# SECTION 02731 - GRAVITY SANITARY SEWERS

## PART 1 - GENERAL

### 1.1 GENERAL

A. This section covers all work necessary for the installation of gravity sanitary sewers and related items complete, including manholes, junction chambers, diversion chambers, house services, and miscellaneous concrete structures.

B. Sewer pipe shall be the size shown on the approved drawings and shall meet all requirements of these specifications. Sewers shall be designed in accordance with Ten States Standards.

C. Material type shall be as shown on the approved drawings, unless otherwise noted.

### 1.2 MINIMUM STANDARDS FOR SANITARY SEWER

A. All new development; commercial or residential must extend sanitary sewer across their road frontage if none exists.

B. Wherever possible, sanitary sewer systems along streets shall be located on the opposite side of the street from water mains.

C. Sanitary sewers shall be designed in accordance with Ten States Standards.

D. As the sanitary sewer system is installed, sewer lines shall be marked with a 2” x 4” or other acceptable stake, with a height allowing a minimum of 6’-0” above grade. Stake shall have the uppermost section painted green, and marked with the letter “SS” to indicate sewer line placement.

### 1.3 PIPE MARKING

Each length of pipe shall bear the name or trademark of the manufacturer, the location of the plant, the date of manufacture, the class, and strength of the pipe. The markings shall be made on the exterior of the pipe barrel near the bell or groove end and shall be plainly visible.

### 1.4 SUBMITTALS

Prior to beginning construction, the Contractor shall submit to the Town for approval, calculations on the thickness or strength class of the materials and drawings showing pipe lengths, joints, and other construction and installation

details. All pipe furnished under this Contract shall be fabricated only in accordance with the drawings and these specifications.

## 1.5 QUALITY ASSURANCE

A. Performance Tests: The Contractor shall test all gravity sewers installed in the project. The Contractor shall constantly check horizontal and vertical alignment. Testing shall include vertical deflection of non-rigid pipe, sewer watertightness for all gravity sewers, and hydrostatic testing of ductile iron pipe as specified in this Section.

B. Line and Grade Requirements: The Contractor shall provide assurance to the Town's Representative that the sewer is being laid accurately to the required line and grade as shown on the drawings. The Contractor shall utilize a laser beam instrument to lay and check the alignment and grade between manholes. Before proceeding with the next section of sewer, the last section shall be checked for proper line and grade. Variations from a uniform line and grade as shown on the drawings and described below shall be cause for rejection of the line.

1. Variance from established line and grade shall not be greater than 1/32 of an inch per inch or pipe diameter and not to exceed ½ inch, provided that such variation does not result in a level or reverse sloping invert; provided also that the variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces, does not exceed 1/64 inch per inch of pipe diameter or ½ inch maximum.

C. Test Sections

1. Initial Performance Test: An initial performance and leakage test will be performed on the first 600 foot sections of sanitary sewer constructed for each size and type sewer material installed. No additional sewer pipe shall be installed until the first section of sewer of each size and type of sewer material has satisfactorily passed the test for line, grade and leakage.
2. Subsequent Performance Testing: After the initial performance and leakage tests and as work progresses, the Town may identify additional sections for testing as conditions warrant. If a review of the Contractor's workmanship leads the Town Representative to question whether or not the tolerances and standards specified are being met, the Town reserves the right to select other locations and lengths to be tested. The Town Representative shall notify the Contractor of the location where additional testing is to be required no later than 15 days after the sewer installation has been completed. Unless otherwise authorized, the Contractor shall arrange to commence the test within 15 days after the sewer has been installed or 15 days after receiving notification by the Town, whichever date is later.

3. Final Performance Testing for Acceptance: Before acceptance and final payment for all new sanitary sewers, the Contractor and the Town's Representative shall check all sewers, even if previously checked, for accurate alignment and grade. All sanitary sewers shall be tested as specified in this Article for watertightness. The program of testing whether by infiltration, exfiltration, airtesting, or vacuum testing shall be determined by the Town.

## 1.6 LENGTH OF OPEN TRENCH

Unless permission is granted by the Town, no more than 100 feet of trench shall be opened at any one time. No more than 30 feet of trench may be opened in advance of the completed pipe laying operation, and no more than one street crossing may be obstructed by the same trench at any one time.

## 1.7 RELATION TO WATER MAINS

A. Sewers must be laid at least 10 feet horizontally from any existing or proposed water main. The distance is to be measured edge to edge. Should specific conditions prevent this separation, the Contractor shall notify the Town's Representative for specific instructions regarding the treatment of the separation. Special conditions may allow installation of the sewer closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so the bottom of the water main is at least 18 inches above the top of the sewer. It may be necessary to install 150 psi water main pipe and joints in congested areas.

B. Whenever the sewer crosses a water main, it should be laid at least 18 inches below the main, or the water main should be relaid with fittings to cross over the sewer. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints.

C. When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer shall be designed and constructed equal to water pipe, and shall be pressure tested to assure watertightness prior to backfilling. Maximum distance between sewer pipe joints and water pipe shall be provided where vertical separation is a problem.

PART 2 - PRODUCTS

2.1 MATERIALS

The use of the following pipe materials meeting or exceeding the minimum requirements /specifications set forth herein is allowable for the construction of gravity sanitary sewers:

- Polyvinyl Chloride Pipe (PVC)
- Ductile Iron Pipe (DIP)
- High Density Polyethylene Pipe (HDPE)

VITRIFIED CLAY PIPE (VCP) is **not** an approved material for the construction of sanitary sewers.

In general, all gravity sanitary sewer pipe shall be the bell and spigot type with elastomeric seal joints and smooth interior walls meeting or exceeding all requirements set forth in the latest ASTM Standard referenced herein.

THE ENGINEER DOES NOT ALLOW THE USE OF SOLVENT CEMENT JOINT FOR GRAVITY SANITARY SEWERS EIGHT (8) INCHES IN DIAMETER OR LARGER.

