

SECTION SS

SANITARY SEWER IMPROVEMENTS

1.0 MATERIALS

1.1 Sewer Pipe, Joints, Fittings and Manholes:

1.1.1 General: This section of the specifications identifies the type of materials and design criteria for the designated materials being used.

1.1.2 Design Standards: The following specifications as revised shall apply to the designated materials:

1.1.2.1 ABS pipe: ASTM D-2321 and D-2751; as amended.

1.1.2.2 PVC pipe: ASTM D-3330, D-3212, D-3034, D-2444, D-2412, D-2321, D-2241, D-2152, D-1784, And D-1598, F679, F789; as amended and CS 256-63; UNI-B-7 and UNI-B-10.

1.1.2.3 Cast Iron and Ductile Iron Pipe: Federal Specifications WWP 421, ASTM 536, ASA A21.51-76, A21.8 and A21.6.

1.1.2.4 Brick: ASTM C62-30 and C32-24.

1.1.2.5 Concrete: ASTM A-615, A-185, C-175, C-172, C-153, C-150, C-144, C-143, C-94, C-78, C-76, C-39, C-33, and C-31.

1.1.2.6 Castings: ASTM A 27-24 and A 48-29; as amended.

1.2 Submittals: The Contractor shall submit in writing to the Engineer, the materials and equipment proposed for use and shall receive approval in writing prior to starting the work.

2.0 POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE, JOINTS AND FITTINGS:

2.1 PVC Pipe, General: All PVC gravity pipe shall be with integral bell and spigot and comply with latest requirement of ASTM D-3034 or F789. The material used for pipe and fittings shall be of PVC plastic having a cell classification of 12454-B or 12454-C as defined in ASTM D-1784. Eighteen-inch PS only is approved under ASTM F679 & F789.

2.2 O-Ring Gasket and Fittings: The o-ring gasket shall comply with ASTM 3212, as amended, and shall be installed at all joints and as outside gaskets at points of contact with manholes and wet wells. Couplings and fittings shall be approved by the pipe manufacturer and shall accommodate the pipe for which they are to be used.

2.3 Standard Dimensional Ratio (SDR): The SDR of the pipe and fittings shall be SDR 35 except 4-inch pipe shall be SDR 33.5 unless otherwise specified.

2.4 Pipe Lengths: The length of each PVC pipe section shall be true and straight in alignment, shall be at least 12 feet in length and as long as practical considering standards of manufacture at the time of construction.

2.5 **Markings:** Pipe and fitting markings shall include the following; pipe marked continuously down the length:

Manufacturer's Name or Trademark
Nominal Size
The PVC Cell Classification
The Legend "Type PSM PVC Sewer Pipe"
ASTM Designation D-3034 (or other designation per this specification)

3.0 **ACRYLONITRILE-BUTADIENE-STYRENE (ABS) SEWER PIPE, JOINTS AND FITTINGS:**

3.1 **ABS Pipe, General:** All ABS pipe and fittings, sizes 8-inch through 15-inch shall be solvent weld joints and shall comply with ASTM D-2680, as amended. Companion ABS pipe and fittings, sizes 4-inch and 6-inch shall comply with

ASTM D-2751, as amended. Materials used for pipe and fittings shall be of same classification as defined in ASTM D-2680 and D-2751, as amended, and of the same manufacturer.

3.2 **Standard Dimensional Ratio (SDR) for ABS Pipe:** A, 4-inch and 6-inch ABS pipe and fittings used shall have an SDR of 35.

3.3 **Couplings:** Normal pipe joints shall be solvent weld as recommended by the manufacturer and of high quality workmanship.

3.4 **Manhole - Wet Well Connections:** O-rings and water-stop rubber gaskets shall be used at all line connections to manholes and wet wells. These connections shall be made in strict accordance with pipe manufacturer's recommendations.

3.5 **Pipe Length:** Normal pipe length shall be not less than 12 feet, unless previously approved by the Engineer.

3.6 **Markings:** Pipe and fitting markings shall include the following; with pipe marked continuously down the length:

Manufacturer's Name and Trademark
Nominal Size
Truss or ABS Classification
ASTM Designation: D-2680, as amended, for Truss pipe and D-2751, as amended, for ABS pipe

4.0 **CAST IRON AND DUCTILE IRON PIPE AND SPECIALS:**

4.1 **Cast Iron Pipe and Specials:** Cast iron pipe shall conform to Federal Specifications WWP 421 or ASA standard for class as shown on plans.

