# SECTION 221313 - FACILITY SANITARY SEWERS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. This Section includes gravity-flow, non-pressure sanitary sewerage outside the building, with the following components:

1. Pipe Line and Trench Excavation
2. Precast concrete manholes.
3. Pipe and Fittings
4. Cleanouts

B. All work performed on sanitary sewer system components shall be completed and approved by the county to the standards and specifications issued by New Castle County Department of Special Services.

C. The Contractor shall furnish all materials and shall construct the pipe lines and all required appurtenances at the locations and to the lines, slopes and elevations shown on the drawings or designated by the Engineer.

D. Manholes shall be built at such points on the pipe lines and of such form and dimensions as are shown on the drawings or as may be directed. Manholes shall be built as pipe laying progresses and the Engineer may stop work entirely on the laying pipe if manhole construction is delayed to such an extent as to be hazardous to construction or the public.

E. The Contractor shall perform all excavation, backfilling grubbing and grading required for construction and installation of pipelines, structures and appurtenances. Excavation shall include removal of pavement, concrete, rock, earth and debris, regardless of character. Trenches and excavations shall be sheeted, shored and braced by the Contractor, as necessary to allow construction and provide safe working conditions, additionally, the Contractor shall be responsible for maintaining a dry excavation by dewatering. He shall also locate, support and protect existing utilities and structures encountered in the work, provide traffic control, dispose of surplus and unsuitable excavated materials and restore backfilled areas to original condition or as required by the drawings and specifications. All backfilled and restored areas shall be maintained by the Contractor, in a proper condition, for the duration of the project.

F. The Contractor is responsible for direct or indirect damage to existing structures, pipelines, conduits, poles, wires and utilities of every description in the vicinity of his work whether above or below ground, or that may be encountered in trench or structure excavation. This responsibility shall include the cost of protection by sheeting, bracing, hand excavation, when warranted, and the expense to repair or replace any existing facility damaged directly or indirectly by construction activities under this contract, whether such facility is or is not shown on the drawings.

G. The Contractor shall verify the location, size and elevation of all existing utilities at the various points of connection and/or crossings prior to starting any work. Any discrepancies in locations or elevations shall be brought to the attention of the Engineer in order that the designs may be adjusted accordingly. Damages suffered or additional costs incurred by the Contractor as a result of his failure to conform to the requirements of this paragraph shall be the sole responsibility of the Contractor. Connections to existing utilities shall be made by the Contractor at such a time and in such a manner as the Engineer may direct, and

the cost shall be included in the price bid for pipeline and structures, unless otherwise defined in the proposal.

H. Excavation and backfill, within an area where a State agency has jurisdiction, shall be done in accordance with requirements and provisions of the permits issued by the agencies for the construction within their respective rights-of-way. Such requirements and provisions, where applicable, shall take precedence and supersede the provisions of these specifications.

1.3 SUBMITTALS

A. Product Data: For the following:

1. Special pipe fittings.

B. Shop Drawings: For the following:

1. Manholes: Include plans, elevations, sections, details, and frames and covers.

2. Pipe and fittings

3. The Contractor shall submit certifications to the Engineer that all pipe, fittings and joints are as specified herein.

C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to sanitary sewerage systems.

B. Utility Compliance: Comply with local Municipality/utility company regulations and standards pertaining to sanitary sewer systems.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Retain first paragraph below for ABS, PVC, or fiberglass piping.

B. Do not store plastic manholes, pipe, and fittings in direct sunlight.

C. Protect pipe, pipe fittings, and seals from dirt and damage.

D. Handle manholes according to manufacturer's written rigging instructions.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities in the areas of work. Call "Miss Utility" (1-800-282-8555) and the Kent County Department of Public Works for assistance in locating existing utilities. If utilities are to remain in place, provide adequate means of protection during construction of sanitary sewer system.

B. If utilities are to remain in place, provide adequate means of protection during construction of sanitary sewer system.

C. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranged to provide temporary service according to requirements indicated:

1. Notify, the Construction Manager, Engineer, and the Owner no fewer than 5 days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without the Construction Manager's and the Owner's written permission.

