

SECTION 02604

UTILITY STRUCTURES AND STORM DRAIN PIPE

PART 1 -- GENERAL

1.01 THE REQUIREMENT

- A. Furnish all materials, labor, equipment, and tools required for the design, fabrication, delivery and installment of utility structures, storm drain pipe, and appurtenances in accordance with the Drawings and as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02200 – Earthwork
- B. Section 03200 – Reinforcing Steel
- C. Section 03250 – Concrete Accessories
- D. Section 03300 – Cast-in-Place Concrete
- E. Section 03400 – Precast Concrete
- F. Section 05540 – Castings

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
 - 2. ASTM C361-16 - Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
 - 3. ASTM C443 – 12 (2017) - Standard Specification for Joints in Concrete Pipe and Manholes, Using Rubber Gaskets
 - 4. ASTM C478 – Standard Specification for Precast Reinforced Concrete Manhole Sections
 - 5. ASTM C857 – Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

6. ASTM C990-09 (2014) – Standard Specification for Joints in Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
7. ASTM C1619 (2017) – Standard Specification for Elastomeric Seals for Joining Concrete Structures
8. ASTM C1628-17 – Standard Specification for Joints for Concrete Gravity Flow Sewer Pipe, Using Rubber Gaskets
9. ASTM C 150 - Standard Specification for Portland Cement.
10. AWWA C 110 – Standard Specification for Ductile Iron Pipe & Fittings for Water and Other Liquids.
11. ASTM C 150 – Standard Specification for Portland Cement
12. AWWA C 151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
13. ASTM D 2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications.
14. ASTM D 3350 – Standard Specifications for Polyethylene Plastic Pipe and Fitting Material.
15. ASTM F 447 – Standard Specifications for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
16. AASHTO R82-17 - Standard Practice for Pipe Joint Selection for Highway Culvert and Storm Drains
17. AASHTO M 198 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
18. AASHTO M 294 – Standard Specifications for Corrugated Polyethylene Pipe (12” to 36”).
19. AASHTO Section 30 – Thermoplastic Pipe.

1.04 SUBMITTALS

- A. Submit samples and/or Shop Drawings in accordance with Section 01300 - Submittals.
- B. In addition to items listed in Section 03400 - Precast Concrete, Shop Drawings shall include, but not be limited to:
 1. Complete layout and installation Drawings and schedules with clearly marked dimensions.
 2. Material certificates on all piping materials.

3. Structural design calculations for manhole and other below grade utility structures sealed by a P.E. registered in the State of South Carolina. Design calculations for precast manholes and vaults shall include confirmation structures adequately resist flotation when completely empty and subjected to groundwater to the full height of structure.
4. Results of leakage test.

PART 2 -- PRODUCTS

2.01 PRECAST MANHOLES, VAULTS, AND METER BOXES

- A. Precast utility structures shall be furnished with waterstops, sleeves and openings as noted on the Drawings. Box out for wall pipes shall conform accurately to the sizes and elevations of the adjoining pipes. Precast utility structures shall be watertight and conform to the requirements of ASTM C 478 and ASTM C857 with the following modifications there to:
 1. Materials shall conform to Section 03400 - Precast Concrete.
 2. Manholes shall meet the following:
 - a. Manhole section shall have an internal diameter of 4'-0", unless noted otherwise.
 - b. Minimum manhole wall thicknesses shall be 5 inches for 4 foot and 5 foot diameter manholes, 6 inches for 6 foot diameter manholes and 7 inches for 7 foot diameter manholes.
 - c. Manholes and utility structures shall include ballast concrete and/or other means necessary to insure manholes resist flotation when empty and subjected to groundwater full height of structure.
 - d. Precast manholes and utility structures shall be as manufactured by NC Products/Oldcastle, Tindall Products, or equal.
 3. The date and name of manufacturer shall be marked inside each precast section.
 4. No more than two lift holes may be cast or drilled in each section.
 5. Dimensions shall be as shown on the Drawings.
 6. Covers and frames shall be as specified in Section 2.13.
 7. Mechanical Details such as piping, electrical, and other details shall be as shown on the Drawings.
- B. Joints between manhole and utility structures riser sections and at base slabs shall be groove type.