4.2 **Steel Pipe for Encasement:** Steel pipe when used for encasing sewer pipe line through bores or tunnel under railroads, highways, roadways or as specified on plans shall have one-quarter inch minimum wall thickness and shall have an inside diameter at least three inches larger than the maximum diameter of the sewer pipe and appurtenances laid therein.

5.0 BRICK:

5.1 General: When bricks are used for manholes they shall be at least equal to Grade B ASTM C 62-30, as amended. They shall be of uniform size, color, quality, thoroughly and uniformly burned, and ring clearly when struck with a hammer.

6.0 CONCRETE AND MORTAR:

6.1 Concrete Materials:

Portland cement shall equal ASTM C-150, Type I unless otherwise approved by the Engineer.

Air-entraining Portland cement shall equal ASTM C-175, as amended.

Concrete Aggregate (ASTM C-33, as amended): Sand shall be clean, sharp and graded from 100 to 4 sieve. Grading proportions shall conform to concrete mix design as specified in paragraph (S-1.08e).

Water shall be clear and potable.

Reinforcing shall be free from rust, scale, oil or any foreign objects, and shall equal the following:

Deformed bars shall be equal to ASTM A-615, Grade 60.

Wire fabric shall be equal to ASTM 185, and shall have tensile strength of 30,000 psi.

6.2 Concrete Quality (psi-28 days): Concrete quality shall be as follows, unless otherwise noted on structural drawings.

1. Footings, Piers, and Manhole Walls	3000 psi normal weight
2. Exterior Grade Slabs	3000 psi normal weight
3. Grade Beams and Walls	4000 psi normal weight
4. Structural Concrete	4000 psi normal weight
5. Paving, Walks, Drives	3000 psi normal weight
6. Manhole Bases	3500 psi normal weight

6.3 Admixes: Admixes shall be as follows:

Retarders shall be used when necessary to minimize checking and cracking.

Accelerators shall be used during cold weather (temperatures below 40°F). Calcium chloride or other salts shall not be used.

6.4 Concrete Testing: Concrete shall be tested by a certified Laboratory. The Laboratory shall be selected and paid by Contractor with testing conforming to ASTM C-39 OR ASTM C-78.

Low strength concrete shall be removed and replaced if so requested by the Engineer.

6.4.1 Evaluation and Acceptance of Concrete: Three samples for strength tests of concrete shall be taken not less than once a day nor less than once for each 100 cu. yd. of concrete or for each 5000 sq. ft. of surface area placed. The samples for strength tests shall be taken in accordance with "Method of Sampling Fresh Concrete" (ASTM C-172). Cylinders for acceptance tests shall be molded and laboratory-cured in accordance with

Method of Making and Curing Concrete Compressive and Flexural Strength Test Specimens in the Field" (ASTM C-31) and tested in accordance with "Method of Test for Compressive Strength of Molded Concrete Cylinders" (ASTM C-39). One cylinder shall be tested at 7 days and the other two at 28 days. The Contractor shall keep a log recording the location of the in-place concrete corresponding to each group of tests.

The Contractor shall furnish to the Engineers certified reports on these tests and shall pay all the expense of making the tests and of furnishing the concrete for preparing and testing the cylinders.

6.4.2 Air-Entraining and Slump: Air-Entraining and slump tests will be tested by the Owner during the construction. Tests will be performed at least once for each day's pour or for each fifty (50) cu. yd. of concrete, if more than 50 cu. yd. are placed in any one day.

6.5 Concrete Mix Design: Trial mix designs shall be made for all strength categories to be used in the job. Trial mix designs shall establish proportions of ingredients that will provide the required strength and minimum shrinkage characteristics at a slump of 3 inches. Maximum size of coarse aggregate shall be one inch for normal weight concrete.

<u>Screen</u>	<u>% Passing</u>
3/4"	100
1/2"	90 - 100
No. 4	25 - 40
No. 50	- 20
No. 100	2 - 15

6.6 Mortar and Mortar Materials: Mortar for laying masonry shall be Type "M" composed of one volume Portland cement, one volume of masonry cement and six volumes of sand.

Aggregates shall conform to the current Standard Specifications for Aggregate for Masonry Mortar of the ASTM, C-144.

Water shall be clean and free of deleterious amounts of acids, alkalies, or organic materials.

