

## SEWER REHABILITATION SPECIFICATIONS

### List of Changes/Corrections

1. November 11, 2002 – Changed this spec section so that the internal and external manhole frame seals and sealants are paid for separately, not included in the cost per vertical foot for rehabbing the manhole. This modification made separate pay items for external manhole frame seals, external manhole frame sealants, internal manhole frame seals, and internal manhole frame sealants.
2. December 10, 2002 – Changed Section 02730/23 4.02 (E) Added the following text to the first sentence, “the cost of removing and disposing existing cleanouts and piping.”.
3. February 27, 2003
  - Added the following text to the end of paragraph E2 on 02730/5, “The coatings shall be factory applied according to the manufacturer’s recommendation. The coating may be touched up in the field as necessary to correct any minor defects.
  - Replaced the word “casting” to “frame” in 02730/20 I, J and L.
  - 02730/21 – Paragraph X, changed unit of measure from vertical feet to “each” so that it is consistent with 02730/6 V.
  - 02730/21 – Paragraph DD, added “and laterals” to the title for this item.
  - 02730/23 – Paragraph E – Deleted “aggregate stone base”.
  - 02730/24 – Paragraph J – Changed “casting” to “frame”.
  - 02730/27 – Paragraph BB – Added “and Laterals” to the title.
  - 02730/27 – Paragraph FF – Added “and stone aggregate base” to the first sentence.
4. February 28, 2003
  - 02731/6 – Paragraph 3.03 A – Added the following text to the end of the second sentence, “ , Scotch Seal 5600 or equal.”
  - 02731/7 – Paragraph 4.01 – Added the following text to the end of the this section, “See Sections 02732, Pipe Rehabilitation by Cured-in-Place Method, and 02735, Pipe Rehabilitation by Fold and Form Pipe method for payment.”
  - 02732/1 – Added “(CIPP)” to the end of the the title because it was not previously defined.
  - 02741/2 – Paragraph 3.01 A – Last sentence, replaced “entire manhole section” with “entire sewer section”.
  - 02741/3 – Paragraph 3.04 – First sentence, replaced “manhole section” with “sewer section”.
  - 02741/4 – Paragraph 4.02 – Added to the end of this section, “See Section 02742, Television Inspection, for payment.”
  - 02742/4 – Paragraph C1 – Changed this sentence to read as “The Television Inspection shall be documented using a computerized datalogger and reporting system similar to WinCan.”
5. March 7, 2003
  - 02730/6 2.24 – Created a new paragraph A that included the following information, “The formed-in-place concrete manholes in Section 02730 are new precast manholes that have a plastic composite liner install at the plant by the manhole manufacturer. See Section 02737 for plastic composite liners that are installed in existing manholes.” The previous paragraphs A and B are now labeled B and C.
  - 02730/20 4.01 R – Added “dust cover” to this item since when an order for a frame and cover is received, the dust cover is always included for Virginia Beach.
  - 02730/22 4.02 P – Added “dust cover” to this item since the dust cover always comes with the frame and cover.
  - 02742/5 4.02 C – Added the following text to clarify that the contractor shall televise the entire sewer section for point repairs, “Post Installation Televising for Point Repairs - For point repairs,

the entire sewer section from the upstream manhole to the downstream manhole shall be televised.”

6. September 8, 2003

- 02730/25 L - Added “patching manhole wall due to existing pipe connection, reshaping of bench and channel invert” to pay description for changing an outside drop connection to an inside drop connection.

7. June 8, 2004

- 02745 - Added this section in its entirety.

8. November 1, 2004

- 02730/20 G – Added “in the horizontal plane”.

9. January 26, 2005

- 02730/15 3.13F – Deleted “or granular fill”.

10. June 2006

- Section 02742 - Was revised to include requirements to have television inspections completed in compliance with the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP). Additionally, the requirements for Neztex Data Exchange Utility were clarified to insure the transfer of data from Hanson IMS to the CCTV inspection equipment.

