with the following additions:

- All pipe shall be machine made by a process which will provide for uniform placement of zero (0) slump concrete in the form and compaction by mechanical devices which will assure a dense concrete in the finished produce. However, reducer cones may be wet-cast.
- Aggregates shall comply with ASTM C 33 except that aggregate shall have a minimum of 50 percent calcium carbonate equivalent.
- Minimum wall thickness shall be as specified for Wall B in the "Class Tables" of ASTM C 76.
- Manholes shall use precast sections of the bell and spigot or tongue and groove design with trapped type preformed O-ring rubber gaskets conforming to ASTM C 443.
- Risers shall be available in standard lengths of one through six feet (1'-6') in increments of one foot (1').
- Manhole steps will not be furnished.
- Exterior surfaces shall be coated with two mop coats of Tnemec 450 Heavy Tnemecol or Koppers Bitumastic Super Service, black or an equivalent system approved by the Engineer.

2.6.5. **Cast-In-Place (Monolithic) Concrete Manholes.** Concrete for cast-in-place (monolithic) concrete manholes shall be Class "A".

Forms for cast-in-place (monolithic) concrete manholes shall provide a smooth interior surface. Forms shall provide for a minimum wall thickness of six (6") inches and a minimum inside diameter at the base of four (4') feet. The inside diameter at the top of the barrel shall not be less than 30 inches.

The exterior surfaces of the manhole shall be coated with two mop coats of Tnemec 450 Heavy Tnemecol or Koppers Bitumastic Super Service, black, or an equivalent system approved by the Engineer.

2.6.6. **Frames and Covers.** All manhole frames and covers shall be in accordance with Section C 1.20, "Cast Iron Castings" All covers shall have pick bars. The seating surfaces shall be matched (machined) for smooth fit. Manhole covers shall cast to include the wording: City of Colleyville.

A double ring of one-half inch (½") GS/5 Precast Concrete Sealant, as manufactured by General Sealants, Inc., or CS102 Con Seal as manufactured by Concrete Sealants, Inc., shall be used to seal the frame to concrete and between all grade rings used in adjusting the manhole. The exterior of the grade rings and frame shall then be mortared.

Watertight rings and covers shall have machined matching surfaces with a watertight gasket held securely in place with stainless steel bolts and washers.

2.6.7. **Pipe Connections.** Rubber boots shall be installed at all pipe penetrations of the manhole to Kor-N-Seal connectors as manufactured by NPC, Inc., Milford, New Hampshire, or equal, shall be used to provide a positive watertight connection for all precast manholes.

2.6.8. **Grade Rings.** Grade rings shall be solid (not split) type, reinforced in accordance with ANSI/ASTM C 478. Outside diameter shall be 40 inches and inside diameter shall be 24 inches. Depths of sections used shall be maximum available to minimize number of joints. Minimum thickness of grade rings to be two- inch (2").

2.6.9. **Adjusting Manholes.** Furnish materials for adjusting manholes in accordance with the materials requirements of Item 479, "Adjusting Manholes and Inlets," and as shown on the plans.

2.7. **C 1.22 Embedment Materials**

2.7.1. **General.** This specification governs the quality of materials used for foundation and embedment materials in the construction of sanitary sewer lines.

2.7.2. **Rock Foundation**

- **Description.** Rock foundation is used to create a stable trench bottom in wet unstable or "spongy" conditions. Rock foundation shall be composed of sound and durable particles of crushed limestone.
- **Gradation.** Sizes shall be well graded from passing the one-inch (1") but retained on the seven-eighths inch (7/8") screen minimum size to a maximum size of five (5") inches in greatest dimension.

- **Wear.** The percent of wear shall not exceed 35 percent when tested in accordance with ASTM C 131.
- **Deleterious Substances.** Rock foundation shall contain no more than one (1%) percent by weight of organic matter, clays, loam, or pebbles and shall contain no more than five (5%) percent by weight of any one or combination of slate, shale, schist, or soft sandstone particles.

2.7.3. Crushed Rock Embedment (Sewer Lines)

- **Description.** Crushed rock embedment shall be composed of sound durable limestone particles. The standard gradation will be used with all pipes.
- **Gradation.**
 - STANDARD CRUSHED ROCK Embedment
 - Retained on 1 inch sieve 0 - 5%
 - Retained on 1/2 inch sieve 40 - 75%
 - Retained on No. 4 sieve. 90 - 100%
 - Retained on No. 8 sieve. 95 - 100%

Note: This gradation is for Gradation Size Number 4 as defined in ASTM C 33.

- **Wear.** The percent of wear shall not exceed 35 percent when tested in accordance with ASTM C 131.
- **Deleterious Substances.** Crushed stone embedment shall contain no more than one (1%) percent by weight of organic matter, clays, loam, or pebbles and shall contain no more than five (5%) percent by weight of any one or combination of slate, shale, schist, or soft particles of sandstone.

2.7.4. Select Materials. Select materials will be defined as gravel, fine rock cuttings, sand, sandy loam or loam free of excessive clay. When wet, the material shall not form mud or muck.

Concrete for Foundation, Embedment and/or Encasement

Portland Cement concrete used for pipe foundation, embedment, and/or encasement shall comply in all respects to the requirements set forth in Section C 1.24, "Concrete," of these specifications. Concrete shall be Class "B".

Materials may be rejected for failure to meet any of the requirements of this section.

2.8. C 1.23 Concrete

2.8.1. General. This section governs all materials used and the handling, measuring, proportioning and mixing of such materials in producing concrete for structures or for incidental or miscellaneous construction.

Concrete shall be composed of Portland Cement, coarse aggregate, fine aggregate, admixtures as required, and water proportioned and mixed as hereinafter provided in these specifications.

Where the type or class of concrete is not shown on the plans or specifically designated in the specifications, concrete used shall be Class "A".

It is the intent of this specification to permit "ready mix," "central mix," or "transit mix" concrete. However, the Contractor will be required to submit evidence that the concrete to be furnished meets all requirements of these specifications including testing by an independent laboratory at the contractor's expense.

2.8.2. Materials

- **Cement.** Portland Cement shall be Type I (Normal), Type II (Sulfate Resistant), or Type III (High Early Strength) in accordance with ASTM C 150. Unless otherwise shown, all cement used shall be Type I.
- **Coarse Aggregate.** Coarse aggregate shall consist of gravel or crushed stone meeting the requirement of ASTM C 33 "Concrete Aggregate." Coarse aggregate with a wear exceeding

40 when tested in accordance with ASTM C 131 will not be acceptable.

- **Fine Aggregate.** Fine aggregate shall be composed of natural sand, conforming to ASTM C 33.

2.8.3. **Admixtures**

- **Air Entraining Admixture.** Air entraining admixtures shall conform with ASTM C 260. The total average air content shall be in accordance with American Concrete Institute 211.1.
- **Water Reducing Admixture.** Water reducing admixtures, if used, shall comply with ASTM C494. They shall be accurately measured and added to the mix in accordance with the manufacturer's recommendations.

2.8.4. **Water.** Water for concrete shall be clean and free from injurious quantities of oil, acid, alkali, salt, organic matter, or other deleterious substances. Water from the City's mains is acceptable with no testing required.

2.8.5. **Curing Materials**

- **Sheet Materials.** Waterproof paper, polyethylene film, and white burlap-polyethylene film shall conform to ASTM C 171.
- **Curing Compound.** Membrane curing compound shall conform to ASTM C 309. Curing compound shall either be Type 1, clear or translucent, or Type 2, white pigmented.

2.8.6. **Storage of Materials**

- **Storage of Cement.** Cement may be delivered in bulk or in bags which are marked plainly with the brand and name of manufacturer. Immediately upon receipt, cement shall be stored in a dry, weathertight and properly ventilated structure which excludes moisture. All storage facilities shall be subject to approval and shall be such as to permit easy access for inspection and identification. Enough cement shall be in storage to complete any pour of concrete started. In order that cement may not become unduly aged after delivery, records of delivery dates shall be maintained, and the Contractor shall use any cement which has been stored at the site for 60 days or more before using cement of lesser age. No cement will be used which is lumped or caked, or has been stored more than 90 days, or when the cement temperature exceeds 170 degrees F.
- **Storage of Aggregates.** The handling and storage of concrete aggregate shall be such as to prevent the admixture of foreign materials. If the aggregates are stored on the ground, the sites for the stockpiles shall be grubbed, cleared of all weeds and grass, and leveled. The bottom layer of aggregate shall not be disturbed or used without recleaning.

Different sizes of aggregates shall be stored in such a manner as to prevent intermixing. Materials in all stockpiles shall be handled in such a manner that segregation of materials within the pile will be avoided and shall be built up in layers not over three (3') feet in depth. Should segregation occur, the aggregates shall be remixed to conform with the grading requirements. Unless otherwise authorized by the Engineer, all fine aggregates shall be stockpiled at least 24 hours before mixing to reduce the free moisture content.

2.8.7. **Measuring of Materials and Measuring Equipment**

All materials shall be measured separately and accurately and batches shall be uniform. The

coarse and fine aggregate shall be measured, or weighed, loose and separately.

When volumetric proportioning is used, the Contractor shall furnish and use approved measuring boxes, pans, or mechanical devices which will give exact volumes of aggregates required for the several classes of concrete involved. Devices used shall be constructed and plainly marked so that the Engineer can conveniently and accurately check the exact quantity of each aggregate being used in any or all batches. A bag of cement as packed by the manufacturer and weighing 94 pounds will be considered as one (1) cubic foot. When proportion by weight is used, the capacity of the weighing equipment shall be adequate to permit required weighing of materials without delaying the production of the mixer. Scales to be used shall be approved by the Engineer and shall be certified in place.

Each scale installation shall be provided with standard 50 pound test weights made of high quality cast iron, cast and finished in such a manner that no foreign material will adhere to the surface, and sealed in the manner prescribed by the United States Bureau of Standards. The minimum number of test weights required shall be of a weight equivalent to ten (10%) percent of the net load capacity of the scales to the nearest greater 50 pounds, but in no case shall less than two (2) weights be furnished.

The device used for measuring the quantity of water shall indicate the quantity in gallons and fractions thereof. The operating mechanism shall regulate the quantity required for any given batch within one (1%) percent, and the supply inlet shall be cut off automatically when water is being discharged into the mixer.

2.8.8.

Concrete Proportions

- **General.** American Concrete Institute 211.1 shall be the basis for selecting the proportions for concrete made with aggregates of normal and high density and of workability suitable for usual cast-in-place structures.
- **Mix Design.** The Contractor shall be responsible for the design of concrete consistent with the minimum requirements of strength and proportions stated herein. The proportions of materials entering into mix to produce concrete of satisfactory quality shall be determined by laboratory tests before the beginning of concrete placement. Design shall be in accordance with ACI 211.1, "Recommended Practice for Selecting Proportions Concrete," subject to maximum water cement ratio, minimum cement content, and minimum strengths set forth herein.
- **Workability.** In general, the workability of any mix shall be that required for the specific placing conditions and method of placement. The concrete shall be of such workability that it can be worked readily into all corners and around reinforcing without segregation of materials or with free water collect on the surface. Compliance with specified slump limitations shall not necessarily designate a satisfactory mix. The Engineer may require changes in proportions at any time as necessary to obtain a mix with satisfactory properties. The slump tests will be made in accordance with ASTM Method of Test for Slump of Portland Cement Concrete, Designation C-143.

In no case shall the quantity of coarse material be such as to produce harshness in placing or honeycombing in the structure when forms are removed.

2.8.9. Concrete Classification

The following table sets forth the classification of concrete used for water and sewer construction in the City of Colleyville:

Class	f'c 28-day psi	Cement Bags/ C.Y.	Max. Water Content (Gal./Bag)	Max. Slump (In.)	Max. Size Aggr. (In.)	Use
A	3,000	5	6.5	5	1-1/2	General. All reinforced concrete structures unless otherwise specified.
B	2,000	4	8.0	4	1-1/2	Blocking, Cradle Concrete Bedding.
C	3,600	6	6.0	4	1-1/2	General. Top Slabs direct traffic structures.

The maximum quantity of coarse aggregate (dry loose volume) per cubic foot of finished concrete shall not exceed 0.82 cubic feet.

The maximum quantity of water as set forth in the table of concrete classification is based on the assumption that the aggregates are in a saturated, surface dry condition. If additional water is required to obtain the desired slump, a compensating quantity of cement will also be added. In no case will the maximum allowable water-content ratio be exceeded.

The concrete mix will be designed with the intention of producing concrete with compressive strengths equal to or greater than those shown when tested in accordance with ASTM C 39, "Compressive Strength of Cylindrical Concrete Specimens."

When tested at seven (7) days, concrete cylinders will have attained at least two-thirds (2/3) the required 28 day compressive strength in order for the strength of the concrete to be considered satisfactory.

2.8.10. Mixing Conditions

- **General.** The concrete shall be mixed in quantities required for immediate use, and any concrete which is not in place within the time limits specified shall not be used. Retempering of concrete will not be permitted.
- **Concrete Temperature.** No concrete shall be placed when the temperature of the concrete to be placed is greater than 90 degrees for less than 50 degrees F. The temperature of the concrete to be placed will be taken using a thermometer immediately before placement with the point of measurement being in the chute or bucket.
- **Cold Weather.** No concrete shall be mixed without the approval of the City when the air temperature is at or below 40 degrees F (taken in the shade away from artificial heat) and falling. If authorized by the City, concrete may be mixed when the air temperature is at 35 degrees F and rising. All cold weather concreting shall be done in accordance with ACI-306.
- **Hot Weather.** Hot weather is defined as any combination of hot air temperature, low relative humidity, and wind velocity that in the judgment of the Engineer would impair the quality of the concrete. All hot weather concreting shall be in accordance with ACI 305. Concrete shall

be placed in the forms without the addition of any more water than required by the design (slump). No excess water shall be added on the concrete surface for finishing. Control of initial set of the concretes and extending the time for finishing operations may be accomplished with the use of an approved water-reducing and set retarding admixture as specified above.

Maximum time intervals between the addition of mixing water and/or cement to the batch and the placing of concrete in the forms shall not exceed the following:

Air or Concrete Temperature Addition of Water to Placement	Maximum Time From (whichever higher)
Non-Agitated Concrete	
Up to 80 degrees Fahrenheit.....	30 minutes
Over 80 degrees Fahrenheit	15 minutes
Agitated Concrete	
Up to 75 degrees Fahrenheit.....	90 minutes
75 to 89 degrees Fahrenheit	60 minutes
Over 90 degrees Fahrenheit (maximum permissible concrete temperature)	45 minutes

The use of an approved set-retarding admixture will permit the extension of the above time maximums by 30 minutes, for agitated concrete only.

Under extreme hot temperature, wind, or humidity conditions, the City may require the use of the set-retarding agent, or may suspend concreting operations if quality of the concrete being replaced is not acceptable.

- 2.8.11. **Curing.** Careful attention shall be given to the proper curing of all concrete. Curing methods shall use sheet materials conforming to ASTM C 171 or membrane curing compound conforming to ASTM C309. Membrane curing compound will not be used on surfaces to be rubbed or on which additional concrete is to be placed.

All concrete shall be cured as set forth in Section C 30.14.

- 2.8.12. **Rejection.** Concrete may be rejected for failing to meet any of the requirements of this specification.

2.9. **C 1.24 Reinforcing Steel**

- 2.9.1. **General.** This specification governs the manufacture of all reinforcing steel used in the construction of reinforced concrete.

Reinforcing steel manufactured under these specifications shall conform to the following specifications of the American Society for Testing and Materials as follows:

ASTM A 82, "Cold-Drawn Steel Wire for Concrete Reinforcement."

ASTM A 185, "Welded Steel Wire Fabric for Concrete Reinforcement."

ASTM A 615, "Deformed and Plain Billet-Steel Bars for Concrete Reinforcement."

All bar reinforcement shall be Grade 60 open hearth, basic oxygen, or electric furnace new billet steel except that stirrups and tie bars may be Grade 40.

Wire for fabric reinforcement shall be cold-drawn from rods hot-rolled from open hearth, basic oxygen, or electric furnace billet steel.

Steel reinforcement shall be stored above the surface of the ground upon platforms skids, or other supports and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust.

When placed in the work, reinforcement shall be free from dirt, paint, grease, oil, or other foreign materials. Reinforcement shall be free from injurious defects such as cracks and laminations.

Rust, surface seams, surface irregularities or mill scale will not be cause for rejection, provided the minimum dimensions, cross-sectional area, and tensile properties meet the physical requirements for the size and grade of steel specified.

Reinforcement shall be bent cold and true to the shapes indicated on the plans. Bending shall preferably be done in the shop. Irregularities in bending shall be cause for rejection.

2.10. C 1.25 Street and Pavement Repair Materials

2.10.1. **General.** This specification governs the quality of materials used to repair streets or other pavements after the installation of sewer lines.

