

## SECTION 02731

### SANITARY SEWER COLLECTOR LINES AND FORCE MAIN

#### PART ONE - GENERAL

##### 1.1 DESCRIPTION

- A. Work included: Furnish all labor, materials, tools and equipment necessary to install, backfill and test all sanitary sewer collector lines and associated structures in accordance with the Drawings and as specified herein.
- B. Related work specified elsewhere:
1. Clearing and Grubbing - SECTION 02110
  2. Rock Excavation - SECTION 02230
  3. Erosion and Sediment Control - SECTION 02270
  4. Stream and/or Highway Crossings – SECTION 2310
  5. Installation of Water Lines and Sanitary Sewer Lines by Horizontal Directional Drilling (HDD) Methodology – SECTION 02670
  6. Seeding and Mulching - SECTION 02900

##### 1.2 QUALITY ASSURANCE

- A. Qualifications of manufacturers: Products used in this Work shall be produced by manufacturers regularly engaged in the manufacture of similar items and with a history of quality production acceptable to the OWNER.
- B. Qualifications of installers: Use experienced workmen to ensure proper installation of the products specified herein. In the acceptance or rejection of installed Work, no allowance shall be made for the lack of experience on the part of the workmen.

##### 1.3 SUBMITTALS

- A. Shop drawings: As a minimum, the following shop drawing information shall be submitted to the OWNER for review and approval:
1. Complete bill of materials to be provided for the work described under this Section.
  2. Manufacturer's catalog cuts for all materials to be provided under this Section.

##### 1.4 RESPONSIBILITY FOR MATERIALS

- A. Material furnished by CONTRACTOR: The CONTRACTOR shall be responsible for all material furnished by him and shall replace at his own expense all such

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material found defective in manufacture or damaged in handling after delivery by the manufacturer. This shall include the furnishing of all materials and labor required for the replacement of installed material discovered defective prior to the final acceptance of the work.

- B. Material furnished by OWNER: The CONTRACTOR'S responsibility for material furnished by the OWNER shall begin at the point of delivery to CONTRACTOR. Materials already on the site shall become the CONTRACTOR'S responsibility on the date of the award of the Contract. The CONTRACTOR shall examine all material furnished by the OWNER at the time and place of delivery to him and shall reject all defective material. Any material furnished by the OWNER and installed by the CONTRACTOR without discovery of such defects will, if found defective prior to final acceptance of the Work, be replaced with sound material by the OWNER. The CONTRACTOR, however, shall, at his own expense, furnish all supplies, labor and facilities necessary to remove said defective material and install the sound material in a manner satisfactory to the OWNER.

## 1.5 PRODUCT HANDLING

A. Handling of materials:

1. All materials furnished by the CONTRACTOR shall be delivered and distributed by the CONTRACTOR. Materials furnished by the OWNER shall be picked up by the CONTRACTOR at points designated by the OWNER and hauled to and distributed at the site.
2. Pipe, manholes, etc., shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.
3. In distributing the material at the site of work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench.
4. Pipe shall be so handled that any coating and lining shall not be damaged. If, however, any part of coating or lining is damaged, repair shall be made by CONTRACTOR at his expense in a manner satisfactory to the OWNER.

- B. Storage of materials: The CONTRACTOR shall be responsible for the safe storage of material furnished by or to him, and accepted by him, and intended for the Work, until it has been incorporated in the completed Project. The interior of all pipes, fittings and other accessories shall be kept free from dirt and foreign matter at all times.

- C. Damaged material: Any material furnished by OWNER, that becomes damaged by the CONTRACTOR after acceptance, shall be replaced by CONTRACTOR at his expense.

## 1.6 WARRANTY

All equipment and materials supplied under this Section shall be warranted to be free from defects in materials and workmanship for a minimum of one (1) year following acceptance by the OWNER.

## **PART TWO - PRODUCTS**

### 2.1 STRUCTURAL REQUIREMENTS

- A. Structural Design of Sewers: Structural design of sewers shall conform to the methods given in the ASCE Manual Number 37 - "Design and Construction of Sanitary and Storm Sewers". In the use of this manual, backfill weight shall equal 130 pounds per cubic feet and  $K_u$  shall be 0.130. The live load for sewers subject to traffic effect shall be determined from a minimum wheel load equivalent to an H-20 loading (16,000 pound wheel load). An allowance of fifty percent (50%) of the design wheel load shall be added for impact. A minimum wheel load of 10,000 pounds per wheel shall be applied to all other sewers not subject to traffic load. Ultimate lengths of rigid pipe shall be measured in terms of ultimate three-edge bearing strength divided by a safety factor of 1.5. Allowable load shall be working strength times a 2.5 load factor for concrete cradle or arch bedding and times a 1.9 load factor for Class B gravel bedding condition.

### 2.2 SEWER PIPE AND MATERIALS

- A. General: All sanitary sewer pipe installed on this project shall conform to the type, classification, and sizes as shown on the Drawings and as described in the Specifications. The pipe materials listed below have been approved for use. However, the acceptability of specific pipe material for use within a specific soil type or condition shall be determined by the PSA Director on an individual basis at the time of design review of the Contract Documents. The type or types of pipe allowed for use on any specific project shall be shown on the approved construction drawings.
1. One type and class of pipe shall be used from manhole to manhole unless approved in writing by the PSA Director. Any changes in size, kind, type and class of pipe being installed shall be made at manholes only.
  2. Pipe plugs shall be of the same material as the pipe. The cost of furnishing and placing pipe plugs shall be included in the unit prices bid for furnishing and installation of pipe and pipe stubs.

