

SPECIAL SPECIFICATION

5946

Sanitary Sewer

1. Description

A. Scope of Work.

Provide and install complete sanitary sewer construction and adjustments in conformity with the details shown on the plans, as described herein, in compliance with the Department's Utility Accommodation Policy (UAP)(Title 43, T.A.C., Sections 21.31-21.55) or as directed.

1. Reference specifications of the American Society for Testing and Materials (ASTM), American Water Works Association (AWWA) and American National Standards Institute (ANSI) will mean the latest standard in effect on the date of the proposal.

B. Other Utilities.

The data furnished on the plans regarding the size and location of all other utility lines has been obtained from field surveys, the utility owner and the various utility companies. Neither the Department nor the Engineer assumes responsibility for the accuracy of the information presented nor does it warrant that all of the utility lines have been shown.

C. Definitions.

1. Sanitary Sewer Main.

Sanitary Sewer Main is defined as that portion of the sanitary sewer system which collects the effluent from the service laterals, including stub outs from the nearest manhole, to the point of final destination.

2. Service Lateral.

Service Lateral is defined as that portion of the sanitary sewer system beginning at a customer property line or other establishment property line which is the point of origin of the effluent being carried by the system to the sanitary sewer main, including the connection into the sanitary sewer main system.

3. Television Inspection.

Television Inspection is defined as furnishing all labor, materials, equipment, tools, logging and incidentals necessary to provide the televising and videotaping of sewer lines utilizing a color closed circuit television inspection unit to determine the condition of the lines.

All new sewer mains will not carry flow until the Engineer approves and accepts the mains for service.

4. By-Pass Pumping.

By-Pass Pumping is defined as furnishing all labor, materials, equipment, tools, appliances and incidentals necessary to perform all operations in connection with by-pass pumping of sewage flow for the purpose of preventing interference with the construction of the sanitary sewer manholes and mains as well as providing reliable sewer service to the areas being served.

The Contractor will be required to provide adequate pumping equipment and force mains in order to maintain reliable sanitary sewer service in all sanitary sewer lines involved. In case of equipment failure, the Contractor shall have on the job site backup pumps and force mains. Under no circumstances shall the flow be interrupted or stopped such that damage is done to either private or public property; or sewage flows or overflows into a storm sewer or natural waterway.

The Contractor shall provide by-pass pumping of sewage around each segment of pipe that is to be televised or replaced and shall be responsible for all required bulkheads, pumps, equipments, piping, and other related appurtenances to accomplish the sequence of pumping. A qualified person shall man the pumps, on-site, at all times during the by-pass procedure. This person shall have at least five (5) years experience in operating and maintaining bypass pumping systems.

All piping, joints and accessories shall be designed to withstand the maximum by-pass system pressure, or a minimum of 50 psi, whichever is greater. During by-pass pumping, no sewage shall be leaked, dumped, or spilled in or onto any area outside of the existing sanitary sewer system. When by-pass pumping operations are complete, all piping shall be drained into the sanitary sewer prior to disassembly.

2. Materials

All materials furnished for this project will be new. A manufacturer's certificate of compliance will be acceptable for quality control.

A. Sanitary Sewer Pipe.

Materials for sanitary sewer pipe shall be of the specific type that is called for on the plans. Install materials as specified by the manufacturer.

1. Rigid Pipe.

Reinforced concrete, ductile-iron pipe, cast iron pipe, and concrete steel cylinder pipe, for the purpose of this Item, will be known as rigid pipe.

2. Flexible Pipe.

Pipe consisting of materials other than those listed above.

- a. Any flexible conduit having a deflection of the inside diameter greater than 5 percent after installation, will not be accepted. A Go, No-Go deflection Testing Mandrel will be furnished, built and used in testing pipe deflection for acceptance, in accordance with the detail drawing as shown on the plans, unless directed otherwise. The clearance from the outside wall of pipe to the trench wall, for flexible pipe, shall be a minimum of 6 inches. Pipe stiffness is to be in accordance with ASTM 3034 SDR 26 [115 psi] or ASTM 2241 SDR 26 [160 psi].

- b. When the trench width is greater than the outside diameter of the pipe plus 2-ft. the pipe will be covered with Class B concrete, in accordance with Item 421, or as shown on the plans.

3. Fiberglass Reinforced Sewer Pipe, Non-Pressure Type.

Fiberglass reinforced sewer pipe, non-pressure type, shall be a factory-formed conduit of polyester resin, continuous roving glass fibers and silica sand built up in laminates and shall conform to the requirements of ASTM D-3262 including the appendix and subsequent specifications, and in accordance with any additional material specifications provided by the utility owner.

- a. **Coupling Joints.** Joints for pipe and fittings shall be confined compression rubber gasket bell and spigot type joints conforming to the material and performance requirements of ASTM D-4161.
- b. **Fittings.** Flanges, elbows, reducers, tees, wyes, laterals, and other fittings shall be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass-fiber reinforced overlays. For pipes 15" or larger in diameter, lateral openings 6 inch or greater in size shall be made using PVC sewer saddles conforming to ASTM D-2661 or Inserta Tee connections conforming to ASTM D-3034 or approved equal minimum pipe stiffness shall not be less than 150 psi for direct bury applications.

4. PMS PVC Pipe.

Poly Vinyl Chloride (PVC) pipe will be made from class 12454-B materials as prescribed in ASTM D-1784. For pipes 4" to 15" in diameter PMS pipe, fittings and joints shall conform to ASTM D-3034 and D-3212 as well as ASTM D-2241 and ASTM D-3139 where applicable, with the exception that solvent cement joints shall not be used. All pipe that is 18" to 27" in diameter shall meet requirements of ASTM F-679.

- a. **Water Main Crossings.** Gravity or force main sewers constructed in the vicinity of water mains will comply with the requirements of the "Criteria for Domestic Wastewater Systems," 30 TAC 217.53, as adopted by The Texas Commission on Environmental Quality (TCEQ) on August 28, 2008.

Mechanical or compression joints, concrete jointing collars, or non-reinforced rubber adaptors shall be used only as approved by the Engineer.

5. Pipe Testing.

All sanitary sewer pipe and fittings shall be tested by laboratory method at the source of supply. The laboratory method shall be approved by the Engineer. All shipments of pipe not so tested shall be accompanied by a certificate of compliance to these specifications prepared by an independent testing laboratory and signed by a licensed professional engineer

6. Steel Casing Pipe.

The component materials, manufacture and testing of all steel pipe will conform to AWWA Standard C-200 for "Steel Water Pipe 6-in. and Larger". The specified pipe size will be the actual inside diameter of the pipe, special or fitting in inches. The diameter and wall thickness of all steel pipe will conform to those shown on the plans.

Pipe will be either Grade A or Grade B, conforming to ASTM Designation A-53.

Pipe ends will be beveled and suitable for field butt welding except as otherwise specified.

Pipe will receive a protective coating conforming to AWWA Standard C-203, "Coal-Tar Protective Coatings and Linings for Steel Pipelines – Enamel and Tape Hot Applied".

Pipe length will be nominal 40 ft. lengths except for specials or as otherwise specified on the plans. Standard and specials will be within 1/16-in. (plus or minus) of the specified or theoretical lengths.

7. Stainless Steel Casing Spacer.

The Casing Spacers are to be constructed of T-304 stainless steel segments which bolt together forming a shell around the carrier pipe. The spacers are to be designed with risers (when needed) and runners to support the carrier within the casing and maintain a minimum clearance of 0.50-in. between the casing ID and the spacer OD. On carrier pipes with an OD less than 16-in., each spacer is to have four (4) riser and runner combinations - two (2) on each segment. On carrier pipes with an OD of 16-in. and larger, each spacer is to contain six (6) riser and runner combinations - four (4) on the bottom segment and two (2) on the top segment. T-304 stainless steel bolts and nuts are to be supplied with the spacers.

The band is to be manufactured of 8-in. wide, 14 gauge, T-304 stainless steel material. The risers are to be constructed of 10 gauge, T-304 stainless steel having a minimum length of 6-in.

Abrasion resistant runners, having a minimum length of 7-in. and a minimum width of 1-in. are to be attached to each riser to minimize friction between the casing pipe and the carrier pipe as it's installed. Runner material is to be of glass reinforced plastic with compression strength of 25,000 psi, flexural strength of 32,000 psi and tensile strength of 22,000 psi. The ends of all runners are to be beveled to facilitate installation over rough weld beads or the welded ends of misaligned or deformed casing pipe.

Interior surfaces of the circular steel shell are to be lined with PVC or EPDM having a minimum thickness of 0.090-in. with a hardness of durometer "A" 85-90.

Spacers will be placed a maximum of 1-ft. on each side of the bell joint and every 8 to 12-ft. apart thereafter.

Physical Properties

1. Band and Risers
 - a. Band - 14 Gauge, T-304 Stainless Steel
 - b. Riser - Minimum 14 Gauge, T-304 Stainless Steel
2. Liner - EPDM or Polyvinyl Chloride
 - a. Thickness - 0.090-in. minimum
 - b. Hardness - Durometer "A" 85-90
 - c. Dielectric Strength - 1/8-in. thick
 - d. 60,000 VPM
 - e. Water Absorption - one (1) percent maximum
 - f. Overlap edges
3. Studs, Nuts and Washers
 - a. T-304 Stainless Steel - 5/16: - 18-in. x 2-in. studs
 - b. 5/16-in. hex nuts
 - c. 5/16-in. washers SAE 2330

4. Runners
1-in. wide or 2-in. wide glass filled polymer runners

Sizes Available:

Length - 7-in.