Any Portland Cement concrete used for street or pavement repair shall comply in all respects to the requirements set forth in Item C 1.24, "Concrete," of these specifications for the class of concrete called for on the plans or set forth in the project documents.

2.10.2. Cement Stabilized Backfill

- **2:27 Backfill or Cement Stabilized Sand.** Backfill material designated as "2:27 backfill material" shall be a lean concrete mix containing two (2) sacks of cement per cubic yard of material. Aggregate used for 2:27 backfill material shall be a free flowing well-graded granular material passing a 1 - 1/2 inch screen and free from sticks, lumps, clay balls and organic matter. The 2:27 backfill material shall be poured wet or dry as directed by the City, and all 2:27 backfill shall be mixed in a concrete mixer of a type approved by the City.
- **Cement Treated Base.** Cement treated base shall consist of aggregate, cement, and water uniformly mixed in a central plant and hauled to the project site. Cement treated base shall have a minimum cement content by weight of four (4%) percent and a minimum compressive strength at seven (7) days of 300 pounds per square inch. If necessary, the minimum cement content shall be adjusted upward to provide the minimum required compressive strength.
- **Storage and Use.** Cement treated materials shall be placed in ditch the same day that they are mixed and/or delivered to the jobsite.

2.10.3. Crushed Stone Base

- **Description.** Crushed stone base shall consist of stone, argillaceous limestone, calcareous clay particles, with or without stone, or conglomerate, and shall not contain thin or laminated pieces or an excess of shale, dirt, organic matter or other injurious materials.
- **Gradation.**
 - Retained on 1 - 3/4 in sieve0%
 - Retained on No. 4 sieve45 - 65%
 - Retained on No. 40 sieve60 - 85%

Material passing the No. 40 sieve shall meet the following requirements when the test samples are prepared and tested in accordance with the applicable ASTM specifications:

The liquid limit shall not exceed 40. The plasticity index shall not exceed twelve (12).

- **Abrasion.** The material shall have a percentage of wear not exceeding 40 when tested in accordance with ASTM C 131.

2.10.4.

Hot Mix Asphaltic Concrete – Course Graded Binder Course

- **Description.** Coarse graded binder course hot mix asphaltic concrete used for street and pavement repair in the City of Colleyville is identical to Type "A" hot mix asphaltic concrete as set forth in TxDOT Item 340. This gradation is normally used as a "base" course on which a fine graded surface course is placed.

- **Gradation.**

- Passing 1½ in. sieve100%
- Passing 1¼ in. sieve95 - 100%
- Passing 7/8 in. sieve70 - 90%
- Passing ½ in. sieve50 - 70%
- Passing No. 4 sieve30 - 50%
- Passing No. 10 sieve20 - 34%
- Passing No. 40 sieve5 - 20%
- Passing No. 80 sieve2 - 12%
- Passing No. 200 sieve1 - 6%

The asphaltic material shall form three (3%) to six (6%) percent of the mixture by weight unless otherwise specified.

- **Stability.** The Hveem stability shall be not less than 35.

2.10.5.

Hot Mix Asphaltic Concrete – Fine Graded Surface Course

- **Description.** Fine graded surface course hot mix asphaltic concrete used for street and pavement repair in the City of Colleyville is identical to Type "D" hot mix asphaltic concrete as set forth in TxDOT Item 340. This material is normally used as a "surface" course either on flexible base, concrete, or hot mix base courses.

- **Gradation.**

- Passing ½ in. sieve.....100%
- Passing 3/8 in. sieve. 85 - 100%
- Passing No. 4 in. sieve..... 50 - 70%
- Passing No. 10 sieve..... 32 - 42%
- Passing No. 40 sieve..... 11 - 26%
- Passing No. 80 sieve..... 4 - 14%
- Passing No. 200 sieve..... 0 - 6%

The asphaltic material shall form from four (4%) to eight (8%) percent of the mixture by weight unless otherwise specified.

- **Stability.** The Hveem stability shall not be less than 35.

- **Tack Coat.** The unit bid prices for coarse graded base course and fine graded surface

course shall include the application of a tack coat to each layer of asphaltic concrete before the next layer is applied and a tack coat shall also be applied to any exposed asphalt or concrete edges that shall abut any hot mix asphaltic concrete. The tack coat shall be a liquid asphalt complying with the specifications of the Asphalt Institute for Type RC-70 or RS-1.

2.11. C 1.26 Casing Pipe for Sewer Crossings

2.11.1. **General.** This specification governs the manufacture of reinforced concrete pipe, corrugated metal pipe, and steel pipe used as casing pipe for sewer lines.

2.11.2. **Reinforced Concrete Pipe.** Reinforced concrete pipe used for casing pipe shall conform to ASTM C 76. The pipe class shall be as shown on the project plans or set forth in the specifications. When not specified, the minimum pipe class used for casing pipe shall be Class III. The pipe joints shall be tongue and groove, but a rubber O-ring joint seal is not required for casing pipe.

2.11.3. Corrugated Metal Pipe

- **Products.** All corrugated metal pipe used for casing for water and sewer lines shall conform to AASHTO M 36. "Zinc Coated (Galvanized) Corrugated Iron for Steel Culverts and Underdrains." All pipe shall be Type I. Zinc coated iron or steel sheets used in the manufacture of the corrugated metal pipe shall conform to AASHTO M 218.
- **Corrugations.** Pipe corrugations may be either 2-2/3" x 1/2", 3" x 1", or 5" x 1".
- **Metal Thickness.** Unless otherwise specified on the plans or in the contract documents, pipe 36- inch in diameter and smaller shall have a wall thickness not less than 0.064 inches (16 Gage), pipe 42-inch through 54-inch in diameter shall have a minimum wall thickness of 0.079 inches (14 Gage), and pipe 60-inch and larger in diameter shall have a minimum wall thickness of 0.109 inches (12 Gage).
- **Couplings.** Couplings bands shall be of the same base metal and have the same coating as the pipe. Bands shall have a minimum metal thickness of 0.064 inches (16 Gage) and shall have a minimum width of ten and one-half (10-1/2") inches.
- **Pipe Coating.** All corrugated metal pipe used for pipe casing shall be bituminous coated in accordance with AASHTO M 190. The pipe coating shall be Type A, and the minimum thickness of the coating shall be 0.05 inches measured on the crest of the corrugations.

2.11.4. Steel Pipe

- **Products.** All steel pipe used for pipe casing for water and sewer lines shall conform to one of the following ASTM specifications:

ASTM Designation	Title
A 134	"Electric-Fusion (Arc) - Welded Steel Plate Pipe (sizes 16 in. and over)"
A 139	"Electric-Fusion (Arc) - Welded Steel Plate Pipe (sizes 4 in. and over)"
A211	"Spiral-Welded Steel or Iron Pipe."

- **Wall Thickness.** All pipe shall be designed to have a wall thickness enough to sustain the maximum expected overburden as well as the concentrated live loads without deflecting the pipe in excess of five (5%) percent. However, steel casing with wall thickness less than 0.250 inches will not be acceptable in any circumstances.
- **Joints.** Steel pipe for casing installations may be shop fabricated in convenient section lengths for transportation to the jobsite. These sections shall be combined by field welding to

provide a single casing assembly over the limits set forth on the plans. Such casing pipe butt welds shall be continuous and free of slag holes.

- **Coatings.** All steel pipe casing shall be cleaned and shop coated inside and out. A uniform bituminous coating at least 0.05 inches in thickness shall then be applied inside and out to the casing. Touch-up after field welding shall be equal to required shop coatings.

Casting pipe may be rejected for failing to meet any of the requirements of this specification.

2.12. C 1.27 Materials for Erosion Control

2.12.1. **General.** This specification governs the quality of materials used for permanent and temporary erosion control after the installation of sewer lines.

2.12.2. **Hydromulching.** When water or sanitary sewer line construction is outside of proposed and/or existing pavement, the entire trench width shall be hydromulched after backfill and compaction operations have been completed. Areas outside the trench area which have been undermined by excavation or damaged during backfill operations shall also be hydromulched.

- **Description:** Seeding shall consist of preparing and planting seed or a mixture of seed of the kind specified along and across such areas as may be designated on the plans and in accordance with these specifications.
- **Planting Season:** All planting shall be completed between the dates specified for each type except when specifically authorized in writing by the Engineer. The seed planted shall be of a type specified with the mixture, rate and planting dates as follows:
 - Type I: Bermuda Grass (hulled) 2 pounds per 1,000 square feet - March 15 through September 15.
 - Type II: Mixture of Bermudagrass (unhulled) and Annual Rye Grass, 8 pounds per 1,000 square feet (Bermudagrass 2 pounds, Rye Grass 6 pounds) – September 15 through March 15.

2.12.3. Fertilizer

- **General:** Fertilizer shall be a commercial product, uniform in composition, free flowing and suitable for application with approved equipment. Fertilizer shall be delivered to the project site in fully labeled original containers. Fertilizer which has been exposed to high humidity or moisture or has become caked or otherwise damaged, shall be rejected.
- **Initial Planting Application:** Fertilizer for the initial planting application shall be of an organic base containing by weight the following (or other approved) ratio of nutrients: 1-2-1 (N-P-K); also containing ten (10%) to fifteen (15%) percent sulfur in sulfate form and traces of iron and zinc as required and approved by the Engineer.
- **Post Planting Application:** Fertilizer for the post planting application shall be a chemical base fertilizer containing by weight the following ratio of nutrients: 3-1-2 (N-P- K). Thirty (30) days after planting, turfgrass areas shall receive an application of the specified fertilizer at the rate of one (1) pound of nitrogen per one thousand (1000) square feet.

2.12.4.

Hyrdomulch

- Mulch will be manufactured from hardwoods only and will be refined specifically for turf hydromulch applications. Three approved mulches are manufactured by Conwed, Weyerhaeuser and Texas Fiber Co.
- Following soil preparation, seed, fertilizer, mulch and water shall be mixed together and applied to the planting area in the following quantities and rates:

Item	Rate per 1000 Square Feet
Turfgrass	Seed as specified above
Fertilizer	9 Pounds
Water	23 Gallons
Mulch	46 Pounds

- **Maintenance:** Contractor will provide irrigation for at least 30 days after planting and for as much longer as necessary to provide a uniform stand of grass. A uniform stand of grass is defined as not less than 100 growing plants per square foot. Growing plants shall be defined as healthy grass plants of two blades or more at least 1½ inches tall. Growth shall be enough that at least one mowing is required before the grass areas are accepted by the Owner.
- **Replanting:** All areas that do not produce a uniform stand of grass must be replanted and maintained until a uniform stand of grass is established.

2.12.5.

Erosion Control Matting

- In addition to hydromulch seeding, erosion control matting will be required where existing or proposed side slopes are 3:1 or steeper within natural channels, drainage ditches, channel banks or embankments: and in areas where the engineer determines that the soil is erodible. Depending upon the type of soil, steepness of the slope and the channel velocity, either Curlex Blankets (Regular or Hi- Velocity) or Enkamat (7010 or 7020) erosion control matting (or their equivalent) shall be placed upon the areas which have been hydromulch seeded.

2.12.6.

Silt Fencing

- The fabric should conform to the following properties, as determined by the Federal Highway Administration Task Force 25 Guidelines, as measured in the weakest direction:

Test Designation	Topic	Average Roll Minimum Value
ASTM D 4632	Grab Strength	90 lbs @ 12"/min.
ASTM D 4632	Grab Elongation	15% @ 12"/min.
ASTM D 4751	Equivalent Opening Size (EOS)	U.S> Sieve No. 20
ASTM D 4491	Permittivity	>.01 sec. -1
ASTM D 4355	U.V. Resistance (500 Hrs Exposure)	70%

The Mullen burst strength shall be greater than 150 psi. The edges shall be treated to

prevent unraveling.

- **Support:** Fence posts shall be spaced a maximum of six feet apart. Woven wire will be used to support the material. Fence posts are to be 4"x4" wood posts or fabricated steel posts.

2.12.7.

Gabion Structure Assembly. Gabions shall consist of rectangular, compartmented wire baskets filled with stone used for slope or bank protection and erosion control on open channels.

Gabion baskets shall consist of uniform hexagonal wire mesh woven in a double twist pattern with openings fabricated in such a manner as to be non-raveling and designed to provide the required flexibility and strength.

The perimeter edges of the twisted wire mesh shall be woven around a reinforcing wire in a manner designed to prevent slippage. The edges of the mesh shall be securely selvaged. All corners shall be reinforced by heavier wire.

Gabions shall be so fabricated that the sides, ends, lid, base and diaphragms can be readily assembled at the construction site into rectangular baskets with a minimum thickness of one foot. Where the length of the gabion exceeds 1½ times its horizontal width, the gabion shall be divided, by diaphragms of the same mesh and gauge as the body of the gabion, into cells whose length does not exceed the horizontal width. Diaphragms shall be secured in the proper position on the base section.

All dimensions are subject to a tolerance of five (5) percent.

Wire shall conform to the following requirements in accordance with current Federal Specifications QQW-461 Class 3 - Finish 5 - Soft.

Wire for Fabric (Diameter)	3.00 mm plus or minus 2.5 percent
Wire for Selvedges and Corners (Diameter)	3.90 mm plus or minus 2.5 percent
Wire for Binding and Connecting (Diameter)	2.20 mm plus or minus 2.5 percent
Tensile Strength (PSI)	60,000 to 70,000
Weight of Zinc Coating for All Wire	0.80 oz/square foot

The stone shall be graded from three (3") to eight (8") inches. The stone shall have a specific gravity of at least 2.40 and shall have a percent of wear not more than 40 when tested in accordance with Texas Department of Transportation Test Method TEX-410-A.

Geotextile fabric for use as filter media shall be placed with a minimum overlap of eighteen (18") inches. Fabric shall be secured as necessary with pins or other suitable means before placing gabion baskets.

As an alternate to Geotextile fabric, a protective aggregate filter layer may be used. The filter shall be designed by a licensed professional engineer specializing in Geotechnical Engineering.

Gabions may be rejected for failure to meet any of the requirements of this specification.

3. CONSTRUCTION

3.1. C 2.3 Removal and/or Adjustment of Existing Structures.

This section of the specifications covers the removal and/or adjustment of existing facilities and structures. The removal and satisfactory disposal, adjustment, and replacement of existing structures shall be in accordance with the plans and these specifications.

All structures which are to be salvaged shall be removed in such a manner as to prevent being unduly damaged.

Materials or parts of structures which are to be broken up, dismantled or removed, and which are to be salvaged shall be removed, loaded, cleaned up, hauled, and unloaded at the site designated on the plans or as directed by the City. Materials which are not designated to be salvaged shall become the property of the Contractor and shall be properly disposed of by the Contractor at the Contractor's cost and expense. Asbestos-cement pipe shall be left in the ground where practical. Asbestos-cement pipe removed shall be disposed of in accordance with E.P.A. requirements for the disposal of asbestos materials.

Existing concrete pavements, driveways, curbs, gutters, sidewalks, etc., to be removed shall be broken up and disposed of at approved sites. The limits for removal will be as specified and any excess removal and the replacement thereof shall be at the entire cost and expense of the Contractor. Where permanent paving (concrete or asphaltic concrete) is to be cut, the pavement shall be cut full depth before opening the ditch to insure a neat straightedge. An approved power driven concrete saw, manufactured especially for the purpose of sawing concrete, shall be suitable for the work to be performed, and the cut shall be vertical to the top and face. The exposed face of the cut shall be vertical for the full depth of the pavement. Saw blades shall be designed to make a clean, smooth cut and guides shall be used to provide true alignment of the cut.

The area where the pavement is to be removed by the use of a concrete saw shall be designated on the plans or as designated by the City's representative.

After the removal of structures, all excavations not to be occupied by new work, and all holes created, shall be backfilled with approved materials thoroughly compacted in place.

All damage done to adjacent property or structures shall be repaired by the Contractor at the Contractor's cost and expense to the satisfaction of the City. Any unsightly places created shall be cleaned up and the site left in a neat, clean and orderly condition.

3.1.1. Removal and Replacement of Fence

The Contractor shall do the necessary removing of fencing on the right of way and shall rebuild same after the pipe line work is completed. The fences shall be rebuilt of the same quality of materials or better than that which was removed. All posts, wires and other material shall be sound, straight, equal to or better than the materials removed. Gates shall be replaced in a manner acceptable to the Inspector, and all corner, gate and end posts shall be well braced.

Where fences are removed, the Contractor shall be responsible for the protection of livestock, etc. with temporary fencing.

3.1.2. Poles, Signs, Guy Wires, Etc.

The Contractor shall be responsible for all damage to street sign posts and signs within the limits of operations that remain in place or are removed and replaced. In the event street sign posts and signs are damaged or destroyed by the Contractor's operations, they shall be replaced at the Contractor's expense.