2.02 BRICK

- A. Brick shall be sound, hard-burned common brick conforming to ASTM C32, Grade MS.

2.03 MORTAR

- A. Mortar shall conform to Section 04100 - Mortar and Masonry Grout.

2.04 CONCRETE

- A. Concrete shall conform to Section 03300 - Cast-in-Place Concrete.

2.05 REINFORCING

- A. Reinforcing shall conform to Section 03200 - Reinforcing Steel.

2.06 PRECAST CONCRETE

- A. Precast concrete shall conform to Section 03400 - Precast Concrete.

2.07 CONCRETE BLOCK

- A. Concrete block shall be solid, rectangular concrete masonry units conforming to ASTM C139.

2.08 CASTINGS

- A. Castings shall conform to Section 05540 - Castings. Casting shall be of the type and size indicated on the Drawings.

2.09 MANHOLE STEPS

- A. Steps shall be constructed of Grade 60 steel reinforcing rod (min. 1/2-inch) and completely encapsulated with a wear resistant and chemical resistant rubber.
- B. Each step shall have a minimum vertical load resistance of 800 pounds and a minimum pull-out resistance of 400 pounds.
- C. The steps shall have 11-inch minimum tread width and shall be placed at 16-inches on center, as shown on the Drawings.
- D. Steps shall be cast in place with the concrete.
- E. Steps shall only be installed as shown on the Drawings or required in the Specifications.

2.10 JOINT SEALANT FOR STRUCTURES

- A. Joint sealant shall be a preformed flexible sealant conforming to the requirements of ASTM C-443-12 (2017) and ASTM C990-09 (2014), paragraph 6.2, Butyl Rubber Sealant. Joint sealant shall be Pro-Stik Butyl Sealant by Press-Seal, Butyl-Nek Join Sealant by Henry CS-102 Butyl Rubber Sealant for all Precast Structures by ConSeal, or equal.

2.11 FLEXIBLE RUBBER SLEEVE

- A. The spring set type shall have a stainless steel interior power sleeve or expander and shall be the PSX assembly by Press-Seal Gasket Corporation, the Kor-N-Seal assembly by National Pollution Control Systems, or Lock Joint Flexible Manhole Sleeve by Interpace Corp.
- B. The cast-in-place type shall conform to ASTM C923 and shall include stainless steel take up clamps.
- C. Flexible seal assemblies shall permit at least an eight (8) degree deflection from the center line of the opening in any direction while maintaining a watertight connection.

2.12 RUBBER BLADDER

- A. The rubber bladder seal shall conform to ASTM C923 suitable for pressure testing at 10 psi minimum, with a 3/8 inch minimum wall thickness.
- B. The rubber bladder seal shall contain an environmentally safe, anti-bacterial compound which turns into a high viscosity gel when in contact with pressurized water.
- C. The rubber bladder seal shall be NPC Contour Seal by Kor-N-Seal, or equal.

2.13 COVERS AND FRAMES

- A. Covers and frames shall comply with Section 05540 - Castings and shall be provided by the utility structure manufacturer.
- B. Manhole covers and frames shall meet the following requirements:
 - 1. Locate so that there is ready access to the manhole steps
 - 2. Clear opening shall be a minimum of 22 inches, unless otherwise indicated on the Drawings.
 - 3. Watertight manhole frames and covers shall be suitable for 20 psi internal pressure and shall be Neenah Model R-1915, Type P or L or equal cast in place.
 - 4. Non-watertight manhole covers shall be perforated and shall be Neenah Model R-1668, or equal.
 - 5. Storm drain grated inlet frames and grates shall be Neenah R-1878-B7G, East Jordan Iron Works V5660, or equal.
 - 6. Curb inlet frames and grates shall be Neenah R-3067, East Jordan Iron Works EJ 7030, or equal, and shall include frame, grate, and hood.
- C. Vault covers shall have lifting handles and shall be bolted with stainless steel bolts complying with Section 05050 - Metal Fastening.