11. December 15, 2006

- 01501/2 – Paragraph 3.01 (A) Added “When performing pipe lining operations, the Contractor shall locate and uncover all existing sanitary sewer cleanout assemblies prior to installing flow control. The Contractor shall monitor and pump down accumulated sewerage through existing cleanout assemblies. If a cleanout assembly cannot be located, the Contractor shall locate the lateral at the right-of-way line and install a standard cleanout assembly prior to proceeding with flow control measures.”
- 02730/19 – Paragraph 4.01(G) Added new line item for Sanitary Sewer Cleanout Assemblies on Existing Main or Lateral.
- 02730/23 – Paragraph 4.02 (G) Added basis of payment for Sanitary Sewer Cleanout Assemblies on Existing Main or Lateral.
- 2731/6 – Paragraph 3.03 (A) Revised wording to clarify requirements to provide watertight connections between liners and manholes.
- 2732/7 – Paragraph 3.01 (K) Revised wording to require liners to be removed within manholes to the springline of the liner.
- 2735/2 – Paragraph 3.01 (I) Revised wording to require liners to be removed within manholes to the springline of the liner.
- Updated phone numbers to reflect change to 385 exchange.

## Section 01501 - Flow Control

### 1. General:

1.01 The Contractor shall furnish all labor, materials, equipment and supplies, and shall perform all work related to the control of sewage flow. Flow control and routing methods shall be subject to review by the City of Virginia Beach's Public Utilities Engineer prior to work commencing on each portion of the system.

### 2. Products:

2.01 Not applicable

### 3. Execution:

3.01 Flow control:

(A) The Contractor shall submit flow control and sewage bypassing arrangement plans to the City of Virginia Beach's Public Utilities Engineer for review and approval at least 48 hours prior to commencing work on each portion of the system. Flow control includes, but is not limited to, plugging, bypass pumping or trucking as appropriate for the work performed. The plans must be specific and complete, and shall include, but not be limited to, the following details:

(1) Capacities of equipment.

(2) Road crossing details.

(3) Protection against pipe breaks.

(4) Sewer plugging methods and bypass time duration for each sewer section.

(5) Size, length, material, and method of installation for suction and discharge piping.

(6) Method noise control for each pump and/or generator.

(7) Bypass pumping locations.

(B) Bypassed flows must be discharged to the sanitary sewer system, appropriate watertight vehicle or appropriate watertight container.

(C) Flows shall be diverted, trucked, or otherwise handled to prevent flows from interfering with the work to be performed on that portion of the system.

(D) When pumping/bypassing is required, the Contractor shall supply the necessary pumps, conduits, engines and other equipment to divert the flow of sewage as appropriate. The Contractor shall have backup equipment available should the primary system fail, and the pumping/bypass system shall be adequate in size to handle the existing peak use flows and additional flows that occur with rainstorms.

- (E) The Contractor shall also furnish the labor and supervision to set up, operate, and maintain the pumping/bypass system. The Contractor shall select pumping/bypass equipment that will not have excessive noise levels from a maximum of sixty decibels (60 db) at a distance of 50 feet (50') in accordance with Section 107 of the Specifications.

### 3.02 Flow Control Precautions

- (A) When flow in a sewer line is plugged, blocked or bypassed by the Contractor, he shall take precautions to protect the public health and to protect the sewer lines from damage that might result from sewer surcharging. Further, the Contractor shall take precautions to insure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved and he shall be responsible for any damage resulting from his flow control operations. When performing pipe lining operations, the Contractor shall locate and uncover all existing sanitary sewer cleanout assemblies prior to installing flow control. The Contractor shall monitor and pump down accumulated sewerage through existing cleanout assemblies. If a cleanout assembly cannot be located, the Contractor shall locate the lateral at the right-of-way line and install a standard cleanout assembly prior to proceeding with flow control measures.
- (B) When flow in a sewer line is plugged or blocked by the Contractor, he shall monitor the conditions upstream of the plug and shall be prepared to immediately start bypass pumping, if needed. Any liquid or solid matter which is bypass pumped from the sewer collection system shall be discharged to another sewer manhole or appropriate watertight vehicle or container only. No such liquid or solid matter shall be allowed to be discharged, stored or deposited on the ground, swale, road, stormwater drainage system or open environment. The Contractor shall protect all pumps, conduit and other equipment used for bypass from traffic.
- (C) Should any liquid or solid matter from the sewer collection system be spilled, discharged, leaked or otherwise deposited to the open environment as a result of the Contractor's flow control operations, he shall immediately cleanup and disinfect the affected area and assume all costs associated with same. The Contractor shall also notify the sewer system operating personnel and appropriate regulatory agencies and perform required cleanup operations at no additional cost to the Owner.