If requested by the Contractor, regulatory and street name signs which interfere with construction or repair work shall either be relocated or made portable by City traffic forces as needed to avoid undue interference with construction activities, provided that all such regulatory and street name signs remain visible to vehicular and pedestrian traffic.

3.1.3. Other Utilities

All water mains, water services, sanitary sewers, sanitary sewer house laterals, storm sewers, power conduits, gas mains, gas service laterals telephone lines, cable television lines, and other appurtenances encountered during construction shall be supported or replaced as necessary to insure uninterrupted service.

Where the exact depth of a utility is not shown on a plan, or the utility is not shown, excavation shall be made before reaching the obstruction to determine adjustments in grade if needed to prevent interference. Redesign to eliminate conflicts may be necessary, and extra compensation will not be paid for such delays.

When it is necessary to remove or adjust another utility, a representative of that utility will be notified to decide method and work to be done. The Contractor shall make satisfactory arrangements with other utilities for the cutting or adjustments required. No extra compensation will be paid due to delays caused by removal of public utility structures or for hand excavation required in or around such structures.

The Contractor will be held liable for any negligent or willful damage to any other utility and shall be expected to pay for the cost of all necessary repairs and any damages resulting to public or private property therefrom.

3.2. C 2.4 Excavation, Embedment and Backfill

This section of the specifications contains detailed specifications and descriptions concerning the following items of work:

- The furnishing of all labor, materials, tools, equipment and machinery necessary for cleaning and removing from the site of the work, wherever located, all obstructions, trees, stumps, brush, vegetation, wood and debris, and all earth, rock, and other materials to be excavated.
- The removal of existing structures except where specifically paid for as set forth in Section C 2.3, "Removal and/or Adjustment of Existing Structures".
- The furnishing, placing, and maintaining of all sheeting, shoring, and bracing necessary to protect the work and adjacent properties and to support all adjacent structures above and below the ground.
- Providing for all pumping, bailing, and draining necessary to keep the excavation free from seepage water and water from other sources.
- Providing for the uninterrupted flow of sewers and surface waters during progress of construction including bypass pumping or temporary lines.
- Removing, after the completion of the work, of all sheeting, shoring, and bracing not necessary to support the sides of the excavation.
- The furnishing and placing of all embedment called for on the plans and contained in the specifications.
- The satisfactory disposal of excess and unsuitable materials not required or which cannot be used for backfilling.
- Backfilling, tamping, compacting, and refilling, after settlement, of all excavation areas.
- The backfilling of all streets, alleys, rights-of-way, easements and other lands, private or public, damaged or occupied by the Contractor in the performance of the contract.
- The replacement of topsoil, where called for on the plans or set forth in the specifications, after backfilling operations have been completed.
- Sodding, sprigging, seeding, or hydromulching where required.
- There will be no classification of excavation. Excavation will include all materials encountered, including rock, regardless of their nature or the manner in which removed.

3.2.2. Borings and Subsurface Information

Any subsurface information shown on plans shall not in any manner be construed as a warranty on the part of the City of the exact nature of the subsurface conditions that will be encountered during construction of the

work. It is intended only as a guide to the Contractor in making investigations preliminary to submitting a bid for the work.

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

3.2.3. Excavation – General

The construction site shall be prepared for construction operations by the removal and disposal of all obstructions and objectionable materials. It is the intent of this specification to provide for the removal and disposal of all objectionable materials not specifically provided for elsewhere by the plans and specifications to a depth of not less than 1 foot below the foundation or subgrade. The removal of such items shall be accomplished before excavation operations. The removal and disposal of such items will not be measured or paid for as a separate contract pay item. Such items will be considered as incidental work and the cost thereof shall be included in such contract pay items as are provided in the proposal and contract.

In general, all excavations shall be made by 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. The quantity of excavation approximately to grade shall not exceed 100 feet from the end of the completed pipe, and no excavation shall be over 300 feet in advance of the completed pipe, unless otherwise authorized.

The sides of the excavation shall be cut and maintained as nearly vertical as practicable to one foot (1') above the top of the pipe and in accordance with current O.S.H.A. Standards. The entire foundation area in the bottom of all excavation shall be firm and stable and, unless necessary, materials shall not be disturbed below grade. "Grade" in this instance is the base of the embedment as will be called for on the plans and/or as detailed. However, any soft, spongy, disintegrated, or other unsuitable materials shall be removed to the depth below grade as directed by the City. Such materials removed shall be replaced with foundation materials as specified in Section C 1.22, "Embedment Materials", or with other material satisfactory to the City and thoroughly compacted in place to the finish grade elevation.

Where the character of the foundation material is such that a proper foundation cannot be prepared at the elevation shown on the plans, then when directed in writing by the City, the Contractor shall deepen the excavation so that a proper foundation can be prepared. If, in the opinion of the City, the condition is the result of the Contractor's negligence to make proper provisions for adequate drainage of the excavation, the cost of the foundation material will not be reimbursed. If the Contractor elects to undercut the trench and use gravel and drain pipe as an underdrain instead of, or in conjunction with, pumping, bailing, draining or well point, the additional work will be considered as incidental work and additional compensation will not be allowed.

Embedment for the pipe, or the pipe itself, will not be laid in water. If the Contractor overcuts the trench it will be brought back to grade by the use of compacted select material from the ditch excavation. The final cleaning and preparing of the foundation area shall be done immediately before the placing of the embedment materials or structures.

3.2.4. Maximum Width of Trench

The width of trench at a point one (1') foot above the top of the pipe being laid shall conform to the following table.

Pipe Type	Size (Inches)	Min Width of Trench	Max Width of Trench
Pipe With Bells	6" through 30"	O.D. + 12"	O.D. + 16"
Pipe With Bells	36" and larger	O.D. + 16"	O.D. + 24"
Pipe With Sleeves, Sockets or Couplings	4" through 12"	O.D. + 12"	O.D. + 16"
Pipe With Sleeves, Sockets or Couplings	15" and larger	O.D. + 16"	O.D. + 21"

The above widths are for trenches without sheeting, shoring, or bracing.

If the maximum allowable trench width is not maintained to a point one (1') foot above the top of pipe, the Contractor shall provide at his expense the next higher class of embedment as directed by the City which will provide adequate support for the pipe material being installed.

3.2.5. **Depth of Cut Show on Plans**

Profile elevations shown on plan-profile sheets for sanitary sewer lines are flow line elevations. Grade stakes placed in the field normally are measured from elevations of reference point hub to flow line of pipe to be installed. Payment for depth of cut will be measured from the actual ground elevation at the centerline of the pipe to the flow line of the pipe to be installed.

Profile elevations shown on plan-profile or profile sheets for water lines are top of pipe elevations.

3.2.6. **Bottom of Ditch in Rock**

Where rock is encountered in the ditch at the elevation where the bottom of the pipe rests, the ditch shall be undercut a minimum of six (6") inches or to the depth indicated on the plans or appurtenant drawings for any special type of bedding.

3.2.7. **Pipe Foundation in Wet Trench**

When ground water is encountered, six (6") inches of crushed stone shall be used instead of any other type embedment material. Where the only purpose of the crushed stone is to provide a dry, stable working surface for the convenience of the Contractor, no additional payment will be made for the use of crushed stone instead of lesser embedment material.

Rock foundation, as defined in Section C 1.22 of these specifications, is to be used only if the trench bottom is so unstable that normal construction will not be permitted. Rock foundation will be placed only at the direction and in the location indicated by the City.

3.2.8. **Blasting**

The use of explosives is discouraged. If the use of explosives is necessary and approval by the City is granted, the Contractor may elect to use explosives in the prosecution of the work. Utmost care shall be exercised so as not to endanger life or property. The Contractor shall use only such methods as are currently used by persons, firms, or corporation engaged in a similar construction business. The Contractor shall be solely responsible for the determination as to whether explosives shall be used. The Contractor shall indemnify the City of Colleyville whole and harmless against any claim of damage or injury to persons or property, real or personal, resulting from the use of explosives by the Contractor or any subcontractor. The Contractor shall furnish the City of Colleyville evidence of insurance enough to cover any such possibility. Insurance shall include the City of Colleyville as an additional insured.

All explosives shall be stored in a safe and secure manner, under the care of a competent guard at all times, and all such storage places shall be marked clearly "DANGEROUS- EXPLOSIVES." Blasting caps and explosives shall be stored separately, and not more than 50 pounds of explosives shall be stored on the site. The method of storing and handling explosives and highly inflammable materials shall conform with Federal and State laws, City of Colleyville ordinances, and Colleyville Fire Department regulations. The Contractor shall notify each utility company with structures in proximity to the site of the work of the intention to use explosives, and such notice shall be given enough in advance to enable the companies to take such steps as they may deem necessary to protect their property for injury. Such notice shall not relieve the Contractor of responsibility for any damage resulting from blasting operations.

No blasting will be permitted within state highway right of way without written permission from the Texas Department of Transportation.

The blasting area will be covered with heavy timbers chained together, a rope mat, or some equally effective method of blast protection, reviewed by the City. In addition to the "DANGEROUS- EXPLOSIVES" sign displayed, two signs marked "EXPLOSIVES, TURN ALL RADIOS OFF" shall be placed in conspicuous locations readily visible to vehicular traffic and not less than 350' from the blasting cap storage area. During each blast, exposed pipe shall be covered with planking.

3.2.9. **Trench Safety, Sheeting, Shoring and Bracing**

The sides of all excavation shall be supported in accordance with O.S.H.A. regulations. In wet, saturated or flowing materials, where it is necessary to install tight sheeting of cofferdams, wood or steel sheet piling shall be used. All sheeting, shoring and bracing shall have enough strength and rigidity to withstand the pressure exerted and maintain the sides of the excavation properly in place and protect all persons or property from injury or damage. When excavations are made adjacent to existing building or 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. Underpinning of adjacent structures or pavement shall be done by the Contractor at his own cost and expense. When required, the pavement shall be removed, the void satisfactorily refilled, compacted, and the pavement replaced. The entire expense of such removal and subsequent replacement thereof shall be borne by the Contractor.

The removal of all trench safety equipment, 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.

3.2.10. **Pumping, Bailing and Draining**

The Contractor shall immediately remove all surface or seepage water from sewers, drains, ditches, and other sources which may accumulate during the excavation and construction work, by providing the necessary underdrains or otherwise, and by doing the necessary pumping, bailing or draining. The Contractor shall have available at all times enough equipment in proper working order for doing the work herein required. All water removed from excavations shall be disposed of in an approved manner, so as not to create unsanitary conditions, cause environmental damage, nor to cause injury to persons or property, or damage to the work in progress, nor to interfere unduly with the use of streets, private driveways or entrances. No water shall be allowed to flow through or over unset concrete or through the completed line. Adequate plugs or night caps shall be properly installed on pipe ends when the work is unattended. No water removed from the site shall be discharged to the City's sanitary sewer system without prior approval of the City.

3.2.11. **Disposal of Excavated Materials**

Suitable excavated materials shall be piled adjacent to the work, in accordance with O.S.H.A regulations, 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. The location of suitable disposal sites is solely the responsibility of the Contractor and must be suitable to the Texas Natural Resource Conservation Commission; the City shall in no way be responsible for the actions of the Contractor. No disposal shall be allowed in flood plains or below the 100-year flood elevation of drainage ways.

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 the work. The excavated material not suitable for bedding or backfill will be disposed of by the Contractor and suitable selected material will be provided at no cost to the City.

3.2.12. **Protection of Trees, Plants, Shrubberty, Etc.**

No trees shall be removed unless so noted on the plans or upon the specific approval of the City. Where trees, plants, shrubberty, etc., are adjacent to the line of the work and are not to be removed or removed and replaced, the Contractor shall protect such trees, plants, shrubberty, etc., by substantial guards; and if, in the opinion of the City, such trees, plants, shrubberty, etc., would be damaged by machinery, etc., hand excavation

may be required. The Contractor shall be responsible for all damages to adjacent trees, plants, shrubbery, etc. All damaged limbs over one (1") inch in diameter shall be sawed clean adjacent to the damaged area or at the trunk and dressed with a suitable tree wound paint. The cost of such protection will not be paid for as a separate contract pay item, and the costs thereof shall be included in such pay items as are provided in the proposal and contract.

3.2.13.

Embedment

Embedment describes the material in the area below, around, and above the pipe as described below. Embedment shall be one of the following types and conform to the requirements of Section C 1.22 "Embedment Materials":

- **Class "A" Embedment.** The trench shall be undercut to a point four (4") inches below the outside of the pipe. The pipe shall be laid to grade on concrete blocks or bricks and properly jointed. The pipe will then be restrained to prevent flotation. Class "B" Concrete will then be poured on either side of the pipe to form the bedding under the pipe and up the sides of the pipe to a depth of one-fourth (1/4) the outside diameter (O.D.) of the pipe. Before the placement of granular embedment, grades will be checked to insure that no flotation or settlement has occurred. Granular embedment material as defined in Section C 1.22 shall then be placed to a point six (6") inches above the top of the pipe barrel in three-inch (3") to six-inch (6") lifts and compacted to 95 percent \pm two (2%) percent of maximum dry density as defined in ASTM D 698, latest revision.
- **Class "B" Embedment.** The ditch shall be excavated to a minimum of six (6") inches below the finished grade. A minimum six (6") inches of crushed stone shall then be placed in the trench. The crushed stone shall then be compacted, graded and bell holes dug. The pipe shall then be placed on the firm trench bottom and jointed. Crushed stone embedment shall then be placed to six (6") inches above the top of the pipe and compacted.
- **Class "C" Embedment.** The trench shall be undercut to a point six (6") inches below the barrel of the pipe. Six (6") inches of granular embedment material as defined in Section C 1.22 shall then be placed in the ditch and compacted. Bell holes shall then be excavated in the embedment material and the pipe laid and jointed. Granular embedment material shall then be carefully placed around the pipe haunch area to a point six (6") inches above the top of the pipe. The embedment shall then be thoroughly consolidated by mechanical tamping to 95 percent \pm two (2%) percent of maximum dry density as defined in ASTM D 698, latest revision.
- **Class "D" Embedment.** The trench shall be undercut to a point six (6") inches below the barrel of the pipe. Six (6") inches of granular embedment material shall be placed in the ditch and compacted. Additional granular material shall then be placed alongside the pipe to a depth of one-fourth (1/4) the outside diameter of the pipe above the bottom of the pipe and compacted. Select material shall then be placed in the trench to a point six (6") inches above the top of the pipe and consolidated by mechanical tamping to 95 percent \pm two (2%) percent of maximum density as defined in ASTM D 698, latest revision.
- **Class "E" Embedment.** The ditch shall be excavated to a minimum of four (4") inches below the finished grade. A minimum four (4") inches or one-eighth (1/8) of the outside diameter of the pipe of crushed stone shall then be placed in the trench. The crushed stone shall then be compacted, graded and bell holes dug. The pipe shall then be placed on the firm trench bottom, and granular embedment material placed along the sides of the pipe to six (6") inches above the top of the pipe barrel. The granular embedment material shall be placed in three-inch (3") to six-inch (6") lifts and compacted to 95 percent \pm two (2%) percent of maximum dry density as defined by ASTM D 698, latest revision.
- **Class "F" Embedment.** The ditch shall be excavated to a minimum of four (4") inches below the finished grade. A minimum four (4") inches or one-eighth (1/8) of the outside diameter of the pipe of crushed stone shall then be placed in the trench. The crushed stone shall then be compacted, graded and bell holes dug. The pipe shall then be placed on the firm trench bottom and jointed. Select material shall be placed under the haunch area of the pipe and along the sides to six (6") inches above the top of the pipe. The select material shall be placed in three-inch (3") to six-inch (6") lifts and compacted to 95 percent \pm two (2%) percent of maximum dry density as defined by ASTM D 698, latest revision.

3.2.14.

Backfill

The placing of backfill shall not begin until the pipe has been laid, jointed and embedded. The excavation shall be backfilled only with materials approved by the City. Normally, material excavated from the ditch will be used

for backfill, except when granular material is used, provided that all hard rock, stones, or boulders with any dimensions greater than two (2") inches, debris and roots larger than two (2") inches, and any soil balls or clods greater than the maximum allowed lift are removed.