D. Should uncharted or incorrectly charted piping or other utilities be encountered during work, consult Owner immediately for directions as to procedure. Repair damaged utilities that are to remain in service to satisfaction of the associated jurisdiction.

## PART 2 - PRODUCTS

### 2.1 EXCAVATION MATERIALS

A. No classification of excavated materials will be made. Excavation and trenching work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.

### 2.2 PRECAST REINFORCED CONCRETE MANHOLES

A. Precast reinforced concrete risers, eccentric cones and bases shall be in conformance with ASTM C478. Joints between riser sections shall be fitted with an "O" ring rubber gasket, meeting the requirements of ASTM C443. Installation of risers shall be in accordance with manufacturer's recommendations under the supervision of the Engineer. Minimum compressive strength of concrete shall be 4000 psi in 28 days.

B. Precast reinforced concrete base and riser sections shall be as manufactured by Atlantic Concrete Products Company, Virginia Precast Corporation, or equal.

C. Interior and exterior joint spaces of all manhole risers shall be filled prior to application of the exterior waterproofing. The interior joint shall be mortared. The exterior joint may be mortared or filled with a joint filler compound. Said compound shall be Pioneer 301 as manufactured by Daubert Chemical Co., Oakbrook, Illinois, or equal.

D. Lifting holes in the walls of precast reinforced concrete risers will be allowed but shall be plugged with rubber stoppers and grouted flush with face or manhole wall after the installation of manhole riser sections. Not more than two holes shall be cast in the walls of each riser section for the purpose of handling.

E. The exterior surface of all precast manholes shall receive a minimum two coat application of a 68 percent solids coal tar type protective coating. The total average dry film thickness shall measure 24 mils with no single measurement to be less than 20 mils. Surfaces shall be prepared in accordance with the manufacturer's instructions and coatings applied in the field in a manner acceptable to the Engineer. The coating material shall be Bitumastic Super Service Black manufactured by Koppers Co., Inc., Pittsburgh, Pennsylvania, Tar-Jet Super Black XX-32-B-22 manufactured by Pennsbury Coatings Corp., New Britain, Pennsylvania, or equal.

### 2.3 FLOW CHANNELS

A. All manhole flow channels and benches shall be constructed of brick or pre-cast into the manhole with care taken to secure smooth and even surfaces with full mortar joints. Channel sections shall be built up to true line and radius, and curved sections shall provide a uniform transition in the flow direction.

B. Materials and construction of flow channels shall be in accordance with appropriate sections for materials so used, as hereinafter specified.

## 2.4 CONCRETE

A. All concrete for manhole base and cradles, encasements, blocking, etc. shall have a minimum compressive strength of 4,000 psi at 28 days.

## 2.5 BRICK

A. All brick shall conform to the "Standard Specifications for Sewer Brick", ASTM C32, Grade SS except that the maximum absorption for the average of five bricks shall not exceed 10 percent; and the individual brick maximum shall not exceed 14 percent.

## 2.6 MORTAR

A. Cement shall be in accordance with the "Standard Specifications for Portland Cement", ASTM C150 for Type II.

B. Sand shall be composed of sharp, angular, silicious grains, coarse, or graded from fine to coarse with the coarsest grains predominating, and sensibly free from clay, loam, dirt, mica, organic matter, or other impurities. Sand containing more than 5 percent by weight of foreign material shall not be used. This limit may be changed for special classes of work if hereinafter specified. Sand exhibiting more than an acceptable amount of fine matter or impurities may be required to be washed after delivery on the work or shall be rejected altogether. Sand for mortar shall be screened to reject all particles of a greater diameter than 1/4-inch and shall not contain more than 5 percent by weight of a very fine material.

C. Unless hereinafter specified otherwise, all mortar shall be composed of cement and sand of the character above specified. The proportion of volume shall be one part of cement to two of sand. One volume of cement shall be 94 pounds net. One volume of sand shall be 0.9 cubic feet, the sand not being packed more closely than by throwing it into a box in the usual way. Mortar shall be fresh mixed in small batches for the work in hand. Tight boxes or platforms made for the purposes shall be used. The sand and cement shall be thoroughly mixed dry, in the proper proportions, until uniform color has been produced, whereupon a moderate dose of water shall be added, so as to produce a stiff paste of the proper consistency.