## 4. Measurement and Payment:

- 4.01 Method of Measurement: This item will not be measured.
- 4.02 Basis of Payment: Payment for flow control will be considered incidental and the cost for flow control shall be included in other bid items.

END OF SECTION



- 1.03 Separation of Water Lines and Sanitary Sewers shall be in accordance with Section 520 of these specifications.
- 1.04 Submittals:
- (A) Submit Shop Drawings of the following:
- (1) Pipe
  - (2) Fittings
  - (3) Flexible couplings
  - (4) Solid sleeves
  - (5) Manholes
  - (6) Manhole frames and covers
  - (7) Manhole steps
  - (8) Mainline and lateral cleanouts
  - (9) Mortar connection of pipe and manhole
  - (10) Grout materials
  - (11) Clay Pipe Adapters
- (B) Submit certification to the Owner that pipe materials used on this project meet or exceed specifications.

2. Products:

- 2.01 Items not currently accepted by the Owner must be submitted for review and approval by the Owner prior to incorporation into the work.
- 2.02 Laterals, in their entirety, shall be constructed of the same material as the main wye including all pipe wyes, ells, and associated fittings, unless approved by the Owner.
- 2.03 Ductile Iron Pipe - Shall meet requirements of ANSI/AWWA C151/A21.51-1996, thickness class 52 with a single thickness of cement/mortar lining with bituminous seal coat. Thickness design shall meet requirements of ANSI/AWWA C150/A21.50-1996. For burial depths exceeding those allowed by the class, pipe and fittings of sufficient wall thickness shall be provided. Pipe shall have cement-mortar lining and an asphaltic seal coat. Cement-mortar linings shall meet requirements of ANSI/AWWA C104/A21.4.
- 2.04 Standard Ductile Iron Fittings - Shall meet requirements of ANSI/AWWA C110/A21.10-93. Pressure rating shall be a minimum of 350 psi for fittings 24-inch and smaller and 250 psi for fittings 30-inch and larger.

- 2.05 Compact Ductile Iron Fittings - Shall meet requirements of ANSI/AWWA C153/A21.53-94. Pressure rating shall be a minimum of 350 psi for mechanical joint fittings 3-inch to 24-inch.
- 2.06 Cast Iron Fittings - Shall meet requirements of ANSI/AWWA C110/A21.10-93. Pressure ratings shall be a minimum of 250 psi. Fittings shall have cement-mortar lining and an asphaltic coat.
- 2.07 Cement Mortar Lining with Bituminous Seal Coat for Cast Iron Fittings and for Ductile Iron Pipe and Fittings - Shall meet requirements of ANSI/AWWA C104/A21.4-1995. Cement Mortar - Shall conform to Section 218 of the Specifications. Cement mortar lining shall be standard thickness.
- 2.08 Exterior Bituminous Coating for Cast Iron Fittings and Ductile Iron Pipe and Fittings - Shall meet requirements of ANSI/AWWA C104/A21.4-1995.
- 2.09 Mechanical Joints and Jointing Materials - Shall meet requirements of ANSI/AWWA C111/A21.11-95.
- 2.10 Retainer Gland Systems - Shall be Ebba Iron, Inc., Mega Lug Series 1100, Star Pipe Products, Stargrip, Ford Meter Company, Uniflange Series 1400 or approved equal.
- 2.11 Mechanical Joint Retainer Glands - Shall be ductile iron, shall meet requirements of AWWA C111, and shall be manufactured by American Cast Iron Pipe Company, Clow Corporation, or Ebba Iron, Inc. or approved equal.
- 2.12 Push-on Joint and Rubber Gasket - Shall meet requirements of ANSI/AWWA C111/A21.11-1995.
- 2.13 Flanged Joints for Cast Iron and Ductile Iron Pipe and Fittings - Shall meet requirements of ANSI/AWWA C115/A21.15-1994. Flanged joint gaskets shall be full face, made of rubber, and shall meet requirements of ANSI B16.21-1978.
- 2.14 Concrete - Shall conform to Section 217 of the Specifications and shall be Class A3, unless otherwise specified.
- 2.15 Concrete Blocks - Shall conform to Section 222 of the Specifications.
- 2.16 Reinforcing Steel - Shall conform to Section 223 of the Specifications for size specified.
- 2.17 Curing Material for Concrete - Shall conform to the applicable requirements of Section 220 of the Specifications.
- 2.18 Non-Shrinking Waterproof Grout - Shall conform to Section 218 of the Specifications.
- 2.19 Polyvinyl Chloride (PVC) Type PSM Plastic Gravity Sewer Pipe
  - (A) Shall meet requirements of ASTM D 3034-81 and be integral bell, gasketed joint pipe with dimension ratio (dr) of 35 and minimum pipe stiffness (ps) of 46 psi at 5 percent deflection.
  - (B) Pipe joint shall meet requirements of ASTM D 3212-81.