- **Tamped Native Material.** After free moisture is gone from the embedment material, the ditch shall be backfilled with native material and compacted by mechanical methods. If hand pneumatic tampers are used, the backfill shall be placed in layers not exceeding six (6") inches in loose thickness and thoroughly compacted to 95 percent Standard Proctor density at optimum moisture content, + two (2%) percent as determined by ASTM D698, latest revision. Backfill shall be placed in uniform layers completely across the trench, and compaction shall proceed in an orderly, uniform manner. If compaction is performed by the use of heavy tamping (sheep's foot) rollers, backfill shall be placed in layers not exceeding six (6") inches in loose thickness and compacted to 95 percent Standard Proctor density at optimum moisture content, + two (2%) percent as determined by ASTM D 698, latest revision.
- **Sand Backfill.** At the option of the Contractor, in areas where the PI of the native material is less than fifteen (15), and the PI of the native material has been verified by testing, granular embedment material (field sand) may be used as backfill material. If this option is selected, the granular embedment material shall be placed above the previously installed and compacted pipe embedment material shall be backfilled as described above.
- **Backfill in areas with new street construction.** The backfill as described above shall continue to within two (2') feet of the subgrade. At this point the trench shall be widened a minimum of one (1') foot on each side. The remaining two (2') feet shall be native material, mechanically compacted in six-inch (6") loose lifts at optimum moisture content, + two (2%) percent, to a density of 95 percent of maximum dry density, as determined at ASTM D698, latest revision.
- **Testing.** The City of Colleyville shall be responsible for testing during backfill operations. If a test does not meet the requirements as outlined above, the Contractor shall be responsible for the cost of additional testing until the compaction requirements are met.

3.2.15. Backfill of Service Line Trenches

Backfill requirements for water or sewer house service lines shall be the same as that required for the line to which they connect unless otherwise specified.

3.2.16. Backfill under Existing Conditions

When existing utility lines have soil or other backfill material removed from beneath them, they will be backfilled in accordance with these specifications before the remaining backfill is placed.

3.2.17. Maintenance of Streets during Construction

The Contractor shall at all times maintain the surfaces of streets on which he/she is working or has worked. The maintenance required will include the filling of holes, blading or otherwise smoothing of the street surfaces (particularly the trench area), cleaning and removal of surplus excavation material, rubbish, etc., sprinkling of streets with water to abate dust nuisance, and the elimination of interference resulting from blocking the street to residents thereon. Any or all of such operations shall be performed by the Contractor upon demand by the City, but the Contractor shall not wait for instruction from the City before performing maintenance work obviously in need of being done to meet the requirements of these specifications. All costs of work covered by this paragraph shall be included in the prices bid for the various items of work, and no separate payment will be made. In the event the Contractor fails or refuses to properly maintain the barricades and/or surfaces of streets on which work is being performed, the City after due notice to the Contractor's Superintendent, will perform the necessary maintenance, and all costs to the City incurred in the performance of such work will be deducted from any monies due or to become due to the Contractor for work performed, or the Contractor will be billed for such costs directly as the City shall elect. Notice to the Contractor to be given by the City shall be in writing, and it shall be delivered to the Contractor's Superintendent or authorized agent. Except in emergency cases, where immediate action is required, the Contractor shall have 24 hours in which to comply with the instructions of the City. Should the Contractor fail to do so, the City will proceed with the work as set forth above. The Contractor shall provide traffic protection as specified in the City of Colleyville's Work Area Traffic Control Manual.

Where traffic must cross open trenches, such as street intersections and driveways, the Contractor shall provide suitable backfill bridges, protective barricades and such other safety equipment as required. The use of machinery must be so regulated as to preclude any unnecessary interference with traffic, utilities, etc. The Contractor shall abide by all applicable Federal, State or Local laws governing excavation work including OSHA and E.P.A. regulations.

3.2.18.

Depth of Cover

- **Sewer lines.** Sewer lines shall be laid to the grades shown on the plans.
- **Water Lines.** Unless otherwise shown on the plans or plan-profile sheets, water lines in the locations described shall have the following minimum depths of cover:
 - **City Streets.** Within the right of way of city streets, all water lines will be laid with the top of the pipe a minimum of 42 inches below the top of the existing or proposed curb, whichever is lower.
 - **County Type Roads.** Where water lines are installed within the right of way of county type roads (no curb and gutter), the top of the water line shall be at least 48 inches below the elevation of the lowest roadside (borrow) ditch existing on either side of the road.
 - **Open Country.** Across open country, cover over water lines shall be a minimum of 48 inches (48").

3.2.19.

Conditions of Pavement

- **Water Lines.** Trenching, embedment, and backfilling for the installation of water lines will be paid at the unit prices set forth on the plans and in the contract documents.
- **Sewer Lines.** Trenching, embedment, and backfilling for the installation of sewer lines will be paid at the unit prices set forth on the plans and contract documents for the various increments of depth of cut.
- **Trench Foundation Materials.** Trench foundation materials will not be paid for as a separate pay item unless its use is directed by the City.
- **Subsidiary Items.** The following items and/or others not covered by specific bid items will be included in the price bid per foot for the various sizes of water lines and sewer lines over twelve (12") inches in diameter or for "Trenching and Backfill" for sewer lines twelve (12") inches and smaller in diameter:
 - Excavation.
 - Furnishing, placing, and compacting embedment material.
 - Pumping, bailing, and draining as may be required.
 - Maintaining satisfactory condition of streets in work area.
 - Disposal of excess material from ditch (spoil).
 - Placing backfill above embedment.
 - Compaction of embankment above embedment layer by tamping, or other methods as required to obtain the densities specified.
 - Clean-up.
 - Finishing trench surfaces (not including pavement replacement to a condition satisfactory to the Owner.

3.3.

C 2.8 Installation of Ductile Iron Pipe

This section of the specifications covers the installation of ductile iron pressure pipe. Except as modified below installation of ductile iron pipelines shall be in accordance with ANSI/AWWA C600.

Where plan-profile or profile sheets are included on the plans, ductile iron lines shall be laid to the grade shown.

Where grades are not shown, minimum cover as set forth in Section C 2.5 shall be maintained.

3.3.1.

Embedment

The minimum permissible Embedment for ductile iron pressure pipe shall be Class "C" as set forth in Section C 2.4. of these specifications. This Embedment requires a six (6") inch envelope of granular Embedment material

completely around the pipe.

3.3.2. **Polyethylene Wrapping**

All ductile iron pressure pipe used in the water distribution system shall be fully wrapped – including appurtenances - with polyethylene wrapping as set forth in Section C 1.20 of these specifications.

Ductile iron pressure pipe used in the sanitary sewer system shall also require a polyethylene wrapping unless specifically shown otherwise on the plans or called for in the project contract documents.

3.3.3. **Pipe Handling**

Ductile iron pipe and appurtenances shall be lowered into the trench in such a manner as to preclude damage to the pipe, appurtenance, their linings and the polyethylene wrap. Damage to the lining shall be repaired in accordance with provisions set forth in ANSI/AWWA C104/A21.4. Damage to the polyethylene wrap shall be repaired in accordance with provisions set forth in ANSI/AWWA C105/A21.5. The pipe is to be kept clean during laying operations and sealed against the entrance of all objects at the close of each operating day.

Where it becomes necessary to deflect the pipe to avoid obstructions, the deflection of each joint shall be made in accordance with the manufacturer's recommendations.

3.3.4. **Joint Making**

The type of joints will be mechanical joint or push-on joints as set forth in Section C 1.18 of these specifications. The methods of making each type of joint will be in accordance with the requirements of ANSI/AWWA C600.

3.3.5. **Ductile Iron Pipe Sewer Lines**

Ductile iron used in sewer lines construction shall be of the class and joint type as shown on the plans and set forth in the documents. Embedment shall also be of the class shown on the plans and set forth in the contract documents.

At connections of ductile iron pipe to PVC, clay, concrete or other types of sewer pipe, prefabricated watertight connectors shall be used. If such connectors are not available and pipe to pipe connection are required, any excess space in pipe bells shall be properly caulked and sealed. The entire joint connection shall then be encased with a minimum of six (6") inches of Class "A" concrete reinforced as shown in the "Concrete Encasement" detail of the Standard Details. It shall extend along the pipe a minimum distance of one pipe diameter on each side of the joint.

3.3.6. **Ductile Iron Pipe in Tunnel**

Ductile iron pipe installed through casing pipe shall be of mechanical or push-on joint. Timber skids, or other types acceptable to the City, shall be furnished and installed as necessary. Each joint shall be made up complete, tightened, and gasket position gauged before the pipe being placed into final position in the casing pipe.

3.3.7. **Thrust Blocking**

Reaction or Thrust Blocking shall be provided at each hydrant, valve, bend, tee, tapping sleeve, and at reducers or fittings where changes in pipe diameter occur. Thrust block shall be centered on the longitudinal axis of the pipe and extended to solid undisturbed ground. The size and shape of the Thrust Blocking shall be as shown on the drawings or as specified in the contract documents.

3.4. C 2.9 Installation of Vitrified Clay Sewer Pipe

This section of the specifications covers the installation of vitrified clay sewer pipe and is provided as guidance for repair and/or maintenance of existing vitrified clay sewer pipe only.

3.4.1. Embedment

The minimum permissible Embedment for vitrified clay sewer pipe with ten (10') feet or less cover shall be Class "F" as set forth in Section C 2.4. of these specifications.

Where the height of backfill over the top of the pipe exceeds ten (10') feet, Class "B" Embedment as defined in Section C 2.4 shall be the minimum permissible Embedment.

3.4.2. Pipe Handling

At all times material shall be handled with care to avoid damage. Whether moved by hand, skidways, or hoists, material shall not be dropped, bumped, or allowed to impact on itself.

Pipe and fittings shall be handled and stored so that no weight, including the weight of the pipe itself, will bear on or be supported by the pre-molded joint material. The spigot ring shall not be dragged on the ground or allowed to be damaged by contact with gravel, crushed stone, or other hard objects.

3.4.3. Laying and Jointing

- **Laying.** The pipe and specials shall be so laid in the trench that after the project is completed to the grade interior surface shall conform accurately to the grade and alignment indicated on the plans. Pipe shall be laid with the bell (or groove) up unless otherwise approved by the engineer.
- **Cleaning.** Before laying, the interior of the bell shall be carefully wiped smooth and clean and the annular space shall be kept free from dirt, stones or water. All water must be kept out of bell hole during laying.
- **Jointing.** Pipe shall be installed and joints made up in complete conformance with the instructions and recommendations regarding proper installation and assembly furnished by the manufacturer.

3.4.4. Connections to Manholes and Other Structures

Where pipe connects with outside faces of manhole walls or the outside faces of the walls of other structures, a short pipe stub twelve (12") to eighteen (18") inches in length shall be extended from the manhole or other wall face to provide a flexible joint near the wall face. Where connecting to an existing manhole, a temporary watertight plug shall be installed in the line at the downstream end (outlet pipe) of the manhole unless service is disrupted. This may be the case where more than one line ties into the manhole. If a disruption of existing service occurs, the new system (line) should be plugged a minimum of three (3') feet from the connection or removal of the plug shall not be done before the acceptance of the new system. The Contractor will be required to remove all water and other materials from the new sanitary sewer system before its connection. The ground water, construction water, and/or other materials shall not be discharged into the City's existing sanitary sewer system. The Contractor's failure to abide by this specification may result in their being barred from doing future construction.

3.5. C 2.10 Installation of Polyvinyl Chloride (PVC) Sewer Pipe

This section of specifications covers the installation of PVC sewer pipe for gravity flow sewers.

3.5.1. Embedment

The minimum Embedment for PVC sewer pipe shall be Class "B" as defined in Section C 2.4 of these specifications.

3.5.2. Storage of Pipe and Fittings

The interior, as well as all sealing surfaces of all pipe, fittings, and other accessories shall be kept free from

dirt, and foreign matter. Pipe bundles shall be stored on flat surfaces with uniform support. Pipe and gaskets stored outside shall be protected from sunlight as recommended by the manufacturer.

Clear plastic sheets shall not be used, and air circulation shall be provided under covering. Gaskets shall be kept away from oil, grease, electric motors (which produce ozone), excessive heat and direct rays of the sun.

3.5.3. Pipe Handling

Materials shall at all times be handled properly to prevent damage in accordance with manufacturer's recommendations. Pipe and fittings shall not be thrown, dropped, or dragged.

3.5.4. Curved Alignment

Where curved alignment is required, the recommended allowable minimum curve radii PVC sewer pipe shall be based on the formula:

$R = 300 D$; where

R = minimum allowable radius of curvature from bending,

D = outside pipe diameter, (where R and D are in the same dimensional units.)

3.5.5. Joining

- **Cutting and Beveling Pipe:** For shorter than standard pipe lengths, field cuts may be made with either hand or mechanical saws or plastic pipe cutters. Ends shall be cut square and perpendicular to the pipe axis. Spigots shall have burrs removed and ends smoothly beveled by a mechanical beveler or by hand with a rasp or file. Field spigots shall be stop-marked with felt tip marker or wax crayon for the proper length of assembly insertion. The angle and depth of field bevels and lengths to stop-marks shall be comparable to factory pipe spigots.
- **Bell Holes for Elastomeric Seal Joints.** The bell hole shall be no larger than necessary to accomplish proper joint assembly. When joint has been made, the void under the bell shall be filled with bedding or haunching material to provide adequate support to the pipe throughout its entire length.
- **Assembly of Joints.** All joints shall be assembled in accordance with the recommendations of the manufacturer. Proper Joining may be verified by rotation of the spigot by hand or with a strap wrench. If unusual Joining resistance is encountered or if the insertion mark does not reach the flush position, disassemble the joint, inspect for damage, reclean the joint components and repeat the assembly steps.

3.5.6. Branch Connections

Fittings for service branches in new construction shall be molded or fabricated with all gasketed connections. Taps into existing lines shall use a gasketed fitting in conjunction with a repair sleeve coupling or a gasketed saddle wye or tee with all stainless steel clamps. Saddles may be mounted on pipe with solvent cement or gasket but shall be secured by metal banding. Saddles shall be installed in accordance with manufacturer's recommendations. Holes for saddle connections shall be made by mechanical hole cutters or by keyhole saw or sabre saw. Holes for wye saddles shall be laid out with a template and shall be deburred and carefully beveled where required to provide a smooth hole shaped to conform to the fitting.

The Contractor will be permitted to use fittings which are prefabricated using pipe sections, molded saddles and PVC solvent cement, provided the solvent cement used in fabrication has cured at least 24 hours before installation. Cemented mitered connections without socket reinforcement shall not be permitted. Only PVC primer and solvent cement shall be used in cementing in accordance with the cement manufacturer's recommendations and ASTM D2855. "Making Solvent-Cemented Joints with PVC Pipe and Fittings."

3.5.7. Manhole Connections

All manhole connections shall be made using proper water stops. If Portland cement grout is incorporated in the manhole connection, the grout shall be of a type that expands, rather than shrinks, upon curing. Where connecting to an existing manhole, a temporary watertight plug shall be installed in the line at the downstream end (outlet pipe) of the manhole unless service is disrupted. This may be the case where more than one line

ties into the manhole. If disruption of existing service occurs, the new system (line) should be plugged a minimum of three (3') feet from the connection to the existing system (line or manhole). The final connection or removal of the plug shall not be done before the acceptance of the new system. The Contractor will be required to remove all water and other materials from the new sanitary sewer system before its connection. The ground water, construction water, and/or other materials shall not be discharged into the City's existing system. The Contractor's failure to abide by this specification may result in their being barred from doing future construction.

3.5.8. PVC Pipe in Casing

Runners or cradles shall be used to support all pipe in casings. One end of the casing spacer or skid shall be secured at the insertion mark on the spigot end of the pipe to avoid over assembly during the installation of the pipe in the casing. Wooden skids shall not be made of creosote treated wood. The maximum span between the supports for pipe lengths of twenty (20') feet shall not exceed that shown in the following table:

MAXIMUM RECOMMENDED SUPPORT SPACING FOR 20-FOOT LENGTHS OF PVC SEWER PIPE AT MAXIMUM TEMPERATURE OF 73.4 DEGREES F (23 DEGREES C)

Nominal Pipe Size (Inches)	Unsupported Span (Feet)
4	6.25
6	6.75
8	7.5
10	8
12	8.25

3.6. C 2.11 Installation of Reinforced Concrete Pipe

This section of the specifications covers the installation of reinforced concrete pipe with rubber gaskets for use in the sanitary sewer system.

3.6.1. Embedment

Where the depth of cut - measured from the pipe flow line to the surface of the ground - does not exceed ten (10') feet, the minimum permissible Embedment for Class III pipe, as defined in ASTM C 76, shall be Class "E" as defined in Section C 2.4 in these specifications.

For all other pipe classifications and trench depths, the Embedment shall be as shown on the plans.

3.6.2. Pipe Handling

Care shall be taken to prevent any collision of one pipe section with another which will result in chipping or spalling, particularly to joint surfaces.