Portland Cement: ASTM C-150, Type 1.

7.0 CASTINGS FOR SEWER MANHOLES, LAMPHOLES, AND INLETS:

7.1 General: This item shall consist of manhole frames and covers, sewer inlet frames and gratings for manholes and inlets. All castings shall conform to the standard design shown on plans.

7.2 Steel Castings: Steel castings shall conform to the latest requirements of ASTM A 27-24, as amended. Steel castings shall be Class B, Hard Grade, unless otherwise specified.

7.3 Iron Castings: Iron castings shall conform to the latest requirements of ASTM A 48-29, as amended.

7.4 Quality: Castings shall be free from pouring faults, sponginess, cracks, blow holes and other defects in locations affecting the strength and value of the casting for the service intended, shall be filleted at angles and the rises shall be sharp and true.

All castings shall be free from warp and shall be true to the shape and dimensions required. Surfaces shall be machined where indicated or where otherwise necessary to secure flat true surfaces.

All covers, gratings, etc. fitting into frames shall fit properly and seat uniformly and solidly.

7.5 Accessories - Bolts, rivets, spacers, small I-beams, channels, plates, etc., used for assembling or supporting grating in multiple grating sewer inlet installations shall be first quality standard commercial materials, free of defects which affect their value for the service intended.

8.0 EMBEDMENT MATERIALS:

8.1 General: Embedment materials listed here include a number of processed materials plus the soil types listed under the Unified Soil Classification System (FHA Bulletin No. 373, as amended). These materials are grouped into categories which are considered to be most suitable for this application.

8.2 Class I: Angular, 6 to 20 mm (1/4 to 3/4-inch), graded stone including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone and crushed shells.

8.3 Class II: Coarse sands and gravels with maximum particle size of 20 mm (3/4-inch), including variously graded sands and gravels containing small percentages of fines; generally granular and non-cohesive, either wet or dry Soil Types GW, GP, SW and SP are included in this class.

8.4 Class III: Fine sand and clay gravels, including fine sands, sand-clay mixtures and gravel-clay mixtures. Soil Types GM, GC, SM and SC are included in this class.

9.0 INSTALLATION AND WORKMANSHIP - SEWER LINES AND MANHOLES:

9.1 Order of Construction: Under normal conditions the waste water treatment facilities if part of project, shall be completed as early as possible to accept waste water as the sewer mains are constructed and connected to the system.

Construction of all sewer lines shall begin at the outlet or the low point in the line. When the construction involves the building of main or submain sewers having one or more laterals or tributaries, the construction of the tributary lines will not be started until the main or submain sewer has been completed to the point where the tributary or laterals discharge into it. Sewer appurtenances shall be constructed as soon as the sewer which they service is constructed to their location. The postponing of the construction of appurtenances until the sewer line has been completed, or the building of appurtenances in advance of the construction of the sewer line, will not be permitted. In general, the construction of sewers 18-inches in diameter and smaller for more than 600 feet, and sewers 21-inches in diameter and larger, for more than 300 feet in advance of appurtenances which are incomplete or the construction of which has not been started, will not be permitted.

10.0 EXCAVATION:

All excavation shall be included in the lump sum bid based on the given number of linear feet stated and bids on a linear foot basis shall be taken for overrun or underrun when such is provided for in the bid forms.

10.1 General: Excavation shall include the furnishing of all labor, materials, tools, equipment, and machinery necessary for: cleaning and removing from the line of the sewer all obstructions, paving, trees, brush, etc., furnishing, putting in place, all necessary sheeting, shoring and bracing to protect the work and adjacent property; all pumping necessary to keep the trenches free of water while the sewer is being laid and to keep all service, collection and outfall lines in use during construction; protecting and restoring, if damaged, to their original condition, all existing pipe, conduits, culverts, telephone or electric circuits, fences, buildings, trees, and all other public or private property where work is done; removing after completion of all sheeting, and disposal as directed of all excess and unsuitable material not needed; all backfilling, tamping, compacting, flushing, and refilling after settlement of all trenches, and restoring to the original surface all streets, alleys or private rights-of-way.

10.2 Method of Excavation: Excavation shall be made in open cut with vertical sides and width as follows: For sewers 12-inch or less in diameter, 24-inch wide; 15-inch or over, 12-inch greater than the inside diameter of the sewer and for manholes a diameter 12-inch larger than the outside of said manhole base.

