DIVISION VII

PVC GRAVITY SANITARY SEWERS

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This division is written so that ordinarily the type of construction described is complete but, where applicable, other divisions are considered a part of this specification.

SECTION 37 - PRODUCT SPECIFICATIONS

These specifications cover the requirements of Poly (Vinyl Chloride) (PVC) gravity pipe and fittings for the drainage of sewage. All PVC gravity sewer pipe shall conform to the physical and performance requirements of the latest revision of ASTM Specification D3034 "Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings," and ASTM Specifications F679 "Poly (Vinyl Chloride) (PVC) Large-Diameter (18"-27") Plastic Gravity Sewer Pipe and Fittings." PVC pipe shall have a minimum pipe stiffness of 46. The Poly (Vinyl Chloride) (PVC) material is classified per ASTM Specification D1784.

SECTION 38 - NOMENCLATURE

The plastics nomenclature used in the specifications are in accordance with the definitions given in Nomenclature ASTM D883 and ASTM F412 unless otherwise indicated. The abbreviation for Poly (Vinyl Chloride) plastic is PVC.

SECTION 39 – JOINTING SYSTEMS

39.01 General. The joint shall provide a permanent seal against exfiltration or infiltration. The joining technique must be elastomeric gasket.

39.02 Elastomeric Gasket Joints. The critical sealing dimensions of the bell, spigot, and gasket shall be in accordance with the manufacturer's standard dimensions and tolerances. The elastomeric compound shall comply in all respects with the physical requirements specified in ASTM Specification F477. The gasket shall provide an adequate compressive force against the sealing surfaces of the bell and spigot so as to effect a positive seal under all combinations of the joint tolerances. The gasket shall be the only element depended upon to make the joint flexible and watertight.

39.03 Fittings. Fittings using snap ring gaskets cannot be used.

SECTION 40 - INSTALLATION

Installation of pipe shall comply with Sections 38 through 45. The Engineer shall approve the type of bedding and backfill material.

SECTION 41 - SCOPE

These specifications describe procedures for installing solid single wall thermoplastic sewer pipe in excavated trenches. These installation procedures are based on design requirement for flexible conduit and provide for proper control of installation practices.

SECTION 42 - GENERAL REQUIREMENTS

The pipe shall be bedded true to line and grade with uniform and continuous support from a firm base in accordance with ASTM Specification D2321. Blocking shall not be used to bring the pipe to grade. Backfill material properly placed and compacted will provide lateral restraint against deflection exceeding 5% of the base inside pipe diameter as per ASTM Specification D3034 and F679.

SECTION 43 - SIGNIFICANT FACTORS IN PIPE/SOIL INTERACTIONS

The type and gradation of the material used in bedding, haunching, and initial backfilling, as well as the manner and care with which it is installed, are important factors in achieving satisfactory installation of flexible conduit. The amount of diametric deflection that can be anticipated during installation is related to the type and gradation of the embedment material and pipe stiffness as well as the care with which it is placed under, around, and over the pipe. Thus careful consideration should be given in choosing these materials and in the method of placement and compaction in accordance with ASTM Specification D2487 and ASTM Specification D2488.

SECTION 44 - TRENCH CONSTRUCTION

44.01 Trench Preparation. During preparation of the trench, certain conditions may be encountered requiring special treatment to provide adequate bedding and foundation or to stabilize the trench walls or bottom. Conditions which may be anticipated are described in this section.

44.02 Trench Width. Care should be taken during excavation of the trench to provide as narrow a trench as practical at a point level with the top of the pipe. If it becomes necessary to construct a trench wider than seven (7) pipe diameters, it is recommended that the pipe be in a sub-trench (see Diagram No. 2) to minimize earth load. However, in no case shall the trench width exceed the pipe manufacturer's recommendation.

44.03 Unstable Trench Walls. Where unstable or running trench soil condition is encountered such as may be found by excavating below ground water, the trench condition must be stabilized before laying the pipe. When excessive ground water conditions exist, the Engineer may elect to use well point or under drains. Care should be taken to prevent displacement of bedding or foundation soil material as a result of lateral or upward movement of the running soil or removal of sand or silt during the dewatering. The Engineer may also elect to use shoring with sheeting, stay bracing, or a trench box to stabilize the trench walls during construction.