3.6.3. Pipe Laying and Jointing

- **Inspection.** Allowable manufacturing irregularities of the pipe shall be fitted and adjusted so that the lower one-half of the inside surfaces of adjacent sections of pipe will provide the best possible flow conditions. Before Jointing, an inspection shall be made to be certain that the pipe ends and gaskets are thoroughly clean with no foreign matter adhering to them.
- **Jointing.** The bell groove slopes of the preceding pipe shall be coated with a lubricated material, such as flax soap or other lubricant approved by the manufacturer for this purpose. Petroleum lubricants will not be permitted. The pipe shall then be assembled by pulling the tongue or spigot of the joint being laid into the groove or bell of the preceding pipe with enough force necessary to make a tight seal on the gasket. All joints shall be checked with a feeler gauge. If any irregularity in the position of the gasket is detected at any point on the entire circumference of the pipe, the pipe shall be removed and the gasket examined for

cuts. If the gasket is undamaged, it may be used again, but both it and the joint must be relubricated. Before the pipe sling is removed, the rubber gasket of the joint shall be checked for proper position as outlined above. Jointing shall be done in a manner to prevent damage to the pipe and joints.

- **Laying.** The pipe and specials shall be so laid in the trench that after the project is completed the interior surface shall conform accurately to the grade and alignment indicated on the plans. Pipe shall be laid with the bell (or groove) end upgrade unless otherwise approved by the engineer.

3.7. C 2.12 Installation of Ductile Iron Fittings

This section of the specifications covers the installation of ductile iron fittings.

3.7.1. Types of Fittings

Ductile iron fittings shall consist of crosses, tees, bends, offsets, plugs, caps, sleeves, connecting pieces, etc. for use with PVC and ductile iron piping systems.

3.7.2. Jointing

- **Mechanical Joint.** Shall comply with procedure set forth in Section C 1.18 of these specifications
- **Push-On Joint.** Shall comply with procedure set forth in Section C 1.18 of these specifications.
- **Flanged Joints.** Flanged connections shall be made by means of erection bolts and drift pins without undue forcing and with no restraint on the ends of the pipe or fittings which would prevent pressure from being evenly and uniformly applied to the gasket. The gaskets shall be full face, manufactured true to shape from approved black neoprene rubber stock of a thickness not less than one-sixteenth (1/16") inch. The gasket shall be of virgin stock and shall conform to the physical and test requirements specified in ANSI WA C111. Finished gaskets shall have holes punched by manufacturer and shall match the flange pattern in every respect. Frayed cut edges resulting from jobsite gasket fabrication shall not be acceptable except under emergency conditions, and then only when specifically approved. The pipe or fitting must be free to move in any direction while bolting. Flanged bolts shall be installed with all bolt heads faced in one direction except specified otherwise.

3.7.3. Polyethylene Wrapping

All ductile iron fittings shall be fully wrapped (double wrapped) with polyethylene wrapping as set forth in Section C 1.20 of these specifications.

3.8. C 2.16 Installation of Miscellaneous Valves

This section of the specifications covers the installation of miscellaneous valves, flap valves and check valves, in sanitary sewer systems.

3.8.1. Handling

Valves shall be carefully handled and lowered into position in such a manner as to prevent damage to any part of the valve. The valve shall be placed in the proper position and held securely until all connections have been made. Valves shall be wrapped with polyethylene wrap as described in Section C 2.17.

3.8.2. Installation of Flap and Check Valves

Where check valves are to be placed in concrete vaults or structures, the floor or bottom shall be completed and inspected before installing the valve. The valve shall be securely blocked so that its weight is carried by the floor rather than being supported by the connected piping.

When installing flap valves on the end of a pipe run, the valve shall be installed in a truly vertical position.

3.9. C 2.17 Installation of polyethylene Wrap

This section of the specifications covers the installation of polyethylene wrap on ductile iron pipe and all fittings

and valves in accordance with ANSI A21.5/AWWA C105, latest revision.

To form a dielectric barrier against electrolytic soil action polyethylene wrap shall be used on all ductile iron pipe fittings and appurtenances.

3.9.1. Installation on Pipe

To install polyethylene wrap on ductile iron pipe, the following procedure shall be followed:

- **Place Wrapping on Pipe:** By the use of a sling or pipe tongs, the pipe shall be raised a suitable working distance off the ground. A polyethylene tube approximately two feet longer than the pipe joint shall be slipped over the spigot end of the pipe, centered, and the excess length gathered near the hoisting sling. The wrapping shall be taped so that smooth unwrinkled wrapping extends one foot past the spigot end. The polyethylene tape furnished shall be in conformance with Section C 1.20.
- **Lower Pipe into Place.** The pipe shall be lowered into the trench and the joint made with the preceding pipe section. A shallow bell hole must be made at joints to facilitate installation of the polyethylene tube.
- **Complete the Wrapping Installation.** After the pipe joint has been made, the bunched polyethylene from the preceding length of pipe shall be pulled over the new pipe length and taped or otherwise secured. The end of the polyethylene on the new pipe section shall be slipped over the first wrap until it overlaps the joint for one (1') foot the end of the preceding length of pipe. The overlap shall be secured in place.
- The slack width shall be taken up to make a snug, but not tight, fit along the pipe barrel and secured at the quarter points.
- **Repairs.** Any rips, punctures, or other damage to the polyethylene shall be repaired with polyethylene tape or with a short length of polyethylene tube cut open, wrapped around the pipe, and secured in place.
- **Successive Pipe Runs.** Repeat steps Place Wrapping on Pipe bullet through The Slack width shall be taken bullet.

3.9.2. Installation on Fittings and Specials

Fittings, such as bends and reducers, shall be wrapped in a manner similar to that described in paragraph C 1.20. However, all bolts on mechanical joint and/or flanged fittings shall receive an extra (separate) wrapping of polyethylene in addition to that described herein. This wrapping shall be beneath the overall wrapping and shall be taped in place using the approved materials. Polyethylene wrapping shall have no bulges, large air gaps or pockets which can accommodate ground water left when the wrapping is completed.

Appurtenances such as valves, hydrants, crosses, etc., shall be wrapped by splitting, tucking and overlapping the polyethylene tube, then closing the field made splices with the required tape. All seams shall be folded twice before taping in accordance with AWWA C 105.

Material to cover valves may be acquired from the overlapping excess polyethylene tube on the adjacent pipe lengths. The tubing should be drawn over the bell of pipe on either side and insulated with field made seams as described above.

Hydrants shall be encased with the polyethylene tubing slipped over the hydrant and extended to a point two (2) to three (3") inches above the ground line. The wrap shall be perforated in the drain region to allow normal drain function of the hydrant.

All fittings and specials that require concrete blocking shall be completely wrapped before pouring the concrete blocking.

3.10. C 2.19 Manhole Construction

This section of the specifications covers the construction of sanitary sewer manholes.

3.10.1. Manholes

Standard sanitary sewer manholes shall be constructed as monolithic concrete structures or as precast reinforced concrete structures. Fiberglass may be used only when specifically approved by the Engineer.

- Foundations.** Foundations of manholes for sanitary sewer shall be of Class "A" concrete. The bottom of the foundation shall be at least eight (8") inches below the bottom of the pipe and shall extend at least six (6") inches past the outside of the manhole. The trough shall be smooth, accurately shaped, and in accordance with the plans. Where changing line sizes, the crowns (top insides) of the pipe shall be matched unless otherwise approved by the Public Works Department. The invert of the manholes shall be shaped and smooth so that no projections will exist and flow channels will be formed in the inverts so that the manhole will be self-cleaning and have smooth flow transitions. They shall be free of areas where solids may be deposited as sewage flows through the manhole from all inlet pipes to all outlet pipes. Where the pipe can be laid continuously through the manhole, the pipe can be placed in the base. Pipe boots such as Kor-n-Seal connection, or approved equal, shall be installed around the pipes where they pass through the manhole wall. After the construction of the manhole, the pipe can be trimmed by cutting out the top half of the pipe after the concrete base is constructed and has cured enough. If it is not possible to lay the pipe continuously through the manhole base, the base may be poured and formed directly in the concrete of the manhole base. The invert bench shall have a minimum slope of 1/4- inch per foot to the pipe trough. The manhole invert shall extend from wall to wall. At changes of direction or changes of grade the minimum drop across the manhole invert shall be 0.1 foot or as shown on the plans.

Pipe extending from the manhole shall be cradled in concrete to the first pipe joint in the same pour as the manhole foundation.

Rock cushion shall be used beneath manhole bottoms where water is encountered. If ground water is present during the pouring of a cast-in-place manhole foundation, a pump shall be used to remove the ground water. Before pouring, the subgrade shall be stable, free from muck, etc. After the concrete foundation has been poured, the pump shall continue to run for at least one (1) hour to enable the concrete to obtain its initial set.

- Precast Reinforced Concrete Manholes.** The standard sanitary sewer manholes of the precast reinforced concrete type shall be constructed of ASTM C 76 Class III reinforced concrete pipe and shall be of the bell and spigot design incorporating trapped ringgaskets.

In precast manhole construction, combinations of joint lengths shall be selected to minimize the number of individual segments required to provide the total depth specified. Long joints shall be used in the bottom with shorter segments used for the top adjustments. The inside diameter of the manhole shall be 48 inch or 60 inch.

Pipe boots such as Kor-n-Seal flexible pipe to manhole connection or approved equal shall be installed at all connections to manhole bases of the diameter pipe being installed. The material is to be EPDM Rubber.

Where precast manhole bottoms are used, the excavation shall be undercut by a minimum of six (6") inches and shall be backfilled to grade with one-inch (1") diameter washed rock.

- Cast-In-Place (Monolithic) Concrete Manholes.** Cast-in-place concrete manholes shall have an inside diameter at the base of four (4') feet or six (6') feet and an inside diameter at the top of the barrel of not less than 30 inches. The manhole shall have a minimum wall thickness of five inches (5") and shall be smooth with no form marks on the interior wall or exterior wall of the manhole exceeding one-quarter inch (1/4") in depth. Concrete used for the manhole barrel shall be Class "A" with a slump of five (5") inches to seven (7") inches during the pour. During the pour of the concrete in the manhole barrel forms, thorough rodding or vibrating shall be completed after approximately each two (2') feet of pour into the form. If cold joints are necessary due to a time lapse of more than one (1) hour between pours or the adjustment of the manhole, a concrete bonding adhesive shall be applied to the existing concrete. A concrete collar at least four (4") inches thick shall extend a minimum of eight (8") inches above and below the new joint around the outside of the manhole. If honeycombing of the barrel of the manhole is found to be present after removal of the forms, such honeycombing shall be repaired as directed. Any form marks shall be smoothed and grouted as directed. Covers may be used at the option of the Contractor to protect the concrete to prevent cracking during the curing process and to protect the manhole during freezing temperatures. The manhole shall not be backfilled for at least twelve (12) hours after forms have been

removed. Cast in place manholes shall be coated before backfill with two mop coats of Ertech 2100 Non-Fibered Asphaltic Emulsion or a coating approved by the Engineer.

Water stops, a flexible pipe to manhole connector, or approved equal, will be installed around the pipe at all pipe-manhole wall penetrations. The material shall conform to ASTM C923.

3.10.2 **Adjusting Manholes.** Adjust manholes in accordance with the construction requirements of Item 479, "Adjusting Manholes and Inlets" and as shown on the plans.

Elevations of manholes may be raised by using precast concrete rings. Elevations of manholes may be lowered by removing existing cast-in-place walls, adjusting rings, or the top section of the barrel below the new elevation and then rebuilding or raising the elevation to the proper height.

Salvage and reuse cast-iron frames and covers. Protect or block off manhole or inlet bottoms by using wood forms shaped to fit so that no debris or soil falls to the bottom during adjustment.

Install a cast-in-place slab at the top of the manhole barrel to receive the cast-iron frame and cover. Form concrete slabs a minimum of 6 in. thick. Set the cast-iron frame for the manhole cover in a full mortar bed and adjust it to the established elevation. If placing in streets, adjust covers to be flush with the top of the pavement.

The following requirements apply for fiberglass manhole adjustments: install concrete grade rings for height adjustment, as required. Construct the chimney on the flat shoulder. Do not load the manhole except on the load bearing shoulder of the manhole. The maximum adjustment height is 18 in.

Use a cut length of approved Fiberglass Reinforced Pipe (FRP) to create a finished liner inside the adjustment rings. Cut the pipe to fit between the casting and the top of the fiberglass manhole reducer. Completely seal the liner pipe to the casting and to the manhole reducer section with sealant as recommended by the manufacturer.

Set the cast-iron frame on top of the cone or adjustment rings using approved sealant materials and adjust the elevation of the casting cover to match the pavement surface. For manholes in unpaved areas, set the top of the frame a minimum of 6 in. above the existing ground line unless otherwise shown on the plans.

3.11. **C 2.20 Installation of Sanitary Sewer Cleanouts**

This section covers the installation of sanitary sewer cleanouts used on the end of some sanitary sewer mains.

Cleanouts shall be installed on sanitary sewer mains where shown on the project plans. Cleanout installations shall consist of a 22-1/2 degree bend (1/16 bend) encased in Class "B" concrete, the appropriate length of six (6") inch diameter pipe for the cleanout stack, and the cleanout casting with cover installed on a 10" x 2' -0" x 2' -10" concrete slab and encased in Class "B" concrete. All cleanouts shall be a minimum of six (6") inches in diameter.

All castings with covers used for cleanouts on sanitary sewer mains shall be heavy duty cast iron.

3.12. **C 2.21 Installation of Sanitary Sewer Services**

This section of the specifications covers the construction of sanitary sewer services used to connect the customer's sanitary sewer system at the property line or utility easement to the City's main.

A sanitary sewer service shall be defined as a service line connecting the customer's sewer system at the property line or utility easement to the City's main and shall consist of the service combination tee wye, the necessary Class "B" concrete cradle or crushed stone for the tee wye, the service pipe necessary to extend the line from the main to the customer's property line and a plug placed in the end of the service line.

Services for single family residences shall normally be four inches (4") in diameter.

3.12.1. **Extra Depth Sanitary Sewer Service**

Where the sanitary sewer main is at a depth much greater than that necessary to serve the abutting property, an extra depth or deep sanitary sewer service connection shall be installed. The extra depth service is identical to a standard or "normal" sanitary sewer service except that pipe risers will be installed at a maximum 45 degree angle into the trench walls to connect the combination tee wye and 45 degree bend to the service pipe.

3.12.2. **Slope and Depth of Cover**

Where possible, a minimum slope of two (2%) percent slope down toward the main will be maintained on all sewer services.

Where the sanitary sewer main is located in the street and the abutting property slopes to the street, the sanitary sewer service shall normally have a minimum depth of four (4') feet below the top of the curb at the point where it passes beneath the curb.

Where abutting property slopes away from the sanitary sewer main, sewer services shall be placed at a depth adequate to serve the normally expected use of the abutting property.

Where water and sanitary sewer services cross, they shall be treated in accordance with the TCEQ regulations.

3.12.3. **Marking**

The end of each sewer service shall be marked with heavy gauge polyethylene tape, six (6") inches in width with a thickness of 0.004 inches. The film should be yellow in color on which has been printed, "Caution Buried Sewer Line Below", in a continuous print. The heavy gauge polyethylene tape shall be that as manufactured by Allen System Marking Tape or approved equal. The tape shall have a minimum tensile strength of 1,700 psi lengthwise and 1,200 psi crosswise.

The tape shall be securely tied to the end of the sewer service and placed in such a manner that when the trench is backfilled, approximately six (6) to twelve (12") inches of tape will be visible above the ground. The tape above ground shall be firmly attached to a two- inch (2") by four-inch (4") stake four (4) feet long.

3.13. **C 2.22 Elevated Crossings**

This section of the specifications covers the installation of elevated crossings of sanitary sewer lines over creeks and waterways.

3.13.1. **Foundations**

Foundations for elevated crossings will be drilled shafts of a diameter enough to carry the dead and superimposed loads. Where rock is present, drilled shafts shall penetrate into sound rock at least 2 feet.

Where no rock is present, the minimum depth of drilled shafts shall be at least ten feet (10') below the bottom of the stream bed.

The use of spread footings as a foundation for elevated crossings is to be avoided.

All drilled shafts will be constructed of Class "A" concrete in accordance with the plans.

3.13.2. **Carrier Pipe**

Where the pipe acts as a structural beam and is not supported by a truss, I beam, etc., the pipe shall be either ductile iron or concrete cylinder pipe specifically manufactured and fabricated for the individual project. There shall be at least one foundation support for each joint of pipe. At each support, the carrier pipe shall be secured to the support with galvanized steel straps.

3.13.3. **Anchorage**

Elevated crossings shall be anchored at each end where the pipe structure enters the ground. Anchorages shall be constructed of Class "B" concrete and of such a size and configuration as shown on the plans and specifications.

3.13.4. **Crossing Appurtenances**

For sanitary sewer main crossings a manhole shall be placed at each end of the crossing behind the anchorages. For water line crossings twelve (12") inches and smaller, a valve shall be placed at each end of the crossing behind the anchorages.

3.14. **C 2.23 Construction of Bored, Jacked or Tunneled Crossings**

This section of the specifications governs the installation of encasement or carrier pipe for sanitary sewer mains by the methods of jacking, boring or tunneling.