Effective heights (all lengths) - 1-in. and 1 1/2-in.

Materials Specifications:

Tensile Strength (ASTM D-638) - 22,000 psi

Flexural Strength (ASTM D-790) - 32,000 psi

Compression Strength (ASTM D-695) - 25,000

Deflection Temperature @ 264 psi (ASTM D-648) - 435 F (224 C)

Deformation Under Load, @ 122 F (50C) - 4000 pound Load, - (ASTM D-648)
1.2 percent.

5. Welding. All risers are to be welded by MIG welding. Welds are to be fully pasivated.

B. Manholes.

Material for manholes will conform to the requirements of Item 465, "Manholes and Inlets", as described below and as shown on the plans.

1. Manhole Structures.

Cast in place concrete structures or pre-cast concrete structures, as detailed on the plans, will be installed where any pipe intercepted is larger than 24-in. in diameter.

2. Pre-Cast Reinforced Concrete Manhole Sections.

Manhole sections are to conform to the requirements of ASTM Designation C-478. The pre-cast sections will have rubber gasket compression joints conforming to the material and performance requirements of ASTM C-443.

3. Monolithically Poured Concrete Manholes.

A minimum of two and a maximum of six throat rings shall be used at each manhole for adjustability. All concrete for manholes shall conform to the provisions of "Concrete (Class "A")", Item No. 421, Hydraulic Cement Concrete. All reinforcing steel shall conform to the provisions of "Reinforcing Steel", Item No. 440 – Reinforcing Steel.

4. Throat Rings.

Adjustment throat rings shall be made of either HDPE or reinforced concrete rings having a maximum thickness of 2 inches. The internal diameter shall not be less than 30 inches, and the width shall be a minimum of 5 inches. Concrete shall conform to the provisions of Concrete (Class "A")", Item No. 421, Hydraulic Cement Concrete. If concrete throat rings are to be installed they must be used in conjunction with a UV stabilized polyethylene liner. I/I barrier must meet the following ASTM standards: ASTM D-790/1505 Density of Polyethylene Materials, ASTM D1238 Melt Flow index, ASTM 638 Tensile Strength @ Yield (50mm/mm), ASTM 790 Flexural Modulus, ASTM 648 Heat Deflection temperature, ASTM D1693.

5. Rings and Covers.

Materials for rings and covers will conform to the requirements of Item 471, "Frames, Grates, Rings and Covers." The rings and covers will be cast iron as manufactured by Trans-Tex Supply Company, No. A-77 (400 pounds), Neenah R-1581 (400 pounds) or equal to the dimensions shown on plans. Covers are to contain no holes or openings. Provide lifting bars with slots cast into the covers. Rings and covers shall have a 30 inch (min.) opening per 30 TAC 217.55 (L) (I) A.

- a. Watertight manhole rings and covers, when designated on the plans, are to be cast iron as manufactured by Trans-Tex Supply Company, No. A-77 O.R. (Watertight) (400 pounds) or approved equal. Covers are to contain no holes or openings except as required for bolts. Lifting bars with slots adequate for pick insertion and cast into the covers are to be provided for lifting purposes. Covers are required to seat on a minimum 5/16-in. diameter rubber ring gasket conforming to the material requirements of ASTM Designation C-443. The rubber gasket is to rest in a groove cast in the ring. A minimum of four (4), 5/8-in. diameter stainless steel, hex head bolts will be provided for each cover. The four (4) bolt holes in the covers will be evenly spaced and provided with minimum 1-1/2-in. diameter counter sinks for the bolt heads. On the fastened and bolted position the bolt heads will not extend beyond the surface of the cover. Gaskets of a size and material, as approved will be provided for the bolts to insure water tightness. Alignment marks will be cast onto watertight rings and covers for proper bolt alignment.
- b. All finished frames and covers will have the bearing surfaces machine ground and sets of rings and covers will be marked in such a way that they can be matched for assembly in the field. All covers will have the words "Sanitary Sewer" cast thereon or as specified in the details.

C. Concrete.

All concrete is to meet the requirements of Item 421, "Hydraulic Cement Concrete". Unless otherwise shown on the plans or required by this specification, all concrete will be Class A.

D. Mortar.

Mortar is to be composed of one (1) part Hydraulic Cement, two (2) parts sand and sufficient water to produce a workable mixture. When used to plaster manholes, it may be composed of one (1) part cement to three (3) parts sand. Lime up to 10 percent may be used. It will have a consistency such that it can be easily handled and spread.

E. Reinforcing Steel.

Reinforcing steel and the placing thereof is to conform to the requirements of Item 440, "Reinforcing Steel", except where welded wire is called for on the plans, the material will be welded wire flat sheets meeting ASTM. A-185. Welded wire rolls will not be used.

F. Cement Stabilized Backfill.

Cement stabilized backfill is to be in accordance with Item 400, "Excavation and Backfill for Structures".

G. Flowable Backfill.

When indicated on the plans, the trench is to be backfilled to the dimensions shown with flowable backfill. The flowable backfill with fly ash will be Mix Design Type B in accordance with Item 401, "Flowable Backfill", or an acceptable mix as approved.

H. Grout.

When shown on the plans for various applications, the grout is to be a cement/sand/water mixture as approved. It will have a consistency such that it will flow into and completely fill all voids.

I. Sewer Main Television Inspection.

The Contractor shall furnish all labor, materials, equipment, and incidentals to provide the televising and a NASSCO-(PACP) standard video, recorded in MPEG-1 format and written to DVD video of sewer lines and manholes utilizing a color, closed-circuit television inspection unit to determine their condition.

The Contractor shall provide a line diagram area sketch and written log for each completed segment of DVD sewer main describing the section being televised, flow and camera direction, position of service connections, description and location of failures, pipe condition, weather conditions, and other significant observations.

Television inspection shall be done one manhole section at a time. Also the flow in the section being televised shall be by-passed if the line is in service and the flow exceeds 25% of the internal pipe diameter. When the depth of flow at the upstream manhole of the manhole section being worked is above the maximum allowable for television inspection, the flow shall be reduced to allowable levels by temporarily plugging or blocking the flow or by-pass pumping, as approved by the Engineer.

The Contractor shall not be allowed to float the camera. There may be occasions during the televised inspection of a manhole section when the camera will be unable to pass an obstruction. At that time, and prior to proceeding, the Contractor shall contact the Inspector. If the length of sewer line cannot be televised because of obstructions, the Contractor shall clean the system as is necessary. If, in the opinion of the Inspector, the obstruction is attributed to a collapsed main or pipe deflection, televising shall be suspended, payment shall be made based on the actual televised length, and the remaining televising of the sewer line shall be continued upon successful correction of the blockage by the Contractor at his expense. No additional payment shall be made for additional setups required due to obstructions encountered during televising.

1. Log Formats. Each DVD will be permanently labeled with the following:
 - Project Name,
 - Date Televised,
 - Station to Station Location and Size of Sanitary Sewer,
 - Street/Easement Location,
 - Name of Contractor,
 - Date DVD Submitted, and
 - DVD Numbers.

2. Videotape Quality. If the Contractor produces a DVD of such poor quality that the Engineer is unable to evaluate the condition of the sanitary sewer main or locate the

sanitary sewer service lateral connections, the Contractor will be required to re-televiser the sanitary sewer main and provide a new DVD of good quality at no additional cost.

3. **Equipment Required For TV Inspections.** The Contractor will be required to have all materials, equipment and labor necessary to complete all videotaping on job site prior to isolating the sewer manhole segment and beginning videotaping operations. A camera with rotating or panning lens capabilities is required. The television inspection equipment shall have an accurate footage counter which displays on the monitor the exact distance of the camera from the center of the starting manhole. A camera with rotating and panning lens capabilities is required. The camera height shall be centered in the conduit being televised. The speed of the camera through the conduit shall not exceed 40 feet per minute.

The television unit shall also have the capability of displaying in color, on DVD, pipe inspection observations such as pipe defects, sags, points of root intrusion, offset joints, service connection locations, and any other relevant physical attributes.

4. **DVD Logs.** The Contractor is to provide, with each completed DVD, a TV inspection report which is a written log of all pipe defects, sags, points of root intrusion, offset points, service connection locations and condition recorded on a footage basis. This log is to also denote the section being televised, flow and camera direction, position of taps or failures, pipe condition and weather conditions.

J. By-Pass Pumping.

The Contractor shall provide and maintain adequate pumping equipment, force mains and other necessary appurtenances in order to maintain reliable sanitary sewer service in all sanitary sewer lines as required for construction. The Contractor shall have backup pump(s), force main(s) and appurtenances ready to deploy immediately. Appurtenances and discharge point shall be approved by the Inspector.

Any spillage, backups and/or overflows, etc. as the result of inadequate equipment are the sole responsibility of the Contractor.

The Contractor shall demonstrate that the pumping system is in good working order and is sufficiently sized to successfully handle flows by performing a test run for a period of 24 hours prior to beginning the work.

The Contractor shall be required to have all materials, equipment and labor necessary to complete the repair or replacement on the job site prior to isolating the sewer manhole or line segment and beginning by-pass pumping operations.