B. Pipe Material:

1. Ductile Iron Pipe: Ductile iron pipe shall be centrifugally cast manufactured in **SANITARY SEWER COLLECTOR LINES**

accordance with ANSI Specification A21.51, latest revision, and shall be internally lined with material specifically designed for use with sanitary sewer applications. Slip joint or mechanical joint pipe shall be used for gravity sewers. Slip joint pipe shall be designed in accordance with ANSI standard A21-50 and specified according to ANSI standard A21-11. Class 51 pipe shall be minimum strength used in all sewer applications. May only be used upon approval of PSA Director. Gaskets shall be furnished by the manufacturer and installed in accordance with his recommendations. Ductile iron pipe shall be used in exposed pipe installations, and where approved by the PSA Director when other pipe materials are subject to crushing.

2. Polyvinyl Chloride (PVC): PVC sewer pipe shall be manufactured in accordance with ASTM Designation 3034-77 (SDR 35). Gravity sewer pipe shall be unplasticized polyvinyl chloride with integral rubber ring wall bell and spigot joints furnished in 12.5' and 20' nominal lengths. Installation of PVC gravity sewer pipe and fittings shall be in accordance with ASTM Designation 2321 and manufacturer's recommendations.

a. PVC sewer pipe shall be stored in accordance with manufacturer's recommendations on flat, even surfaces and shall remain racked on the pallets as delivered to the job site until such time as the trench is ready for placement of the pipe; i.e., PVC pipe shall not be strung out on the job site in excess of one day's work.

b. The PSA Director may require additional strength PVC pipe including SDR-26, SDR-21, DR-18 or concrete encasement of SDR-35, or both where depth exceeds twelve feet (12') and where additional protection is required for the pipe.

3. PVC (Ribbed Pipe): Ultra-Rib pipe meeting ASTM F-794 with a stiffness factor of 46 may be used. Installation of both shall be in strict compliance with manufacturer's written instructions. All fittings used shall be designed specifically for pipe used and be approved for use by same manufacturer of pipe. Connections to manholes shall be made by manufacturer's recommended methods and approved by PSA Director.

4. PE Pipe: Polyethylene plastic pipe shall be high density polyethylene pipe which meets the applicable requirements of ASTM F714 Polyethylene (PE) Plastic Pipe (SDR-PR) based on Outside Diameter, ASTM D1248, ASTM D3550.

a. All pipe shall be made of virgin material. No rework except that obtained from manufacturer's own production of the same formulation shall be used.

b. The pipe shall be homogenous throughout and shall be free of visible cracks, holes, foreign material, blisters, or other deleterious

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faults.

c. Dimension Ratios: The minimum wall thickness of the PE pipe used as gravity sewer line shall be a minimum of SDR 17. Additional strength pipe material may be required for deep sewer lines.

d. For sewer installations pipe material color shall be white, black or whatever is specified with interior of pipe having a light reflective color to enhance viewing for television inspection.

e. PE pipe for sewer installations of four inch (4") diameter or larger shall be straight pipe sections of 40' or shorter. Rolled pipe is not approved for use in PSA systems.

f. All service line connections to PE pipe shall be made using a fused service saddle. No direct tap to PE pipe shall be permitted.

g. PE pipe shall be assembled and joined at the site using the butt-fusion method to provide a leak proof joint. Threaded or solvent-cement joints and connections shall not be permitted. All equipment and procedures used shall be used in strict compliance with the manufacturer's recommendations.

h. Butt-fused joint shall be true alignment and shall have uniform roll-back beads resulting from the use of proper temperature and pressure. Joint shall be allowed adequate cooling time before removal of pressure. Fused joint shall be watertight and shall have tensile strength equal to that of the pipe. All joints shall be subject to acceptance by the OWNER and/or his representative prior to insertion. All defective joints shall be cut out and replaced at no cost to the OWNER. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than ten percent (10%) of the wall thickness, shall not be used and must be removed from the site. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, any section of pipe having other defects such as concentrated ridges, discoloration, excessive spot roughness, pitting, variable wall thickness or any other defect of manufacturing or handling as determined by the OWNER and/or his representative shall be discarded and not used.

5. Sanitary Sewer Force Main: Sanitary sewer force main shall be constructed of SDR-21 PVC pipe, AWWA C900 DR-14 PVC pipe or Class 51 ductile iron pipe with sewer specific lining and joined with push-on joints as indicated on Drawings. High-density polyethylene (HDPE) DR-11 pipe is also acceptable for sewer force mains. HDPE pipe joints shall

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be connected using heat fusion, electrofusion, thermal welding and flanges in conformance with manufacturer's recommendations. To facilitate future locating of PVC or HDPE sewer force mains, a 12 gauge solid copper wire shall be laid with pipe and in metal to metal contact with all fittings, valves, and service connections. Wire splices shall be made with a minimum of six tight twists of stripped (bare) wire. Where sewer force mains are greater than six (6) feet in depth, wire shall be brought to the surface every one hundred (100) feet and placed in a standard water meter box or approved junction box. All valves, fittings, and other related appurtenances shall be rated for a minimum working pressure of 150 lbs. per square inch (PSI). Sewer force mains using PVC pipe shall be C900 D-18 PVC for four inches (4") and larger in diameter and SDR-21 PVC pipe for force mains two and three inches (2" & 3") in diameter.

- C. Air Release Valve: Force main vacuum/air release valve shall be Crispin Model S20 or equal with a 1/2" orifice and 2-inch screened inlet furnished with backflushing attachment.
  
- D. Bedding: Bedding, haunching, and initial backfill construction shall be in accordance with the manufacturer's recommendation. All PVC pipe shall be bedded in compacted granular material. Haunching of pipe shall be accomplished with compacted granular bedding, which shall extend at minimum to the spring line of the pipe barrel. Granular material shall be well-graded, crushed stone meeting the requirements of VDOT gradation 57 or 68 stone.
  