Saddle connections are not permitted for new construction.

A. Polyvinyl Chloride Pipe

1. Pipe: Polyvinyl chloride (PVC) gravity sanitary sewer pipe shall be the integral wall bell and spigot type with elastomeric seal joints and smooth inner walls meeting or exceeding all of the requirements set forth in ASTM D-3034 for pipe diameters 15 inches or less and meeting or exceeding all the requirements set forth in ASTM F-679 for pipe diameters greater than 15 inches.

Pipe diameters 15 inches or less shall have a minimum cell classification of 12454-B or 12454-C. Pipe diameters greater than 15 inches shall have a minimum cell classification of 12454-C. All pipe shall have a minimum tensile strength of 34.50 MPa as defined in ASTM D-1784.

PVC sanitary sewer pipe shall have a minimum pipe stiffness of 46 psi for each diameter when measured at 5% vertical ring deflection and tested in accordance with ASTM D-2412.

The minimum wall thickness for PVC sewer pipe 15 inches or less in diameter shall conform to SDR-26 Type PSM as specified in ASTM D-3034. The minimum wall thickness for PVC sewer pipe greater than 15 inches in diameter shall conform to T-1 as specified in ASTM F-679.

NOTE: Polyvinyl Chloride (PVC) Ribbed Sewer Pipe meeting or exceeding all of the requirements set forth in ASTM F 949-86a or ASTM F 794 is acceptable provided it has a smooth interior. The minimum cell classification shall be 12454-B or 12454-C as defined in ASTM D-1784. PVC Ribbed Sewer Pipe shall have a minimum pipe stiffness of 50 psi when measured in accordance with ASTM D-2412.

2. Joints: Flexible gasketed joints shall be compression type so that when assembled, the gasket inside the bell will be compressed radially on the pipe spigot to form a watertight seal. The assembly of joints shall be in accordance with the pipe manufacturer's recommendation and ASTM D-3212. The gaskets sealing the joint shall be made of rubber of special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five (5) years experience in the manufacture of rubber gaskets for pipe joints. The gasket shall be a continuous ring of flexible joint rubber of a composition and texture which is resistant to common ingredients of sewage, industrial wastes and groundwater, which will endure permanently under the conditions likely to be imposed by this service. The gasket shall conform to the requirements of ASTM F-477.

All field-cutting of pipe shall be done in a neat, trim manner using a hand or power saw, and the cut end shall be beveled using a file or wheel to produce a smooth bevel of approximately $15^{o}$ with a minimum depth of one-third the pipe wall thickness. Field cut pipe will only be allowed to be installed at manholes, at prefabricated tees and wyes, and at the connection of new sanitary sewer to existing sanitary sewer.

Only smooth exterior pipe shall be used at manhole connections. PVC pipe entering a manhole shall have a manhole water stop gasket supplied by the manufacturer firmly clamped around the pipe at the manhole, unless a flexible entry type manhole system is used.

3. Fittings: Only manufactured fittings made of PVC plastic having a cell classification of 12454-B or 12454-C as defined in ASTM D-1784 shall be used.

B. Ductile Iron Pipe

1. Pipe: Ductile Iron Pipe in diameters from eight (8) inches through thirty-six (36) inches shall be centrifugally cast and shall conform to ANSI Specifications A21.51 and AWWA C-151, latest revision. Ductile Iron Pipe shall be pressure Class 350, 300, 250, 200, or 150 depending upon site conditions and shall be provided in minimum laying lengths of eighteen (18) feet. Ductile Iron pipe larger than thirty-six (36) inches in diameter shall be approved on a case by case basis by the Town Superintendent

2. Joints: Mechanical joints, slip or flanged joints shall be provided. Mechanical joints and accessories shall conform to AWWA Standard C-111, ANSI A-21.11. The bolts and nuts shall be corrosion resistant high strength alloy steel. The O-ring gaskets sealing the slip joint shall be made of rubber of special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five (5) years experience in the manufacturer of rubber gaskets for pipe joints. The gasket shall be a continuous ring of flexible joint rubber of a composition and texture which is resistant to common ingredients of sewage, industrial wastes and groundwater; and which will endure permanently under the conditions likely to be imposed by this service. The gasket shall conform to the requirements of AWWA C-111 (ANSI A-2111). Flanged joints shall be manufactured with laying dimensions, facing and flange details in accordance with AWWA Standard C-115 (ANSI A-21.15) Class 125.

3. Fittings: Fittings shall be standardized for the type of pipe and joint specified and shall comply with ANSI A-21.10, AWWA C-110 and AWWA C-153, ANSI A21.53.

4. Weights and Marking: Weights of pipe fittings shall conform strictly to the requirements of ANSI Specifications. The class designations for the various classes of pipe and fittings shall be cast onto fittings in raised numerals, and cast or stamped on the outside of each joint of pipe. Weights shall be plainly and conspicuously painted in white on the outside of each joint of pipe and each fitting after the exterior coating has hardened.

5. Pipe shall be standard cement lined and seal coated with an approved bituminous seal coat in accordance with AWWA C-104 (ANSI A21.4).

C. High Density Polyethylene Pipe

1. Pipe and fittings: HDPE pipe shall be the wall bell and spigot type with elastomeric seal joints and smooth interior walls. Pipe and fittings shall be made from high molecular weight high density polyethylene material meeting the requirements of ASTM D-3350 Call Class PE 334433C. All material shall be virgin resin.

All HDPE pipe shall have a minimum pipe stiffness of 46 psi when measured in complete accordance with ASTM D-2412. The Ring Stiffness Constant (RSC) classification value for the pipe between bell and spigot shall comply with the minimum value of 57 lb/ft.

Only manufactured wyes, tees, and adapters of the bell and spigot type shall be used. Only smooth exterior pipe shall be used at manhole connections.

2. Joints: Flexible gasketed joints shall be compression type so that when assembled, the gasket inside the machined groove on the pipe spigot will be compressed radially in the pipe bell to form a watertight seal. Joints shall meet the requirements of ASTM D-3212.