The depth of the trench shall be figured from the surface of the ground to the flow line of the pipe. The bottom of the trench shall be excavated and shaped so as to give a full bearing for the lower third of all pipes. No allowance will be made for excavation for bells.

If the bottom of the trench is in rock, the excavation shall be carried six inches below grade, backfilled and thoroughly tamped with earth, sand, or chat. The cost for this excavation shall be included in the unit price bids as provided in the bid form and will not be considered in calculations of depth of work. Bedding for VCP shall conform to WPCF Manual of practice No. 9-Class B-compacted granular bedding with tamped backfill.

Precaution must be made to prevent slides and cave-ins. Tight sheeting shall be provided to maintain the sides and bottom of the trench in wet, caving, or flowing ground. Sloping side of the trenches will be permitted only with written approval of the Engineer and then no extra shall be allowed for the extra excavation. Safe access shall be provided to all private or public property along the line of work, with no allowance for extra pay for the same.

Excavation for all structures shall be figured on a basis of vertical sides, and a size two feet outside of the outside edge of all footings. No allowance will be made for sheeting, dewatering, or furnishing and placing ballast if found necessary or for necessary backfilling. All other specifications for excavation herein contained shall apply.

10.3 Excavation in Advance of Construction: The amount of trench excavated approximately to grade shall not exceed 150 feet and no trench excavation whatever shall be made farther than 300 feet in advance of sewer construction.

10.4 Earth Excavating: Earth excavation shall comprise all materials, wet or dry, to be excavated and removed other than those described as rock excavation. No rock classification shall be considered unless specifically mentioned in the bid forms and a bid item provided.

10.5 Rock Excavation: Rock excavation shall comprise solid rock in formations in original bed or well defined ledges more than twelve (12) inches in thickness, or detached solid masses of stone more than twenty-seven (27) cubic feet in volume, which cannot be excavated, loosened or removed by any other process other than by drilling and blasting. No soft or disintegrated rock which can be removed with a pick or jack hammer, without first drilling and blasting, will be classified as rock excavation. This classification does not preclude contractor from drilling or blasting other material at no extra charge.

All rock excavation will be included in the lump sum or unit price work for pipe and/or appurtenances in place and no extra charge will be allowed for rock excavation unless separate provision is made by the Engineer for such charges to be shown in the bid form.

10.6 Trenching, Bedding and Backfill: All excavation during its progress and after its completion shall conform to lines and grades shown in plans. Bottom of trenches shall be shaped as nearly as possible to fit the bottom one-third (1/3) of the pipe to be laid, with bell holes at the joints of all pipes so that the pipes will have uniform bearing on the ground from end to end. Should the trench be excavated to a greater depth than that shown in plans, it should be refilled to grade with well-tamped materials, not with standing that it may be necessary to bring such material from other localities to form a solid, approved bed.

10.7 Excavation Under Paving: Unless otherwise directed or authorized by the Engineer, all paving encountered in the line of trenching shall be removed and replaced. Paving shall be replaced with construction conforming in type quality and dimensions to the pavement removed, or to a higher standard. Selected backfill material shall be used and shall be sufficiently damp to be properly compacted by tamping. The backfilling shall be done in even layers, not exceeding six (6) inches in depth. The tamping shall continue until maximum compaction is obtained, or until compaction comparable to the adjacent material has been reached. When the pipeline crosses paved streets or alleys, the original cut in the pavement shall be of the same width as the trench to be excavated. After backfilling and tamping, the paving cut shall be widened by saw cut to give the new paving base twelve (12) inches bearing on solid ground on each side of the trench. The new paving over the cut shall be of the same materials as the rest of the street. All settlement in paving shall be replaced during the period of construction. Sidewalks or curbs across the line of the trench shall be tunneled where such tunnels will be less than 8 feet long. If a curb, gutter or sidewalk is damaged, the entire section, stone, or block shall be replaced in a first-class manner and of same material as the damaged part. Utilize Oklahoma Department of Transportation specifications on asphalt, AC and PCC paving.

10.8 Tunneling: Tunneling will be permitted wherever it is convenient to do so, provided the length of any tunnel shall not exceed one-half of the depth of the trench at the point where the tunnel is constructed, and provided that in no case shall the tunnel length be more than eight (8) feet unless special permission is given by the Engineer. Earth or sand backfill shall be thoroughly tamped into the tunnel from the open trench at the ends. If tunneling is required or directed by State or Federal regulations for such as highway crossings or if it is the regulation of a railroad to require tunneling for a crossing, such tunneling shall be performed in strict accordance with such rules and regulations and without additional cost to the Owner. Tunneling will also be required where specifically

provided for on the plans and/or in the bid form.