D. Frames and covers shall be identical throughout the Contract.

2.14 GRATES

A. Grates shall comply with Section 05540 - Castings.

2.15 CONCRETE BALLAST

A. Concrete ballast shall be Class B concrete in conformance with Section 03300 - Cast-in-Place Concrete. Ballast shall be provided as necessary to insure manhole resists flotation when empty and subjected to full height groundwater conditions.

2.16 FLEXIBLE JOINT SEALER

A. Flexible joint sealer shall be a rubber ring waterstop as manufactured by Fernco Joint Sealer Co., or equal.

2.17 EPOXY BONDING AGENT

A. Epoxy bonding agent shall conform to Section 03250 - Concrete Accessories.

2.18 REINFORCED CONCRETE PIPE (RCP) – STORM DRAINS AND CULVERTS

A. Pipe and Joints

1. Reinforced concrete pipe and fittings shall conform to ASTM Standard C-76, Class III, Wall thickness B, unless otherwise noted on the Contract Drawings. Pipe may be provided with bell and spigot or tongue and grooved ends. Pipe joints shall be designed as per ASTM C-1628 – 17. All pipe shall be of the sizes indicated on the drawings. Elliptical reinforcement will not be permitted. All pipe shall be aged at the manufacturing plant for at least fourteen (14) days before delivery to the job site.

B. Gaskets

1. Gaskets shall be leak-resistant with elastomeric seals (gaskets) made of natural rubber, synthetic rubber, or a blend of both meeting the physical requirements prescribed in Specification ASTM 1619-11(2017) for Class A, or C gaskets. .

C. Joint Lubricant

1. Joint lubricant shall be of the type recommended by the manufacturer. Use of petroleum-based lubricants is not permitted.

2.19 DUCTILE IRON PIPE (DIP) – ROOF DRAINS

A. Pipe

1. Shall be centrifugally cast in metal molds or sand lined molds in accordance with ANSI A21.51 (AWWA C151) of grade 70-50-05 ductile iron. The above standard covers

ductile iron pipe with nominal pipe sizes from three (3) inches up to and including fifty-four (54) inches in diameter.

2. Shall have a rated working pressure of 150 psi.
3. Shall be a minimum PC 150.

B. Fittings

1. Shall be manufactured in accordance with ANSI A21.10 (AWWA C110).
2. Shall be manufactured of grade 70 - 50 - 05 ductile iron.
3. Shall have a rated working pressure of 250 psi.
4. Grey iron fittings which conform to the specifications contained herein may be used with ductile iron pipe providing the piping systems minimum working pressure is met or exceeded, and only where ductile iron fittings are not manufactured for a specific fitting.

C. Coatings and Linings for Pipe and Fittings

1. The standard asphaltic coating shall be applied to the exterior wall of the pipe and fittings in accordance with ANSI A21.51 (AWWA C151).
2. The pipe and fittings shall be cement mortar lined to twice the standard thickness in accordance with ANSI A21.4 (AWWA C104) except as specified in the pipe schedule. A seal coat of asphaltic material shall be applied to the mortar lining.

D. Joints

1. Joints shall be push on type in accordance with ANSI A21.11 (AWWA C111).

2.20 SMOOTH LINED CORRUGATED POLYETHYLENE PIPE - STORM DRAINS AND CULVERTS

A. General

1. Smooth lined corrugated polyethylene pipe shall be used for storm drains and shall be BLUE SEAL watertight HDPE pipe as manufactured by Hancor, Inc., N-12 WT IB (Watertight) Pipe by ADS, Inc., or approved equal.

B. Pipe and Fittings

1. Smooth lined corrugated polyethylene pipe and fittings shall conform to AASHTO M252-TYPE S for 4" to 10"φ and AASHTO M294 - TYPE S for 12" to 36"φ. All pipes shall be of the sizes indicated on the drawings.