3. Gaskets: The gaskets shall be made of a rubber of special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five (5) years experience in the manufacture of rubber gaskets for pipe joints. The gasket shall be a continuous ring of flexible joint rubber of a composition and texture which is resistant to common ingredients of sewage, industrial wastes and groundwater, which will endure permanently under the conditions likely to be imposed by this service. The gasket shall conform to all requirements of ASTM F-477.

4. Installation: The installation shall be in conformance with all applicable ASTM requirements including F-412, D-2321, D-2412, D-3212, and D-3350.

D. Manholes and Other Structures: Manholes shall be constructed of monolithic concrete or precast manhole section. Precast manhole section shall conform to requirements of ASTM Specification C478, latest revision.

1. Materials for manholes, junction chambers, diversion chambers, and miscellaneous concrete structures shall comply with the following:

a. Concrete shall be Class A with a minimum compressive strength of 4000 psi. Ready-mix concrete shall conform to ASTM C94 Alternate 2. Maximum size of aggregate shall be 1-1/2 inches. Slump shall be between 2 and 4 inches.
b. Forms for chamber and structures shall be plywood or other approved material. Steel forms shall be used for the inside face of monolithic concrete manholes.
c. Reinforcing steel shall conform to ASTM A615, Grade 40 deformed bars, or ASTM A616, Grade 40 deformed bars.
d. Mortar Materials

(1) Sand - ASTM Designation C144, passing a No. 8 sieve.
(2) Cement - ASTM Designation C150, Type 1.
(3) Water - shall be potable.

e. All joints shall be fully sealed and waterproofed. Rubber gaskets for precast concrete manhole sections shall meet the requirements of ASTM C443. The gasket shall be the sole element depended upon to make the joint flexible and watertight.

f. The manufacturer of the precast manholes shall provide core-drilled opening to produce a smooth, uniform, cylindrical hole

of the proper size to accommodate a resilient connector meeting the requirements of ASTM C 923 for all sewers entering and leaving the manhole. The resilient connectors shall be either Press-Seal Gasket Corp., which provided PSX gasket or Press Wedge II; or similar flexible manhole sleeves furnished by Kor-N-Seal by NPG System, Inc. or equal.

g. Precast manhole sections shall be steam cured and shall not be shipped from the point of manufacture for at least five days after having been cast. The exterior surface of each section shall be thoroughly coated with a coal tar epoxy type coating as manufactured by TNEMEC Co. Tnemec-46H413 Hi-Build Tneme-Tar; or approved equal by the Engineer. Final dry mils thickness shall be a minimum of 12 mils. Monolithic concrete manholes and other concrete structures shall be cured for a minimum of seven days and then coated in the field with a coal tar epoxy type coating as mentioned above.

h. Manhole castings shall be of good quality cast iron and/or ductile iron, conforming to ASTM Designation A48. Casting shall have a total weight of not less than 380 pounds and shall conform to the design of the manhole casting as shown on the standard detail sheet. Castings shall have three bolt holes equally spaced around base of frame and shall be securely anchored to cone section to provide a water tight-fit with three 3/8-inch stainless steel bolts and expansion shields. Unless specifically designated otherwise, manhole castings shall be the non-locking type.

I. Manhole steps shall be made from a steel reinforcing rod encapsulated in a copolymer polypropylene resin. The manhole steps shall equal or exceed OSHA requirements. Manhole steps manufactured by M.A. Industries, Inc., PS-1-PF, Clay & Bailey Mfg. Co., or equal, are acceptable.

j. Any other special manholes, junction chambers, diversion chambers, and miscellaneous concrete structures shall be constructed as detailed on the drawings.

k. The Contractor may, at his option, furnish and install a combination precast concrete base and first section with precut openings for service. Detailed drawings shall be submitted to the Town prior to manufacture.

l. Precast manhole sections shall have a lifting eye cast into the wall for lifting the section. Lifting holes through the precast section will not be allowed

E. Grease Trap:

a. Exterior Grease trap tank shall be constructed of 6000 psi concrete. All tank joints shall be sealed watertight with butyl rubber extrudable preformed gasket material. All outside riser ring surfaces shall be waterproofed 1/8" thick with trowelable grade butyl rubber back plaster.

b. Interior Grease trap tanks shall be a WATTS Interceptor or an approved equal.

## PART 3 - EXECUTION

### 3.1 INSPECTION AND REJECTION OF PIPE

A. The quality of all materials, the process of manufacture, and the finished pipe shall be subject to inspection and approval by the Town. Such inspection may be made at the place of manufacture or on the work after delivery, or at both places; and the pipe shall be subject to rejection at any time if it fails to meet any of the specifications' requirements even though sample pipes may have been found to be satisfactory at the place of manufacture.

B. Prior to being lowered into the trench, each pipe shall be carefully inspected, and those not meeting the specifications shall be rejected and at once removed from the work site.

C. Any pipe which has been damaged after delivery will be rejected and replaced at the Contractor's expense.

### 3.2 HANDLING PIPE

Each pipe section shall be handled into its position in the trench only in such manner and by such means as the Town approves as satisfactory. As far as practicable, the Contractor will be required to furnish slings, straps, and other approved devices to permit satisfactory support of all parts of the pipe when it is lifted.

### 3.3 NOTICE TO TOWN

The Town Superintendent shall be notified when the pipes are to be laid in the trench. At least 15 feet of the pipe shall, under ordinary circumstances, be laid before covering begins.

### 3.4 LAYING PIPE

A. All pipe shall be reinspected for soundness and damage due to handling immediately before being lowered into the trench. Any pipe found to be unsound

or damaged will be rejected and shall be removed immediately from the site of the work.

B. All pipe shall be laid accurately to the required line and grade as shown on the drawings, and in the manner prescribed by the pipe manufacturer and appropriate ASTM Specifications, to form a close, concentric joint with the adjoining pipe and to bring the invert of each section to the required grade. The supporting of pipe on block will not be permitted.