K. Bedding and Backfill.

Backfilling for sanitary sewers is divided into three (3) separate zones: (a) bedding: the material in trench bottom in direct contact with the bottom of the pipe; (b) initial backfill: the backfill zone extending from the surface of the bedding to a point 1 foot above the top of the pipe; and (c) secondary backfill: the backfill zone extending from the initial backfill surface to the top of the trench. Materials and placement for each of the zones shall be as described herein

1. Bedding.

- a. **Stable Material:** Existing stable material present during excavation including:

- (1) Trench bottom free of water, muck, debris;

- (2) Rock in boulder, ledge or coarse gravel (particle size not larger than 1- ¾ inch) formations;
 - (3) Coarse sand and gravels with maximum particle size of 1- ¾ inch, various graded sands and gravels containing small percentages of fines, generally granular and non-cohesive either wet or dry; and
 - (4) Fine sands and clayey gravels; fine sand, sand-clay mixtures, clay and gravel-clay mixtures.
- b. Unstable Material: Existing unstable materials are: Silt, muck, trash or debris in the trench bottom bearing level; rock, in ledge or boulder, or coarse gravel (minimum particle size larger than 1- ¾ inch) formations.
- c. Bedding Material: The existing material at the bearing level shall be removed and replaced to a minimum depth of 6 inches or 1/8 inch of the outside diameter of the pipe, whichever is greater, with bedding material. The bedding material shall extend up the sides of the pipe sufficient to embed the lower quadrant of the pipe. The bedding material shall be composed of well-graded, crushed stone or gravel conforming to the following requirements unless modified by the Engineer:

<u>Sewer Gravel</u>	<u>Percent</u>
Passing 1-1/2 inch sieve	100
Passing 1 inch sieve	95 – 100
Passing 3/8 inch sieve	25 – 60
Passing No. 4 sieve	0 – 10
Passing No. 8 sieve	0 – 5

- 2. Payment for additional excavation must be approved by the Inspector.
- 3. Initial Backfill: Initial backfill shall consist of gravel which conforms to the requirements for bedding material.
- 4. Secondary Backfill: Secondary backfill shall generally consist of materials removed from the trench and shall be free of brush, debris and trash. Rock or stones having a dimension larger than 6 inches at the largest dimension shall be sifted out and removed before the material is used in the secondary backfilling zone. Secondary backfill material shall be primarily composed of compactable soil material

3. Construction Methods.

A. Excavation.

Excavation as required to complete the work as outlined herein will be performed in accordance with Item 400, “Excavation and Backfill for Structures”.

B. Trench Excavation Protection.

Excavation greater than 5-ft. in depth is to be protected as specified in Item 402, “Trench Excavation Protection”, or Item 403, “Temporary Special Shoring”.

C. Trenching.

Trench walls shall be vertical. The practice of undercutting at the bottom or flaring at the top will not be permitted except where it is justified for safety and with the Engineer's and/or Inspector's approval. In special cases, where trench flaring is required, the trench walls shall remain vertical to a depth of at least 1 foot above the top of the pipe.

The trench bottom shall be square or slightly curved to the shape of the trenching machine cutters. The trench shall be accurately graded along its entire length to provide uniform bearing and support for each section of pipe installed upon the bedding material. Bell holes and depressions for joints shall be dug after the trench bottom has been graded and bedding installed. The pipe shall rest upon the new bedding material for its full length

Where over-excavation occurs, the under-cut trench shall be restored to grade at the Contractor's expense by replacement with a material conforming to the requirements of the bedding material or a material approved by the Engineer.

1. Width of Trench.

Minimum Width of Trench. The minimum width of pipe trenches, measured at the crown of the pipe, shall be not less than 12 inches greater than the exterior diameter of the pipe, exclusive of bells. The minimum base width of such trench shall be not less than 12 inches greater than the exterior diameter of the pipe, exclusive of special structures or connections. Such minimum width shall be exclusive of trench supports and not greater than the width at the top of the trench.

Maximum Width of Trench. The maximum allowable width of trench for pipelines measured at the top of the pipe shall be the outside diameter of the pipe (exclusive of bells or collars) plus 24 inches. A trench wider than the outside diameter plus 24 inches may be used without special bedding if the Contractor, at his expense, furnishes pipe of the required strength to carry additional trench load. Such modifications shall be submitted to the Engineer and approved in writing. Whenever such maximum allowable width of trench is exceeded, except as provided for on the drawings, or in the specifications, or by the written approval of the Engineer, the Contractor, at his expense, shall encase the pipe in concrete from trench wall to trench wall, or other pipe bedding material approved by the Engineer. Any excavation wider than this maximum width or subsequent Surface or Paving work, will be done at the Contractor's expense.

2. **Grade of Trench Bottom.** The trench is to be over-excavated to a depth of 6-in. below the grade line established for the bottom of the pipe, regardless of the type of pipe. The grade line of the pipe is to then be met by the addition of a layer of approved bedding material as directed.
3. **Excavation Below Grade.** Any part of the bottom of the trench excavated below the limits specified in Section 3.T.2. "Grade of Trench Bottom", is to be corrected with approved material and compacted as directed. Should excessive over-excavation occur, except at bell holes, the grade is to be restored in accordance with the methods described in Section 3.T.4, "Unstable Conditions at Grade".
4. **Unstable Conditions at Grade.** Where the bottom of the trench at grade is found to be unstable or to include ashes, cinders, any type of refuse, vegetable or other organic material, or large pieces of fragments or inorganic materials which in the judgment of the Engineer should be removed, the Contractor is to excavate and remove such unsuitable material to the a depth no less than 6-inches below pipe. Before the pipe is laid the grade is to be restored by backfilling with an approved material in layers of 3-in. prior to compaction. The layers are to be slightly moistened and thoroughly compacted so as to

D. Bedding and Backfill.

Prior to laying the pipe, the normal or select bedding material will be shaped to conform to the outside diameter of the pipe as shown on the plans. Bedding material shall be consolidated to assure it is incorporated from the bottom of the trench up to the pipe centerline. A hand-held vibrator, commonly used for concrete work, can be used for this purpose. The vibrator shall be inserted every 3 feet on each side of the pipe.

For sewer lines up to 24 inches in diameter initial backfill material shall be placed in two lifts above the bedding material the pipe is set on. The first lift shall be spread uniformly and simultaneously on each side and under the bottom quadrant of the pipe to the midpoint or spring line of the pipe. Consolidate the Initial Backfill material as specified for bedding.

Placement of the first lift of initial backfill shall be subject to inspection and approval prior to placement of second lift, which shall extend from the spring line of the pipe to a minimum of 1 foot above the top of the pipe. The second lift shall be evenly spread in a similar manner as the first lift.

For diameters 24 inches and larger, initial backfill material shall be evenly and simultaneously spread alongside, under the lower quadrant the pipe and over the pipe in 12 inch lifts to a point sufficient to a minimum of 1 foot above the top of the pipe. Consolidate the Initial Backfill material as specified for bedding.

The secondary backfill material shall be placed in maximum 12 inch loose lifts or as directed by the Engineer and/or Inspector.

E. Pipe Installation.

1. General.

All sanitary sewer mains shall be constructed in accordance with the specifications herein outlined and in conformity with the required lines, grades, and details shown on the plans and as directed by the Engineer. Successful passage of the air test, as described under TCEQ 30 TAC 217.53 Criteria, shall be required for the acceptance of the mains.

After the trench has been carefully graded and all bell holes excavated, approval is required prior to placing the pipe therein.

All sewers are to be laid in straight alignment, so that a light can be seen from one manhole to the other even for the smaller size of sewers. The pipe is to be laid accurately to line and grade, with the spigot end downstream entering the bell to full depth and in such a manner as not to drag earth into the annular space.

Pipes and fittings are to be fitted together and matched so that they will form a sewer with a smooth and uniform invert. Special care is to be taken to provide uniform bearing for the entire length of pipe.

Water Main Crossings: Where gravity or force main sewers are constructed in the vicinity of water mains, the requirements of the TCEQ 30 TAC 217.53 (d) shall be met.

2. Pipe and Fittings.

Proper and suitable tools and appliances for the safe and convenient handling of the pipe and fittings are to be provided and used. Care is to be taken to prevent any damage to the pipe coating. All pipe and fittings will be examined for defects right before placing into the trench and no materials are to be laid that are known to be defective.

Any defective pipe discovered after being laid is to be removed and replaced with acceptable pipe at the Contractor's expense. Wherever the pipe requires cutting, it is to be done with a standard wheel pipe cutter for pipe 12 inches and smaller. Cutting methods for larger pipes are to be as approved. Each cut is to be smooth and at right angles to the axis of the pipe.

Pipe Laying: The Contractor shall be required to commence construction and laying of pipe at the downstream end of the sanitary sewer outfall line and proceed non-stop in a forward upstream direction.

No pipe shall be laid within 10 feet of any point where excavation is in progress. Pipe laying shall proceed upgrade with the tongue or spigot pointing in the direction of flow. Pipe shall be lowered into the trench without disturbing the prepared foundation or the trench sides.

The drilling of lifting holes in the field will not be permitted. Pipe shall be installed by means of a concentric pressure being applied to the pipe with a mechanical pipe puller. Pulling or pushing a joint of pipe in place by using a crane, bulldozer, or backhoe will not be permitted. Pipe shall be pulled home in a straight line with all parts of the pipe on line and grade at all times. No side movement or up and down movement of the pipe will be permitted during or after the pulling operation.