- (C) Rubber gaskets shall meet physical requirements specified in ASTM F 477-76(1981) or ASTM D 1869-78 in all respects.
- 2.20 Flexible Couplings shall be of a gasketed, sleeve type. Each coupling shall consist of a steel middle ring, two steel followers, two rubber compounded wedge section gaskets, and sufficient galvanized track head steel bolts to properly compress the gaskets. Couplings shall be of the type to match piping in which installed. Couplings shall be manufactured by Dresser Manufacturing Company or Smith-Blair Products of Rockwell International or Ebba Iron, Inc. or approved equal.
- 2.21 Clay pipe adapters for ductile iron to clay or PVC to clay shall be a flexible coupling, Fernco or equal. Clay pipe adapters shall have corrosion-resistant and rustproof stainless steel clamps, band screw and housing. Clay pipe adapters shall conform to applicable sections of ASTM C443, C425, C564, D1869, and C1173.
- 2.22 Flanged Adapters for Joining Plain-end Pipe to Flanged Items - Shall be style 128 or 127 as manufactured by Dresser Manufacturing Division of Dresser Industries or type 912 or 913 as manufactured by Smith-Blair Products of Rockwell International.
- 2.23 Manholes shall be as follows:
- (A) Manhole frames and covers shall be roadway type with deep socket covers and shall be fitted with dust pan. Dust pan shall have lifting handles. Machine frames and covers to prevent rattling. Each cover shall have cast or embossed on it in letters not less than 1-inch high "SEWER." The frame and cover shall weigh at least 380 pounds. Manhole frames and covers shall be Capital Foundry Model MH-C-21-Y and watertight manhole frames and covers shall be MH-C-21-Y/WT or MH-C-21-JC-WT. All frames and covers shall receive a coat of black asphaltum paint prior to delivery. All castings shall conform to latest edition of ASTM A-48 Class 30 and shall be uniform quality.
  - (B) Manhole steps for brick manholes shall be aluminum meeting requirements of alloy 6005-T5 or alloy 6061-T6. Steps shall be Aluminum Company of America No. 14976, or Washington Aluminum Company, Inc., No. F14-1001.
  - (C) Manhole steps for precast concrete manholes shall be M.A. Industries Model PS1-PF; KOR-N-SEAL Model 90312-13; Delta Pipe Products Wedg-Lok Model WL-11; or Lane International Corp Model P-10938.
  - (D) Bricks - Shall conform to Section 222 of the Specifications. Manhole brick shall meet requirements of ASTM C 32-1991 Grade MS "Sewer and Manhole from Clay or Shale."
  - (E) Precast reinforced concrete manhole sections shall meet requirements of ASTM C478-82. No reduction in the inside diameter of large sanitary sewer manholes will be allowed below the cone section.
    - (1) Manhole section joints shall be Butyl-Tite joints and shall meet the requirements of ASTM C-990.
    - (2) Protective coating for concrete manhole section interior shall be two coats of approved epoxy-resin-based high build coatings, such as; Sika

Corporation, Sikagard 62, or E-bond Epoxies Incorporated, Superstik 105 and 108 or approved equal. The base and top coats shall be of distinctively different colors; however, the top coat shall be gray. The coatings shall be factory applied according to the manufacturer's recommendation. The coating may be touched up in the field as necessary to correct any minor defects.