C. Pipe laying shall proceed upgrade, beginning at the lower end of the sewer.

D. Watertight work is required, and the Contractor shall construct the sewers with the type of joint specified.

E. All pipe shall be laid to the line and grade as shown on the drawings. Variations from a uniform line and grade as shown on the drawings shall be cause for the line to be rejected.

F. The ends of the pipe shall be satisfactorily cleaned just before laying, and the joint shall be made in a satisfactory manner in accordance with the recommendations of the manufacturer of the particular type of joint. All joint work shall be done by experienced workmen.

G. PVC (polyvinyl chloride) gravity sewer pipe and fittings, ASTM Designation D3034 SDR 26, shall be installed in accordance with ASTM D2321. Only materials classified as Class I will be acceptable for bedding, haunching, and initial backfill. Placement and compaction shall be in accordance with ASTM D2321.

H. All PVC pipe shall have a deflection test performed by the Contractor in the presence of the Town Representative.

I. All pipe shall be bedded as described in these specifications. Bell holes shall be excavated in advance of pipe laying so the entire pipe barrel will bear uniformly on the prepared subgrade.

J. Each length of pipe shall be mechanically pulled “home” with a winch or come-along against the section previously laid and held in place until the trench and bedding are prepared for the next pipe section. Care shall be taken in laying the pipe so not to damage the bell end of the pipe. Mechanical means consisting of a cable placed inside the pipe with a winch, jack, or come-along shall be considered to pull the pipe home where pushing the pipe will not result in a joint going completely home and staying in place. Pushing the pipe home shall be done by means of a block and push bar. Use of hydraulic excavating equipment as the means of pushing or moving the pipe to grade will not be permitted.

K. The Contractor shall use laser beam equipment to maintain accurate alignment and grade. A qualified operator shall handle the equipment during the course of construction. If bending of the laser beam due to air temperature variations or dust in the air is apparent "within the pipe" units, a fan shall be provided to circulate the air. However, air velocity shall not be so excessive as to cause pulsating or vibrating of the beam. Survey instruments may be used for checking alignment and grade if questions arise about the accuracy of the work.

L. Open excavation shall be satisfactorily protected at all times. At the end of each day's work, the open ends of all pipes shall be protected against the entrance of animals, children, earth, or debris by bulkheads or stoppers. The bulkheads or stoppers shall be perforated to allow passage of water into the installed pipe line to prevent flotation of the pipe line. Any earth or other material that may find entrance into the main sewer or into any lateral sewer through any such open end of unplugged branch must be removed at the Contractor's expense.

M. The Contractor shall prevent all ground water and surface water from entering the existing sewer system during construction.

N. Sanitary sewers that require crossing a county legal drain shall be approved and constructed per the latest standards of the Hancock County Surveyor's Office.

## 3.5 TRENCHING

The width of the trench at and below the top of the sanitary sewer shall be only as wide as is necessary for proper installation and backfilling. The trench width shall be consistent with safety requirements and manufacturer's recommendations for the type of pipe. The minimum width of trench for sanitary sewers 42-inches in diameter and less shall be 1.25 times the outside diameter (O.D) plus 12-inches

The integrity of the sewer pipe and structures is predicated upon the proper bedding procedures and width of trenches. Should these limits be exceeded, the Contractor shall be responsible for remedial measures as may be required.

The pipe trench shall not be excavated more than one hundred (100) feet in advance of pipe laying. Whenever pipe trenches are excavated below the designed bedding bottom, the Contractor shall fill the over-excavation with mechanically compacted No. 8(1/4-inch to 3/4-inch) crushed stone or No. 8 fractured face aggregate.

All rock, boulders and stones 6-inches in diameter and larger encountered in trenches shall be removed. Boulders or rocks are not to be used for trench backfill. Remove any rock encountered to six (6) inches below the pipe, and replace with No. 8 crushed stone or No. 8 fractured face aggregate, compacted.

In cases where material is deposited along open trenches, the material shall be placed so that no damage will result to the work or adjacent property as a result of rain or other surface wash.

If the bottom of the trench is of undesirable material, an additional six (6) inches of trench bottom shall be excavated and filled with Class 2 crushed stone and compacted using a hand held mechanical tamper. Where the distance to stable ground is excessive, the Engineer shall order in writing, other types of foundation as deemed necessary, subject to the approval of the Town.

## 3.6 BEDDING

Bedding material shall be compacted No. 8 crushed stone or No. 8 fractured face aggregate unless otherwise shown on plans. Bedding shall be placed in the trench bottom such that after the pipe has been placed, imbedded to grade, and aligned, there remains a 4-inch minimum depth of material below the pipe barrel and a minimum of 3-inches below the bell.

A. Plastic or Flexible Pipe

Bedding shall be placed around the sides of the pipe up to the springline (1/2 the Outside Diameter). This material shall be shovel sliced or otherwise carefully placed and "walked" or hand tamped to ensure compaction of the haunch area and complete filling of all voids. From the springline to twelve (12) inches above the crown of the pipe, bedding shall be added in six (6) lifts and "walked" in for compaction. Backfilling of the remainder of the trench shall be as specified.

B. Ductile Iron

Bedding shall be placed around the sides of the pipe up to the springline (1/2 the Outside Diameter). This material shall be shovel sliced or otherwise carefully placed and "walked" or hand tamped to ensure compaction of the haunch area and complete filling of all voids. From the springline to the top of the pipe, bedding shall be added in six (6) lifts and "walked" in for compaction. Backfilling of the remainder of the trench shall be as specified.

## 3.7 BACKFILL

A. Materials

Class I — Angular, six (6) to forty (40) millimeters (1/4 to 1-1/2 inch) graded stone such as crushed stone. INDOT Classification No.5, No.8, No.9, and No. 53. A No. 8 gravel containing a minimum 50% mechanical crush count, and meeting the following nominal size and percents passing will be considered an equivalent Class I material: 100% passing 1” sieve, 75-95%

passing 3/4" sieve, 40-70% passing 1/2" sieve and 0-15% passing No.4 Sieve.