11.0 DEWATERING TRENCHES AND EXCAVATIONS:

Equipment shall be provided and maintained to furnish satisfactory drainage for all excavation and trenches. All ground water infiltration, surface or storm water that may enter the excavation, shall be removed for the proper construction and protection of the work.

12.0 HIGHWAY AND RAILROAD CROSSINGS:

All highway and railroad crossings shall conform with the plans and shall fulfill requirements of the State Department of Transportation and/or the owner of the railroad. The contractor is obligated to inform the appropriate agency(ies) or office of intended construction and he shall be solely responsible for maintenance of such crossings in good condition under terms of the required maintenance bond. Utilize Oklahoma Department of Transportation specifications on asphalt, AC and PCC paving.

13.0 CONCRETE CRADLE AND COVER:

Whenever the cover over the sewer pipe is less than two (2) feet, or when the pipe is located in stream beds or such other locations that it might be damaged or displaced by floods or other means, the pipe shall be enclosed in concrete as shown on plans.

14.0 UNDERGROUND OBSTRUCTIONS:

The sewer lines or improvements may cross existing water lines, gas lines, telephone cables, power cables and other buried obstructions. It shall be the contractor's responsibility to, 1) notify appropriate owner(s) of buried facilities prior to excavating nearby; 2) exercise extreme care in excavating around all obstructions and protecting same to avoid damage; 3) hand excavating around obstructions in advance of machine excavation to avoid damage; 4) protect and support buried obstructions where, in the opinion of the Engineer, it is not necessary for the contractor to relocate the obstruction; and 5) make repairs and restore as necessary to as good conditions as when found. All sewer and water crossings or parallel lines shall be in accordance with ODEQ Water Pollution Control Construction Standards, 252:655-9-1 as amended.

15.0 CONNECTIONS TO OTHER SEWERS OR APPURTENANCES:

Connecting of sewers or appurtenances to other sewers or appurtenances shall be made in accordance with the plans. The work shall be done in a workmanlike manner in such a way as not to damage any of the structures involved. No sewer shall project beyond the inside wall line of other sewers or of sewer appurtenances.

16.0 SEWER GRADES:

The grade line shown on the plans is the elevation of the invert or flow line of the sewer. The grade line shall be established in the trench by use of a Laser beam instrument.

17.0 PIPE PROTECTION:

During the process of laying, and before pipe is backfilled, it shall be protected from injury due to blasting, handling shoring materials, careless backfilling or any other means, and when pipe laying is not in progress the upper end of the pipe shall always be closed by an approved stopper plug.

18.0 PIPE LAYING:

18.1 General: This section covers the actual placement and installation of the sewer pipe, fittings, couplings and valves in the trench or excavation. Only competent persons knowledgeable in laying the type of pipe specified shall be employed on this phase of work.

The pipe, fittings and appurtenances shall be placed in the trench with care. Under no circumstances shall the pipe or other materials be dropped or dumped into the trench nor dragged along the trench bottom.

18.2 Vitrified Clay Pipe (VCP): Installation of VCP, fittings and appurtenances, shall conform to the latest requirements and guidelines as published in the National Clay Pipe Institute Handbook - Clay Pipe Installation. Competent persons and suitable equipment necessary for the installation of VCP shall be used at all times.

18.3 Polyvinyl Chloride (PVC) Pipe: Installation of PVC pipe, fittings, couplings and appurtenances shall conform to the latest revisions of ASTM D-2321 and for the laying conditions and materials found at the construction site. All fittings and couplings must be of the same manufacturer. Accessory and specialty items must be compatible with pipe and fittings to be laid. Manufacturers instructions for making up couplings and connections must be followed in all detail to assure a quality end product.

18.4 ABS Pipe: This pipe system shall be installed in strict conformance with manufacturers instructions and recommendations, using fittings, couplings and appurtenances as supplied by a single manufacturer.

18.5 Cast Iron Pipe (CIP) and Ductile Iron Pipe (DIP): CIP and fittings shall conform with latest revision of Federal Specifications WWP 421. DIP fittings shall comply with latest revision of ASA A 21 51-76, Class 2. The pipe shall be designed for: 1) a minimum working pressure of 200 psi, or as shown on plans; and 2) physical properties shall be equal to "18/40" iron unless otherwise specified on plans.