Should coupled joints of pipe be out of line or off grade, they shall be removed one joint at a time and brought to the proper line and grade. The lifting or moving of several joints of coupled pipe at one time to close a partially open joint or to fine grade under laid joints of pipe will not be permitted.

Laser Beams: The use of laser beams for vertical control shall be required. The Contractor shall provide, to the Inspector when requested, a level and rod of sufficient sensitivity to accurately determine differences in elevation between points 300 feet apart with one instrument set-up.

No pipe shall be installed in tunnels except as provided on the plans, or with the permission of the Engineer. If the Contractor finds it necessary to install pipe in tunnels not provided on the plans, he shall submit to the Engineer, prior to commencement of work, a detailed outline of procedures, methods, and use of materials depending on existing soil conditions.

No horizontal or vertical curves shall be permitted in conformance with appropriate regulatory agency requirements.

Before leaving the work unattended, the upper ends of all pipelines shall be securely closed with a tight fitting plug or closure. The interior of laid pipe shall be kept free from dirt, silt, gravel, or foreign material at all times. All pipes in place must be approved before backfilling.

When replacing an existing system in place, Contractor shall maintain screens to prevent the entrance of construction debris into the sewer system.

3. Service Connections (Sanitary Sewer Laterals).

- a.** Sanitary sewer laterals fittings and appurtenances shall conform to the Sanitary Sewer specifications and shall be installed by the Contractor as specified herein, or as directed by the Engineer and in accordance with the plans.
- b.** Service Line Installation: All service line installations shall be performed in accordance with this specification. For sanitary sewer mains that are 12" in diameter or smaller, all laterals shall be connected using the appropriate size tee/wye placed in line with the main line. For mains larger than 12", Inserta Tee conforming to ASTM 3034-88 or approved or equal may be used.
- c.** Connection to the Customers end of the lateral shall be performed using a "Fernco coupling" or approved equal. All Cleanouts at job sites shall have installed an approved heavy duty sanitary sewer cap
- d.** Service Connections.
 - (1) Provide reconnections of all existing sewer service laterals to new lines installed or to provide connections of new laterals to existing sanitary sewer mains. Locate laterals and insure service is not interrupted to homes or other establishments.
 - (2) Wyes, bends, tees, stacks, and other hardware required are to be installed for service laterals as shown on the plans or as directed.

4. Coating and Wrapping Underground Steel Pipe.

Exterior surfaces of all steel pipe fittings and specials which are to be installed underground and which are not to be encased in concrete will be cleaned to bare metal by wire brushing with a power driven wire brush, sand blasting, or other approved methods. A prime coat compatible to the polyvinyl tape to be used will then be applied to the pipe. Following the application of the prime coat, the pipe will be wrapped with Scotchrap, Trantex V-10 polyvinyl tape, or approved equal. The tape will not be applied until the prime coat is completely dry.

The tape will be spirally and tightly wrapped on each section of the pipe with a 50 percent lap. The joint will be protected with tape 8-in. in width on pipe greater than 12-in. in size.

Each section of pipe will be cleaned, primed, and wrapped to within 6-in. of each end. The priming and wrapping will be completed, and the bare pipe wrapped with tape lapped 3-in. over the originally taped sections.

F. Manhole Construction.

Manhole construction is to be in accordance with Item 465, "Manholes and Inlets", and as specified herein.

Footings or bases of manholes shall be a minimum of 6 inches in depth below the bottom of the pipe.

1. All invert channels of manholes are to be constructed and shaped accurately so as to be smooth, uniform and cause minimum resistance to flow. The bench is to be finished smooth with a slope of 1/2-in./ft. from the manhole walls to the edges of the invert. The top half of all sewer pipes within the invert channel or bench zone are to be removed flush to the inside manhole walls.
2. Joints on sewer pipes are not to be cast or constructed within the wall sections of manholes.
3. Concrete cradles are not required for new pre-cast manholes. Concrete cradles are to be provided for all influent and effluent pipes on new monolithic manhole and sewer pipe systems. Concrete cradles are to extend beyond the outside walls of the manhole a minimum of 36 inches.

On new monolithic sewer manhole and pipe systems and new pipe systems connecting to existing manholes, pipes entering a manhole above the lowest sewer are to project 2 inches from the inside wall. Such pipes are to be installed with a joint a minimum of 6 inches and a maximum of 18 inches from the outside manhole wall. A concrete cradle is to be provided for the pipe extending from the manhole wall a minimum distance of 36 inches.

4. Where connections to existing manholes are required, the adjacent pipe bedding is to be prepared to proper grade, the existing manhole neatly cut and the new pipe inserted so that the end is projecting 2 inches from the inside wall. The invert is then to be reshaped to properly channel new flows. Debris of any kind is to be kept out of new or existing manholes or mains.
5. Voids between exterior pipe walls and manhole walls at all pipe connections in manholes are to be filled with a non-shrink grout, concrete or mortar as approved or as shown on the plans and inspected prior to backfilling.
6. Monolithically Poured Concrete Manholes. Wall thickness of the manhole is not to be less than 6 inches. The structure is to be poured in a manner to produce dense, compacted walls free of honeycomb surfaces throughout the pour. The base is to be poured monolithically with the walls to the manhole.
 - a. Concrete: All concrete shall conform to the provisions of "Concrete (Class A)", or shall be of the class as noted on the plans.
 - b. Reinforcing Steel: All reinforcing steel shall conform to provisions of "Reinforcing Steel", Item No. 440.
 - c. Membrane Curing Compound: All membrane curing compound shall conform to the provisions of "Membrane Curing", found in Item No. 420.
 - d. Base Diameter: The minimum base diameter shall be 8 inches greater than the outside diameter of the manhole.

- e. Cold Joints: A cold joint will be allowed should the manhole invert depth exceed 12 feet. One joint will be allowed per each 12 feet of depth and that joint shall be approved by the Engineer.
 - f. Backfill: No backfill shall be placed around the manhole until 24 hours after the pour has been completed. Flowable fill shall be used from the base of the manhole to 1 foot below the cone section or otherwise as authorized by the Engineer. Backfill for the cone section of the manhole shall conform to the provisions of "Secondary Backfill", Section 2.K.4.
7. Throat rings shall be mortared between all bearing surfaces sufficient to provide a minimum, in place, mortar thickness of ¼ inch. No more than 4 throat rings may be used on any manhole or no more than 21 inches from the top of the cone to the top of the ring and cover.
 8. Manhole Ring Encasement. All manhole rings are to be encased with non-reinforced Class B concrete, except for manholes in existing or new roadways. Manhole ring encasements are to extend 6 inches below the top of the cone and have a minimum thickness when measured at the manhole ring of 1 foot. The surface of the encasement is to be 4-1/2 inches below the top of the manhole ring as shown on the plans or as approved.
 9. Where manholes are constructed in existing or proposed roadways and where directed or shown on the plans, the exterior exposed surfaces of the ring, mortar, throat rings, and manhole surface are to be coated with a 1/8 inch minimum thickness of Trowel Mastic No. 710-23 asbestos fiber as manufactured by Flintkote, or equal prior to placement of concrete.

G. Jacking, Boring, or Tunneling Pipe.

1. Jacking: Suitable pits or trenches shall be excavated for the purpose of jacking operations for placing end joints of the pipe. When trenches are cut in the side of embankment, such work shall be securely sheeted and braced. Jacking operations shall in no way interfere with the operation of railroads, streets, highways or other facilities and shall not weaken or damage such facilities. Barricades and lights shall be furnished as directed by the Engineer to safeguard traffic and pedestrians.

The pipe to be jacked shall be set on guides to support the section of pipe being jacked and to direct it in the proper line and grade. Embankment material shall be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the opening thus provided. The excavation for the underside of the pipe, for at least ⅓ of the circumference of the pipe, shall conform to the contour and grade of the pipe. A clearance of not more than 2 inches may be provided for the upper half of the pipe.

The distance that the excavation shall extend beyond the end of the pipe shall depend on the character of the material, but it shall not exceed 2 feet in any case.

The pipe shall be jacked from downstream end. Permissible lateral or vertical variation in the final position of the pipe from line and grade will be as shown on the plans or as determined by the Engineer.

Any pipe that cannot be repaired to its original condition or is damaged in jacking operations shall be removed and replaced at the Contractor's expense. Jacking pits shall be backfilled immediately upon completion of jacking operations.

Excavation for "Boring" pits and installation of shoring shall be as outlined under "Jacking." Boring operations may include a pilot hole which shall be bored the entire length of crossing and shall be used as a guide for the larger hole to be bored. Water or drilling fluid may be used to lubricate cuttings. Variation in line and grade shall apply as specified under "Jacking."

2. Tunneling: Tunneling may be used when the size of the proposed pipe would make the use of tunneling more satisfactory than "Jacking" or "Boring." The excavation for pits and the installation of shoring shall be as specified under "Jacking." The lining of the tunnel shall be of the material shown on the plans. Access holes for grouting annular space shall be spaced a maximum of 10 feet.

Joints: Joints for pipe for "Jacking," "Boring," or "Tunneling," shall be as specified in "Sanitary Sewers", or as shown on the project plans or shop drawings as per pipe manufacturer's recommendation.