Class II — Coarse sands and gravels with maximum particle size forty (40) millimeters (1-1/2 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 and INDOT classification for "B" borrow material are included in this class.

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. These materials are not acceptable for pipe bedding,

Class IV — Silt, silty clays and clays, including organic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH and CL are included in this class. These materials are not acceptable for pipe bedding.

Materials shall be agreed upon prior to construction. No significant deviation from this standard will be permitted without authorization.

B. Placement

1. Areas Subject to Vehicular Traffic

In areas under proposed or existing paved roads or under or within five feet of pavement, sidewalks, curbs, gutters or similar structures, granular backfill material complying with the requirements of the Indiana Department of Highways Standard Specifications, most recent edition, shall be used.

## 3.8 INSTALLATION OF MANHOLES AND OTHER STRUCTURES

A. Manholes and other structures are to be constructed at locations shown on the drawings and in accordance with the following specifications:

1. Precast concrete manhole sections shall conform to ASTM Designation C478, except as modified herein:

a. The joint design of the precast sections shall consist of a bell or groove on one end of the unit of pipe and a spigot or tongue on the adjacent end of the joining section.

b. The joint shall consist of a round rubber gasket confined in a groove in the spigot end of the precast manhole section and shall conform to Sections 6.1.6, 6.1.7 and 9 of ASTM Designation C443, latest revision and a flexible butyl rubber joint sealant between joints.

2. Openings in manhole sections for sewer connections shall be core-drilled at the point of manufacture and shall be done to produce a smooth uniform, cylindrical hole of proper size to accommodate a resilient connector meeting requirements of ASTM C 923. The resilient connectors shall be either Press-Seal Gasket Corp., PXS Gasket or Press-WEDGE II; or similar flexible manhole sleeves furnished by Kor-N-Seal by NPC Systems, Inc., or equal.
3. Manhole bases shall be cast-in-place concrete, reinforced, or monolithic base and first section combination. Manhole bases shall be cast or placed on a minimum of 6 inches of compacted crushed stone.
4. Manhole channels or inverts shall be preformed and poured with Class "B" concrete to the spring line of the connecting pipe. The finished invert shall be a semi-circular shaped smooth channel directing the flow to the downstream sewer.
5. Monolithic concrete manholes, junction chambers, and other cast-in-place concrete structures shall be cured for a minimum of seven days. The exterior surfaces shall then be coated thoroughly with a coal tar epoxy type coating as manufactured by TNEMEC Co., Tneme-46H413 Hi-Build Tneme-Tar or approved equal by the Engineer. Coating shall be 12 mil minimum dry film thickness. Each joint of precast concrete manhole sections, lifting holes, and holes left by the removal of cores shall be fully mortared and shall be coated with a 12 mil minimum dry film thickness of coal tar epoxy as specified upon reaching its final set.
6. Any additional holes cut in the field shall be drilled with a core-dill in a manner approved by the Town.
7. Manhole frames and lids shall weigh not less than 380 pounds and shall be of good quality cast iron, conforming to ASTM A48. Unless specifically designated otherwise, manhole castings shall be the non- locking type. All manhole frames shall be cast or drilled with three holes equally spaced around the base of the frame and shall be securely anchored to the cone section with three 3/8-inch stainless steel bolts, nuts, and washers. The joint between the casting frame and cone section shall be sealed with a pliable butyl rubber and coated with a coal tar epoxy coating upon reaching its final set to become a watertight joint.

## 3.9 HOUSE/BUILDING SERVICES

A. The Contractor shall install 6-inch diameter house/building service sewer which shall be installed as shown on the Standard Details. The house/building service shall extend from a "wye" or "tee" fitting in the main sewer line to the property line or easement line, unless stated otherwise.

B. The Contractor shall contact the individual property owners for the preferred location of the house/building service to best suit the property owner's needs. If the Contractor is unable to contact the property owner in advance of laying the

main sewer by or across the property, the Contractor shall so notify the Town's Representative in writing.

C. Fittings for house/building service connections on a main line sewer 15 inches in diameter or smaller shall be tees or 45-degree wyes and shall be of the same material as the main line sewer, unless otherwise approved by the Town Superintendent.

D. House/building services and connections on main line sewers greater than 15 inches in diameter shall be of a type that will maintain the structural integrity of the main line sewer and provide a watertight connection. Intrusion of house/building services into the flow way of the main sewer shall not be permitted.

E. Six-inch lateral pipe shall connect to the main line sewer at an angle of 15 degrees to 45 degrees from the spring line and shall include the necessary bends and straight pipe sections to reach the property line at the elevations specified. A pipe stopper or a bell cap shall be placed on/in the last bell. This stopper or bell cap shall be compatible with the type of infiltration/exfiltration test performed on the sewer.

F. The Contractor shall furnish and use the proper fittings, couplings, and adapters suited to make the transition between different pipe materials which will maintain the structural integrity and the watertightness of the entire sewer system.

G. At the discretion of the Town Superintendent, if improper installation practices are suspected, or questionable bedding materials and methods are employed, or in cases where the installations are unsatisfactory, the Contractor will have to perform deflection testing on the 6-inch house laterals as specified in these Standards.

H. Backfill around fittings and lateral pipe shall be carefully placed and compacted to prevent damage from backfill settlement and shall be installed in the same manner as described for sewer installation.

I. The Contractor shall mark the end of each house lateral with a 5/8-inch steel rod 5 feet long placed vertically over the end of the lateral. The rod shall be painted green and left sticking above the existing ground not more than 1 inch.

J. The Contractor shall keep accurate horizontal and vertical location measurements of each house/building service installed. The location of all house/building services shall be shown on record drawings. The accuracy of the measurements shall be the Contractor's responsibility.