D. Sand obtained from the excavation shall not be used.

## 2.7 MANHOLE STEPS

A. Manhole steps shall be made of 3/8 inch diameter (No. 3) steel reinforcing bars, ASTM A615, Grade 60, encased in polypropylene plastic. Manhole steps shall have notched tread ridge with retainer lug on each side.

B. Manhole steps shall be cast in place during manufacture of precast reinforced concrete manholes. Embedment length shall be suitable for minimum 5 inch thick, precast reinforced concrete riser walls.

C. Manhole steps shall be OSHA approved and as manufactured by M.A. Industries, Inc., Peachtree City, Georgia, ICM, Inc., Jacksonville, Arkansas, or equal.

D. Manhole steps shall be spaced twelve (12) inches apart. The maximum spacing from top of manhole to the first step shall not exceed sixteen (16) inches.

## 2.8 MANHOLE FRAMES AND COVERS

A. Frames and covers for manholes shall be set by the Contractor as the work progresses. The frame shall be well bedded in mortar.

B. Material for frames and covers shall be in accordance with the standard specifications for gray iron castings ASTM A48 for Class No. 35.

C. All frames and covers shall be of the sizes and types detailed on the drawings with "NEW CASTLE COUNTY SANITARY SEWER" cast on the cover for manholes in public right of way and “SANITARY SEWER” for manholes on private property.

## 2.9 DUCTILE IRON PIPE AND FITTINGS

A. Ductile iron pipe for gravity sewer construction shall be Tyton Joint, Class 52 ductile iron pipe as manufactured by U.S. Pipe. All fittings shall be 250 PSI cast iron or 350 PSI ductile iron fittings per ANSI/AWWA requirements.

B. Pipe and fittings shall have a 401 internal coating and external asphaltic coating approximately 1 mil thick.

## 2.10 POLYVINYL CHLORIDE PIPE AND FITTINGS

A. Polyvinyl chloride (PVC) pipe, used for sewer construction, shall equal or exceed the requirements of ASTM D 3034 and shall have a minimum standard dimension (SDR) ratio of 26 and the minimum pipe stiffness, as tested in accordance with ASTM D 2412, shall be 45 when measured under 5 percent deflection at 73 degrees Fahrenheit. Pipe shall be manufactured with integral wall bell and spigot joints in standard lengths not exceeding 20.0 feet.

B. All fittings shall have a minimum SDR of 26.

C. All polyvinyl chloride (PVC) pipe and fittings shall utilize an elastomeric O-ring gasketed joint assembled in accordance with the manufacturer's recommendations.

D. Polyvinyl chloride wye branches, pipe stoppers and other fittings shall be manufactured in accordance with the same specifications and shall have the same thickness, depth of socket, and annular space as the pipe. Tee wye fittings will not be permitted for use. Wye branches shall be complete pipe sections. Saddles will not be permitted for use.

E. Polyvinyl chloride pipe shall be delivered and stockpiled in unit pallets. Stacking of pallets above 5 feet in height will not be allowed. If pipe is stockpiled for more than 30 days prior to installation in the trench, it must be suitably covered with reflective material to protect the pipe from ultra-violet rays emanating from sunlight. Do not use plastic sheets. Allow for air circulation under covering.

F. Bowed sections of pipe will be unacceptable and installation of pipe which has bowed, whether or not the bow has been corrected, will not be allowed on this project.

PART 3 - EXECUTION

3.1 PIPELINE AND MANHOLE TRENCH EXCAVATION

A. The Contractor shall excavate, maintain and backfill all excavation necessary for completing the work under the contract. Unless otherwise specified or approved, excavation shall be open cut. No extra compensation will be allowed for hand excavation and backfill necessary to complete the work or required by the Engineer.

B. Trenches shall be excavated to the necessary width and depth, as shown on the drawings and as required for the protective sheeting, pull boxes, etc. No extra compensation will be allowed for trenches wider than that detailed on the drawings.

C. The sides of the trenches shall be practically plumb and shall not be sloped unless approved in writing by the Engineer. Trench sides shall be supported or sheeted as required to protect utilities, etc., and required for safety. Safety regulations shall be as required by state safety codes and OSHA.