- E. Service Connections: Polyvinyl chloride (PVC) sewer pipe conforming to ASTM Designation 3034-77 (SDR-35); or Schedule 40 PVC pipe conforming to ASTM Designation 1785-76 shall be used between the sewer main and the cleanout. SDR-21 PVC pipe shall be used where additional strength pipe is required.
  - 1. The PVC SDR 35 joints shall be made with bonded-in-bell elastomeric seal. Schedule 40 PVC joints shall be made with a solvent weld bell and spigot joint using PVC pipe cleaner and glue as supplied by the manufacturer.
  - 2. No-hub pipe shall not be permitted.
  - 3. There shall be no bends in service line from main to cleanout except as indicated on approved PSA Sewer Detail Drawings.
  - 4. Branch sewer force main (service or public force main) connections to a primary force main (public force main) shall include an isolation valve and check valve on the branch sewer force main.
  
- F. Hydraulic Cement Mortar and Gravel: Cement mortar and grout shall consist of a mixture of hydraulic cement, fine aggregate, water and admixture.

1. Cement shall be Portland Cement Type I or II.
2. Fine Aggregate Grade C shall be used.
3. Water used with cement or lime shall be clean, clear, and free of oil, acid, salt, alkali, organic matter or other deleterious substances.
4. Admixtures shall conform to Section 217 of VDOT Specifications.
5. Hydraulic cement mortar and grout shall contain from 3 to 7 percent entrained air. Air entrained cement may be used in lieu of plain cement and air entraining admixture. Mortar and grout shall be mixed with a minimum amount of water necessary to obtain required consistency. Mortar and grout shall be properly cured and protected for not less than three (3) days.
  - a. **Cement Mortar** shall consist of one part hydraulic cement, 2 1/2 parts fine aggregate by weight and sufficient water to produce a stiff mix. Grade C Fine Aggregate shall be used.
  - b. **Non-Shrink Mortar** shall consist of one part hydraulic cement, 2 1/2 parts fine aggregate by weight, a set retardant or other admixture which will reduce the amount of required mixing water and sufficient water to produce a stiff mix. Grade C Fine Aggregate shall be used.
  - c. **Cement Grout** shall consist of one part hydraulic cement, 2 parts fine aggregate by weight and sufficient water to produce a free flowing mix. Grade A fine aggregate shall be used.
- c. **High Strength Grout and Mortar** shall consist of a prepackaged, non-shrink hydraulic cement mixture with a 7-day compressive strength of at least 4,000 psi when tested in accordance with ASTM C109 and with a 7-day bond strength of at least 1,000 psi when tested in accordance with VTM-41, except that epoxy will not be used to develop the bond.

### **PART THREE - EXECUTION**

#### 3.1 GENERAL REQUIREMENTS

- A. Contractor shall provide all labor, equipment and material and perform all work required for installation of sewer lines, manholes and appurtenances as outlined on Drawings and on Specifications, all of which become part of the Contract Documents.
- B. All construction of sanitary sewer mains and appurtenances in PSA systems shall be in strict accordance with plans and specifications prepared as part of the

Contract Documents and as approved by the PSA Director. All materials shall be new and unused. Prior to construction of the approved sanitary sewer, Contractor shall provide field stakeout including adequate line and grade stakes in order that sanitary sewer and appurtenances may be constructed in accordance with Contract Drawings.

- C. Engineer or surveyor shall prepare legible cut sheets at all manholes and midpoints of pipe between manholes indicating all pertinent construction data to include sewer service connection locations, concrete encasement or cradle, manhole invert and top (frame and cover elevations). Three sets of all cut sheets shall be submitted to the PSA for review.
- D. If any deviation is contemplated in location or line grade of any sewer, structure or appurtenance as shown on the Contract Drawings, a revision of the Drawings showing the proposed deviation shall be submitted to the PSA Director for review and approval before any changes are constructed. Design Engineer of Record must concur in any revision of drawings. Minor field changes may be made with approval of PSA field inspector.
- E. Contractor shall contact Miss Utility at 1(800) 552-7001 at least 48 hours prior to any excavating operations. Contractor shall be responsible for determining exact location and depth of all underground utilities, which are shown on the Drawings or marked on the ground. Contractor shall exercise care in determining the location of any underground utility to avoid damaging or disrupting utility service. If Contractor inadvertently damages any utility line or cable, he shall be responsible for immediately contacting the affected utility company and repair, or have repaired, the damage at his expense. Contractor shall at all times be subject to the provisions of the Virginia Underground Utility Damage Prevention Act.
- F. Should Contractor discover and/or damage any underground utility facilities, which are not shown on Drawings and/or marked on the ground, Contractor shall promptly notify utility owner and Owner's project representative. Relocation of any utilities shall be approved and coordinated with the appropriate utility owner.

### 3.2 EXCAVATION

- A. Excavation shall conform to the lines and grades shown on the plans. The width of excavation for trenches shall be a minimum of 24" plus the outside diameter of the pipe. Excavation shall not be carried below the established grades and any excavation below the required level shall be backfilled with suitable, thoroughly compacted granular bedding material. Contractor shall install all sheeting, bracing, and shoring necessary to perform the work, to protect existing structures and all excavations as required under Virginia OSHA Regulations. Compliance with provisions of the Overhead High Voltage Line Safety Act is required.
- B. Dewatering equipment shall be sized to maintain the trench in a satisfactory dewatered condition suitable for pipe laying and backfilling. Pipe laying will be

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permitted only where the depth of water is maintained below the bedding material. Bedding material shall not be placed on unstable trench material.