3. Grouting of Bores or Tunnels: Annular Space between casing pipe and limits of excavation (borehole) shall be pressure grouted, unless otherwise specified on the plans.

H. Concrete Encasement, Cradles, Saddles and Collars.

1. Concrete Encasement. When concrete encasement is shown on the plans or when directed, the trench is to be excavated and fine graded to a depth conforming with the details and sections shown on the plans. The pipe is to be supported by pre-cast concrete blocks of the same strength as the concrete for encasement and securely tied down to prevent floatation. Encasement concrete is to be placed to a depth and width conforming with details and sections shown on the plans.
2. Concrete Cradles. When concrete cradles are shown on the plans or when directed, the trench is to be prepared and the pipe supported in the same manner as described in Concrete Cradles, of this Section. The cradle constructed in accordance with details and sections shown on the plans. Strap/Tie Downs shall be No. 4 rebar diameter minimum or better as determined by the Engineer.
3. Concrete Saddles. When shown on the plans or when directed, pipe to receive concrete saddle is to be backfilled in accordance with Section 3.D. of this specification to the spring line and concrete placed for a depth and width conforming with details and sections shown on the plans.
4. Concrete Collars. When shown on the plans or when directed, concrete collars are to be constructed in accordance with details and sections shown on the plans.

I. Adjust or Abandon Manholes.

Existing manholes are to be adjusted or abandoned in accordance with Item 479, "Adjusting Manholes and Inlets", and as specified herein.

1. Manholes shall be lowered below subgrade before placing base materials and openings shall be protected by hatch covers.

Existing manhole rings and covers which are determined by the Engineer to be in an unacceptable condition, will be removed and replaced with new rings and cover. Contractor shall take all necessary measures to prevent damage to existing or new rings, cover, or cone from equipment and materials used in or taken through the work area.

If an existing or new manhole cover, ring, or cone is damaged by the Contractor, it shall be replaced (as approved by the Engineer) by the Contractor at his expense. (the contractor shall upgrade the cone and ring to meet 30 TAC 217.55 (2)(2)(a))

Manholes shall be adjusted after the base material has been laid and before placing of the surface course. Manholes that are going to be adjusted on an existing surface course not being replaced will be in accordance to with the local jurisdiction's governing standards and details. All manholes shall then be raised, or lowered a sufficient height so as to be level with the finished surface course. Adjustment in height will be made by addition or removal of "throat rings" above the manhole "cone" where feasible. A minimum of two and a maximum of six throat rings shall be used at each manhole. Material excavation from around the manholes shall be replaced with concrete in accordance with Standard Drawings, and select materials from the excavation (as shown on the plans or specified by the Engineer). All excess materials shall be disposed of by the Contractor at his own expense in an approved location.

2. Manholes existing on sewer lines replaced by new sewer piping and which are no longer needed for the revised sewer network are to be classified as "Abandon Manhole". Work required on an abandoned manhole is to consist of installing a permanent concrete plug on all pipes within the manhole, removing the top of the manhole to an elevation of 2 feet below proposed subgrade or existing grade, whichever is the lower elevation, and backfilling the manhole with a grout material as specified. The ring and cover of the manholes are to be removed and delivered to the Sanitary Sewer Owner's facility designated by the Engineer. If directed, drainage holes are to be drilled in the bottom of manhole walls prior to backfilling.

J. Cut and Replace Pavement.

Where sewers must be installed in streets or other paved areas that are going to remain, the work is required to be in accordance with Item 400, "Excavation and Backfill for Structures".

When allowed by the construction sequence shown on the plans or as directed, a "Temporary Concrete Cap" of the depth and class of concrete as shown on the plans, or as directed, may be used in lieu of a permanent repair.

As an alternate when shown by the plans, or as directed, pavement repair may be accomplished by a "Temporary Asphalt Cap" of the depth and class as shown in the plans in lieu of a permanent repair.

K. Cut and Replace Concrete Sidewalks, Driveways, and Curbs.

Existing concrete sidewalks, driveways, and curbs required to be removed and replaced solely for sewer installation are to be a part of sewer work. Removal is to be in accordance with Item 104, "Removing Concrete". Replacement is to be in accordance with the plans and with Item 529, "Concrete Curb, Gutter and Combined Curb and Gutter", Item 530, "Intersections, Driveways and Turnouts", and Item 531, "Sidewalks."

As an alternate when shown by the plans, or as directed, concrete sidewalk repair may be accomplished by a temporary asphalt (4-inch depth, Type C) pavement in lieu of a permanent repair.

Any work done due to damage to curbs, sidewalks and driveways outside the limits shown on the plans or approved in advance will not be measured for payment but is to be replaced at the Contractor's expense.

L. Removing and Replacing Chain-Link and/or Wire Fence.

Existing chain link or wire fences required to be removed solely for sewer installation is to be replaced as part of the sewer work to a condition comparable to that at removal. The existing fence materials may be reused if they are not damaged during removal. Any removal or damage to existing fences outside the limits shown in the plans or not approved in advance will not be measured for payment but is to be restored at the Contractor's expense.

M. Abandon Sewer Lines.

When shown on the plans, existing sewer lines, including any washouts and voids, are to be abandoned by injecting the line with a flowable cement based grout of at least 100 psi. The grout mix design and method of installation are to be approved prior to beginning operation.

Abandonment of sanitary sewer lines shall be accomplished by installing the grout material with sufficient pressure and in numerous locations. The method of installation shall be able to meet the requirement of completely filling the existing sanitary sewer line and any voids adjacent to the sanitary sewer line. The method shall adequately provide for the removal and legal disposal of existing sewer materials in the system. The method shall provide for the release of air. When intermediate points are required to be constructed for the abandonment of the system, they shall be a part of the abandonment project process.

Sanitary sewer pipes smaller than 15 inches in diameter are generally not required to be grouted, unless it is required by the plans. Pipes to be abandoned shall be grouted only if required by the plans and payment as per these specifications is provided.

N. Television Inspection.

Immediately upon cleaning the sanitary sewers, all new sewer mains are to be televised and videotaped to determine the condition of the line and to locate service connections. The Engineer, Inspector and Contractor will observe the TV inspection in progress. The Contractor is to submit 1 copy of a color DVD of the recordings and logs of the televised inspection to the Engineer.

The Contractor shall not be allowed to float the camera. There may be occasions during the televised inspection of a manhole section when the camera will be unable to pass an obstruction. At that time, and prior to proceeding, the Contractor shall contact the Inspector. If the length of sewer line cannot be televised because of obstructions, the Contractor shall clean the system as is necessary. If, in the opinion of the Inspector, the obstruction is attributed to a collapsed main or pipe deflection, televising shall be suspended, payment shall be made based on the actual televised length, and the remaining televising of the sewer line shall be continued upon successful correction of the blockage by the Contractor at his expense. No additional payment shall be made for additional setups required due to obstructions encountered during televising.

The Contractor is solely responsible for any damage of sewer mains as a direct result of televising operations. Any repair shall also be the responsibility of the Contractor. The method(s) used for securing passage of the camera are at the discretion of the Contractor, as approved by the Engineer. No separate and/or additional payment will be made for any excavation, man entry, or any other method which may be required to retrieve video equipment that may have been hung up, destroyed, and/or lost during the operation.

- 1. Post-Construction Television Inspection.** TV inspection is to be done one manhole (structure) section at a time the flow in the section being televised shall be by-passed if the line is in service and the flow exceeds 25% of the internal pipe diameter. When the depth

2. **Obstructions and Hindrances.** All sections of the new sewer main are to be televised. Contractor is to insure the main is clean and clear of obstructions prior to performing televising activities. Any abnormalities such as, but not limited to, misaligned joints, cracked/defected pipe, rolled gaskets, shall be repaired by the contractor at his expense. Sections requiring repair shall be re-televised to verify condition of repair. No additional payment is to be made for additional set-ups required or delays due to repairs or removal of obstructions.
3. **By-Pass Pumping.** The Contractor shall perform by-pass pumping operations in accordance with the Specifications.

The Contractor shall furnish all labor, supervision, tools, equipment, appliances, and materials to perform all operations in connection with by-pass pumping of sewage flow for the purpose of preventing interference with the televising of the sanitary sewer manholes and mainlines as well as providing reliable sewer service to the occupants of the buildings being served.

The Contractor will be required to provide adequate pumping equipment and force mains in order to maintain reliable sanitary sewer service in all sanitary sewer lines involved in this project. The Contractor shall notify the Inspector should a surcharge occur during the televising process which results in overflows of sewage. In case of by-pass equipment failure, the Contractor shall discontinue work and release sewer flows until such time as equipment failure is corrected. The location of the pump(s), force main(s), and discharge points shall be approved by the Engineer. Under no circumstances shall the flow be interrupted or stopped, such that damage is done to either private or public property, or sewage flows or overflows into a storm sewer or waterway

The Contractor shall provide by-pass pumping of sewage around each segment(s) of pipe that is to be televised and shall be responsible for all required bulkheads, pumps, equipment, piping, and other related appurtenances to accomplish the sequence of pumping. A qualified person shall man the pumps, on-site, at all times during the by-passing procedure. This person shall have at least five (5) years experience in operating and maintaining bypass pumping systems.