Where encasement or carrier pipe is required to be installed under railroad embankments or highways, streets, or other facilities by jacking, boring or tunneling methods, construction shall be made in a manner that will not interfere with the operation of the railroad, highway, or other facility, and will not weaken or damage any embankment or structure. During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained, as approved by the City, until the backfill has been completed and then shall be removed from the site. The Contractor shall notify the Railroad Company or Texas Department of Transportation at least 48 hours before construction. The Contractor shall provide insurance with limits as required by the governing authority.

The drilling of pilot holes for the alignment of pipe before its installation by jacking, boring or tunneling will not be a requirement but may be necessary to maintain grade. The drilling of pilot holes will be considered as incidental work and the cost thereof shall be included in such contract pay items as are provided in the proposal and contract.

The Contractor shall take the proper precautions to avoid excavating beyond the limits of excavation needed to install the pipe. All damages shall be repaired or replaced at the Contractor's expense.

The removal of any obstruction that conflicts with the placing of the pipe will not be measured for Payment or paid for as a separate contract pay item.

The removal of any such obstruction will be included in such contract pay items as are provided in the proposal and contract.

The Contractor shall dispose of all surplus materials at the Contractor's expense.

Jacking, boring, or tunneling may be used instead of open cut at the Contractor's discretion. No additional compensation will be provided.

All excavations shall be safely secured at all times to prevent unauthorized access to the excavation site.

3.14.1. **Construction by Jacking**

If the grade of the pipe at the jacking end is below ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking operations and for placing end joints of the pipe. This excavation shall not be carried to a greater depth than is required for placing of the guide and jacking timbers and no nearer the roadbed than the minimum distance shown on the plans.

At the other end of the pipe, an approach trench shall be excavated accurately to grade. All open trenches and pits shall be braced and shored in such a manner to adequately prevent caving or sliding of the walls into the trench or pit and be in accordance with OSHA standards for trench safety.

Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head not less than 6 inches larger than the outside diameter of the pipe, usually of timber, and suitable bracing between jacks and jacking head shall be provided so that pressure uniformly will be applied to the pipe uniformly around the ring of the pipe. The jacking head shall be of such weight and dimensions that it will not bend or deflect when full pressure is applied at the jack. The jacking head shall be provided with an opening for the removal of excavated materials as the jacking proceeds. A suitable jacking frame or backstop shall be provided. The pipe to be jacked shall be set on guides which are straight and securely braced together in such a manner to support the section of the pipe and to direct it in the proper line and grade. All timber and other materials used in the construction of the jacking assembly will be of such quality and dimensions that they will withstand all stresses to which they are subjected in such a manner as to insure even pressures on the pipe during jacking operations. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe.

As the jacking proceeds, the embankment materials shall be excavated slightly in advance of the pipe in such a manner to avoid making the excavation larger than the outside diameter of the pipe, with the excavated material being removed through the pipe. The excavation for the underside of the pipe, for at least one-third of the circumference of the pipe, shall conform to the grade of the pipe. The excavation for the top half of the pipe shall conform closely to the outside diameter of the pipe and a clearance greater than two (2") inches will not be permitted. All voids between the pipe and the earth will be filled with grout proportioned one (1) part Portland cement to five (5) parts washed sand and an air entrainment agent to facilitate grout flow if necessary. Grout holes may be provided in the pipe or grouting may be made through drill holes from the ground surface if practical. The grouting shall follow immediately upon completion of the jacking operation.

All carrier pipe installed by jacking shall be supported by quarter point cradle of Class "B" concrete across the jacking pit and to the first joint in the ditch section on each end.

The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall not exceed two (2') feet in any case. Preferably, the pipe shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the plans will be permitted only to the extent of one (1") inch per ten (10') feet, provided that such variation shall be regular and only in one direction and that the final grade the flow line shall be in the direction indicated on the plans.

When jacking of pipe is once begun, the operation shall be carried on without interruption, insofar as practicable to prevent the pipe from becoming firmly set in the embankment.

Any pipe damaged in jacking operations shall be repaired or removed and replaced at the Contractor's expense.

The pits or trenches excavated to facilitate jacking operations shall be filled immediately after the jacking of the pipe has been completed unless an encasement pipe only has been installed; in which case, the trenches and pits shall be left open until the carrier pipe has been laid through and manholes have been built if required. The pipe or trenches will then be backfilled.

3.14.2.

Construction by Boring

The hole shall be bored mechanically with a suitable boring assembly designed to produce a smooth, straight shaft and so operated that the completed shaft will be at the established line and grade. The size of the bored hole shall be of such diameter to provide ample clearance for bells or other joints. All carrier pipe installed by boring shall be supported by quarter point cradle of Class "D" concrete across the boring pit and to the first joint in the ditch section on each end. All bore pits and other excavations shall be completed in accordance with OSHA standards.

All voids will be grouted with a 1:5 minimum mix of Portland cement and clean washed sand with enough air entertainment to facilitate flow. Grout will be considered a part of the unit price of the boring operation.

3.14.3. Construction by Tunneling

The tunnel shall be excavated in such a manner and to such dimensions which will permit placing of the proper supports necessary to protect the excavation in accordance with OSHA standards. The Contractor shall take proper precautions to avoid excavating earth or rock or shattering rock beyond the limits of excavation shown on the plans. All damages by excavating and blasting, either to surface or subsurface structures, shall be repaired or replaced at the Contractor's cost and expense.

Adequate provisions shall be made for safety and health of the workers in accordance with OSHA standards. All equipment operated in the tunnel shall be powered by either air or electricity. No equipment will be permitted in the tunnel that uses a petroleum product for fuel. Electric lights shall be used for illumination of the tunnel construction.

The Contractor shall monitor the quality of air in the tunnel in accordance with OSHA standards.

A supply of fresh air shall be provided and maintained at all times in all underground places and provisions shall be made for the quick and complete removal of gases and dust resulting from blasting or other tunnel operations. Except when unnecessary due to natural ventilation, artificial ventilation shall be maintained in the tunnel by ventilating plants of ample capacity operated when needed to meet the preceding requirements.

If required by the plans or if required for safety, suitable steel or timber sheeting, shoring and bracing shall be used to support the sides and roof of the excavation. Supports may be left in place provided that they clear the encasement or carrier pipe. No separate Payment will be made for supports left in place. Nothing contained herein shall prevent the Contractor from placing such temporary or permanent supports as shall be deemed necessary, nor shall it be construed as relieving the Contractor from full responsibility for the safety of the work, and for all damages to persons and property.

If specified, the entire void between the outside of the pipe and the tunnel walls shall be backfilled with Class "D" concrete or grouted with 1:5 minimum mix grout of Portland cement and clean washed sand with enough entrained air to facilitate flow. The minimum thickness of concrete required for backfill in excess of the minimum dimensions shown on plan will be at the entire expense of the Contractor. The carrier pipe shall be inspected by televising or other means to insure that the pipe is constructed to proper line and grade before placement of grout.

All pipe damaged during operations shall be repaired or removed and replaced at the Contractor's expense.

3.14.4. Joints

When reinforced concrete pipe 24 inches and larger in diameter with tongue and groove joints is used for the encasement pipe, the interior joints for the full circumference shall be sealed and packed with mortar and finished smooth and even with the adjacent section of pipe.

3.15. C 2.24 Removal and Replacement of Paved Surfaces

This section of the specifications covers the removal of paved surfaces for the installation of sanitary sewer facilities and the replacement of these paved surfaces after the utilities have been installed.

3.15.1. Detours and Barricades

The Contractor shall deliver a construction traffic control plan to the City Transportation Department for approval. After approval, the Contractor shall, before closing any street or causing any obstruction to traffic on any street, furnish and erect suitable barricades and warning signs to protect the traveling public, as set forth in the Texas Municipal Uniform Traffic Control Devices (TMUTCD). The barricades and warning signs will be constructed, placed, and adequately maintained as directed by the City.

3.15.2. Cuts of Sidewalk, Driveway, or Curb and Gutter

When a sidewalk, driveway, or curb and gutter are cut, such cuts shall be made with a pavement saw. At the discretion of the Owner, the Contractor may break out sidewalks, driveways, curb and gutter, etc., to the nearest expansion joint, but no additional Payment will be made for the removal and replacement of the additional pavement unless previously approved by the City.

3.15.3.

Pavement Cuts

Before removal, all existing pavement shall be cut with a pavement saw the full depth of the pavement to be removed. If the depth of cut is not enough and a ragged edge results, the pavement shall again be sawed and a neat straightedge established. The additional saw cut and pavement replacement shall be at the Contractor's expense.

In reinforced concrete streets, the reinforcement shall be cut at the centerline of the ditch and bent back.

3.15.4.

Pavement Replacement

■ Type 1. Asphalt Street HMAC - Hot Mix Asphaltic Concrete.

- The existing pavement shall be sawed to a neat straight line and removed. This line shall be as shown in the standard details for existing street backfill and repair.
- The pipe and Embedment shall be installed as shown in the standard Embedment details, and Embedment material shall extend to a point at least one (1') foot above the top of the pipe.
- Tamped native material shall then be placed in the ditch from the top of Embedment to the bottom of the 2:27 concrete or cement treated base as shown on the standard detail for existing street backfill and repair.
- This material shall be thoroughly compacted after placement.
- An eight-inch (8") layer of 2:27 concrete or cement treated base, extending twelve (12") inches outside the ditch line on each side shall be placed to a point six (6") inches below the existing surface
- A tack coat of MS-Z or SS-1 shall be applied to the surface of backfill material and the edge of the existing hot mix. The tack coat shall be applied to each layer at a rate not to exceed 0.05 gallons per square yard of surface.
- Six (6") of HMAC Type D or two (2") inches of HMAC Type D and four (4") inches of HMAC Type B or shall be placed and compacted.

■ Type 2. All Concrete Streets

- The existing pavement shall be sawed full depth to a neat straight line and removed. This line shall be at least twelve (12") inches back of the firm banks of the ditch when the ditch width conforms to maximum and minimum widths as set forth in Section C 2.4.
- The pipe and Embedment material shall be installed, as shown in the Embedment details and granular Embedment material or crushed stone shall extend to a point at least one (1') foot above the top of the pipe. This material shall be thoroughly tamped after placement.
- Tamped select native material shall then be placed in the ditch from top of Embedment to within one foot (1') below the bottom of the existing concrete surface.
- Eight (8") inches of 2:27 concrete or cement treated base backfill material shall be placed in the ditch to the bottom of the original pavement surface.
- Any material remaining between the sawed removal lines shall be removed to the bottom of the original pavement surface.
- Install No. 4 rebar doweled at least 30 inches in length on 24" inch centers into existing pavement. Steel rebar shall be No. 4 bars on 24"

- centers installed both ways.
- All concrete paving shall be replaced at a minimum thickness of six (6") inches or to match existing pavement thickness and shall be poured and finished by broom or burlap drag to match existing surface. Type 2 (white pigmented) curing compound shall be applied to the surface of the slab.

3.16. C 2.25 Utilities Construction within Texas Department of Transportation Right of Way

This section of the specifications covers the construction of sanitary sewer lines within highway right of way under the jurisdiction of TxDOT.

Where proposed lines are in a state highway right of way, the work shall not be started until the Contractor has an approved permit from TxDOT, received through the City. In addition, the Contractor shall notify the TxDOT maintenance foreman at least 48 hours before commencing any work covered by the approved permit.

The Contractor shall provide and employ adequate warning signs, barricade, lights, watchman, etc., to fully protect workers and the traveling public in accordance with TxDOT requirements.

When the crossing of a highway is permitted by open cut, the Contractor shall prosecute the work in such a manner that one-half the traveled roadway is open to traffic at all times.

Highway crossings shall be tunneled and cased in accordance with Section C 2.34. However, in certain cases only where specifically shown on the plans, the Contractor shall make the crossing by open cut.

No changes shall be made in location as shown on the plans within the limits of a state highway right of way without prior authorization of TxDOT and the City.

3.16.1. Backfill Requirements

All backfill requirements in this section shall conform to current TxDOT requirements.

After the installation of the pipe and the Embedment, the ditch shall be backfilled with Type 1 Backfill in all cases except the following:

Type 2 Backfill, when allowed by the permit, agreement, or by the TxDOT representatives, may be used only in trenches parallel and adjacent to right of way lines and in areas where there will be no earthwork construction or construction traffic except that this method may be used for placing backfill which will later be removed by highway construction.

Types 3 or 4 Backfill may be required for special conditions where the possibility of settlement or erosion of backfill must be eliminated or when, after backfill is started, it becomes apparent that Type 1 Backfill is unsuitable.

3.16.2. Types of Backfill

- **Type 1 Backfill (Compacted Backfill)**. Type 1 Backfill shall consist of compacted material obtained from suitable soil excavated from the trench, or from sources outside the highway right of way. Material shall be free of rock, lumps, or clods that will not break down under compaction.

Backfill material shall be placed in the trench in layers not to exceed six (6") inches in depth and compacted. Water shall be added as required to facilitate compaction.

Compaction shall be done with rollers or mechanical tamps. Use of rollers will be permitted only when such use is not believed detrimental to any highway facility and the type roller used is acceptable to the TxDOT representative. When rollers are employed, mechanical tamps shall be used along sides of trench to compact any backfill that cannot be reached with rollers.

Compacting shall be continued until a backfill density equal to that of the adjacent undisturbed material has been obtained.

Where trenches lie within the limits of drainage ditches and channels which are in rock, the Type 1 Backfill used in trench shall be sealed with one (1') foot of concrete backfill struck off flush with the top of rock.

- **Type 2 Backfill (Water Jetted Backfill)**. Type 2 Backfill shall consist of suitable material excavated from the trench or other acceptable material obtained from sources outside the highway right of way.

Backfill shall be placed in the trench in layers not to exceed two (2') feet in depth by blading, dozing, or other approved means and then jetted with water delivered under pressure through a metal jet. After the trench is filled and jetted, additional material shall be mounded thereon and rolled with construction equipment.

- **Type 3 Backfill (Stabilized Sandy Soil or Washed Sand)**. Stabilized backfill shall consist of either sandy soil free of lumps and clods or washed concrete sand, stabilized with two sacks of Portland cement per cubic yard.

If aggregates are not moist enough to produce a mixture suitable for compaction, water shall be added as required. Either transit mix or stationary type mixers may be used.

After mixing, the stabilized material shall immediately be placed in the trench in uniform layers not to exceed six (6") inches in depth and compacted as specified for Type 1 Backfill. Compaction shall be completed within two hours after mixing.

- **Type 4 Backfill (Lean Concrete)**. Concrete backfill shall contain either one or two (2) sacks of Portland cement per cubic yard of concrete as may be specified by the agreement or permit or by the TxDOT representative.

Concrete aggregates shall be washed.

Concrete may be mixed on the project in an approved mixer or in an approved central mixing plant. Slump shall be between three (3) and six (6") inches as directed by the TxDOT representative.

Concrete shall be deposited in lifts not to exceed eighteen (18") inches in depth. Enough vibration shall be done to eliminate voids but care shall be exercised that contamination by adjacent soil does not occur during vibration. All concrete shall be placed within one hour after mixing.

3.17. **C 2.28 Deflection Testing of PVC Sanitary Sewer Mains**

This section of the specifications covers the deflection testing by the Contractor of PVC sewer mains.

Deflection testing will be done after the sanitary sewer installation is complete and all backfill has been completed and in place for at least 30 days. The Contractor will pull a mandrel through the pipe to test for a maximum five (5%) percent deflection. The mandrel will be constructed and sized as listed on the mandrel deflection table.

Mandrel Deflection Table

5 PERCENT DEFLECTION MANDREL

Nominal Size, In.	Mandrel O.D., In.	Tolerance In.	Nearest 1/16	Min Runner Length In.	Min # of Mandrel Runners
6	5.45	± 0.01	5-7/16	4	6
8	7.28	± 0.01	7-4/16	4	6
10	9.08	± 0.01	9-1/16	5	8
12	10.79	± 0.01	10-13/16	6	8
15	13.20	± 0.01	13-3/16	8	8
18	16.13	± 0.01	16-2/16	8	1 2
21	19.00	± 0.01	19	8	1 2
24	21.36	± 0.01	21-6/16	8	1 2
27	24.07	± 0.01	24-1/16	8	1 2
18	16.53	± 0.01	16-1/2	8	9
21	19.30	± 0.01	19-5/16	8	9
24	22.08	± 0.01	22-1/16	8	9
27	24.84	± 0.01	24-13/16	8	9
30	27.62	± 0.01	27-5/8	10	9
33	30.38	± 0.01	27-5/8	10	9
36	33.15	± 0.01	33-1/8	12	9
42	38.68	± 0.01	38-11/16	12	9

3.18. C 2.29 TV Inspection of Sanitary Sewer Mains

This section of the specifications covers the City inspection by closed circuit television (TV) of all sanitary sewer mains.