- C. Not more than one hundred fifty feet (150') of trench shall be opened in advance of the completed pipe laying. Trench walls shall be protected in accordance with current OSHA regulations. Excavation at manholes and similar structures shall provide a minimum clearance of eighteen inches (18") between the outer surface of the structure and the embankment or sheeting.
- D. Rock excavation: Rock excavation, when needed, shall be defined and performed in accordance with Section 02230 - ROCK EXCAVATION. All blasting operations shall be in accordance with existing ordinances and regulations. Where excavation is made in fractured rock or boulders, no rock shall remain nearer than six inches (6") to any part of the sewer pipe when laid, nor shall rock project beyond the lines and grades of masonry structures. No blasting shall be performed within forty feet (40') of a tested or completed sewer. The ends of sewers adjacent to blasting shall be covered to avoid receiving debris.
- E. Wherever foundation material is unsuitable, it shall be excavated until a stable foundation is achieved. Granular material, VDOT stone type 21A, shall then be placed in six inch (6") layers and compacted until the trench bottom has been stabilized. Standard granular pipe bedding material shall be placed in accordance with Section 2.2-C of these Specifications.

### 3.3 BACKFILL

- A. Backfill shall begin at the top of the standard granular bedding and shall be placed in six inch (6") layers for the initial one foot over the pipe and shall be thoroughly tamped to ninety-five percent (95%) of the maximum theoretical compaction density as determined by a standard proctor on the material. Remainder of the backfill shall be in two foot (2') layers properly tamped.
- B. Backfill material shall be free of perishable material, frozen clods, sticky masses of clay and other unsuitable matter. Rock pieces larger than one inch (1") shall not be used in the backfill which is within two feet (2') of the pipe. No rock over five inches (5") in its greatest dimension shall be used in any backfill. Manholes and cleanouts shall be backfilled in same manner as the sewer pipe. Backfill material shall not be dropped directly on the pipe from a height greater than three feet (3').
- C. Backfill in areas not subject to vehicular traffic shall be compacted to such a degree that any subsidence will not be objectionable or detrimental to normal use. Backfill and replacement in existing or proposed roads shall be executed in full accordance with the requirements of the Virginia Department of Transportation Standards. All surplus materials excavated, but not used in backfill, shall be disposed of in approved areas provided by the Contractor.

### 3.4 PIPE INSTALLATION

- A. All gravity sewer mains, service laterals and force mains shall have a minimum cover of three feet (3') as measured from top of pipe to finish grade. The PSA Director may require additional cover as needed for pipe protection. Sewers, which have a depth of cover less than three feet (3'), shall be approved and installed as per PSA Director's written instructions.
- B. All pipe and fittings shall be carefully handled with non-metallic slings or other approved devices to prevent damage to protective coatings or joints. Lifting equipment shall be satisfactorily rated to handle the pipe sizes used. Pipe shall not be dumped or dropped into trench. Each section of pipe shall be thoroughly inspected for defects before being lowered into the trench.
- C. Pipe shall be laid true to line and grade with bells upstream and shall be jointed together such that the completed pipe will have a smooth invert. Pipe shall be pushed home by hand. The use of equipment (i.e. backhoe) shall not be permitted. Cutting of pipe shall be performed by sawing. Standard bedding shall be shaped to the curvature of both the bell and barrel of the pipe. The trench shall be kept free of water while the work is in progress. The ends of the pipe shall be cleaned so that proper joints can be made. As the work progresses, the interior of the pipe shall be cleared of dirt, cement, or other deleterious material.
- D. Except as required for use of a laser level, exposed end of all pipe and fittings shall be fully closed to prevent earth, water or other substances from entering pipe. Trench shall be completely backfilled at end of each workday. When new pipe is tied into an existing manhole, new pipe shall be plugged with a standard sewer plug and shall remain plugged until all new line(s) that will flow to existing manhole have been completed, tested, and accepted.

### 3.5 BY-PASS PUMPING DURING SEWER LINE INSTALLATION

- A. Contractor shall be responsible at all times for maintaining sewer flows during project to include any required by-pass pumping of wastewater between manholes during installation of sewer lines and/or manholes. By-pass pumping system shall provide continuous full conveyance and containment of wastewater present during the work and shall not surcharge the upstream (suction) manhole by more than two (2) feet above the manhole invert.
- B. Contractor shall furnish all pumps, pipe, fittings, plugs, etc. required to perform by-pass pumping operation. Backup or replacement pumping equipment shall be available to the project site to ensure that continuous by-pass pumping can be provided. All pumping equipment shall be provided with sufficient mufflers to prevent excessive noise.
- C. Authorization from the ENGINEER shall be required to utilize by-pass pumping overnight or during the weekends. In the event it is not possible to temporarily reconnect sewer lines at the end of the work day or over week-ends, Contractor

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shall be responsible for continuous attendance, operating and maintaining by-pass pump operations around the clock to insure continued conveyance of existing wastewater flows.

- D. By-pass pumping shall not be diverted to another sanitary sewer system without the approval of the ENGINEER.
- E. A by-pass pumping plan shall be submitted for approval prior to beginning the work. This plan shall outline the by-pass pumping procedures and include the capacity and components of all by-pass pumping equipment.