C. Joints

1. Joints shall be watertight bell and spigot type; Hancor, Inc. BLUE SEAL, ADS, Inc. N-12 WT IB, or equal.

D. Foundation Drains

1. Foundation drains shall conform to AASHTO M252-TYPE C. Drains shall have drilled perforations and be Heavy Duty-AASHTO Pipe as manufactured by Hancor, Inc., Single Wall Corrugate Pipe by ADS, Inc., or approved equal.

2.21 BACKFILL MATERIAL

- A. The material obtained from excavation of the pipe trench or elsewhere on site with a particle size not greater than 3 inches shall be used for pipe backfill if they conform with the soil classes given in Table 1. Imported materials meeting the criteria of Table 1 may also be used.

TABLE 1 – ACCEPTABLE BACKFILL MATERIAL AND COMPACTION REQUIREMENTS

SOIL CLASSIFICATIONS				
DESCRIPTION	ASTM D 2321	ASTM D 2487	AASHTO M 43	Minimum Standard Proctor Density %
Graded or crushed, crushed stone, gravel	Class I	--	5 56	Dumped
Well-graded sand, gravels and gravel/sand mixtures, poorly graded sand, gravels and gravel/sand mixtures; little or no fines	Class II	GW GP SW SP	57 6	95%
Silty or clayey gravels, gravel/sand/silt or gravel and clay mixtures; silty or clayey sands, sand/clay or sand/silt mixtures	Class III	GM GC SM SC	Gravel and Sand (<10% fines)	95%

PART 3 -- EXECUTION

3.01 DESIGN CRITERIA

- A. Minimum structural design loading for underground precast concrete vaults shall be as indicated in ASTM C857, unless otherwise noted herein. Precast items subjected to vehicular traffic shall be designed for H-20 traffic loading. Other precast items shall be designed for a vertical live load of 300 psf.
- B. Walls of precast items shall be designed for a vertical surcharge of 100 psf.
- C. Precast manholes and vaults shall be designed to resist flotation when totally empty and subjected to groundwater full height of the manhole/vault.

3.02 FABRICATION AND CASTING

- A. Fabrication and casting shall conform to Section 03400 - Precast Concrete, and to Section 03300, Cast-in-Place Concrete.
- B. All base sections designated to receive concrete ballast and all electrical manholes shall extend monolithically a minimum of 6 inches beyond the outside face of the wall for the entire periphery. All other utility structures shall have a standard base.
- C. Utility structures built around existing pipe shall have a cast-in-place base slab.

3.03 HANDLING, TRANSPORTING, AND STORING

- A. Handling, transporting and storing of precast items shall comply with Section 03400 - Precast Concrete.

3.04 STRUCTURE INSTALLATION

- A. Installation shall conform with Section 03400 - Precast Concrete and with the manufacturer's recommendations or to Section 03300 - Cast-in-Place Concrete.
- B. Frames and covers or grates shall be set so that tops are at elevations indicated on the Drawings or flush with finished grade where no elevation is indicated.
- C. Joints between riser sections shall be sealed with joint sealant.
- D. All openings in utility structures shall have flexible rubber sleeves sized to fit the connecting pipe and installed to provide watertight joints in accordance with the manufacturer's recommendations. The interior of the sleeve shall be filled with Class B concrete.
- E. Openings that are too large for flexible rubber sleeves shall utilize rubber bladder seals which are expanded by water injected using a pressure pump.
- F. All units shall be installed plumb and level.
- G. All lift holes and joints shall be filled with non-shrink grout conforming to Section 03600 - grout inside and out.
- H. The manhole frames shall be set to their required elevations either with grade rings or with two or three courses of brick masonry laid around the top of the upper wall section. Such brick work shall be given a 1-inch mortar coat on the inside and out.
- I. Concrete ballast shall be placed so that it bears directly on the utility structure base against the outer wall monolithically encircling the structure for the full height indicated on the Drawings. Additional ballast may be required where the depth or elevation of the structure varies from the Drawings.
- J. Brick or Concrete Block

Brick or concrete block shall be laid with broken joints and all horizontal and vertical joints filled with cement-sand mortar. Outside of walls shall be plastered with a minimum 1-inch thick coat of cement-sand mortar troweled smooth.