Procedure for making up joints shall be those recommended by the manufacturer. Cutting of CIP shall be done in a workmanlike manner by means of mechanical cutters. Except where necessary in making connections or as authorized by the Engineer, pipe shall be laid with the bells facing in the direction of laying. When CIP is laid above the land surface, it shall be supported on piers, as detailed on the plans. Where connections are made between CIP and other type pipe, the connections shall be made in a thorough and workmanlike manner using proper specials and fittings to suit the actual conditions.

19.0 JOINTS AND COUPLINGS:

All joints, couplings and connections shall be made in a thorough and workmanlike manner to conform with the manufacturer's recommendations for the type of pipe being laid.

Particular attention will be given to the cleaning of all facings and surfaces to be joined or connected to assure a quality tight fit. For solvent weld joints or connections the specific manufacturer's recommendations will be followed in all instances.

20.0 BACKFILL:

20.1 General: Sewer lines must be backfilled so that no strain is placed on the pipe and to prevent movement of the pipe. Backfill material selection is critical during each stage of backfill.

20.2 Center Loading: After laying of the pipe is completed, it shall be center loaded, by hand, with select material to prevent movement of each pipe section during testing and/or final backfilling.

20.3 Minimal Backfill Criteria - Material Classification: To ensure maximum installation quality, the Contractor will conform to the following procedures based on backfill material being used.

20.3.1 Class I Material: Place Class I material to the spring line of the pipe but 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 material, little care need be taken and no compaction is necessary in placing the initial backfill material if Class I material is used. If Class II or III material is used above the spring line, achieve compaction consistent with 20.3.2, and 20.3.3, below, depending upon the material used. Where unstable trench walls exist because of migratory materials such as water-bearing silts or fine sand, take care to prevent the loss of side support through the migratory action.

20.3.2 Class II Material: Place Class II material to the spring line of the pipe and compact by hand or mechanical tamping. However, in the initial stage of placing this material, take care to ensure that sufficient Class II 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 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 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 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. With similar trench moisture conditions, puddle or flood backfill materials to achieve consolidation except during freezing weather. Place the initial backfill to provide a 9-inch cover over the top of the pipe, then puddle or flood. Allow time for the puddled or flooded mass in each layer to solidify until it will support the weight of a man. Apply only enough water to give complete saturation of the haunching and backfill material.

Drain off excess water or it will retard the drying and consolidation of the haunching and backfill material.

20.3.3 **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 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 under 20.3.2 above, using hand or mechanical tamping, but achieve a minimum of 90 percent Standard Proctor Density.

20.4 **Final Backfill:** After carefully placing initial backfill, the final backfilling may be done with equipment. The materials should not contain large lumps or boulders that might damage pipe or hinder compaction. Final compaction may be obtained by using water and/or compaction equipment, depending on type of backfill material used. Heavy mechanical compaction equipment should not be used unless there is a minimum of 5 feet of cover. The backfill material shall be neatly graded off to a crown slightly above original ground elevation. All spoil material shall be removed and work site left in a neat condition.

It is permissible to use excavated material as final backfill if it does not contain large stones, frozen clumps of dirt, etc. Final backfill shall be of compaction comparable to adjacent material.

20.5 **Testing:** To meet specified compaction requirements, an Engineer approved testing laboratory will perform standard density tests, in accordance with ASTM-D698, as amended, and moisture content, at the following frequencies:

- | | |
|--------------------------------|--------------------------------------|
| 1. Backfill trenches for pipe: | Each 1,000 linear feet of trench |
| 2. Other areas: | Each lift-station site |
| | Each Fourth Manhole per Owner's rep. |

Materials or workmanship which fail to meet specification requirements shall be reworked and retested until such requirements are met. The Contractor shall pay for all compaction testing and in case of failure, for retesting.

21.0 **MANHOLES:**

Manholes shall be built at each location shown on the plans and in the form and dimensions shown on the detail drawings. Materials for manholes may be standard manhole brick, cast-in-place concrete or manhole made from precast circular segments conforming to latest revision of ASTM C-478 and/or ASTM C-76.