Part of the final inspection on all projects shall include a closed circuit TV inspection of the completed sanitary sewer pipe installation, exclusive of services, and all imperfections in the installed facility revealed by the TV survey shall be remedied by the Contractor before the acceptance of the project as complete. All TV survey work, including furnishing of necessary personnel, equipment and materials, shall be performed by the City at no cost to the Contractor, but the Contractor shall fully cooperate with the City in the making of this TV survey.

3.18.1. Contractor Responsibilities

The Contractor shall insert a continuous yellow plastic polypropylene line with no knots with a diameter of ¼-inch or larger in all sanitary sewer mains, exclusive of services, to aid in the threading of TV cable and camera controls. The polyethylene line shall be extended to and secured to the top of each manhole and cleanout. The sewer main shall be thoroughly cleaned and flushed with water, by the Contractor, before TV inspection. Mains that are live, such as sanitary sewer renewals, shall have the plastic line taut to the upper portion of the pipe so as to prevent blockage of the sanitary sewer.

3.18.2. Basis for TV Acceptance

Sewer mains will receive T.V. inspection acceptance if no visible defects are detected as described herein. Sewer mains laid at 0.7% grade or greater shall retain no water at any point. Sewer mains laid at less than 0.7% grade may retain a maximum of one (1") inch of water. Swags or dips in excess of one (1") inch will require grade correction by the Contractor.

3.19. **C 2.30 Air Testing of Sanitary Sewer Mains**

This section of the specifications describes the procedures to be used in air testing sanitary sewer mains where such procedures are required before acceptance by the City.

All pipe shall be backfilled before air testing.

Air tests shall be made by the pressure drop versus time method.

For pipes less than 36 inches in diameter, the air test shall be performed by testing complete sections of pipe between manholes. For pipes 36 inches in diameter and over, the air test may be performed by testing each joint connection individually. The Contractor shall have the option, however, of testing pipe over 36 inches in diameter by testing sections of pipe over various lengths if so desired.

The Contractor shall furnish all material, equipment and labor necessary to perform the air test. Air gauges shall be recently calibrated and shall be stamped showing the date of calibration.

Should the sanitary sewer system fail air testing, the Contractor shall repair the leaks and retest at no expense to the City.

3.19.1. **Testing Pipe Less than 36-inches in Diameter**

Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking. All air used shall pass through a single control panel.

Three individual hoses shall be used for the following connections: From the control panel to pneumatic plugs for inflation; from the control panel to a sealed line for introducing the low- pressure air; and from a sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

The air compressor shall be of adequate capacity for charging the system.

The following procedure shall be used for air testing a sewer system: All pneumatic plugs shall be seal-tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The sealed pipe shall be pressurized to five (5) psig. The plugs shall hold against his pressure without bracing and without movement of the plugs out of the pipe.

After a manhole-to-manhole reach of pipe has been backfilled and the pneumatic plugs checked, the plugs shall be placed in the line and inflated to 25 psig. Low pressure air shall be injected into the line until the internal pressure reaches 4 psig. Two minutes shall then be allowed for the pressure to stabilize. If the pipe section to be tested is submerged in ground water, a pipe probe shall be inserted into the backfill adjacent to the centerline of the pipe. The pressure in the probe shall then be determined by reading the pressure when air first begins to slowly pass through it. This reading is back pressure due to ground water submergence, and all gauge pressures in the test should be increased by this quantity. After the pipe pressure has stabilized at 3.5 psig or the adjusted pressure due to ground water submergence, a stop watch shall be started and the time required for the internal pressure to reach 2.5 psig determined. Minimum permissible holding time for runs of single pipe diameter are indicated in the table at the end of this section of the specifications.

3.19.2. **Testing Pipe 36-inches and Larger in Diameter**

Pipe 36 inches and larger in diameter may be air tested at each joint by utilizing a joint tester similar to the Cherne Joint Tester. No joint shall be air tested until the pipe has been backfilled. At no time shall pipe installation exceed 100 feet from the latest joint tested unless sections of pipe are being tested. The time allowed for the pressure drop from 3.5 psig to 2.5 psig shall be ten (10) seconds. Failure to pass the air test shall be cause for rejection. Rejected pipe shall be removed. Reinstallation and/or repairs may be made at the option of the City.

3.19.3. Basis for Air Test Acceptance

Sewer mains will receive air test acceptance only after meeting the test requirements. If the installation fails to meet this requirement, the Contractor shall, at his sole expense, determine the cause of test failure. The Contractor shall then repair or replace any defective material or work and retest the main.

AIR TEST TABLES

MINIMUM HOLDING TIME IN MINUTES

AN O SECOND S REQUIRED FOR

PRE~~S~~URE TO DROP FROM 3 .5 TO 2.5

PSIG

1 Pipe Diameter (in .)	2 Min. Time min:sec	3 Length for Min Time (ft.)	4 Time for Longer Length (sec.)	Specifications Time for Length (L) Shown in (min:sec)											
				NOTE: TO BE USED WHEN TESTING ONE DIAMETER ONLY											
				100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.	450 ft.	500 ft.	600 ft.	650 ft.	
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:48	4:07
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24	7:07	8:33	9:15
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24	12:11	15:11	16:27	
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48	19:47	23:44	25:43	
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38	28:29	34:11	32:02	
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04	44:31	53:25	57:52	
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41	64:05	76:55	83:20	
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31	87:15	104:42	113:20	
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33	113:58	136:45	148:09	
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48	144:14	173:05	187:30	
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15	178:04	213:41	231:30	
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53	215:28	258:34	286:06	
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46	256:25	307:42	333:21	
39	36:50	61	36.114 L	60:11	90:17	120:22	150:28	180:34	210:39	240:45	270:51	300:56	361:08	391:14	

3.1. C 2.32 Concrete Structures and Concrete Blocking and Cradle

This section of the specification shall govern the construction of concrete structures or concrete structural units as well as the construction of concrete cradles and blocking for pipelines.

Materials used in the performance of work described in this section of the specifications shall comply with Section C 1.23, "Concrete," and C 1.24, "Reinforcing Steel," of these specifications.

3.1.1. Structural Excavation and Backfill

This item shall govern the excavation for the placing of such structures as indicated or specified; for the disposal of all material from such excavation; and for the backfilling around completed structures to the level of the original ground. Unless otherwise provided, the work included hereunder shall provide for the removal of old structures or portions thereof, trees, and all other obstructions when such removal is necessary for the proper completion of the proposed construction. Excavation will be unclassified.

Excavation shall be done in accordance with the lines and depths indicated on the plans or as established by the Engineer. Unless written permission is given by the City, no excavation shall be more than three (3') feet from the footing in any direction.

The final elevation to which a foundation is to be constructed shall be as shown on the plans or as raised or lowered when such alterations are judged proper to satisfactorily comply with the design requirements for the structure. Should it be found necessary, in the judgment of the City, to increase or decrease the depth of footings from that shown on the plans, the necessary alterations in the details of the structure shall be accomplished in a manner as directed by the City.

When a structure is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation and the final removal of the foundation material to grade shall be performed just before the footing is to be placed.

The excavation shall be maintained in a dry condition. All pumping or bailing from the interior of any excavation shall be done in such a manner as to prohibit the movement of water through or alongside any concrete being placed.

As soon as practicable, the excavated areas around the structure shall be backfilled with approved material.

Backfill which will not support any portion of the completed structure shall be placed in layers not more than eight (8") inches in loose Measurement or as otherwise recommended and shall be compacted to a density equal to the adjacent undisturbed material. Material for backfill shall be composed of earth only and shall contain no wood, roots, other concrete, stones, trash, or debris of any kind.

Backfill which will support any portion of the structure shall consist, to maximum extent available, of the excess earth obtained from structure and trench excavations. Additional material may be obtained from borrow pits as necessary.

All materials placed in fills and embankments shall be free from rocks or stones larger than three (3") inches in their greatest dimension, brush, stumps, logs, roots, debris, and organic or other deleterious materials. No rocks or stones shall be placed in the upper eighteen (18") inches of any fill or embankment. Rocks or stones within the allowable size limit may be incorporated in the remainder of fills and embankments provided they are distributed so that they do not interfere with proper compaction.

After preparation of the fill or embankment site, the subgrade shall be leveled and rolled so that the surface materials of the subgrade will be as compact and well bonded with the first layer of the fill or embankment as specified for subsequent layers.

All fill and embankment materials shall be placed in approximately horizontal layers not to exceed eight (8") inches in uncompacted thickness. Material which is deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled before compaction.

Each layer of material being compacted shall have a uniform moisture content to insure satisfactory compaction. The Contractor will be required to add water and harrow, disc, blade, or otherwise work the material in each layer to insure uniform moisture content and adequate compaction. Each layer shall be thoroughly compacted by rolling or other method approved by the Engineer to 95 percent of the maximum density at optimum moisture content as determined by ASTM D 698. If the material fails to meet with the density specified, the compaction methods shall be altered as necessary to obtain the specified density. All compaction shall be accomplished at a moisture content from zero (0) to two (2%) percent above optimum.

No backfill shall be placed against any abutment or retaining wall until such structure has been in place at least seven (7) days. Backfill placed around abutment and piers shall be deposited on both sides to approximately the same elevation as at the same time.

3.1.2. **General Requirements**

Before starting work the Contractor shall inform the City as to the methods of construction and the amount and character of equipment he proposes to use, the adequacy of which shall be subject to the approval of the City.

Plans for forms and false work to be used in the construction of the various units of a structure shall be submitted if requested by the City. Such plans shall be complete enough to show all essential details of the proposed forms, false work, and bracing.

Forms for walls or columns shall not be erected on concrete footings until the concrete in the footing has cured at least two (2) curing days. Concrete may be placed in walls or columns as soon as the forms and reinforcing steel placement have been approved by the City. Approval by the City of any construction methods, equipment, or form and false work plans will not relieve the Contractor of responsibility for the safety or correctness of methods used, adequacy of equipment, or from carrying out the work in full accordance with the contract.

3.1.3. **Curing Day**

A curing day will be any calendar day on which the atmospheric temperature, taken in the shade and away from artificial heat, is above 50 degrees F. for at least eighteen (18) hours. Colder days may be counted if proper provisions are made, and the air temperature adjacent to the concrete is maintained above 50 degrees F. throughout the entire day.

3.1.4. **Construction Joints**

Construction joints shall be placed as shown on the plans unless otherwise specifically authorized. All construction joints shall be made on horizontal and vertical planes and formed with mortises of keys made in the concrete unless shown otherwise on the plans. Enough section shall be provided in horizontal and vertical keys to resist shear. Where construction joints are placed, forms shall be tightly framed around the reinforcing steel to prevent the escape of mortar, and the joint shall be so made that its trace in the exposed face of the finished structure will be an exactly vertical or horizontal line. Where, to accomplish this purpose, finishing strips are needed, they shall be nailed to the forms and the concrete carefully finished to them. The surface of finished concrete and forms shall be thoroughly cleaned and wetted immediately before resuming concreting. Care shall be exercised to obtain maximum density and insure against honeycomb, etc.

Special care shall be taken to remove all laitance and to roughen any smooth set surface with picks or by other approved methods before the plastic concrete is placed against the old concrete.

3.1.5. **Forms**

Except where otherwise specified, forms may be constructed of either timber or metal as elected by the Contractor.

Forms shall be designed for the pressure of a liquid weighing 150 pounds per cubic foot. The rate of placing the concrete shall be taken into consideration in determining the depth of the equivalent liquid. An additional live load of 50 pounds per square foot shall be allowed on horizontal surfaces.

If at any stage of the work, the forms show signs of bulging or sagging, that portion of the concrete causing such conditions shall be removed immediately, if necessary, and the forms shall be reset and braced securely against further movement.

Nominal one inch lumber surfaced to a uniform width and thickness will be permitted for general use on the various portions of structures if backed by enough number of studs and wales. All forms shall be face lined with

an approved type of form lining material. If desired by the Contractor, facing for such surfaces may be constructed of three-quarter (3/4") inch plywood backed by adequate studs and wales, in which case form lining will not be required.

Forms shall be built mortar tight and of material of enough strength to prevent bulging between supports and shall be set and maintained to the lines designated until the concrete is hardened enough to permit form removal. Forms shall be maintained in such a manner as to prevent warping and shrinking. All details of form construction shall be subject to the approval of the City, and permission to place concrete will not be given until the form work is complete to its satisfaction.

Where corners occur, suitable chamfer strips shall be placed at the angle of the forms to round off or bevel them.

All forms shall be constructed so as to permit removal without injuring the concrete.

At the time of placing concrete, the forms shall be clean and entirely free of all chips, dirt, sawdust, and other extraneous matter.

For thin wall sections and other locations where access to the bottom of the forms by other methods would be cumbersome and inadequate, clean-out openings shall be provided.

Only approved form spreaders shall be used.

Metal form ties of an approved type shall be used to hold forms in place, and they shall have provision to permit ease of removal of the metal as hereinafter specified.

Metal ties shall be held in place by devices attached to walls. Each device shall be capable of developing the strength of the tie.

All metal appliances used inside of forms to hold them in correct alignment shall be removed to a depth of at least one-half (1/2") inch from the surface of the concrete and shall be so constructed that the metal may be removed without undue injury to the surface by chipping or spalling. Such devices, when removed, shall leave a smooth opening in the concrete. Burning off of rods, bolts, or ties will not be permitted. Where wire ties are used, all wires, upon removal of the forms, shall be cut back at least one-half (1/2") inch from face of the concrete with a sharp chisel or nippers.

All cavities produced by the removal of metal ties shall be carefully cleaned and completely filled with re-tempered sand cement mortar mixed in proportion of one to three, and the concrete shall be left smooth and even.

3.1.6. **Reinforcing Steel**

When placed in the work, reinforcement shall be free from dirt, paint, grease, oil or other foreign materials. Before being placed in the work, reinforcement shall be cleaned of all loose mill scale and rust. Tightly adhered scale or rust which resists removal by vigorous wire brushing need not be removed except that excessive loss of section to the reinforcement due to rust shall be cause for rejection. Excessive loss of section shall be defined as loss of section to the extent that the reinforcement will no longer meet the physical requirements for the size and grade of steel specified. Reinforcement shall be placed in the position shown on the plans. In the plane of the steel parallel to the nearest surface of concrete, bars shall not vary from plane placement by more than one-twelfth of the spacing between bars. In the plane of the steel perpendicular to the nearest surface of concrete, bars shall not vary from plan placement by more than one-quarter (1/4") inch.

The reinforcing steel shall be spaced its required distance from the face of the forms by means of approved galvanized metal spacers or approved precast mortar or concrete blocks. All reinforcing steel shall be wired together at all intersections. Before any concrete is placed, all mortar shall be cleaned from the reinforcement.

Reinforcement shall be supported and tied in such manner that a practically rigid cage of steel is provided. If the cage is not adequately supported to resist settlement or floating upward of the steel, overturning of truss

bars, or movement in any direction during concrete placement operations, permission to continue concrete placement will be withheld until corrective measures are taken.

Enough Measurements shall be made during concrete placement to insure compliance with spacing and clearance requirements herein specified. All reinforcing bars in all members shall be supported rigidly in their correct locations, in slabs, beams, walls, columns, drilled shafts, or footings.

No concrete shall be deposited until the City has inspected the final placement of the reinforcing metal and given permission to place concrete.

3.1.7. Placing Concrete – General

The Contractor shall give at least 24 hours advance notice before pouring concrete in any unit of the structure to permit the inspection of forms, the placement of reinforcing steel, and the preparations for the mixing and placing of the concrete. The mixing of concrete and placing of same in the form shall not be commenced until the City has given its approval of the forms, the placing of reinforcing and miscellaneous steel, and the Contractor's arrangements for mixing and placing concrete. No concrete shall be placed in any unit before completion of the form work and the placement of the reinforcing and other steel. No concrete shall be placed before the completion of any other operation which might prove detrimental to the concrete.

Whenever it is necessary to continue the mixing, placing and finishing of concrete after the daylight hours, the site of the work shall be brilliantly lighted so that all operations are plainly visible. In general, however, concrete placing shall be so regulated as to permit finishing operations to be completed in the daylight hours.

The City reserves the right to order postponement of concrete placing operations when, in its opinion, impending weather conditions may result in rainfall or low temperatures which will impair the quality of the finished work. In case rainfall should occur after placing operations are started, the Contractor shall provide ample covering to protect the work. In case of drop in temperature, the provisions set forth herein shall be applied.

The sequence and manner of placing concrete shall be as provided on the plans. The operation of depositing and compacting the concrete shall be conducted so as to form a compact, dense, impervious mass of uniform textures which shall show smooth faces on all surfaces.

The method and manner of placing shall be such as to avoid the possibility of segregation of the aggregate or the displacement of the reinforcement. Concrete shall not have a free fall enough to cause segregation of materials. Tremies shall be used in order that the free fall of mix shall be held to a maximum of three (3') feet, unless otherwise approved by the Engineer.