D. In non-paved areas strip surface vegetation and topsoil and place in stock piles which are separated from the trench excavated materials. Topsoil shall not be used for general trench refill.

E. The excavation of all trenches shall be fully completed at least twenty (20) feet in advance of pipe laying, unless otherwise authorized or directed. The Engineer may require the backfilling of open trench, over completed pipelines, or ahead of the pipe laying operation, if in his judgement such action is necessary, and the Contractor shall have no claim for extra compensation.

F. Should work be stopped for any reason and any excavation is left open for an unreasonable length of time, the Contractor shall refill the excavation at his own expense if so directed, by the Engineer or the DOH Inspector. He shall not reopen the excavation until he is ready to complete the facility. Should the Contractor refuse or fail to refill any excavation completely within forty-eight (48) hours or immediately if it poses a safety hazard after a proper notice, has been given by the Engineer or DOH Inspector the Owner shall be authorized to do the work. The resulting expenses shall be deducted from monies due the Contractor.

G. The Contractor shall complete excavation as nearly as practicable to the lines of the pipeline to be installed as detailed. All cavities in the bottom of the trench shall be filled to the required level with compacted crushed stone or gravel.

H. Excavated materials shall be graded, hauled, stored and protected as such material found suitable will be required for backfilling, repaving or other purposes. Material classified as unsuitable shall be disposed of by the Contractor at a location approved by the Engineer. Hauling of excavated materials for any purpose shall not entitle the Contractor to additional compensation. Only those excavated materials designated by the Owner shall become property of the Contractor.

I. All stockpiled materials shall be placed in such a way to prevent damage to the trench, structures, drainage areas or private property. Excavated materials shall not be placed on private property unless a temporary easement agreement is obtained from the property Owner by the Contractor.

J. The Contractor shall remove, relocate, change or protect all structures including but not limited to signs, mailboxes, overhead and buried utilities as required for construction whether shown on drawings or not. No extra compensation will be allowed for property damage, injury or loss of time due to obstructions encountered not shown on plans.

K. The Contractor shall be responsible for any damage to curb, gutter, sidewalk, traffic control devices, pavement material and lawns. Any damage resulting directly or indirectly shall be replaced in kind by the

Contractor without additional compensation. The reuse of disturbed curb, gutter or sidewalk is prohibited. New sections shall be installed to the nearest undisturbed control joint.

3.2 PIPELINE TRENCH BACKFILL

A. Materials excavated from the trench except topsoil shall be used for trench backfill, provided that, in the opinion of the Engineer, the excavated material is suitable for this purpose. Backfill material shall be free from large lumps, pavement, pieces of concrete and stones.

B. Suitable material, as approved by the Engineer, shall be carefully deposited in the trench by methods which will not damage or disturb the pipeline or structure, and shall be solidly tamped around the pipe or structure. Backfill material shall be placed in 8-inch layers. Compaction shall be accomplished by mechanical tampers. Care shall be taken in the use of mechanical tampers not to injure or move the pipe or to cause the pipe to be supported unevenly. Each layer shall be mechanically tamped for the full trench width unless an alternative method is approved in writing by the Engineer.

C. Every backfill layer shall be compacted to 95% of maximum density at optimum moisture content as determined by the Modified Proctor Test, ASTM D1557 Method C. Materials containing an excess of moisture shall be permitted to dry until the moisture content is within the specified range. Materials too dry shall be wetted uniformly until the moisture content is in the specified range. Backfilled trench sections which fail to meet density requirements three consecutive times shall be excavated and properly disposed of by the Contractor.

D. No compacting shall be done when the material is too wet to be compacted properly. At such times the work shall be suspended until the backfill materials have dried sufficiently to permit proper compaction or such other precautions shall be taken as may be necessary to obtain proper compaction. The Contractor is responsible for hauling, storing and drying of excavated material to be used in backfill operations within the prices bid.

E. The Contractor shall coordinate with the Construction Manager who will hire a geotechnical testing agency to provide compaction tests of the backfilled trenches during construction or upon completion of the backfill operations. Field density testing may be performed at a rate of 1 test per 100 linear feet of trench, at a depth specified by the Engineer. Such testing shall be arranged by the Contractor and performed by an independent testing agency approved by the Engineer.