## 3.10 STUBS, CONNECTIONS, BULKHEADS, AND MISCELLANEOUS ITEMS OF WORK

A. Where special junction chambers are to be constructed or where existing sewers carrying sanitary sewage are encountered, the Contractor shall provide and maintain temporary connections to prevent a nuisance. All such temporary connections, pumping, and diversions shall be included at the Contractor's expense.

B. Where called for, connections and stubs for future sewer connections shall be provided.

C. New sewer connections to existing manholes shall be considered on a case by case basis. Where approved, the connector shall be neatly made by cutting a hole in the existing structure, concreting the sewer in place, and providing a watertight connection.

D. The Contractor shall not connect any existing sewers or house/building services prior to the completion of the exfiltration/infiltration tests, air tests, and acceptance of the sewer without the written permission of the Town.

## 3.11 TESTING

All gravity sanitary sewers shall be tested for infiltration by means of a low pressure air test as generally described herein. Alternate infiltration tests will only be allowed upon written approval by the Town Superintendent.

Any leakage shall be corrected by the Contractor at his expense. The method of repair shall be approved by the Town Superintendent. Grouting of the joint or crack to repair the leakage shall not be permitted. If the defective portion cannot be located, the Contractor shall remove and reconstruct as much of the work as necessary to obtain a system that passes infiltration requirements.

All gravity sanitary sewers constructed of flexible pipe (PVC and HDPE) shall be mandrel tested no sooner than thirty (30) days after installation in accordance with these Standards.

The Contractor shall bear the complete cost and shall provided all equipment and supplies necessary to perform the tests required.

All tests shall be conducted under the observation of the Town's Representative. It shall be the Contractor's responsibility to coordinate and schedule testing.

A. Low Pressure Air Test

1. Equipment

At a minimum the following equipment shall be provided:

a. Mechanical or pneumatic plugs;
b. Air control panel;
c. Shut-off valve, pressure regulative valve, pressure relief valve and input pressure gauge. The pressure regulator or relief valve set shall be set no higher than 10 psig to avoid over pressurization; and
d. Continuous monitoring pressure gauge having a range of 0 to at least 10 psi. The gauge shall be no less than 4 inches in diameter with minimum divisions of .0.10 psi and an accuracy of $\pm$ 0.04 psi.

To reduce the potential for sewer line over-pressurization, two (2) separate hoses shall be used. One hole will connect the control panel to the sealed line for introducing low pressure air. The other will be used for constant monitoring of air pressure buildup in the line.

If pneumatic plugs are utilized, a separate hose shall be required to inflate the pneumatic plugs. The sealing length shall be equal to or greater than the diameter of the pipe to be tested. The pneumatic plug shall be able to resist internal testing pressures without requiring external bracing.

2. Ground Water Elevation and Air Pressure Adjustment.

The ground water level shall be determined by excavation by the Contractor. If the groundwater table is above the pipe, test pressures shall be increased.

a. Air Pressure Adjustment

The air pressure correction, which must be added to the 3.5 psig normal test starting pressure, shall be calculated using 0.43 psig for foot of groundwater above the lowest crown of the sewer pipe to be tested. The result gives the air pressure correction in pounds per square inch to be added. For example, if the groundwater is 11.5 feet, the 3.5 to 3.0 pressure drop will be increased by 5 psi. The time will then be measured for a pressure drop from 8.5 psi to 8.0 psi.

b. Maximum Test Pressure

In no case should the starting test pressure exceed 9.0 psig. If the average vertical height of groundwater above the pipe invert is more than 12.7 feet, the section so submerged may be tested using 9.0 psig as the starting test pressure. The 9 psig limit is intended to

further ensure workman safety and falls within the range of the pressure monitoring gauges normally used.

3. Test Procedure

Following are general procedures to be employed in the performance of the test. Test data information shall be submitted to the Town at the completion of the test.

a. Plug Installation and Testing

After a segment of pipe has been backfilled to final grade, cleaned, prepared for testing, and the specified waiting period has elapsed, the plugs shall be securely placed in the line at the ends of each segment to be tested.

Seal test all plugs before use. Seal testing may be accomplished by laying one length of pipe on the ground and sealing it at both ends with the plugs to be checked. The sealed pipe should be pressurized to 9 psig. The plugs shall hold against this pressure without bracing and without any movement of the plugs out of the pipe. No persons shall be allowed in the direct line of the pipe during plug testing. Plug the upstream end of the line first to prevent any upstream water from collecting in the test line. This is particularly important in high groundwater situations.

When plugs are being placed, the pipe adjacent to the manhole shall be visually inspected to detect any evidence of shear in the pipe due to differential settlement between the pipe and the manhole. A probable point of leakage is at the junction of the manhole and the pipe. This fault may be covered by the pipe plug, and thus not revealed by the air test.

b. Line Pressurization

Low pressure air shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig greater than the average back pressure of any groundwater above the pipe, but not greater than 9.0 psig.

c. Pressure Stabilization

After a constant pressure of 4.0 psig (greater than the average groundwater back pressure) is reached, the air supply shall be throttled to maintain that internal pressure for at least 2 minutes. This time permits the temperature of the entering air to equalize with the temperature of the pipe wall.

d. Timing Pressure Loss

When temperatures have been equalized and the pressure stabilized at 4.0 psig (greater than the average groundwater back pressure), the air hose

from the control panel to the air supply shall be shut off or disconnected. The continuous monitoring pressure gauge shall then be observed while the pressure is decreased to no less than 3.5 psig (greater than the average back pressure of any groundwater over the pipe). At a reading of 3.5 psig, or any convenient observed pressure reading between 3.5 psig and 4.0 psig (greater than the average groundwater back pressure), timing shall commence with a stop watch or other timing device that is at least 99.8% accurate.

4. Test Times

The length of time shall be determined by adding the calculated times for the length of sewer main, and the total length of service laterals as shown on the following table.