### 3.6 TRENCH DEWATERING DURING SEWER LINE INSTALLATION

- A. All ground water which may be found in the trenches and any water which may get into them from any cause whatsoever shall be pumped or bailed out so that the trench shall be dry during the pipe laying period. No water shall be permitted to reach concrete until it has set sufficiently. All water pumped from the trenches shall be disposed of in a manner satisfactory to the OWNER. CONTRACTOR shall provide at least two (2) pumps for each trench opened in wet ground and at the same time, he shall have one (1) pump in reserve.
- B. If, during any time that CONTRACTOR is permitted to lay pipe in a trench containing unavoidable trench water and construction is interrupted for any reason, the open ends of pipe shall be closed by watertight plugs or caps, or other means approved by the OWNER. In any case, such protection shall be provided when work is suspended overnight or on weekends and holidays, regardless of the condition of the trench with respect to water at the time that the work is suspended.
- C. CONTRACTOR shall be responsible for the protection of all structures, including pipes and manholes, against any tendency to float under conditions of high water, whether due to high ground water or flood conditions on the project site. It shall be the responsibility of the CONTRACTOR to take whatever steps may be required, including the installation and operation of pumps and pumping systems, well points or relief devices, to prevent any structure from floating during construction.
- D. Cost of the necessary pumps, well points or other appurtenances required to prevent flotation shall be included in the unit prices bid in the Proposal for the various bid items, and no extra compensation shall be allowed for such work. Any damage which may occur to any part of the work as the result of the flotation effect of ground or flood waters shall be repaired in a manner fully satisfactory to the OWNER, at no additional cost to the OWNER.
- E. CONTRACTOR shall provide and place all necessary flumes or other channels of adequate size to carry temporarily all streams, brooks, stormwater or other water, which may flow along or across the lines of the pipe line. All flumes or channels thus utilized shall be tight so as to prevent leakage into the trenches. Water pumped from trenches shall be led to natural watercourses. Existing sewers shall not be employed as a drain for

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the removal of dewatering wastes.

### 3.7 SEPARATION OF WATER LINES AND SANITARY SEWERS

A. General - The following factors shall be considered to provide adequate separation:

1. Materials and types of joints for water and sewer pipe;
2. Soil conditions;
3. Service branch connections into the water line and sewer lines;
4. Compensating variations in the horizontal and vertical separations;
5. Offsetting of pipes around manholes.

B. Parallel Installation

1. Normal Conditions - Water lines shall be laid at least ten feet (10') horizontally from a sewer line whenever possible, distance shall be measured edge-to-edge unless determined by PSA Director to be unusual conditions.
2. Unusual Conditions - When local conditions prevent a horizontal separation described above, the following construction shall be used:
  - a. Bottom (invert) of water main shall be at least eighteen inches (18") above top (crown) of sewer.
  - b. Where this vertical separation cannot be obtained, sewer shall be constructed of AWWA approved water pipe, hydrostatically pressure tested in place without leakage prior to backfilling. Pressure test shall be 30 psi.
  - c. Sewer manhole shall be made 100% water-tight construction and tested in place by vacuum testing to top of manhole cover frame without leakage for 30 minutes.

C. Crossing

1. Normal conditions - water lines crossing over sewers shall be laid to provide a separation of at least eighteen inches (18") between the bottom of the water line and the top of the sewer whenever possible.
2. Unusual conditions - when local conditions prevent a vertical separation as described above, the following construction shall be used:
  - a. Sewers passing over or under water lines shall be constructed of AWWA approved water pipe, hydrostatically pressure tested in place without leakage prior to backfill. Pressure test shall be 30 psi.

- b. Length of sewer pipe shall be centered at the point of the crossing so that joints shall be equidistant and as far as possible from water line.
  - 3. Water lines passing under sewers shall, in addition, be protected by providing:
    - a. Vertical separation of at least eighteen inches (18") between invert of sewer and crown of water line. Sewer shall be encased along its length where it is within 10' of water line.
    - b. Adequate structural support for sewers to prevent excessive deflection of joints and settling on and breaking of the water line.
    - c. Length of water line shall be centered at the point of the crossing so that joints shall be equidistant and as far as possible from sewer.
- D. Sewers or Sewer Manholes. No water pipes shall pass through or come in contact with any part of a sewer manhole.

### 3.8 SERVICE CONNECTIONS

- A. SDR 35 and schedule 40 PVC pipe lateral service connections to the sewer main shall be made by means of a commercially manufactured tee, wye, or wye branch. Service laterals may also be connected to the sewer system at a manhole using inside drop connection. A sewer cleanout the same size as the service line shall be installed in accordance with the Detail Drawings. Pipe material shall be of the same type to and including the cleanout stack.
- B. All taps to an existing manhole or pipe shall be supervised or performed by the PSA. A minimum of 48 hours notification is required by the PSA when scheduling sewer taps.
- C. Sewer service line shall be four inches (4") minimum for residential service and six inches (6") minimum for non-residential service. Sewer cleanouts shall be same size as service line and shall be installed per Sewer Detail drawing. Additional sections of pipe shall be installed behind cleanout as indicated on detail drawings to prevent conflict with other utilities generally located in this area.
- D. Sewer service connections from manhole or sewer main to the cleanout shall be installed with the same care as the sewer main. Proper excavation, slope of pipe and standard granular bedding shall be provided throughout. All gravity sewer mains and service laterals shall be air tested. For air testing procedures see Section 3.10-C.
- E. No connection shall be made to the vertical portion of a cleanout except for private force main. Refer to Sewer Detail Drawings for specific requirements including the use of Schedule 40 material.

- F. All sewer service connections or portions of sewer service connections outside of the public right-of-way or sewer easement shall be privately owned and maintained.
- G. A sampling manhole, which conforms to Detail Drawings, shall be installed on sewer service lateral for all non-residential facilities. Manholes may be installed at property line in lieu of cleanout or between cleanout at the property line and the facility. Sampling manholes shall be tested by either vacuum method or exfiltration.