It is recommended that these trench supports be left in place after construction. If the shoring is to be removed, the slot left in the tamped fill should be filled and tamped in compliance with Section 43, "Haunching and Initial Backfill."

44.04 Unstable Trench Bottom. Where an unstable (i.e. water, mud, etc.) trench bottom is encountered, stabilization of the trench bottom is required. This can be accomplished by undercutting the trench depth and replacing to grade with a foundation and bedding of processed stone or processed gravel as described for Class I in Section 43, "Bedding." The use of processed gravel and stone will act as a mat into which the unstable soil will not penetrate. The depth of the foundation and bedding is dependent on the severity of the trench bottom; however, a six (6) inch layer is sufficient in most cases. If the foundation contains large particle size material that might damage the pipe, provide a cushion of acceptable bedding material between the foundation and the pipe. Care should be taken to prevent migration of the bedding material into the foundation material.

44.05 Rock Excavation. When the pipe is laid in a rock cut, a layer of bedding six (6) inches deep shall be provided as described in accordance with Section 42, "Bedding."

SECTION 45 - BEDDING

Prior to pipe installation, carefully bring the bedding material to grade along the entire length of pipe to be installed. To provide adequate support for the pipe, the following bedding procedures are recommended:

Class I Material. When Class I material is used for bedding, little or no compaction is necessary due to the nature of the angular particles. A depth of six (6) inches of Class I material is generally sufficient to provide uniform bedding. If Class I material is used for bedding, it must also be utilized for haunching up to or higher than the spring line of the pipe to avoid loss of side support through migration of Class II or Class III haunching material into the bedding.

Class II Material. Take care with Class II material to provide a uniformly compacted bedding. Excavate the bedding material or place to a point above the pipe bottom, determining such point by the depth of loose material resulting in preparation of the bedding and the amount of compaction that will be required to bring the material to grade. Use hand or mechanical tamping to compact the bedding material to a minimum 85 percent Standard Proctor Density. Slightly damp material will generally result in maximum compaction with a minimum of effort. If water is added to improve compaction or if water exists in the trench, take care to avoid saturation of Class II material which could result in additional stability problems of the bedding. Carefully bring the surface of the bedding to grade after compacting it.

Class III Material. Provide uniform pipe bedding for Class III material in the same manner as outlined for Class II materials except use hand or mechanical tamping to compact the bedding material to a minimum of 90 percent Standard Proctor Density. Take care to avoid excessive moisture in Class III material when used for bedding.

SECTION 46 - HAUNCHING AND INITIAL BACKFILL

The placement of embedment material in the area around the pipe must be installed with care. The pipe's ability to withstand loading in a trench depends in a large part on the methods employed in its installation. The following procedures are recommended for the various soil types:

Class I Material. Use under wet conditions. In any area where the pipe will be installed below existing or future ground water levels or where the trench could be subject to inundation, Class I material shall be used for bedding, haunching, and initial backfill. However, in the initial state of placing this type of material, care should be taken to ensure that sufficient Class I material has been worked under the haunch of the pipe to provide adequate side support.

Precautions should be taken to prevent movement of the pipe during placing of the material under the pipe haunch. Except for the protection of the pipe from large particles of backfill material, little care need be taken and no compaction is necessary in placing backfill material in the balance of the initial backfill area above the pipe. Where unstable trench walls exist because of migratory materials such as waterbearing silts or fine sand, care should be taken to prevent the loss of side support through the migratory action.

Class I Material - Use under dry conditions. In any areas where ground water will not be experienced at any time above the level of the foundation material or where the trench will not be subject to inundation, Class I material shall be placed to or higher than the spring line of the pipe and with a minimum of effort to compact the material. However, in the initial stage of placing this type of material, take care to ensure that sufficient Class I material has been worked under the

haunch of the pipe to provide adequate side support. Take precautions to prevent movement of the pipe during placing of the material under the pipe haunch. Except for the protection of the pipe from large particles of backfill materials, little care needs to be taken and no compaction is necessary in placing the initial backfill material if Class I material is used. If Class II or Class III material is used above the spring line, achieve a compaction ratio of 85 percent Standard Proctor Density.