This shall be the minimum specified time required for a 0.5 psi pressure drop for the sizes and lengths of pipe (including laterals). The portion of the line being tested shall be acceptable if the time in minutes for the air pressure to decrease 0.5 psi is greater than the time shown.

| pipe diam. (in) | minimum time (min:sec) | length for minimum time (ft) | time for longer length (sec) | Specification Time for Length (L) shown (min:sec) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 100ft | 150ft | 200ft | 250ft | 300ft | 350ft | 400ft | 500ft |
| 6 | 2:50 | 398 | 0.427 L | 2:50 | 2:50 | 2:50 | 2:50 | 2:50 | 2:50 | 2:51 | 3:12 |
| pipe diam. (in) | minimum time (min:sec) | length for minimum time (ft) | time for longer length (sec) | Specification Time for Length (L) shown (min:sec) | | | | | | | |
| | | | | 100ft | 150ft | 200ft | 250ft | 300ft | 350ft | 400ft | 500ft |
| 8 | 3:47 | 298 | 0.760 L | 3:47 | 3:47 | 3:47 | 3:47 | 3:48 | 4:26 | 5:04 | 5:42 |
| 10 | 4:43 | 239 | 1.187 L | 4:43 | 4:43 | 4:43 | 4:57 | 5:56 | 6:55 | 7:54 | 8:54 |
| 12 | 5:40 | 199 | 1.709 L | 5:40 | 5:40 | 5:42 | 7:08 | 8:33 | 9:58 | 11:24 | 12:50 |
| 15 | 7:05 | 159 | 2.671 L | 7:05 | 7:05 | 8:54 | 11:08 | 13:21 | 15:35 | 17:48 | 20:02 |
| 18 | 8:30 | 133 | 3.846 L | 8:30 | 9:37 | 12:49 | 16:01 | 19:14 | 22:26 | 25:38 | 28:51 |

5. Determination of Line Acceptance

If no pressure drop is observed, the section undergoing testing shall have passed and shall be presumed to be free of defects. The test may be discontinued once the prescribed time has elapsed even if the 0.5 psig drop has not occurred.

6. Determination of Line Failure

If the pressure drops before the appropriate time has elapsed, the air loss rate shall be considered excessive and the section of pipe shall be determined to have failed the test.

Any section of sewer that fails shall be repaired and retested until it is within the limits specified. All methods and materials used in the repair shall be approved by the Town's Representative. Grouting of new sewers is prohibited as a repair method. The Contractor shall submit the proposed method and plan for approval to the Town in writing.

## 3.12 HYDROSTATIC TESTING

A. A hydrostatic test on ductile iron pipe with push-on type joints has two purposes: one is to set the gaskets in place, and the other is to provide a leakage test.

B. Said test shall include all ductile iron sewer pipe with push-on type joints installed by the Contractor. The Contractor shall make arrangements with the Town for scheduling the test after the sewer pipe is ready for testing. The test shall be performed in the presence of the Town Representative on the day mutually agreed upon.

C. Water for testing may be obtained from the Town. The Contractor shall furnish all necessary equipment, piping, pumps, fittings, gauges, and operating personnel to properly conduct the test.

D. Hydrostatic test on ductile iron pipe with push-on type joints installed as gravity sewers and siphons shall be in accordance with the following provisions:

1. The ends of the sewer section being tested shall have test plugs or caps adapted with a tap of adequate diameter to fill and pressurize the system with eater.
2. When a section is terminated at a manhole with a plan end (spigot), the pipe must extend into the manhole of sufficient length to accommodate a restraining cap. The benchwall shall be formed in the manhole after the test section has been approved.
3. Water shall be introduced into the section to be tested at the lower end. The upper end shall have an orifice at the top of the plug or cap to expel air when filling the system with water. All air shall be expelled from the pipe.
4. The test plugs or caps shall be capable of withstanding an internal pressure of 175 psi.
5. The system shall be tested in conformance with Section 13 of AWWA Specifications 600, at 50 pounds per square inch over a period of not less than on hour. The system will not be acceptable until all leaks have been repaired.
6. Hydrostatic test may be dangerous if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed in such a way as to prevent blowouts. Inasmuch as a force of 2,500 pounds is exerted on an 8-inch plug by an internal pipe

pressure of 50 psi, it should be realized that sudden expulsion of a poorly installed plug or cap can be dangerous. As a safety precaution, no one shall be allowed in the manholes when the pipe is pressurized.

E. A hydrostatic test on ductile iron pipe with push-on type joints installed as force main shall be in accordance with Article 3.12, paragraph D., with the following exception:

1. The force main shall be subjected to an internal pressure equal to 50% more than the maximum operating pressure, but in no case less than 50 psig or greater than 120 psig.

## 3.13 DEFLECTION TEST FOR SELECT PIPE

A five (5) percent "GO-NO-GO" Mandrel Deflection Test shall be performed on all HDPE and PVC gravity sanitary sewer pipe.

These pipes shall be mandrelled with a rigid device sized to pass five percent (5%) or less deflection (or deformation) of the base inside diameter of the pipe. The mandrel test shall be conducted no earlier than thirty (30) days after reaching final trench backfill grade, provided that in the opinion of the Engineer sufficient water densification or rainfall has occurred to thoroughly settle the soil throughout the entire trench depth. If densification, has not been achieved within the thirty (30) day time frame, the mandrel size shall be increased to measure a deflection limit of three percent (3%).

The mandrel (GO-NO-GO) device shall be cylindrical in shape and constructed with nine (9) or ten (10) evenly spaced arms or prongs. Mandrels with less arms shall not be allowed. The mandrel diameter dimension "D" shall be equal to the inside diameter of the sanitary sewer. Allowances for pipe wall thickness tolerances or ovality (from heat, shipping, poor production, etc.) shall not be deducted from the "D" dimension but shall be counted as part of the 5% or less deflection allowance. Each pipe material/type required to be Mandrel tested shall be tested with a mandrel approved by the pipe manufacturer and meeting the requirements of this Section. The "D" mandrel dimension shall carry a tolerance of $\pm$ 0.01 inches.