### 3.9 TRAPS/SEPARATORS

- A. Grease traps, volatile liquid separators, or other such devices may be required by the PSA Director on non-residential facilities where, due to the nature of their operation, it is deemed necessary.
- B. Grease trap or volatile liquid separator is to be located externally in a manner so that all discharges from the kitchen plumbing except garbage grinders, pass through the grease trap or volatile liquid separator prior to entering the sanitary sewer; all other domestic waste water shall by-pass the grease trap.
- C. Grease trap or volatile liquid separator designs shall be reviewed on an individual basis during the plan review process. A minimum capacity of 500 gallons or 30 minutes of peak flow storage shall be provided per each grease trap.
- D. Adequate access for inspection and maintenance of grease trap or volatile liquid separator is to be provided. Owner of facility served by a grease trap or volatile liquid separator shall be responsible for proper operation and maintenance.

### 3.10 MANHOLES

- A. Only precast manhole sections shall be used. Manholes shall be constructed with manhole frames, covers and steps. Frames and covers shall be East Jordan Models 1045Z and 1040AGS or equivalent per Detail Drawings. Covers for use in areas subject to flooding and/or sewer surcharging shall have "cam bolt" locking system to secure the cover to the frame. All covers shall have a minimum of two cored pickbars for ease of lifting per Detail Drawing.
- B. Casting shall be best quality tough, gray iron, free from defects, blow holes, and other imperfections and shall meet the requirements of AASHTO Designation 306-05. The castings shall be sound, free to form and thickness, cleaned by means of sand blast and neatly finished. The material bearing surfaces shall be machine ground and finished to insure satisfactory seating. Covers shall have the words "Sanitary Sewer" cast into the top. Castings shall receive one coat of black asphaltum paint at the factory. Locations and type of manhole vents will be as indicated on the Drawings.
- C. Covers shall be furnished with means of lifting. Covers that rock under normal

load, will be rejected. Frames shall be bolt-down type, with butyl mastic sealer placed between frame and manhole. Mortar shall not be permitted. Frames shall have a nut and washer installed on top and bottom to facilitate minor elevation adjustments. The adjustment space between the bottom of the frame and the top of the manhole section shall be formed and filled with 3000 psi concrete.

- D. Steps for manholes shall be made of fiberglass construction, cast iron, or steel and shall have a plastic coating. Steps shall be spaced a maximum of 16 inches (16") and a minimum of 12 inches (12") apart. The bottom step shall be within 24 inches (24") of the bottom of the manhole.
- E. Precast concrete manholes shall consist of precast reinforced concrete sections, an eccentric conical section and a standard base section with poured uniform bottom inverts. Flat top manholes can be used only with approval of PSA Director. Where soil conditions dictate their use, expanded base section, extending a minimum of four inches (4") and a maximum of eight inches (8") beyond the outside vertical wall (riser section) of the manhole shall be used. Manhole shall be installed with steps vertically aligned over manhole bench. Access hole in flat top manhole section shall be centered over manhole steps.
- F. Manholes shall have a minimum inside diameter of four feet (4'). Manholes over fifteen feet (15') in total depth (lowest invert to top of cover) shall be 5' in diameter. Larger diameter manholes shall be provided for inside drop connections and where required by the PSA Director. Manholes larger than 5' in diameter shall have the reducing slab or reducing cone installed just below the frame or standard cone section. Manholes deeper than 20 feet shall have safety slabs installed every 10 feet.
- G. Precast base section shall be installed on a compacted stabilized foundation of bedding material foundation prepared similar to that required for the proper installation of the adjacent sewer pipe as described elsewhere in these Specifications.
- H. Precast manhole sections shall be manufactured in accordance with ASTM Designation C478, latest revision. Each section shall have not more than two (2) holes for the purpose of handling and setting. These holes shall be tapered and shall be plugged up with rubber stoppers and an approved non-shrink grout after installation. Exterior surfaces of all concrete manhole sections shall have two coats (minimum 16 dry mils) of coal tar epoxy, Koppers Co. Bitumastic 300-M or equal.
- I. A cold applied butyl mastic joint sealer manufactured specifically for the purpose shall be used to make a watertight joint between manhole sections and/or grade rings. Mortared joints are not permitted. All new manholes shall be pre-cast concrete inverts except straddle manhole. All straddle manhole and all field-constructed inverts shall be with ready mix (3000 psi) concrete and shall only be used with approval of PSA Director.

- J. Standard manhole drop connections shall be installed where indicated on the drawings. Drop connections shall conform to the Detail Drawings.
- K. The invert channels of the manhole shall be smooth and semi-circular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Invert benches shall be constructed of ready mix concrete (3,000 psi) over the entire existing bench.
- L. The invert channel shall be at least 0.75 times the diameter of the pipe in depth. The minimum difference in elevation of inverts of incoming and outgoing pipes shall be 0.10 feet.
- M. Where grade rings are required to meet specified grade, the maximum height/thickness and minimum number of rings shall be used. Cone sections and grade rings may be predrilled with matching holes to accept threaded rod installation or drilled in the field. Refer to Detail Drawings.

### 3.12 PIPE CONNECTION AT MANHOLES

- A. All new manholes shall be supplied with an approved flexible boot connection suitable for specified pipe and manhole. All rubber boots for 8 inch (8") pipe shall have a maximum flexibility of 24° in any direction from center. Boot flexibility for pipe sizes larger than 8 inch (8") shall be per the manufacturer's recommendations. Twenty inch (20") and larger pipe connections shall have the first joint located four feet (4') from the inside face of the manhole. Flexible joint manhole connection shall be as manufactured by Pres-Seal Gasket Corporation, Fort Wayne, IN; or approved equal.
- B. Manhole to pipe installation procedures shall be as follows:
  - 1. After manhole has been set to line and grade, inspect flexible connector boot for damage and clean out inside of boot. Clean surface of pipe barrel to be installed.
  - 2. Insert pipe into connector boot until end of pipe breaks plane of manhole wall and flush with manhole invert. Position pipe in center of connector.
  - 3. Install take-up clamp(s) in groove(s) at pipe receiving end of boot and tighten clamps to 60 in/lbs. of torque **PRIOR** to adjusting pipe to desired angle of deflection.
  - 4. After desired deflection angle of pipe has been achieved, install bedding and backfill material in accordance with these Specifications.