All piping, joints, and accessories shall be designed to withstand the maximum by-pass system pressure, or a minimum of 50 psi, whichever is greater. During by-pass pumping, no sewage shall be leaked, dumped, or spilled into or onto any area outside of the existing sanitary sewer system. When by-pass pumping operations are complete, all piping shall be drained into the sanitary sewer prior to disassembly. The Contractor shall demonstrate that the pumping system is in good working order and can successfully handle flows during cleaning and televising operations, prior to commencing with the cleaning and televising of the system.

4. **Video Equipment Operations.** The Contractor is to be responsible for the TV inspection equipment having an accurate footage counter which displays on the monitor the distance of the camera from the centerline of the starting manhole.

The camera height is to be adjusted such that the camera lens is always centered (1/2 ID or higher) in the pipe being televised. In no case will the television camera be pulled or propelled through the line at a speed greater than 40-ft. per minute.

5. Post Repair TV Inspection. Upon completion of any repairs required by the Inspector, Engineer, the Contractor will re-televiser the sewer and submit these DVDs to the Inspector. These DVDs are to be permanently labeled as described in Section 2.I. and are to be used as a portion of the acceptance criteria. This post repair-TV inspection is to be done to the satisfaction of the Engineer, and is subject to the same acceptance criteria as the post construction-TV inspection DVDs. Post repair-TV inspection is to be provided at the Contractor's expense.

No separate or additional payment will be made for any excavation, man entry or any other method, which may be required to retrieve video equipment that has been entangled, destroyed or lost during the televising operation.

O. By-Pass Pumping.

The Contractor shall provide by-pass pumping of sewage and wet weather flows around each segment(s) of pipe that is to be replaced. The Contractor will be required to provide in writing a sequence of by-pass pumping for review and approval by the Inspector. Refer to the construction plans for the construction phasing and diversion requirements. The Contractor shall also provide the Inspector a sketch showing the location of by-pass pumping equipment for each line segment(s) around which flows are being by-passed. The Contractor shall be responsible for all required bulkheads, pumping, equipment, piping, etc., to accomplish the sequence of pumping. The Contractor shall cease by-pass pumping operations and return flows to the new and/or existing sewer when directed by the Inspector. All piping(s), joints and accessories shall be designed to withstand at least twice the maximum system pressure, or a minimum of 50 psi whichever is greater. During by-pass pumping, no sewage shall be leaked, dumped, or spilled in or onto, any area outside of the existing sanitary sewer system. When by-pass pumping operations are complete, all pumping shall be drained into the sanitary sewer prior to disassembly.

- a. Pump Condition. The Contractor shall demonstrate that the pumping system is in good working order and can successfully handle flows 24 hours a day.
- b. Pump Operation. The Contractor shall plug off and pump down the sewer manhole and line segment in the immediate work area and shall maintain the sanitary sewer system so that surcharging does not occur. Where work requires the line to be locked beyond working hours, the Contractor shall operate the by-pass pump and man the operation 24 hours a day.

The Contractor shall complete the repair, replacement, rehabilitation as quickly as possible, satisfactorily meet all tests, and repair all deficiencies as specified prior to discontinuing by-pass pumping operations and returning flow to the sewer manhole or line segment.

The Contractor shall notify the inspector, should a surcharge occur during the rehabilitation process resulting in the overflow of sewage. If the Contractor is unable to regain control of the situation, the rehabilitation operation should be suspended until such time as the overflows have been controlled. Any damage to the materials, equipment and/or adjacent properties due to such surcharge shall be repaired at the Contractor's expense.

The Contractor shall ensure that no damage will be caused to private property as a result of by-pass pumping operations. Ingress and egress to adjacent properties shall be maintained at all times. Ramps, steel plates or other methods shall be employed by the Contractor to facilitate traffic over surface piping. High traffic commercial properties may require alternate methods.

In the event, that sewage accidentally drains into the storm drainage system or is spilled within the project, the Contractor shall immediately stop overflow, notify the inspector, and take necessary action to clean up and disinfect the spillage using an High Test Hypochlorite (HTH), or equal, chemical to the satisfactory of the Engineer. If sewage is spilled onto public or private property, the contractor shall wash down, clean up and disinfect the spillage to the satisfaction of the Engineer.

The Contractor shall locate by-pass pumping suction and discharge lines so as to not cause undue interference with the use of streets, private driveways and alleys. In cases where the suction and or discharge lines are required to be buried for vehicle/pedestrian traffic, cost for this work is incidental and includes complete restoration of any surface features disturbed. Force main piping may be laid inside of storm drainage pipes to avoid surface interference with vehicular or pedestrian traffic. Flows shall not be allowed to spill from said force mains into said drainage pipes. The use of existing storm drain systems shall be approved by the Engineer. Force mains laid in storm sewers shall be pressure pipe and fittings.

The Contractor shall not intentionally damage or remove portions of existing storm sewer system structures or sanitary sewer structures for the purpose of installing by-pass pumping system without specific approval from the Inspector. If a structure is damaged, it shall be reconstructed or replaced to the satisfaction of the Engineer at the Contractor's expense.

The Department shall not be responsible for any damage to the by-pass pumping system sustained by the Contractor directly or indirectly as a result of storm water runoff within streets, ditches and/or storm sewer systems. The Contractor shall be responsible for any and all damage that results directly or indirectly from the interference of storm water runoff to by-pass pumping equipment, piping and/or appurtenances. It is the intent of these specifications to require the Contractor to establish adequate by-pass pumping as required regardless of the flow conditions.

4. Traffic Control

A. General.

1. Follow procedures for traffic control safety according to Item 502 of the Department's Standard Specifications for Construction of Highways, Streets and Bridges.
2. All streets and traffic ways shall be kept open for the passage of traffic and pedestrians during the construction period unless otherwise approved.
3. When required to cross, obstruct or temporarily close a street or traffic way, the Contractor shall provide and maintain suitable bridges, detours or other approved temporary expedients for the accommodation of traffic. Closing a street or traffic way shall be for the least amount of time required, to complete the work that is requiring the closure, if less than 8 hours. Passage on the street or traffic way shall be restored immediately upon completion of the work.
4. The Contractor shall give the required advance notice of proposed operations to the fire and police departments and area medical facilities.
5. The Contractor shall give 48 hours notice to owners or tenants of private property who may be affected by proposed operations.
6. The Contractor shall provide signs, signals, barricades, lights and all other equipment, service and personnel required to regulate and protect all traffic and warn of hazards as

7. Provide and operate traffic control required to direct and maintain an orderly flow of traffic in all areas under the Contractor's control or affected by the Contractor's operations.
8. Provide traffic control at the following locations:
 - a. at each change of direction of a roadway and at each crossroad,
 - b. at detours and hazardous areas, and
 - c. at parking areas.

B. Traffic Notes and Special Conditions.

1. It is the Contractor's responsibility to insure that all traffic control devices are properly installed and maintained. All locations and distances will be determined in the field, by the Contractor, using the Texas Manual on Uniform Traffic Control Devices. If the traffic control devices do not conform to established standards, or are incorrectly placed or insufficient, the Engineer shall have the authority to stop construction operations, without suspending time charges, until such time as the conditions are corrected.
2. The Contractor shall notify the Engineer then contact the Local Municipality or County one week in advance of any street closure.
3. As work progresses, location for traffic control devices will be adjusted and modified by the Contractor, as necessary or directed.
4. Additional traffic control devices, special directional devices, or business name signs (as requested by businesses) may be required at the Contractor's expense.
5. The Contractor shall be responsible for suitable access accommodations for:
 - a. pedestrians, including school children,
 - b. delivery of mail by the U.S. Postal Service, and
 - c. residents and all businesses during all phases of work.
6. At no time shall the Contractor have more than 50-ft. of trench un-backfilled or un-concreted, nor more than two open excavation areas at any one time, unless previously approved.
7. The Contractor shall provide for lane closings and traffic routing such that a minimum of two lanes on one-way streets and one lane each way on two-lane streets is maintained open to traffic at all times.

C. Parking Control.

1. Contractor related vehicular parking shall not interfere with public traffic or parking, access by emergency vehicles, other utility operations, or construction operations.

Temporary parking facilities for the public will be provided by the Contractor as required due to construction operations.

2. Parking of all construction and private vehicles will be monitored by the Contractor.

3. Free vehicular access to and through parking areas will be maintained.
4. Parking will be prohibited in non-designated areas.
- D. Haul Routes. The Contractor shall consult with governing authorities to establish haul routes and site access.
- E. Traffic Control While By-Pass Pumping. The Contractor shall locate by-pass pumping suction and discharge lines so as to not cause undue interference with the use of streets, private driveways and alleys; to include the possible temporary trenching of force mains at critical intersections. Traffic control shall be approved.
- F. Payment for the above traffic control operations will not be paid for separately, but will be considered subsidiary to this Item.

5. Testing.

A. Manhole Testing.

Successful passage of a vacuum test is required for acceptance of standard sanitary sewer manholes.