K. Connection to Existing Pipe

1. Verify the diameter and invert elevation of existing pipe to be connected to new utility structures prior to beginning work on the structures.
2. Provide adequate protection to prevent damage to the existing pipe.
3. Provide adequate means for plugging and/or transferring the existing flow in the pipe to allow for the construction of inverts and grouting.
4. Cut off the existing pipe sufficiently for connection to the new structure and remove.
5. Thoroughly clean all foreign matter and coat the pipe surface with epoxy adhesive where the pipe joins the new structure.
6. Install a flexible joint sealer around the pipe.
7. Grout inside and outside of wall penetration with nonshrink grout.

L. Backfill structures in accordance with Section 02200 - Earthwork.

M. Clean all structures of any accumulation of silt, debris, or foreign matter and keep clean until final acceptance of the work.

N. Excavation shall conform to Section 02200 - Earthwork.

O. Structure bases shall bear on a minimum of 8 inches of compacted stone unless otherwise indicated on the Drawings.

P. Channel Inverts

1. Inverts shall be placed using Class B concrete with forms sufficient to provide a smooth half-round shape as shown on the Drawings. Manhole bases employing full depth precast inverts are acceptable.
2. Where the slope of the line does not change through a manhole, a constant slope shall be maintained in the invert. Where slope changes occur within a given manhole, the transition shall be smooth and shall occur at the approximate center of the manhole.
3. Inverts shown on the Drawings are taken at the center of the manhole unless otherwise noted.

3.05 ADJUSTMENTS TO EXISTING UTILITY STRUCTURES

A. Adjust structures as indicated on the Drawings using concrete or cast iron adjustment rings by approved methods.

B. Clean covers and inlet castings of all foreign material and paint with one coat of coal tar epoxy.

3.06 ADJUSTING COLLARS AND FINAL ADJUSTMENTS

- A. Adjusting collars shall be as shown on the Drawings. Final adjustments shall be made so that the manhole ring and cover will be smooth and flush with the finished grade of the adjacent surface, or as otherwise indicated on the Drawings for manholes shown above grade.

3.07 PIPE INSPECTION

- A. Each length of pipe and fittings delivered to the property shall be inspected by the Contractor, in the presence of the Engineer, for flaws, cracks, dimensional tolerances and compliance with the referenced Standards. The Contractor shall provide the Engineer with suitable templates or calipers for checking pipe dimensions. Only lengths of pipe and fittings accepted by the Engineer and so marked may be installed in the work.

3.08 PIPE INSTALLATION

- A. Trenching, bedding and backfilling shall be as specified in Section 02200 - Earthwork of these Specifications and Section 2.04 Backfill Material of this Specification. Under no condition shall pipe be laid in water or when trench conditions or weather are unsuitable for such work.
- B. All pipes and fittings shall be handled carefully in loading and unloading. They shall be lifted by hoists or lowered on skidways in such a manner as to avoid shock. Derricks, ropes or other suitable equipment shall be used for lowering the pipe into the trench. Pipe and fittings shall not be dropped or dumped.
- C. Each pipe and fitting shall be inspected before it is lowered into the trench. The interior of the pipe and all joint surfaces shall be thoroughly cleaned and shall thereafter be maintained clean. The open ends of pipe shall be securely plugged whenever pipe laying is not in progress.
- D. Pipe and fittings shall be selected so that there will be as small a deviation as possible at the joints and so that inverts present a smooth surface. All joints shall be installed, made up and inspected in accordance with approved printed instructions of the manufacturer. Pipe and fittings which do not fit together to form a tight joint will be rejected.
- E. Cutting of reinforced concrete pipe will be permitted only at connections to structures and be accomplished by abrasive saws. Cutting of other pipe materials shall be done only with mechanical cutters and in accordance with the manufacturer's recommendations.
- F. Pipe shall be laid accurately to the lines and grades shown on the drawings or as directed by the Engineer.
- G. If an adequate foundation for the pipe is not available at the desired depth, additional excavation shall be required and the foundation brought to desired grade with suitable granular material.
- H. Rock outcroppings, very soft soils such as muck, and other similar materials not providing proper foundation support shall be removed/replaced with suitable granular material.
- I. Bedding material directly under the pipe invert shall be left in native condition and not compacted. Pipe shall be placed on the bedding, then backfilled under the pipe haunches

before further backfill is placed.