(F) Manhole Inserts

(1) Manhole inserts shall be manufactured from corrosion-proof material suitable for atmospheres containing hydrogen sulfide and diluted sulfuric acid and other gases associated with waste water collection systems.

(2) The insert shall be manufactured to fit the manhole frame rim upon which it rests.

(3) Ventilation shall be provided by a vent hole and/or a valve. The hole or valve shall allow a maximum release of 0.5 to 1.5 psi and 5 gallons of water per 24 hours and is not effected by debris that may collect in the bottom of the dish.

(4) High Density Polyethylene Inserts

i. The body of the insert shall be made of high density polyethylene copolymer material that meets ASTM D1248, Class A, Category 5, Type 111 with a minimum impact brittleness temperature of -180 degrees F. The thickness shall be uniform 1/8" or greater.

ii. The lift strap shall be made of a woven polypropylene web and shall be seared on all cut ends to prevent unraveling. The lift strap shall be attached to the bowl of the dish by a wide head stainless steel rivet.

iii. The high density polyethylene inserts shall be Knutson Manhole Inserts, No Flow In Flow Manhole Inserts, or equal.

(5) Stainless Steel Inserts

i. The insert body shall be manufactured of 304 stainless steel with a thickness of not less than 18 gage.

ii. The dish shall have a handle of 3/16" plastic coated stainless steel cable installed on the body of the dish. The handle shall be attached with a #6 high grade stainless steel rivet.

iii. The stainless steel inserts shall be "Rainstopper" or equal.

(G) Pipe to manhole connection shall be sealed with a flexible connector. The port shall be cored to the size, shape, surface finish, and location required and not cast in the manhole. The flexible connector shall be a 3/8-inch thick neoprene compound meeting ASTM C443-79 specifications. The connector shall be "Kor-N-seal" as manufactured by National Pollution Control Systems, Inc.; "PSX Series Six" as Manufactured by Press-Seal Gasket Corporation; or "IPS Flexible Manhole Connector" as manufactured by International Precast Supply.

2.24 Formed-in-Place Concrete Manhole with Plastic Composite Liner

- (A) The formed-in-place concrete manholes in Section 02730 are new precast manholes that have a plastic composite liner install at the plant by the manhole manufacturer. See Section 02737 for plastic composite liners that are installed in existing manholes.
  - (B) Concrete: The concrete shall be Type I/II Portland cement concrete with 5/8 inch minus coarse aggregate with fiber reinforcement and plasticizers producing an average compressive strength of 4,000 psi at full cure.
  - (B) Plastic Composite Liner: The liner shall meet the requirements specified in Section 02737 of these Specifications.
- 2.25 Pipe to sleeve sealant shall be grouting compound shall be non-shrink grouting compound manufactured by 3M Company or be an equivalent product having strength properties of 80 psi tensile and 700 percent elongation in accordance with ASTM D 3574-81 test E, and linear dimension change shall not exceed 18 percent when subject to wet and dry cycles in accordance with ASTM D 756-78, G and D 1042- 51(1978).
- 2.26 Mechanical type pipe to wall sleeve seals shall be "Link-Seal" pipe to wall closures manufactured by Thunderline Corporation, Wayne, Michigan "S" model with 316 stainless steel bolts. Seals shall be modular mechanical type, consisting of interlocking synthetic rubber links shaped to fill annular space between pipe and wall opening and shall provide watertight seal between pipe and wall opening.
- 2.27 Cleanout
- (A) Housing and lid shall be Capitol Foundry Model No. VB-110T-C/0 or approved equal. Plug shall be 4 inch ABS by Sloan Mfg. Co. part 3054 or approved equal (ASTM D 2661-40).
- 2.28 Inserta Tee (For rehabilitated lines only)
- (A) The inserta tee is comprised of three parts; PVC hub, stainless steel band and rubber boot as manufactured by Fowler Manufacturing Co., Inc.
  - (B) PVC hub and rubber boot shall be engineered to accept the wall thickness and internal radius of the pipe. The PVC hub and rubber boot shall not protrude more than ½ inch into the sewer pipe.
  - (C) The PVC hub shall be in accordance with ASTM D-3034.
  - (D) The rubber boot shall be in accordance with ASTM C-443.
  - (E) The inserta tee shall be sized to accept 4 inch and 6 inch service lines.
- 2.29 Pipe (Stone) Bedding - Shall consist of fine aggregate fill which shall conform to Section 202 - fine aggregate, grading A or coarse aggregate fill conforming to Section 203 - coarse aggregate, Size No. 57.
- 2.30 Select Material - Soil material obtained from roadway cuts, borrow pits or commercial sources that is designated or reserved for use as a foundation for the subbase, subbase material, shoulder surfacing, trench backfilling or other specified purposes and having