5. Grout, cement or concrete **SHALL NOT** be placed in the inside or outside of the manhole boot section. The manhole boot must provide a flexible connection.
- C. Precast manhole sections shall be manufactured for the specified size, angle and number of pipe connections required. Specialty cast manhole pipe opening and boots shall be provided when the pipe slope exceeds twelve percent (12%). Field modification or abandonment of any part of a precast manhole will not be permitted without written approval of the PSA Director. Any approved field modification(s) or repairs shall be performed by a qualified person(s) approved by the manufacturer.
- D. Inside of manholes (walls, steps, invert, pipe connections, benches) and frame and cover shall be kept clean and free of dirt, stone, mastic, trash and construction materials. Manholes shall be cleaned prior to testing.
- E. Abandonment of manholes and sewer lines shall be performed in accordance with the Detail Drawings.
- F. A rubber water stop shall be used around pipe at manhole connection of straddle manhole. Refer to Detail Drawings.

### 3.13 ACCEPTANCE TESTS

#### A. General

1. Sewers will be inspected to determine if any deviation from line and grade have occurred. Pipe alignment will be checked by illuminating interior of pipe. If pipe shows poor alignment, displaced pipe, or any defect, including a visible leak, defect shall be corrected before leak testing of the pipe. All sewer lines are subject to internal inspection and testing by closed circuit TV at PSA Director's discretion.
2. Air testing shall be used, test methods and acceptability criteria shall be in accordance with the Uni-Bell low pressure air test. Air testing of gravity lines shall be required for all types of pipe and materials.

#### B. Manhole Acceptance Tests

1. Manholes, including frame, shall be tested by vacuum testing from the top of the frame. Inflatable stoppers shall be used to plug all lines into and out of the manhole being tested including any vent line. The stoppers shall be positioned in the lines far enough from the manhole to insure testing to those portions of the lines not air tested. Vacuum tests shall be made with a vacuum of 10" Hg. The time for the vacuum to drop from 10" to 9" of Hg must be greater than 60 seconds.

2. Contractor shall furnish weirs, stand pipes, pipe plugs, water, pressure gauges, stop watches, air compressor, vacuum pump, hose and such materials and assistance as required to perform these tests. All acceptance tests shall be conducted by Contractor in the presence of a PSA Inspector.
3. Acceptance tests shall not be made until sanitary sewer, manholes and proposed sewer service connections, as shown on the approved sewer plans, have been installed, the sewer trenches (including manholes and cleanout stacks) backfilled and compacted to finished sub-grade.
4. Contractor shall schedule all acceptance tests with the project inspector at least forty-eight (48) hours in advance. No sewers or sewer service connections are to be excluded from this testing procedure.
5. Manholes which fail to maintain the stipulated vacuum for the time period specified shall be deemed to have failed the vacuum test and is unsatisfactory for acceptance by the OWNER. Repairs shall be made by replacing the butyl mastic joint sealer between the manhole sections. Coatings of any type **SHALL NOT** be applied on the inside of the manhole. Coatings of the outside of the manhole shall only be allowed upon approval of a waiver request by the PSA Director. Any manhole that fails to pass this test **shall be replaced by the Contractor at his expense.**

C. Sewer Pipe Testing Procedures

1. Whenever it is necessary to construct underdrains or place gravel under pipe lines in order to dewater trench during construction of sewers, acceptance test will not be made until any pumps, which have been used in dewatering process, have been disconnected or drains have been taken out of service.
2. Contractor shall schedule all acceptance tests with PSA Director at least forty-eight (48) hours in advance. Each section of completed sewer shall be tested. Generally, sewers will be tested from manhole to manhole. No sewer or sewer service connection is to be excluded from this testing procedure.
3. Low Pressure Air Testing Procedure - The test procedure shall be conducted in the following manner: (Vacuum test of manholes is generally inverse of low pressure air test of sewer lines)
  - a. Contractor shall thoroughly clean and remove all debris, silt, earth or other materials from the sewer prior to acceptance testing.
  - b. Proper test plugs shall be supplied and installed by Contractor. Test gauges used in air test procedure shall have a range of 0-10 psi and shall be calibrated in divisions of 0.10 psi with an accuracy of +/-

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one percent. Test gauges shall be calibrated at least once a year and the date and results displayed on the equipment including date of calibration. Calibrations shall be certified by an independent testing lab. Test gauges shall be located outside of manhole during testing.

- c. If pipe to be tested is expected to be below ground water table, Contractor shall either:
- Install a small diameter perforated vertical pipe from invert elevation of the sewer to the surface prior to backfilling; or
  - Insert a pipe probe by boring or driving into the backfilling material adjacent to the invert elevation of the pipe, and determine the depth of the ground water level above the pipe invert immediately prior to acceptance testing the sewer.
  - All gauge pressures for test shall be increased by the amount of this back pressure due to ground water over the invert of the pipe.
  - In lieu of the above water depth determination, Contractor may add three (3) psi to the gauge pressure in the test.
- d. Contractor shall add air slowly to the portion of the pipe under test until the internal air pressure is raised to 4.0 psi gauge plus the ground water pressure.
- e. As a safety precaution, no one shall be allowed in manhole after air pressure is increased in the sewer line. If the inspector suspects that the test plug may be leaking, pressure shall first be relieved before any adjustments are made to eliminate air leakage at the plug.
- f. Contractor shall allow air temperature to stabilize for at least two (2) minutes with the pipe subjected to an internal pressure of 4.0 psi by adding only the amount of air required to maintain the pressure.
- g. After temperature stabilization, the test will begin. If the internal air pressure decreases, the time required for the pressure to drop from 3.5 to 2.5 psi gauge will be observed and recorded. The time interval shall be compared with the established standards in accordance with Detail Drawings for time and length of test section for various diameters of the sewer. All pipes 15 inches or less shall be tested for a pressure drop of 1.0 psi gauge.
- h. Pipe which fails to maintain the stipulated pressure for a period equal to or greater than the holding time shown in Table I shall be deemed to have failed the low pressure air test and is unsatisfactory for acceptance by the OWNER. Any sewer that fails to pass this test