F. Whenever test results indicate compaction densities less than specified, the Contractor shall, at his own expense, secure the specified compaction using methods approved by the Engineer. The testing agency, so employed by the Contractor, shall submit a copy of all testing reports directly to the Engineer. Each report shall contain the project identification name and number, name of Contractor, name of testing agency, and location of sample tested by station, street and depth, as a minimum.

G. The Contractor shall, at his own expense, maintain all refilled excavations in proper condition. Trench surfaces shall be reshaped when necessary. If the Contractor fails to make repairs within forty eight (48) hours after receipt of written notice from the Owner, the Owner may refill said depression wherever necessary and the cost of so doing will be retained from any monies due or to become due the Contractor under the Contract. The Contractor shall be fully responsible for any injury or damage that may result from lack of maintenance of any refilled excavation at any time prior to final acceptance.

H. All unauthorized excavations made by the Contractor shall be immediately backfilled in accordance with the requirements of the specifications for trench backfill at the Contractor's expense.

I. After completion of backfilling, all material not used shall be disposed of as approved by the Engineer, and all places on the line of the work shall be left clean and in good condition. This cleaning up shall be done by the Contractor without extra compensation. If he fails to do this work within a reasonable time after

receipt of notice, it will be performed by the Owner, and the cost will be retained from the monies due the Contractor under the contract.

J. No backfilling of pipelines will be allowed until measurements of pipe and an inspection has been performed by the Owner's representative, and until the Engineer has authorized the backfill. Any unauthorized backfill of pipelines shall be uncovered by the Contractor at his expense if required by the Engineer.

## 3.3 DEWATERING

A. All excavations must be kept free of water below the subgrade of the work while work is in progress. This may be accomplished by ordinary pumping methods or by well points, whichever will produce the required results. Upon removal of dewatering equipment, the Contractor shall backfill all holes and restore disturbed areas to their original condition.

B. Dewatering for the structures and pipelines shall commence when groundwater is first encountered and shall be continued until such time as backfill has been completed. No concrete or pipe shall be laid in water nor shall water be allowed to rise over them until the concrete or mortar has set at least eight (8) hours. Groundwater shall not be allowed to rise around the pipe until the trench is backfilled.

C. The Contractor shall dispose of the water from the work in a suitable manner without damage to adjacent property. No water shall be drained into work built or under construction without prior consent of the Engineer. Water shall be disposed of in such a manner as not to damage property or be a menace to the Public Health.

D. In the event the Contractor's dewatering operations affect any water supplies within the project area, the Contractor shall take whatever steps that are required to provide uninterrupted water service.

E. The Contractor shall remove any siltation deposits in storm sewer systems, resulting from his dewatering or construction operations. He shall also be responsible for conveyance of dewatering flows and for erosion and sediment control.

## 3.4 SHEETING, SHORING AND BRACING

A. The contractor shall furnish and install all sheeting, shoring and bracing necessary to insure safe working conditions and to prevent damage to public and private property and structures. If, in the opinion of the Engineer, the sheeting, shoring, or bracing is not of proper quality or is not properly placed to insure safe working conditions and to prevent property damage, the Contractor shall remedy such inadequacy at his own expense as may be directed by the Engineer. Sheeting, shoring, and bracing shall be removed as backfilling progresses, except at such locations as the Engineer may direct or approve it to be left in place.

B. The condition of all excavations made by the Contractor shall be the responsibility of the Contractor. No extra compensation will be allowed for property damage, injury or loss of time, due to excavation slides or cave-ins at any time under any circumstances.

C. The Contractor shall cut off any sheeting left in place, at least eighteen (18) inches below finished grade, and shall remove the material cut off without compensation.

D. Where necessary, in quicksand, soft ground, or for the protection of any structure or property, sheeting shall be driven to such depth below the bottom of the trench as may be required to protect all existing and/or proposed work.

E. The cost for furnishing, placing and removal of sheeting, shoring or bracing shall be included in the prices bid.

F. A trench box is an acceptable alternative to sheeting, shoring or bracing providing such boxes conform to safety codes.