- J. Class I materials may be dumped around pipe. Voids shall be eliminated by knifing under and around the pipe or by other approved technique.
- L. Inorganic silts, and gravelly, sandy, or silty clays, and other Class IV materials (not shown in Table 1) shall not be used for pipe backfill.
- M. Any section of the pipe that is found defective in material, alignment, grade, joints, or otherwise, shall be satisfactorily corrected by the Contractor at no additional cost to the Owner.

3.09 PIPE TRENCH COMPACTION

A. General

- 1. Place and assure backfill and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.
- 2. In no case shall degree of compaction below “Minimum Compactions” specified be accepted.
- 3. Compaction Requirements: Unless noted otherwise on the Drawings or more stringently by other sections of these Specifications, comply with following trench compaction criteria:

TABLE 2 – MINIMUM COMPACTIONS

LOCATION	SOIL TYPE	DENSITY
1. Compacted select backfill:		
All applicable areas	Cohesive soil	95 percent of maximum dry density by ASTM D698
	Cohensionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254
2. Common trench backfill:		
Under pavements roadways surfaces, D698 within highway right-of-ways, adjacent to retaining walls	Cohesive soils	95 percent of maximum dry density by ASTM D698
	Cohensionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254
Under turfing, sodded plant seeded, non-traffic areas	Cohesive soils	95 percent of maximum dry density by ASTM D698
	Cohensionless soils	75 percent of maximum relative density by ASTM D4253 and ASTM D4254

- 4. Ensure backfill materials have moisture content within three (3) percent of optimum moisture content at the time of placement.

3.10 INSPECTION AND TESTING OF STORM DRAINS

- A. Visual Testing - The Contractor shall provide at his own expense, all labor, material, measuring devices, and video equipment necessary to perform complete direct or remote visual inspection of all installed storm piping.
- a. If visual inspection of storm piping shows settlement, separation of pipe joints, incorrectly installed gaskets, or cracked or damaged pipe unacceptable to the Owner and Engineer, the Contractor shall:
 - i. Locate and repair or replace defective joints or pipe at his expense;
 - ii. Perform leakage testing as specified in 3.04 B., below.
- B. Leakage Testing – The Contractor shall provide at his own expense, all labor, material, measuring devices and water necessary to perform the required tests per AASHTO R 82-17 as modified herein. All tests shall be performed in the presence of the Engineer. Disposal of water shall be in accordance with Section 01010.
- a. Tests by Manufacturer - An infiltration and exfiltration test for the pipe shall be made at the place of manufacture. Certified test results shall be submitted. The infiltration or exfiltration allowance shall not exceed 250 gallons per inch of pipe diameter per mile per day. One joint test for each two hundred feet of pipe to be furnished.
 - b. Exfiltration and Infiltration Tests by Contractor - The pipe shall be tested for leakage by exfiltration and/or infiltration tests after installation and back-filling. Exfiltration or infiltration shall not exceed 250 gallons per inch of pipe diameter per mile per day. If the leakage is greater than that volume allowed, the Contractor shall locate and repair or replace defective joints or pipes at his expense until the leakage is within the specified allowance.
 - c. Exfiltration tests shall be performed on all pipe where the ground- water elevation is one foot above the crown of the pipe or less. Exfiltration tests shall impose a head of at least 2 feet on the pipe at the maximum elevation of the length to be tested. An allowance of an additional 10 percent of gallonage shall be permitted for each additional 2 feet of head over the initial 2 foot minimum. Infiltration tests shall be performed for all other pipe where the groundwater table is greater than one foot above the crown of the pipe.
- C. Cost of Testing and Repairs - Any and all work necessary to bring the line into conformance with the infiltration and deflection specifications shall be performed by the Contractor at no extra cost to the Owner. All apparent sources of infiltration and excessive deflection shall be repaired by the Contractor.