**shall be replaced by the Contractor at his expense.** A single coupling or pair of repair clamps shall be allowed between manholes to facilitate replacement of defective materials or workmanship. "Fernco" flexible couplings SHALL NOT be used on new sections of sewers except upon approval of a waiver request by the PSA Director.

4. Sewer Force Main Testing Procedure – Sewer force mains shall be hydrostatically tested at 150% of the design operating pressure or a minimum pressure of 50 psi for 30 minutes. Allowable leakage shall be the same as established for water pipe lines in the PSA Water and Sewer Regulations.

### 3.14 CARE AND RESTORATION OF PROPERTY

- A. Excavating machinery and cranes shall be operated with care to prevent damage to existing structures and/or wires.
- B. On paved surfaces, the CONTRACTOR shall not use or operate tractors, bulldozers, or other power-operated equipment the treads or wheels of which are so shaped as to cut or otherwise damage such surfaces.
- C. All surfaces which have been damaged by the CONTRACTOR'S operations shall be restored to a condition at least equal to that in which they were found immediately prior to the beginning of operations. Suitable materials and methods shall be used for such restoration.
- D. CONTRACTOR shall replace and repair all lawns, terraces, shrubs, trees, plants, fences, sidewalks, curbs, cross walks, gutters, driveways, or pavements, and repair and make good all other damage that may occur during construction work. CONTRACTOR will be held responsible for all damage that may occur after pipeline is constructed and that which may be directly or indirectly attributed to operations as they are carried on. CONTRACTOR shall not operate his equipment or store materials on private property without first having obtained written consent of Property Owner.
- E. CONTRACTOR'S attention is directed to importance of maintaining closed fences and/or gates on all property thus protected at present. In the event that fences are encountered in the line of the Project, or along rights-of-way, temporary fences shall be installed by CONTRACTOR before removal of existing fences. Temporary fences shall be installed totally on the Project easement near appropriate boundary of the right-of-way. Such temporary fence shall be of like quality and design as fence being replaced, and shall be maintained by CONTRACTOR in efficient condition until replaced by him with replacement fence. After construction has progressed beyond location of temporary fence, temporary fence shall be removed and permanent replacement fence, of quality and design at least equal to that existing, shall be erected on easement, in same location(s) as before construction.

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- F. Wherever, with Property Owner's written permission, it is necessary that gates in fenced lands be opened, or used periodically, the CONTRACTOR shall use special caution to prevent the escape of, or damage to, livestock, horses, or other property thus now protected, including the installation of cattle-guard devices, if necessary.
- G. Damage to, or loss of, fenced property, real, live or other, shall be totally the responsibility of CONTRACTOR, and CONTRACTOR shall save harmless the OWNER and OWNER from any and all claims arising out of such damage or loss.
- H. No additional compensation shall be allowed for temporary fences, the cost of which shall be included in respective unit price bid in proposal for various depths and sizes of pipe installed. Upon completion of the sewer construction, CONTRACTOR shall replace all the permanent fences on the rights-of-way or adjacent private property with fences of comparable type, size and construction as the original fences. No additional compensation shall be allowed for replacement of permanent fences, the cost of which shall be included in respective unit price bid in proposal for various depths and sizes of pipe installed.
- I. Compensation for replacement of lawns, ornamental shrubs, etc. and any additional work arising by reason of construction of sewer on private property and right-of-ways shall be included in respective unit price bid for various depths and sizes of pipe and appurtenances installed.
- J. Restoration of existing property or structures shall be done as promptly as practicable and shall not be left until the end of the construction period.

3.15 PROTECTION OF EXISTING STRUCTURES, PRIVATE PROPERTY, AND RIGHTS-OF-WAY

- A. All existing pipes, poles, wires, fences, curbing, property-line markers, and other structures which, in the opinion of the OWNER must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from injury by CONTRACTOR, and in case of injury, CONTRACTOR shall notify the appropriate party so that proper steps may be taken to repair any and all damage done. When owners do not wish to make the repairs themselves, all damage shall be repaired by CONTRACTOR, or, if not promptly done by him, OWNER may have repairs made at expense of CONTRACTOR.
- B. All utility services shall be supported by suitable means so that the services shall not fail when tamping and settling occurs. The CONTRACTOR must cover same in the unit price bid for sewer line construction.
- C. CONTRACTOR shall not be compensated for any additional work involved if utilities or underground structures cross trench line transversely above or below the sewer line.

- D. CONTRACTOR shall consult OWNER or his representatives prior to removing or disturbing any tree, shrub, bush, fence, sidewalk, building structure, or improvement that may be encountered in the line of the sewer line or in path of the easement, or right-of-way secured by the OWNER. Immediately upon completion of laying of necessary pipe, fittings, and appurtenances through each piece of private property, CONTRACTOR shall backfill the trench, tamping same in a careful and workmanlike manner, replacing sod, lawns, bushes, shrubs, or whatever else may have been removed, disturbed or altered during progress of the work.

**- END OF SECTION -**