Each part of the forms shall be filled by depositing concrete directly as near its final position as possible. The coarse aggregate shall be worked back from the face of the forms and the concrete shall be forced under and around the reinforcement bars without displacing them. Depositing large quantities at one point in the forms and running or working it along the forms will not be allowed.

After the concrete has taken initial set, the forms or the reinforcing steel shall not be jarred or any strain placed on projecting reinforcement.

Chutes, troughs, or pipes used as aids in placing concrete shall be arranged and used so that the ingredients of the concrete will not be separated. Open troughs and chutes shall extend, if necessary, down inside the forms or through holes left in the forms, or the ends of such chutes shall terminate in vertical downspouts. All chutes, troughs, and pipes shall be kept clean and free from coating by hardened concrete by a thorough flushing with water before and after each placement. Water used for flushing shall be discharged clear of the concrete in place.

Where the Contractor's operations involve the placing from above, that is, directly into an excavated area in or through the completed forms, particularly in the case of abutments, piers, columns, retaining walls, walls, floors, footings, and deep girders, all concrete so placed shall be deposited through a vertical sheet metal or other approved pipe not less than six (6") inches nor more than ten (10") inches in diameter. The pipe shall be

made in sections so that the outlet may be adjusted to proper heights during placing operations.

Concrete shall be placed in continuous horizontal layers approximately twelve (12") inches in thickness. The rate of delivery shall be so arranged that a cold joint is not allowed to form between loads. The Contractor shall avoid unauthorized construction joints by placing required portions of abutments, piers, walls, floors, slabs, columns or superstructures in one continuous operation. As a safety precaution, openings in the forms shall be provided for the removal of laitance and other foreign material.

All concrete shall be well compacted and the mortar flushed to the surface of the forms by continuous working with concrete spading implements and mechanical vibrators of an approved type. Vibrators of the type which operate by attachment to forms or reinforcement will not be permitted. The vibrators shall be applied to the concrete immediately after deposit and shall be moved throughout the mass, thoroughly working the concrete around the reinforcement, embedded fixtures, and into the corners and angles of the forms until it has been reduced to a plastic mass. The mechanical vibrator shall not be operated so that it will penetrate or disturb layers placed previously which have become partially set or hardened. The vibration shall be of enough duration to accomplish thorough compaction and complete Embedment of reinforcement and fixtures but shall not be done to an extent that will cause segregation. Vibration shall be supplemented by hand spading to insure the flushing of mortar to the surface of all forms.

3.1.8. Placing Concrete in Cold Weather

No concrete shall be placed when the atmospheric temperature is at or below 40 degrees F., taken in the shade away from artificial heat unless permission is given by the City. In cases where the temperature drops below 40 degrees F. after the concreting operations have been started, the Contractor shall furnish enough canvas and frame work or other type of housing to enclose and protect the structure in such a way that heated air around the forms and fresh concrete can be kept at a temperature not less than 40 degrees F. for a period of five days after the concrete is placed.

It is understood that the Contractor is responsible for the protection of concrete placed under any and all weather conditions. Permission given by the City to place concrete during low temperature or freezing weather will in no way relieve the Contractor of the responsibility for satisfactory results. Should concrete placed under such conditions prove unsatisfactory, it shall be removed and replaced by the Contractor at his expense.

The concrete shall be placed in horizontal layers of not more than twelve (12") inches in thickness extending from end to end or side to side of the section between walls or approved joints. A time interval of no longer than 30 minutes shall elapse between the placing of successive layers. The concrete shall be compacted, evenly distributed and placed around the reinforcement, openings and structure so that honeycomb and/or defective areas are eliminated.

Wall forms shall at all times during the placing of the concrete and until its initial set has occurred, be maintained in true alignment and grade. During the placing of the concrete, frequent inspection shall be made and the necessary corrective measures taken if forms or supports show any tendency to become displaced.

Forms shall be removed in accordance with a time schedule to be approved by the City, and all defective areas, tie pits, etc., shall be immediately treated in accordance with the requirement of other items of these specifications.

3.1.9. Types of Finishing for Concrete

In general, except as elsewhere permitted in these specifications, special documents, specific plans, or by direction of the City, finishes shall be an integral part of a monolithic process. The following schedule of finishes shall apply according to their applicability unless otherwise specified, amended, or extended.

- **Screeing.** Screeing is an operation normally associated with horizontal concrete surfaces such as slabs. Screeing shall be done as soon as concrete has been approximately leveled. The screed shall be designed adaptable to the use intended, shall have provision for vertical adjustment, and shall be rigid enough to remain true to shape during use.
- The screed shall be vertically adjusted so as to leave the concrete surface at an elevation slightly above

grade after the initial strike off to allow for consolidation and finishing. Continue screeding and tamping alternately or in unison until the concrete is properly consolidated and surface voids are eliminated. The surface shall then be brought to a smooth, true alignment by means of longitudinal screeding, then finished as specifically required.

- **Surface Rubbing.** Carborundum fluted surface stones provide an abrasive which, when applied in surface rubbing at the proper time in the concrete aging process, will remove form marks, surface imperfections, and otherwise smooth, shape, or finish the surface.
 - **"First Surface Rubbing."** As soon as the forms are removed all necessary pointing shall be done. When the pointing has set enough to permit rubbing, all surfaces requiring surface finish shall be wet and given a first surface rubbing with a No. 16 Carborundum Stone or an abrasive of equal quality. The rubbing shall be continued enough to bring the surface to a paste, to remove all form marks and projections, and to produce a smooth dense surface without pits or irregularities. The material that has been ground to a paste shall be carefully spread or brushed uniformly over the surface and allowed to take a reset. The use of cement to form a surface will not be permitted.

In general, chamfered corners shall not be rubbed in the first surface rubbing.
 - **"Final Finish."** The surface of the entire structure requiring finish shall be cleaned of all drip marks, dirt, and discolorations and shall be given a final finish rubbing with a No. 30 Carborundum Stone or an abrasive of equal quality. On completion of this rubbing, the finished surfaces shall be neatly stripped with a brush, and the mortar on the surface shall be allowed to take a reset. After the mortar has taken a reset, the surface shall be washed down with clean water. The entire structure shall be left with a clean, neat, and uniform appearing finish, and shall be uniform in color.
- **Wood Float Finish.** Surfaces shall be finished using a wood float to a true even plane with no coarse aggregate visible. Enough pressure shall be used on the wood float to bring all excess moisture to the surface so that it can be removed. The surface shall have a uniform appearance and shall meet straightness requirements.
- **Steel Trowel Finish.** After all surface moisture has disappeared following the wood float finish, surfaces shall be steel trowelled to a smooth, even, impervious finish, free from blemishes including trowel marks. Where indicated on the plans, a floor hardener shall be applied to slabs receiving a steel trowel finish.
- **Brush Finish.** Following the steel trowel finish, surface of the concrete shall be brushed lightly with a soft-bristled brush. The brush shall be kept clean and shall be dipped in water frequently so that it will be clean and wet at all times. Brushing shall be limited to that necessary to remove the glaze and produce a nonslip surface.
- **Power-Machine Finish (option).** Instead of hand finishing, surfaces of slabs may be finished by using an approved power finishing machine in accordance with the directions of the machine manufacturer. The preparation of concrete surfaces for finishing by machine shall in general be the same as required for hand finishing, and the finish shall be of the quality required for the specific surface.

As soon as concrete placing operations have been completed for a slab section of enough width to permit finishing operations, the concrete shall be approximately leveled and then struck off, tamped, and screeded using a longitudinal screed. The surface shall then be brought to a smooth, true alignment by means of longitudinal screeding, floating, belting, and/or other methods. When templates are used, they shall be of such design as to permit early removal to avoid construction joints and to permit satisfactory finishing at and adjacent to the site of the template.

While the concrete is still plastic, the surface shall be straightedged by the use of a standard ten (10') foot metal straightedge. Deviations in excess of permissible variations shall be corrected. The final surface finish of the slab shall be done after the initial straightedging, and corrective adjusting, if required, is completed.

3.1.11. Finishing Exposed Surfaces

All tie wires shall be cut back below the surface and then pointed over. All imperfections such as fins shall be removed and local surface depressions pointed over. Exposed interior surfaces, excluding vaults unless otherwise specified, and exterior surfaces to an elevation of one (1') foot below planned grade, which will be exposed to view after backfilling, shall be surface rubbed with Carborundum fluted surface stones.

3.1.12. Curing Concrete

All upper surfaces not formed shall be cured by one of the following methods:

- **Wet Covering.** The surface shall be covered by wet burlap, cotton mats or canvas covering immediately following the finishing operations and shall be kept thoroughly wet for a period of four (4) curing-days after the concrete is placed. Covering shall be held in direct contact with the concrete. Water used for curing shall be free from injurious quantity of oil, acid, alkali, salt, or other deleterious substances.

Immediately following the finishing operations, concrete slabs, including roof slabs, shall be covered with wet cotton mats or with a temporary covering of canvas or burlap. The temporary covering will be required when the size of slab, size of mats, or other factors are such that the mats cannot be placed immediately following the finishing operations without marring the finish of the slab.

Canvas or burlap covering material shall weigh not less than twelve (12) ounces per square yard, and the sections shall be placed with a lap at the edges of at least eight (8") inches. Cover material shall be saturated with water before placing and shall be kept saturated as long as it remains in place. Care shall be exercised in the placing of the cover material to prevent marring the concrete surface.

When temporary coverings are used, they shall remain in place only until the slab has hardened enough that a cotton mat covering can be substituted without marring or disturbing the slab finish. Cotton mats shall be thoroughly saturated before placing and shall be kept on the slab in a saturated condition for a period of at least four (4) curing- days after the concrete is placed.

- **Impervious Coating.** Immediately after finishing, the surface of the concrete shall be covered with a continuous, uniform, water impermeable coating of curing compound. Immediately after removal of the side and end forms, the sides and ends of all concrete shall receive a like coating. The solution shall be applied under pressure with a spray nozzle in such a manner as to cover the entire exposed surface thoroughly and completely with a uniform film.

The rate of application shall be such as to insure complete coverage, but the area covered shall not exceed 200 square feet per gallon of curing compound.

Under normal conditions, the curing compound, after application, shall dry to touch within one (1) hour and shall dry thoroughly and completely within four (4) hours. When thoroughly dry, it shall provide a continuous flexible membrane free from cracks or pinholes and will not disintegrate, check, peel, or crack during the required curing period. If for any reason the seal is broken during the curing period, it shall be immediately repaired with additional sealing solution.

3.1.13. **Blocking and Cradle**

Concrete blocking including vertical tie-down and horizontal blocking and cradle shall be Class "B" concrete unless specified otherwise or shown on the Standard Details. Concrete cradles shall be placed under the pipe as directed by the City in areas of unsatisfactory foundation conditions or when there is an excessive cover over the pipe.

Blocking at bends shall be computed based upon pipe thrust at bends, or tees, with internal pressure of 150 psi. Where upward thrusts are to be blocked, the concrete blocking shall be of enough weight to resist the thrust and the concrete shall be reinforced as directed. Other blocking sizes shall be computed based upon a maximum safe allowable soil bearing pressure of 2,500 pounds per square foot of undisturbed earth.

The concrete blocking shall be placed against undisturbed trench walls, with a minimum of eighteen (18") inches between trench wall and pipe. Blocking shall extend a minimum of 0.75 X pipe diameter below and above the centerline of pipe and shall not extend beyond any joints. If requested by the Engineer, the ends of the thrust blocks shall be contained in wood or metal forms. Where upward thrusts are to be blocked, the concrete shall be formed from the centerline of pipe upward.

Concrete blocking shall be considered subsidiary to the various items. No additional Payment will be made for concrete blocking.

This Item will be measured as follows:

- 4.1 **Sanitary Sewers.** will be measured by the foot, of the various sizes, types, and wall thickness (if applicable), of sanitary sewer specified, complete in place, tested, and accepted by the Engineer. Sanitary sewer will be measured longitudinally along the centerline of the sewer between the inside faces of the manholes.
- If the installation involves a connection to an existing sewer line, the measurement will be made from the end of the existing sewer line to the inside face of the manhole on the work being measured.
- Sanitary sewer pipe will be measured as described above and classified as sanitary sewers for the purposes of payment.
- Wyes, tees, and bends are subsidiary to this Item. Include them in the measurement for payment of pipe sewer main in which they are installed. Plugs are subsidiary to the pertinent bid items.
- 4.2 **Manholes.** Measured by Each manhole, of the various types specified, complete in place.
- 4.3 **Connection to Existing Manhole (Sansewr).** Measured by Each existing manhole that proposed pipe is being connected to.
- 4.4 **Epoxy Manhole Liner.** Measured by the foot of inside the manhole that epoxy liner is applied to.
- 4.5 **Remove Existing Wastewater Manholes.** Measured by Each existing manhole that is being removed.
- 4.6 **Remove Existing Wastewater Line.** Measured by the foot of existing sewer line that is to be removed of the various sizes specified.
- 4.7 **Connect to Existing Sewer Line.** Measured by Each connection to existing sewer line of the various sizes specified.
- 4.8 **Post Construction Television Inspection.** Measured by the foot, of the various sizes and types specified along the axis of the pipe and no deductions will be made for valves or fittings.
- 4.9 **Vacuum Excavation.** Measured by the Hour.
- 4.10 **Adjusting Manholes** will be measured by each manhole adjusted.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit prices bid for the items described below. These prices are full compensation for furnishing materials and their preparation; for excavation and backfill; for preparation, shaping, and fine grading the bottom of the trench; for cutting and restoring existing pavement; for hauling, placing, and joining of pipes, valves, and fittings; for constructing bollards, vent piping, stacks, and manholes; and for necessary appurtenances and other items of materials, labor, equipment, tools, and incidentals.

- 5.1 **Sanitary Sewers.** Payment for sanitary sewers will be made at the unit price bid for "Sanswr(10in)(PVC)(SDR18)(RESJT)" of the various sizes, types, and wall thickness (if applicable) specified, complete in place.

Unless otherwise specified on the plans or this specification, excavation, disposing of unsuitable excavated material, backfilling, and the material used for backfill for the complete installation of the sanitary sewer system are subsidiary to and included in the unit price bid for the pipe and any structure for which payment is required.

Fittings, including necessary concrete blocking, pipe clamps, nipples, pipe coatings, lubricants, etc., are subsidiary to the sanitary sewer mains in which they are installed. If additional fittings are required due to plan changes or alterations in line or grade, they will be subsidiary to the sanitary sewer lines in which they are installed.

- 5.2 **Manholes.** Payment for manholes will be made at the unit price bid for "Manholes (Sanitary Sewer)" of the various types specified, complete in place. Rings, covers, and steps are subsidiary to this bid Item.
- 5.3 **Connection to Existing Manhole (Sansewr).** Payment for connecting to existing sanitary sewer manholes will be made at the unit price bid for "Connection to Existing Manhole (Sansewr)". This price is full compensation for labor, materials, excavation, and backfill required to connect proposed sewer pipe to existing sanitary sewer manholes.
- 5.4 **Epoxy Manhole Liner.** Payment for lining inside of manholes with epoxy will be made at the unit price bid for "Epoxy Manhole Liner". This price is full compensation for labor and materials required to line the inside of proposed manholes with epoxy.
- 5.5 **Remove Existing Wastewater Manholes.** Payment for removing existing sanitary sewer manholes will be made at the unit price bid for "Remove Existing Wastewater Manholes". This price is full compensation for labor, materials, excavation, and backfill required to remove existing sanitary sewer manholes.
- 5.6 **Remove Existing Wastewater Line.** Payment for removing existing wastewater line of the various sizes specified will be made at the unit price bid for "Remove Existing Wastewater Line (8)". This price is full compensation for labor, materials, excavation, and backfill required to remove existing sanitary sewer lines of the various sizes specified or found.
- 5.7 **Connect to Existing Sewer Line.** Payment for connecting proposed sanitary sewer lines to existing sewer lines or new manhole connection to existing sewer lines will be made at the unit price bid for "Connect to Existing Sewer Line". This price is full compensation for labor, materials, excavation, and backfill required to connect proposed sanitary sewer lines and/or manholes to existing sewer lines.
- 5.1. **Post Construction Television Inspection.** Payment for post construction television inspection of water line will be made at the unit price bid for "Post Construction Television Inspection". This price is full compensation for labor and materials needed to perform the inspection.
- 5.2. **Vacuum Excavation.** Payment for vacuum excavation of water line will be made at the unit price bid for "Vacuum Testing". This price is full compensation for labor and materials needed to perform the excavation.

- 5.3. **Adjusting Manholes.** Payment for each manhole adjusted will be made at the unit price bid for "Adjusting Manholes (Sanitary Sewer)." The excavation and backfill required are subsidiary to this bid item.