Class II Material. Place Class II material to the spring line of the pipe and compact by hand or mechanical tamping. Take precautions to prevent movement of the pipe during placing of the material through the pipe haunch. Place initial backfill material in two stages: one to the top of the pipe and the other to a point at least six (6) inches over the top of the pipe. Compact each stage of haunching and initial backfill by hand or mechanical tamping to a minimum of 85 percent Standard Proctor Density. If the remaining backfill material contains large particles which could damage the pipe from impact during placement, increase the second stage of initial backfill to a point at least twelve (12) inches over the top of the pipe. If the trench width is less than twice the diameter of the pipe where the moisture content at the pipeline grade is negligible and not subject to seasonal or local variations, Class II material can be installed for pipe haunching in a dry state by hand placement with no compaction.

Class III Material**.** Place Class III material with care under the lower haunch area of the pipe, compact, and then place additional material to the spring line of the pipe. If care has been taken to shape the bedding material to the curvature of the pipe, only one stage of placement will be required to bring the haunching material to the spring line of the pipe. In either event, thoroughly compact the haunching material to a minimum of 90 percent Standard Proctor Density. Take precautions to prevent movement of the pipe during placing of material under the pipe haunch. Perform initial backfilling in the same manner as outlined for Class II materials using hand or mechanical tamping, but achieve a minimum of 90 percent Standard Proctor Density.

SECTION 47 – BACKFILL

47.01 General. The material that completes the backfilling operation need not be as carefully selected as the initial backfill. It is usually placed in the trench by machine. Care should be taken, however, to avoid large stones, frozen clumps of dirt, etc. which could damage the pipe by impact or by being forced through the soil cushion and against the pipe.

47.02 Trench Backfill. See Division V – Storm and Sanitary Sewer, Paragraph 27.07 Trench Backfill, Paragraph 27.08 Backfilling Under Pavement and Paragraph 27.09 Nonshrinkable Backfill.

SECTION 48 - TESTING

48.01 Testing for Tightness. See Division V, Storm and Sanitary Sewers, Paragraph 27.13 Exfiltration and Air Testing.

48.02 Test for Deflection. After the pipe has been laid and backfilled, the Engineer shall require appropriate deflection testing. This test is conducted by pulling a pointed mandrel through the pipe as described in Appendix “A.” The Engineer shall designate the method of testing to be used. Upon completion of backfill the maximum allowable deflection shall not exceed 5% of the pipe’s base inside diameter in accordance with Appendix X2 of ASTM Specification D3034 and F679. The base inside diameter of the pipe shall be determined in accordance with Appendix Section X1 of ASTM Specification D3034 and F679. Testing shall be conducted on a manhole to manhole basis or in total, as specified. To ensure accurate measurement, it is important that the line to be tested is completely water flushed.

This test will not be run for at least thirty (30) days after the trench has been backfilled. If the trench was dewatered, the water table will be permitted to recover to at least three- fourths of its previous depth above the pipe before this thirty (30) day period starts.

48.03 Test Rejection. Should the results of any test fail to meet the criteria established in these specifications, the Contractor shall, at Contractor's expense, locate and repair the rejected section and retest until it is within specified allowance.

48.04 Alignment. Sewers shall be laid with straight alignment between manholes. Straight alignment shall be checked by either using a laser beam or lamping.

SECTION 49 – EXPOSURE OF PIPE OR MANHOLES

The Contractor shall conduct the work at all times in such a manner as will ensure no disruption to the normal function of the sanitary sewer collection system. Particular attention shall be paid to the threat of introduction of storm water or other waters to the piping and manholes of the collection system. The Contractor shall take whatever precautions are necessary, such as, but not limited to installation of plugs in exposed pipes and manholes when work is not in progress or when leaving the work site. The Contractor will be held responsible for damages which may occur to either the collection system or to private property through introduction of storm water or other waters to exposed piping or manholes relating to the construction work.

APPENDIX "A"

Deflection measurements shall be made upon completion of the project providing the pipe has been installed for not less than thirty (30) days and not more than twelve (12) months prior to testing. The Engineer shall require either complete or random deflection testing. If a random deflection procedure is specified, it shall be on a manhole to manhole basis, preferably in select areas as described below:

1. Where high ground water was encountered,
2. Where trench walls or bottoms were difficult to stabilize,
3. Where minimum Proctor Density was difficult to achieve,
4. Where frozen soil was utilized for final backfill,
5. Where heavy rains were encountered during construction, and
6. Any other areas that could present special problems.