1. Hydrostatic testing is to be conducted by plugging with Inspector-approved plugs all influent and effluent pipes in the manhole and filling the manhole to the top of the cone with water. Additional water may be added over a 24-hour period to compensate for absorption and evaporation losses. At the conclusion of the 24-hour saturation period, the manhole is to be filled to the top of the cone and observed. A loss of water within the next 30-minute period is to be considered an unsuccessful test. The Engineer is to be notified when the 30-minute test is going to be conducted.
2. Vacuum Testing:
 - a. General. Manholes shall be tested after installation and prior to backfilling with all connections (existing and/or proposed) in place. Lift holes shall be plugged with an approved non-shrink grout prior to testing. Drop-connections and gas sealing connections shall be installed prior to testing.
 - b. Test Procedure. The lines entering the manhole shall be temporarily plugged with the plugs braced to prevent them from being drawn into the manhole. The plugs shall be installed in the lines beyond drop connections, gas sealing connections, etc. The test head shall be inflated in accordance with the manufacturer's recommendations. A vacuum of 10 inches of mercury shall be drawn, and the vacuum pump will be turned off. With the valve closed, the level vacuum shall be read after the required test time. If the drop in the level is less than 1 inch of mercury (final vacuum greater than 9 inches of mercury), after two minutes with all valves closed the manhole will have passed the vacuum test.
 - c. Approval. Manholes will be approved in relation to vacuum test requirements if they meet the criteria above.
 - d. Any manhole which fails the initial test must be repaired with a non-shrink grout or other suitable material based on the material the manhole is constructed of. Manholes shall be repaired on the exterior surface only prior to backfilling. The manhole shall be retested as described above until a successful test is made. After a successful test, the temporary plugs will be removed.

- e. Repairs to existing manholes. Any existing manhole which fails to pass the vacuum test shall be closely examined by the Engineer, and the Contractor to determine if the manhole can be repaired. Thereafter, the Contractor shall either repair or remove and replace the manhole as directed. The manhole shall then be retested. The Owner may elect to simply remove and replace the existing manhole with a new manhole.
- f. Measurement and Payment. Vacuum testing of new manholes will not be a pay item. The cost of this work will be included in the bid price for the new manhole

B. Low Pressure Air Testing.

The Contractor will conduct low pressure air tests on completed sections of sewer main. The air test results will be used to evaluate materials and construction methods on the pipe line sections. Successful air tests will be mandatory for the acceptance of the lines. Copies of test results are to be made available to the Inspector upon request.

1. Materials for Air Testing.

The Contractor is to furnish all materials and equipment for air testing including the Air Compressor.

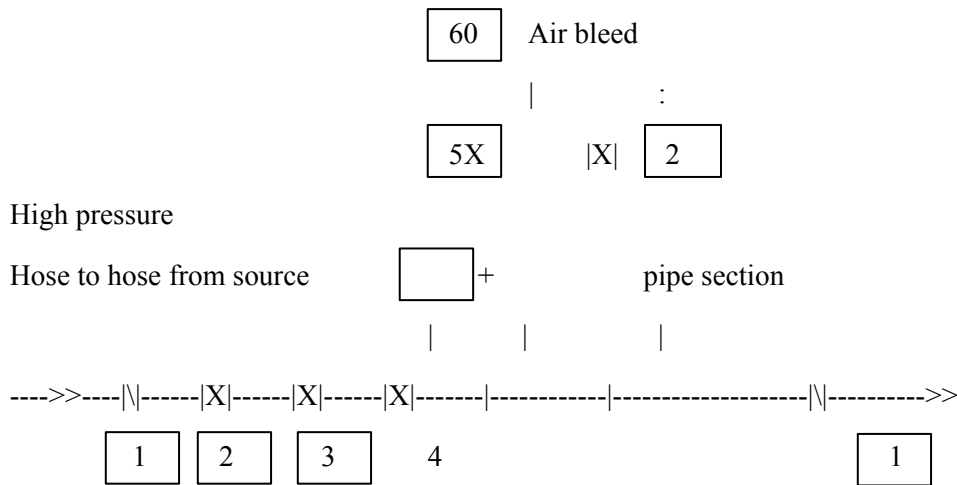
Compressor Air Supply. Any source which will provide at least 300-cu. ft. per minute at 100 pounds per square inch.

The equipment for air testing will consist of valves, plugs, and pressure gauges used to control the rate at which air flows to the test section and to monitor the air pressure inside the plugs and, for large diameter pipe, joint testers as manufactured by Cherne Industrial, Inc., of Edina, Minn., or an approved equal. Test equipment is to be assembled as follows:

- Hose connection,
- Shut off valve,
- Throttle valve,
- Pressure reduction valve,
- Gage cock, and
- Monitoring pressure gage.

Figure 1

Air Testing Equipment Assembly Order



2. Test Procedures.

The procedure for the low pressure air test shall conform to the procedures described in ASTM C-828, ASTM C-924, ASTM F-1417 or other appropriate procedures, except for testing times. The test times shall be as outlined in this section. For sections of pipe less than 36-inch average inside diameter, the following procedure shall apply unless the pipe is to be joint tested. The pipe shall be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure is stabilized, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be computed from the following equation:

$$T = (0.085xDxK) \div Q$$

T = Time for pressure to drop 1.0 pound per square inch gauge in seconds

K = 0.000419xDxL, but not less than 1.0

D = Average inside pipe diameter in inches

L = Length of line of same pipe size being tested, in feet

Q = Rate of loss, 0.0015 cubic feet per minute per square foot internal surface shall be used since a K value of less than 1.0 shall not be used.

There are minimum testing times for each pipe diameter as follows:

Table 1			
Pipe Diameter	Minimum Time	Length for Minimum Time	Time for Longer Length
Inches	Seconds/Ft	Feet	Seconds/Ft
6	340	398	0.855
8	454	298	1.520
10	567	239	2.374
12	680	199	3.419
Table 1 cont.			
Pipe Diameter	Minimum Time	Length for Minimum Time	Time for Longer Length
Inches	Seconds/Ft	Feet	Seconds/Ft
15	850	159	5.342
18	1,020	133	7.693
21	1,190	114	10.471
24	1,360	100	13.676
27	1,530	88	17.309
30	1,700	80	21.369
33	1,870	72	25.856

Note: Test time starts after the required 60 seconds of stabilization time.

The test may be stopped if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of the testing period, then the test shall continue for the entire test duration as outlined above or until failure. Lines with a 27 inch average inside diameter and larger may be air tested at each joint. Pipe greater than 36 inches diameter must be tested for leakage at each joint. If the joint test is used, a visual inspection of the joint shall be performed immediately after testing. The pipe is to be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be 10 seconds.

C. Deflection Testing.

Deflection test shall be performed on all flexible pipes.

For pipelines with inside diameters less than 27 inches, a rigid mandrel shall be used to measure deflection. For pipelines with an inside diameter 27 inches and greater, a method approved by the Engineer or Inspector shall be used to test for vertical deflections. Other methods shall provide a precision of $\pm 0.2\%$ deflection. The test shall be conducted after the final backfill has been in place at least 30 days. No pipe shall exceed a deflection of five percent. If a pipe should fail to pass the deflection test, the problem shall be corrected and a second test shall be conducted after the final backfill has been in place an additional 30 days. The tests shall be performed without mechanical pulling devices.

1. Mandrel Sizing. The rigid mandrel shall have an outside diameter (O.D.) equal to 95% of the inside diameter (I.D.) of the pipe.

The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe, all dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.

2. Mandrel Design: The rigid mandrel shall be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75% of the inside diameter of the pipe. A proving ring shall be provided and used for each size mandrel in use.
3. Method Options: Adjustable or flexible mandrels are prohibited. A television inspection is not a substitute for the deflection test. A deflectometer may be approved for use on a case by case basis. Mandrels with removable legs or runners may be accepted on a case by case basis.

D. T.V. Camera Testing.

After the vacuum tests on the manholes and the air tests on the sewer lines are performed by the Contractor, the utility owner may perform a T.V. Camera Test with their forces and equipment on the completed sewer lines. The T.V. test will be observed by the Department and Contractor personnel as the camera is run through the sewer lines.

Any sections in the sewer lines found by the camera such as broken pipe, misaligned pipe joints (that could result in a leak), etc. as determined to be damaged or abnormal are to be repaired or replaced by the Contractor at his expense.

6. Measurement.

A. Sewer Excavation and Non-stabilized Backfill.

Sewer excavation and non-stabilized backfill will be measured in accordance with Item 400, "Excavation and Backfill for Structures" but will not be measured for payment and will be considered subsidiary to the sewer line installation.

B. Trench Excavation Protection.

Trench excavation protection will be measured by the linear foot along the centerline of the trench where the depth exceeds 5 feet.

C. Sanitary Sewers.

Longitudinal measurement of sanitary sewers will be made along the centerline of the sewer from center of manhole to center of manhole or end of main by the linear foot of the various sizes and types (when a specific type is required) of sewers shown on the plans, in accordance with this specification, complete and accepted.

D. Plugging existing sewer lines will be considered subsidiary to the pipe installation.

E. Sanitary Sewer Cleanouts.

One way cleanouts are to be installed on all laterals at the customer's property line and will be measured for payment by each installed.

F. Sanitary Sewer Laterals.

The lengths of laterals will be measured from the centerline of the sewer main to the connection at or within the customer's property line or premises. Wyes, tees, and bends of any kind will not be paid for separately for laterals but will be measured for payment by the linear foot of lateral to be installed.

G. Jack, Boring or Tunneling.

Jacking, Boring or Tunneling will be measured by the linear foot of bore or tunnel as measured from face to face of jacking pits.