3.5 SELECT BACKFILL

A. Should the Contractor encounter unsuitable material during excavation, he shall remove and dispose of such material at a location approved by the Engineer. The cost of such disposal shall be included in the prices bid for pipe and structures.

B. Should sufficient suitable material from excavations on the project not be available for backfill, the Contractor shall furnish Select Backfill upon approval of the Engineer. Special backfill shall conform to Delaware Department of Transportation Standard Specifications.

3.6 LAYING BRICK

A. All brickwork shall be laid by competent mechanics.

B. All brick shall be laid in a full bed of mortar with all vertical and horizontal joints filled solid with mortar.

C. Joints shall be not less than 3/8-inch or more than 1/2-inch wide except as otherwise specified in (E) below.

D. No brickwork shall be laid when the temperature is below 40 degrees or when the indications are for lower temperature within 24 hours. The contractor shall take such measures as may be approved to prevent brickwork from being exposed to freezing temperatures for a period of not less than five days after laying.

E. Special care shall be taken in laying brick in inverts of manholes to insure a uniform flow of water through the sections. In such locations, joints shall not exceed 1/16-inch in thickness and each brick shall be laid in full mortar bed with joints on bottom side and end made in one operation. No grouting or working in of mortar after laying the brick will be permitted.

3.7 MANHOLE TESTS

A. If inspection reveals any visible leakage or seepage in any manhole, the contractor will be required to accomplish such remedial measures as may be directed by the Engineer. Caulking or patching of interior manhole surfaces will not be acceptable.

3.8 PIPE INSTALLATION

A. Pipe and fittings shall be carefully handled and lowered into the trench. Special care shall be taken to insure that each length shall abut against the next in such a manner that there shall be no shoulder or unevenness of any kind along the inside of the pipe.

B. Before pipe is placed, the bottom of the trench shall be carefully shaped to fit the lower part of the pipe exterior with reasonable closeness for width of at least 60% of the pipe width. Bell holes shall be dug sufficiently large to insure the making of proper joints and so that after placement, only the barrel of the pipe receives bearing pressure from the trench bottom. No pipe shall be brought into position until the

preceding length has been thoroughly bedded and secure in place. Any defects due to settlement shall be made good by the Contractor without additional compensation therefore.

C. Proper and suitable tools and appliances for the safe and convenient handling and laying of pipe shall be used.

D. Whenever a pipe requires cutting to fit into the line or to bring it to the required location, the work shall be done in a satisfactory manner so as to leave a smooth end.

E. The pipes shall be thoroughly cleaned before they are laid and shall be kept clean until the acceptance of the completed work. The open ends of all pipe lines shall be provided with a stopper carefully fitted so as to keep dirt and other substances from entering. This stopper shall be kept in the end of the pipe line at all times when laying is not in actual progress.

F. All concrete required to support and reinforce wye branches, bends and other fittings shall be placed as directed, and the cost thereof shall be included and covered within the price bid.

G. Backfill materials shall be hand placed and mechanically tamped in six inch layers, placed uniformly on both sides of the pipe, to a point at least one foot above the pipe crown. Each layer shall be thoroughly compacted for the full trench width and under, around and over the pipe.

H. Pipeline detectable tape shall be installed continuously along all sewer mains. The tape shall be installed directly above the pipe and 12 inches from the ground surface. The tape shall be Lineguard type III Detectable tape as manufactured by Lineguard, Inc. of Wheaton, Illinois or equal. The tape shall be a minimum of two inches wide, imprinted in green with the words "CAUTION -- SEWER LINE BELOW" and be capable of being detected with inductive methods.

I. For refill of the remaining trench depth, refer to "Excavation and Backfill" Section of these specifications.

J. Pipe installation shall be achieved at the elevations identified on the contract drawings.

## 3.9 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Form continuous concrete channels and benches between inlets and outlet.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 6 inches above finished surface in non-paved areas and place berm to top elevation per New Castle County Standard.

## 3.10 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

## 3.11 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Heavy-Duty, top-loading classification cleanouts in all areas. Cover shall read “SEWER” or “S”. Casting manufactured by East Jordan Iron Works Model 1574.