minimal California Bearing Ratio (CBR) value of 15 and meeting the requirements of VDOT Section 207, Section Material, Type III.

- 2.31 Suitable Material - Soil material obtained from on-site project trenching operations that can be re-used in backfilling operations. Within the roadway prism, suitable material must meet all the requirements established for select material. Outside the roadway prism, suitable material does not need to meet the requirements of select material except that the materials shall be free from roots, muck or debris.
- 2.32 Coarse Aggregate Fill - Shall conform to Section 203 - Coarse Aggregate, Size No. 57.
- 2.33 Aggregate Base Material - Soil material designated or reserved for use as a foundation for pavement or other specified purpose and meeting the requirements of VDOT Section 208.

3. Execution:

3.01 Familiarization

- (A) The Owner will endeavor to familiarize the Contractor with all known underground utilities and obstructions, but this will not relieve the Contractor from full responsibility for anticipating and locating all underground utilities and obstructions in accordance with Section 105.07 of the Specifications. State law mandates the notification of utility owners 48 hours in advance of excavation. For location of utilities call "Miss Utility" at 1-800-552-7001. Contractor shall locate existing utilities, culverts, and structures, above or below ground, before any excavation starts. Coordinate work with utility services. Protect, maintain in service, and prevent damage to utilities not designated to be removed. When utilities are encountered and are not shown on Drawings or when locations differ from those shown on Drawings, notify the Owner for instructions before proceeding.
- (B) The Contractor shall conform to the "Overhead High Voltage Act" (effective July 1, 1989) and shall contact the necessary authorities prior to start of construction.
- (C) The Contractor shall be required and agrees to comply with all the provisions of the "Virginia Underground Utility Damage Prevention Act" (Section 56-265.14 et seq., Code of Virginia, 1950, as amended) and hereby agrees to hold the City of Virginia Beach harmless against any loss, damages or claims of any nature whatsoever arising out of the Contractor's failure to comply with the requirements of said Act.
- (D) When construction appears to be in close proximity to existing utilities, the trench(es) shall be opened a sufficient distance ahead of the work or test pits made to verify the exact locations and inverts of the utility to allow for possible changes in line or grade.

3.02 Site Preparation

- (A) Clearing and Grubbing: Clearing and grubbing work shall be restricted to area within the rights-of-way or easements indicated on the Drawings. Contractor

shall conduct clearing and grubbing in accordance with Section 301 of these Specifications.

(B) Existing Trees and Shrubs

- (1) The Contractor shall contact the City of Virginia Beach Landscape Services Division prior to the start of work for inspection of tree protection.
- (2) Special care shall be exercised to minimize injuries to trees, and any damaged branches should be properly pruned. This repair work will be done on a daily basis without exception.
- (3) When it becomes absolutely necessary to remove a tree, and as approved by the City Landscape Services Division, it shall be completely taken out, including the stump.
- (4) Provide protection for roots and branches over 1-1/2 inches diameter that are cut during construction operations. Provide earth cover as soon as possible.

(C) Debris Clean Up

- (1) Clean up debris resulting from site clearing operations continuously with the progress of the work.
- (2) Remove debris from site in such a manner as to prevent spillage. Keep pavement and area adjacent to site clean and free from mud, dirt, and debris at all times.

3.03 The Contractor shall ensure that pipes, fittings and other materials shall be carefully handled to prevent breakage and damage. Pipes shall not be unloaded by rolling or dropping from trucks or cars, but shall be handled by carefully lifting and lowering into position, using approved slings or clamps. Any material which has been damaged shall be removed and replaced with sound material.