Manhole accessories such as rings and covers shall be furnished as shown on detail drawings. All covers shall have continuous, even bearing frames so as to avoid rocking. Each manhole cover shall be solid and furnished with a concealed pickhole for removing the cover with a pick or other tool. There shall be a clean opening through the cast iron ring of at least twenty-two (22) inches.

The manhole base shall be at least 16-inches larger diameter than the barrel and consist of at least six (6) inches of 3,000 psi concrete below the flow line laid at least twenty-four (24) hours before the vertical work is started. The base shall be monolithically poured on poured-in-place manholes. Split tile inverts shall be used through the manholes wherever possible. The shaping of the flow channels shall be smooth and done with a suitable template or with pipe sections. The concrete bottom of the manhole shall be given a four (4) inch slope from the wall to the sewer channel.

The invert shall be built after the manhole is completed on top of the six-inch concrete base and shall have a depth of one-half the diameter of the sewer pipe plus four-inch slope to the wall. The manhole shall be constructed to a height so that: 1) The cover will be flush with street or alley paving; or 2) cover is six (6) inches above surrounding ground level in fields; or 3) at a level specified on the plans which is above the expected flood plain elevation.

Per OSDH Standards, the minimum inside diameter of manholes shall be 48-inches. Manholes less than 4.5 feet deep shall have the full diameter extending from top to bottom of the manhole.

22.0 LAMPHOLES:

Lampholes shall be constructed of materials specified at locations shown on the plans and the detail drawings thereof.

23.0 TESTING:

23.1 General: All materials used by the contractor must meet the appropriate material specifications as listed in Section S - 1.01 b of these specifications.

23.2 Alignment and Deflection: After the lines and manholes are completed all new linework shall be checked for alignment by the Contractor under supervision of the Engineer. The sewer pipe will be checked using a flashing light in the line at one manhole which shall show a full round view of the inside of the pipe at the next adjoining manhole. In addition, PVC, Truss and ABS pipe shall be tested for deflection after completion. This test shall consist of pulling a mandrel through the pipe. The allowable deflection shall not exceed five (5) percent of the internal diameter of the pipe.

23.3 Infiltration/Exfiltration: See page (infiltration) of ground water into the VCP sewer line and manholes shall not exceed 200 gallons per 24 hours per inch diameter per mile of the sewer pipe.

Infiltration of ground water into PVC, or ABS pipe sewer lines and manholes shall not exceed 100 gallons per 24 hours per inch diameter per mile of sewer. All lines shall be tested for infiltration/exfiltration, OSDH Standards Section 21.32.

23.4 Air Testing: An air test may be required by the Engineer in lieu of or in addition to infiltration test on PVC, ABS and/or Truss pipe sewer lines. When air test is performed, the minimum time requirements for exfiltration air testing for a 0.5 psig pressure drop from 3.5 psig to 3.0 psig shall not be less than that time shown in the following table, per 400 ft. of length, ASTM C-828-76T, as amended.

<u>Pipesize</u>	<u>Time</u>
4-inch	2.5 minutes
6-inch	4.0 minutes
8-inch	5.0 minutes
10-inch	6.5 minutes
12-inch	7.5 minutes
15-inch	9.5 minutes
21-inch	10.5 minutes

Air testing is to be paid for by the Contractor.

24.0 METHOD OF MEASUREMENT AND PAYMENT:

24.1 Sewer Lines: Pipe sewers shall be measured in linear feet along the center line of the sewer actually laid. On sewers 12-inch in diameter and less, no deductions will be made for standard manholes. On sewers larger than 12-inch in diameter, deductions will be made for all manholes and other structures. Where sewers are classified for payment according to the depth of cut, measurements of depth will be made from the original ground surface to the flow line grade of the sewer, and will be made at regular 25-foot stations.

24.2 Manholes: Manholes will be measured on a vertical-foot basis. Measurement will be from the finished flow line to the top of the cast iron ring. No allowance shall be made in the depth for the concrete base.

24.3 Specials and Incidentals: Specialty items and incidentals will be measured separately if identified on the bid schedule, otherwise they will be considered as part of other major items.

24.4 Payment: The Contractor will be paid on a unit price basis. The quantities listed in the Bid Schedule are not guaranteed and are listed only for the purpose of comparing bids. Payment will be made for the actual quantities constructed or installed, whether they are more or less than the listed quantities. The quantities will be measured as specified hereinafter.

Items are not considered complete and eligible for payment unless all backfilling, restoration and cleanup has been accomplished.