H. Carrier Pipe.

Carrier pipe used in bores and tunnels or backed into place will be measured by the linear foot of pipe installed from end to end of pipe to the limits shown on the plans

I. Casing or Liners.

Casing or liners for open cut, split casing, bores and tunneling, where required on the plans, of the size and material required will be measured by the linear foot actually installed in accordance with the plans.

J. Vertical Stacks.

Vertical Stacks will be measured by the linear feet. Footage will be measured from the finish grade elevation (centerline) minus invert elevation minus 8 feet.

K. Manhole Structures.

Manholes structures will be measured by each manhole structure complete in place. Manhole structures will be installed where any pipe intercepted is larger than 24-inch in diameter. Rings and Watertight Covers, concrete ring encasement and I&I Barriers, will not be measured for payment, but will be considered subsidiary to the manhole.

L. Pre-Cast and Cast-in-Place Manholes.

Manholes to 6 feet deep and designated on plan will be measured by each type manhole complete in place including those exceeding 6 feet in depth from the lowest invert elevation to the top of the ring. Rings and Watertight Covers, concrete ring encasement and I&I Barriers, will not be measured for payment, but will be considered subsidiary to the manhole.

M. Pre-Cast and Cast-in-Place Manholes Extra Depth.

Depth of pre-cast manholes deeper than 6 feet will be measured by the number of vertical feet in excess of 6 feet.

N. Adjusted or Abandoned Manholes.

Manholes adjusted or abandoned as prescribed herein, will be measured by each manhole. The excavation and backfill required and the I&I Barrier for Adjust Manholes will not be measured for payment, but will be considered subsidiary to this Item.

O. Flowable Backfill.

Flowable Backfill will be measured by the cubic yard in accordance with Item 401, "Flowable Backfill", but not to exceed the minimum trench width specified in Section 3.C.1, "Width of Trench" or as shown on the plans.

P. Select Bedding Material.

Where directed to be used for rigid pipe installations, Select Bedding Material will be measured by the cubic yard as dimensioned on the plans. Select Bedding Material is always required for Flexible Pipe installation; therefore, it will not be measured for payment.

Q. Concrete Encasement, Cradles, Saddles and Collars.

Concrete encasement, cradles, saddles and collars for pipe will be measured by the cubic yard as dimensioned on the plans or as directed, complete in place. Reinforcing if required will not be measured.

R. Concrete Curb, Sidewalks, and Driveways.

For concrete curbs, sidewalks, and driveways required to be removed and replaced due to placement of sewer lines, removal of the existing concrete and pavement replacement will be measured by the linear foot or by the square yard as dimensioned and detailed on the plans, but not to exceed the minimum trench width specified in Section 3.C.1, "Width of Trench".

S. Cut and Replace Pavement.

The work to be done in the cutting and replacement of pavement will be measured by the square yard in accordance with the dimensions and details shown on the plans but not to exceed the minimum trench width specified in Section 3.C.1, "Width of Trench".

T. Removing and Replacing Chain-Link and/or Wire Fence.

This work will be measured by the linear foot of fence removed and replaced, regardless of the type or height of the fence, complete in place. The existing fence materials may be reused unless, the existing materials were damaged during removal and should not be reused. The Contractor is to provide new material for the replacement work at his expense.

U. Abandon Sewer Lines.

When shown on the plans, this work will be measured by linear foot complete in place.

V. Television Inspection.

This Item will be measured by the linear foot of main televised for TV inspection according to the size ranges specified in the plans. The linear foot measurement will be determined as the distance from the center of sewer manhole to the center of sewer manhole.

W. Hydrostatic Pressure Test.

Hydrostatic testing of manholes will not be measured for payment

X. By-pass Pumping.

This Item will be measured by the "Lump Sum" as the work progresses. No additional measurement or payment will be made for conditions caused by the Contractor during construction.

7. Payment.

A. Sewer Excavation.

Payment for sewer excavation and non-stabilized backfilling in accordance with these specifications will not be paid for directly but will be included in the unit price bid for the sanitary sewer pipe installation. Select bedding and stabilized backfill will be paid for under their own items of work.

B. Trench Excavation Protection

Payment will be made at the unit price bid for “Sanitary Sewer (Trench Excavation Protection)” in place. Payment will include all components of the trench protection system which can include but not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering/diversion of water to provide adequate/acceptable drainage, any additional excavation or backfill required, jacking, jack removal, removal of the trench support after completion and all other labor, materials, tools, equipment and incidentals necessary to complete the work.

C. Sanitary Sewers.

Payment will be made at the unit price bid for “Sanitary Sewer” of the size, and type (when a specific type is required) specified on the plans complete in place.

Sanitary sewer service connections will be paid for at the unit price bid for “Sanitary Sewer (Lateral Pipe)” of the size specified per linear foot complete in place.

D. Sanitary Sewer Laterals.

Payment will be made at the unit price bid for “Sanitary Sewer (Lateral Pipe)” of the size and type (when a specific type is required) specified on the plans per linear foot complete in place.

E. Jacking, Boring or Tunneling.

Jacking, Boring or Tunneling will be paid for at the contract unit price bid per linear foot of jacking, boring or tunneling, which price shall be full compensation for furnishing all materials (except carrier pipe, casings or liners), labor, tools, equipment and incidentals necessary to complete the work, including excavation, grouting, backfilling, restoration to original ground conditions, and disposal of surplus materials.

F. Carrier Pipe.

Carrier pipe of the size and type specified on the plans shall be paid for at the contract unit price bid for "Carrier Pipe for Jacking, Boring or Tunneling" per linear foot of pipe installed and measured as prescribed above, complete in place.

G. Casings or liners of the size, type and installation method specified on the plans shall be paid for at the contract unit price bid for "Casing or Liner" per linear foot of casing or liner installed and measured as prescribed above, complete in place.

H. Vertical Stacks.

Payment will be made at the unit price bid per vertical foot, complete in place.

I. Sanitary Sewer Cleanouts.

Payment will be made at the unit bid price for “Sanitary Sewer (Cleanout)” of the size and type (when a specific type is required) specified on the plans, complete in place.

J. Manhole Structures.

Payment for Manhole structures, including the stack, rings, watertight covers, steps and concrete ring encasement, I&I Barriers, will be made at the unit price bid for “Sanitary Sewer Manhole Structure (Complete)” of the type specified.

K. Pre-Cast Manholes.

Payment for Pre-Cast manholes, including the stack, rings, watertight covers, steps and concrete ring encasement, I&I Barriers, will be made at the unit price bid for “Sanitary Sewer Pre-Cast Manhole (Complete)” of the type specified.

L. Pre-Cast Manholes Extra Depth.

Payment for extra depth manholes will be made at the unit price bid per vertical foot as measured, for “Sanitary Sewer Pre-Cast Manhole (Extra Depth)”.

M. Abandon or Adjust Manholes.

Manholes abandoned or adjusted will be paid for at the unit price bid for “Sanitary Sewer (Abandon Manhole)” or “Sanitary Sewer (Adjust Manhole)”.

N. Flowable Backfill.

Payment for “Flowable Backfill” will be made at the unit price bid for “Sanitary Sewer (Flowable Backfill)”, but not to exceed the minimum trench width specified in Section 3.C.1. “Width of Trench”.

O. Select Bedding Material.

Payment for “Select Bedding Material” for rigid pipe installations will be made at the unit price bid for “Sanitary Sewer (Select Bedding)”. The select bedding for flexible pipes will not be paid for directly but will be subsidiary to the flexible pipe.

P. Concrete Encasement, Cradles, Saddles and Collars.

Payment will be made at the unit price bid for “Sanitary Sewer (Concrete Encasement, Concrete Cradles, Concrete Saddles and Concrete Collars)”.

Q. Concrete Curbs, Driveways, and Sidewalks.

Payment for replacement of curbs, driveways, and sidewalks will be made at the unit price bid for “Sanitary Sewer (Cut and Replace Concrete Sidewalk)”, “Sanitary Sewer (Cut and Replace Concrete Sidewalk)(Asphalt)”, “Sanitary Sewer (Cut and Replace Concrete Driveway)”, and “Sanitary Sewer (Concrete Curb)”.

R. Cut and Replace Pavement.

Payment will be made at the unit price bid for “Sanitary Sewer (Cut and Replace Pavement)” of the type and replacement material shown on the plans.

S. Remove and Replace Chain-Link and/or Wire Fence.

Payment will be made at the unit price bid for “Sanitary Sewer (Remove and Replace Fence)”.

T. Abandon Sewer Lines.

Payment will be made at the unit price bid for “Sanitary Sewer (Abandon Pipe)” of the size shown on the plans.

U. Television Inspection.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Sanitary Sewer (Television Inspection)" of the various size ranges specified in the plans. This price will include all labor, materials, equipment, tools, logging, and all incidentals necessary to complete the work.

V. Hydrostatic Pressure Test.

No direct payment will be made for hydrostatic testing manholes.

W. By-Pass Pumping.

The work performed and material furnished in accordance with this Item and measured as provided under "Measurement" will be paid for the unit price bid for "Sanitary Sewer (By-Pass Pumping)". Partial payments of this "Lump Sum" bid will be as follows:

1. When initial set-up and operation of the by-pass system begins, 40% of the line item will be paid.
2. The remaining portion of the line item will be paid when the by-pass pumping operations for the entire job are completed.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the various unit prices. These prices are full compensation for furnishing materials and for equipment, labor, tools, and incidentals.