The mandrel shall be hand pulled through all sewer lines and any section of sewer not passing the mandrel shall be uncovered, replaced or repaired to the Town's satisfaction and retested.

The contact length (L) shall be measured between points of contact on the mandrel arm. The length shall not be less than that required by the Town Representative.

The Contractor shall provide proving rings to check the mandrel. Upon request, drawings of mandrels with complete dimensions shall be furnished by the Contractor to the Town for each diameter and specification of pipe.

## 3.14 MANHOLE VACUUM TESTING

A. A vacuum test shall be conducted by the Contractor on all manholes to ensure watertightness and manhole integrity. The test shall include the frame and adjusting rings.

B. The equipment required to conduct a vacuum test on manholes includes inflatable pipe plugs, test head, vacuum pump, flexible air hose, and a vacuum gage. The test equipment shall be capable of drawing a vacuum of 10-inch Hg. The equipment shall be designed specifically for the purpose of testing manholes. Manufacturer's performance information shall be submitted to the Town Superintendent for approval prior to testing.

C. Acceptance standards for leakage shall be established from the elapsed time for a negative pressure change from ten (10) inches to nine (9) inches of mercury (Hg).

D. The procedure for conducting an air test on manholes shall be in accordance with the following procedure:

1. Each manhole shall be tested immediately after assembly and prior to setting the casting or backfilling around the structure.
2. All lift holes shall be plugged with non-shrink grout.
3. All pipes entering the manhole shall be securely plugged and adequately braced against the inside of the manhole to prevent being drawn out of the pipe.
4. The test head shall be placed on the inside of the cone section and sealed with an inflatable seal.
5. A vacuum of 10 inches of mercury (Hg) shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to 9 inches.
6. The maximum allowable leakage rate for a four (4) foot manhole shall be in accordance with ASTM C1244. The manhole shall pass if the time is greater than the following:

| manhole depth (feet) | manhole diameter (inches) | | | | |
|---|---|---|---|---|---|
| | 48 | 54 | 60 | 66 | 72 |
| | time (seconds) | | | | |
| 8 | 20 | 23 | 26 | 29 | 33 |
| 10 | 25 | 29 | 33 | 36 | 41 |
| 12 | 30 | 35 | 39 | 43 | 49 |
| 14 | 35 | 41 | 46 | 51 | 57 |
| 16 | 40 | 46 | 52 | 58 | 67 |
| 18 | 45 | 52 | 59 | 65 | 73 |

| | | | | | |
|---|---|---|---|---|---|
| 20 | 50 | 53 | 65 | 72 | 81 |
| 22 | 55 | 64 | 72 | 79 | 89 |
| 24 | 59 | 64 | 78 | 87 | 97 |
| 26 | 64 | 75 | 85 | 94 | 105 |
| 28 | 69 | 81 | 91 | 101 | 113 |

## 3.15 CLOSED CIRCUIT TELEVISION INSPECTION

A. The sections of sewers which do not pass the watertightness tests as specified in this Article, shall be inspected by closed circuit television and shall be repaired as directed by the Town Superintendent.

B. The Contractor shall furnish a qualified television technician, a trained supervisor, and sufficient personnel to perform all the work required in the inspection operation.

C. The Contractor shall furnish spare cameras and related equipment to prevent delays due to equipment breakdowns. Cameras shall be equipped with remote-control focusing devices, remote-control devices to adjust the light intensity, and enough cable shall be furnished to inspect 1,000 linear feet of sewer in a continuous operation. One camera shall be small enough to pass through a 6-inch opening.

D. The Contractor shall clean the sewer, where required, one section at a time. After the sewer is cleaned, the television camera shall be attached to the end of the a rod or line so that it can be pulled through the pipe line. The camera shall trail a line of steel cable which will be attached to a winch of sufficient size to be able to pull back or retrieve the camera whenever necessary.

E. The camera shall transmit a continuous image to the television monitor. This image shall be clear and sharp enough to enable those viewing the monitor to be able to easily see the interior condition of the pipe line being inspected.

F. For each television inspection unit being used, the Contractor shall provide a mobile air conditioned viewing room large enough to accommodate at least three people for the purpose of viewing the monitor while the inspection is in progress. Minimum size of the monitors shall be 17 inches, measured diagonally across the viewing screen. Electrical power to operate the equipment shall be provided by the Contractor.

G. The Contractor shall furnish all equipment required for making a continuous video tape of the view which appears on the monitor.

H. The Town’s Representative shall be present at all times during television inspection of the sewers and will indicate to the Contractor whatever data may be required to be logged and prepared for record purposes. The Contractor shall

prepare and furnish to the Town not less than two copies of the complete record, video tape, and report of all inspection work done.

I. The cost of this work (should it become necessary) shall be included as part of the bid, and no additional compensation will be made to the Contractor.

3.16 RECORD DRAWINGS

A. The Contractor shall prepare or be responsible for the preparation and submittal of record drawings as described in Section 01001.

B. Record drawings shall be certified to accuracy by a registered Professional Engineer.

PART 4 - FIGURES

4.1 STANDARD DETAILS

| Figure | Description |
|---|---|
| 2731A | Standard Sanitary Manhole Detail |
| 2731B | Manhole Spacer Ring Detail |
| 2731C | Standard Sanitary Manhole Frame and Cover Details |
| 2731D | Standard Drop Manhole |
| 2731E | Sewer Pipe Bedding Detail |
| 2731F | Concrete Encasement Detail |
| 2731G | Jacking and Boring Details |
| 2731H | House/Building Service Connection |
| 2731I | House/Building Service Connection View-2 |
| 2731J | House/Building Service Connection Bedding Detail |
| 2731K | House/Building Service Clean-out Detail |
| 2731L | Grease Trap Detail |

END OF SECTION 02731