3.07 FLUSHING AND TESTING OF STRUCTURES AND SEWER PIPES

- A. The Contractor shall provide all water, plugs, hoses, pumps, equipment, etc. necessary for the proper flushing and testing of the structures and sewer pipes.

- B. Obstruction - After backfilling, all structures and sanitary sewers shall be inspected for obstructions and shall be flushed with water. Flushing shall be a minimum velocity of 2.5 feet per second for a duration acceptable to the Engineer. Flushing shall remove all dirt, stones, pieces of wood and other debris which accumulated in the sewer during construction. The Contractor shall provide a means acceptable to the Engineer for removal of debris flushed from each section of sewer. If after flushing, any obstructions remain, they shall be removed at the Contractor's expense.
- C. Visual Inspection - Sewer lines shall be visually inspected from every manhole by use of mirrors, television cameras, or other devices for visual inspection, and the lines shall all exhibit a fully circular pattern when viewed from one manhole to the next. Lines which do not exhibit a true line and grade or have structural defects shall be corrected to meet these qualifications.
- D. Leakage - Sewers shall be tested for leakage. The program of testing shall fit the conditions as mutually determined by the Engineer and the Contractor. The Contractor shall take all necessary precautions to prevent any joints from drawing while the sewers or their appurtenances are being tested. The Contractor shall, at his own expense, correct any excess leakage and repair any damage to the pipe and their appurtenances, or to any structures resulting from or caused by these tests.
- E. Leakage Test Procedure - Each section of sewer shall be tested by closing the lower end of the sewer to be tested and the inlet sewer of the upper manhole with stoppers and filling the pipe and manhole with water to a point 6 feet above the crown of the open sewer in the upper manhole, or, if ground water is present, 6 feet above the sections average adjacent ground water level as indicated by a monitor well installed adjacent to each manhole. The line shall be filled with water prior to testing and allowed to stand until the pipe has reached its maximum absorption, but not less than two (2) hours. After maximum absorption has been reached, the head shall be re-established and tested for at least six (6) hours maintaining the head specified above by measured additions of water. The sum of these additions shall be the leakage for the test period.

If ground water is present to a height of at least 6 feet above the crown of the sewer at the upper end of the pipe section to be tested, the leakage test may be made by measuring the rate of infiltration using a suitable weir or other measuring device approved by the Engineer. Whether the test is made by infiltration or exfiltration, the allowable leakage shall not exceed 100 gallons per day per inch of diameter per mile of sewer being tested.

Where the actual leakage exceeds the allowable, the Contractor shall discover the cause and correct it before the sewer will be accepted. For the purpose of this subsection, a section of sewer is defined as that length of sewer between successive manholes or special structures or stubouts for future connections.

- F. Low Pressure Compressed Air Test - If the leakage cannot be located by infiltration or exfiltration testing, this type test may be used. The pipeline shall be considered acceptable, when tested at an average pressure of 3.0 psi greater than the average back pressure of any groundwater that may submerge the pipe, if the section under test does not lose air at a rate greater than 0.0030 cfm per sq. ft. of internal pipe surface.

- G. Deflection Test - No sooner than thirty (30) days after final backfill installation, each section of PVC pipe shall be checked for vertical deflection using an electronic deflecto-meter or a rigid "Go-No-Go" device. Vertical deflection shall not exceed five (5) percent of the inside pipe diameter for PVC pipe.

Where the actual deflection exceeds the allowable, the Contractor shall discover the cause and correct it before the pipe will be acceptable. For the purpose of this subsection, a section of sewer is defined as that length of sewer between successive manholes or special structures or stubouts for future connections.

- H. Cost of Testing and Repairs - Any and all work necessary to bring the line into conformance with the infiltration and deflection specifications shall be performed by the Contractor at no extra cost to the Owner. All apparent sources of infiltration and excessive deflection shall be repaired by the Contractor.

- END OF SECTION -