The period of thirty (30) days to twelve (12) months is deemed an adequate time period for the soil to settle and stabilize. This phenomenon is dependent on geographical climatic conditions such as heavy rains or snows, changing water tables, extended dry periods, or freeze-thaw cycles. The Engineer shall designate when the testing will be performed.

Instructions for mandrel deflections testing are as follows:

1. Completely flush the line making certain the pipe is clean of any mud or trash that would hinder the passage of the mandrel.

2. During the final flushing of the line, attach a floating block or ball to the end of the mandrel, pull rope and float the rope through the line. A nylon ski rope is recommended.

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

4. Connect a second rope to the back of the mandrel. This will enable you to retrieve the mandrel if excessive deflection is encountered.

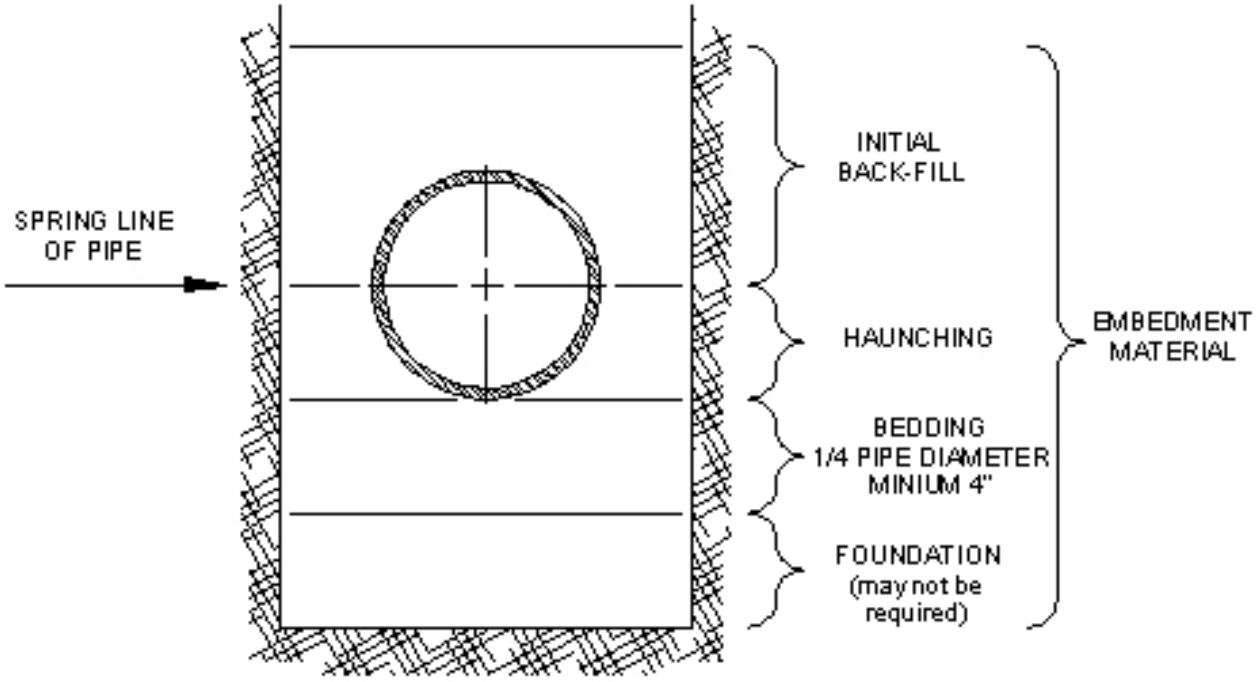
5. Remove all slack in the pull rope by gently pulling the rope at the far manhole. After the slack has been removed, place a tape marker on the rope close to the pipe where the mandrel will exit. If mandrel encounters excessive deflection, the marker will provide a means of measuring the travel distance of the mandrel so the deflected area can be located.

6. Draw mandrel through the sewer line.

7. An increasing resistance to pull is an indication of excessive deflection. If this occurs, measure the distance of the rope from the marker to the manhole.

8. Retest.

DIAGRAM 1



PIPE ZONE TERMINOLOGY

DIAGRAM 2

SUB-TRENCH DESIGN