B. Set cleanout frames and covers in cast-in-place-concrete, 10 inches on all sides of riser pipe by 4 inches deep and placed 8 inches below grade. In non-paved areas place fill on concrete up to grade. In paved areas place pavement on concrete up to grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

## 3.12 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 221316 "Sanitary Waste and Vent Piping."

B. Make connections to existing underground manholes.
1. Make branch connections to underground manholes by cutting opening into existing unit large enough to allow for installation of pipe to manhole connector. Connector to be Z-Lok by A-Lok Products. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

   a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
   b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

2. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

C. Connect to grease interceptors specified in Section 221323 "Sanitary Waste Interceptors."

## 3.13 LAYING PIPE IN FREEZING WEATHER

A. No pipe shall be laid upon a foundation into which frost has penetrated, nor at any time when the Engineer shall deem that there is danger of the formation of ice or the penetration of frost at the bottom of the excavation unless all required precautions as to the minimum length of open trench and promptness of backfilling are observed.

## 3.14 ARTIFICIAL FOUNDATION

A. Whenever directed, the Contractor shall lay pipe upon an artificial foundation which he shall construct. Such foundation may consist of gravel, sills, planks, or other timber construction, or of concrete; all to be of the form and dimensions and placed in the manner required by the Engineer.

## 3.15 PIPE TESTING

A. GENERAL

1. Contractor shall furnish all labor, tools, materials, and equipment, including mirrors, flashlights or other artificial lighting, pump, compressors, stopwatch, gauges, and meters, subject to the approval of the Engineer for testing in accordance with these specifications.

B. MIRROR TESTING OF SANITARY SEWERS

1. Upon completion of pipe laying and backfilling to a point at least two (2) feet above the crown of the pipe, the Engineer will conduct a mirror test to check for defects, excess deflection, leakage, and for horizontal or vertical misalignment. Mirror testing shall consist of reflecting sunlight or artificial light via mirrors through the completed section of pipeline, which, in order to be accepted, shall be true and straight in horizontal and vertical alignment to allow for the full passage of the reflected light.

C. LEAK TESTING USING AIR

1. Sewers shall be tested in sections not exceeding 400 feet unless otherwise approved by the Engineer. Each section shall be tested immediately upon completion thereof. Each section shall meet the air pressure drop limitations specified herein.

2. All material and labor required for leakage tests shall be furnished by the Contractor within the price bid.

3. Sewers shall be tested using the low-pressure air method in accordance with the requirements of ASTM C-828 and the Uni-Bell Plastic Pipe Association recommendations, based upon the Ramseier test time criteria. Procedural and equipment details shall be submitted to the Engineer prior to acceptance of its use for testing.

4. If the test time for the designated size and length, elapses before the test pressure drops 0.5 psig, the section undergoing the test shall have passed.

5. If the pressure drops 0.5 psig before the appropriate test time has elapsed, the air loss rate shall be considered excessive and the section of pipe has failed the test. Contractor shall determine at his own expense the source or sources of leakage and he shall repair or replace all defective materials and/or workmanship to the satisfaction of the Engineer. The completed pipe installation shall then be retested and required to meet the requirements of this test.

D. MANDREL TESTING OF SANITARY SEWERS

1. Sanitary sewer pipe shall be deflection tested not less than 30 days after the trench backfill and compaction has been completed. The test shall be conducted by pulling an approved solid pointed mandrel through the completed pipeline. The diameter of the mandrel shall be 95 percent of the inside diameter of the pipe. The mandrel shall be a rigid, non-adjustable mandrel having an effective length of not less than its nominal diameter.

2. Testing shall be conducted on a manhole to manhole basis and shall be done after the line has been completely cleaned and flushed. Any portion of the sewer which fails to pass the test shall be excavated, repaired or realigned and retested with both air and deflection tests.

3.16 DEFECTS TO BE MADE GOOD

A. If, at any time before the expiration of the guarantee period under this contract, any broken pipe, or any other defects are found in any of the lines or in any of the appurtenances, the Contractor shall cause the same to be removed and replaced by the proper material and workmanship, without extra compensation for the labor and material required, even though such injury or damage may not have been due to any act,

default, or negligence on the part of the Contractor. All materials shall be carefully examined by the Contractor for defects prior to installation, and any found defective shall be rejected for use.

END OF SECTION 221313