3.04 Pipe Installation

- (A) Pipe and fittings shall be carefully inspected by the Contractor for cracks and defects before lowering into the trench, and the Contractor shall remove faulty pipe or fittings from the site.
- (B) The Contractor shall keep pipe clean. Exercise care to keep foreign material and dirt from entering pipe during storage, handling, and placing in trench. Close ends of in-place pipe at the end of any work period to prevent entry of animals and foreign material.
- (C) The pipe shall be bedded as specified in Section 520 of these Specifications.
- (D) Pipe shall not be laid when weather or trench conditions are unsuitable.
- (E) The trench shall be kept free of water at those times that work is in progress. The ends of the pipe shall be cleaned so that proper joints can be made.

- (F) As the work progresses, the interior of the pipe shall be cleared of dirt, cement, or other superfluous material.
- (G) Not more than 100 feet of trench shall be opened in advance of the pipe laying unless authorized by the Owner.
- (H) Gravity sewers shall be installed so as to maintain a true alignment and grade as indicated on Project Drawings. No joint deflection shall be permitted. After completion, the pipe shall exhibit a full circle of light when lighted at one manhole and viewed from the next. Commence laying gravity sewers at the lowest point on a section of line and lay pipe with the bell ends upgrade.
  - (1) Pipe joint. Preparatory to making pipe joints on gravity sewer lines, clean and dry all surfaces of joint pipe and jointing material. Use lubricants, primers, adhesives, and similar materials as recommended by the manufacturers. Place, fit, join, and adjust the jointing materials or factory fabricated joints as recommended by the manufacturer to obtain the degree of watertightness required. As soon as possible after the joint is made, place sufficient backfill material, as specified under Section 520, along each side of the pipe to resist forces that might tend to move the pipe off line and grade.
- (I) Lay force main pipe with bell ends facing the direction of laying. Where grade is 10 percent or greater, pipe shall be laid uphill with bell ends upgrade.
- (J) Force Main Air Vent/Water Blow-off Assemblies - Shall be provided at locations indicated on Project Drawings and at all high points on the mains. Construct boxes for air vent/blow-off assemblies as indicated on Project Drawings.
- (K) Installation of PVC gravity sanitary sewer pipe shall be in strict accordance with manufacturer's recommendations. PVC pipe shall be joined as recommended by the manufacturer using rubber ring gaskets in bell ends.
- (L) Installation of ductile iron pipe shall be in strict accordance with ANSI/AWWA C600-99.
- (M) The joining of like pipe shall be accomplished using solid sleeves of like material. Shop drawings shall be submitted to the Owner for approval. Use of retainer glands with D.I. sleeves is required in pressure applications.
- (N) The joining of unlike types of pipe shall be accomplished by commercially manufactured couplings as detailed on the Project Drawings and fittings acceptable to the Owner. Shop drawings shall be submitted.
- (O) Where nonferrous metallic pipe (for example copper tubing) crosses any ferrous piping material, maintain vertical separation of one foot. If one foot of clearance cannot be maintained, neoprene padding must be installed between the two utilities.
- (P) When work is not in progress, for any reason, the lines shall be securely plugged to the satisfaction of the Inspector. The Contractor shall provide the appropriate

flow control equipment and labor to re-establish the system in useful service at the end of the day.

- (Q) Mechanical Joint Pipe shall be joined in accordance with manufacturer's printed recommendations. Tighten nuts on alternate sides of the gland until pressure on the gland is equally distributed.
- (R) Push-on Joint Pipe shall be joined in accordance with manufacturer's printed recommendations.
- (S) Backfill, compaction and surface restoration shall be completed as specified under Sections 107 and 520. Place backfill over the pipe immediately after the pipe has been laid.
- (T) Installation of Water/Sewer Valve Extension Stem on Existing Valve - Shall be in accordance with City of Virginia Beach, Department of Public Utilities Standard Details. Valve operator extensions, as required, will be provided to bring operating nut to within 12-inches minimum - 42-inches maximum, of finished grade.
- (U) Restoration of Property - Shall include, but not be limited to, replacement of shrubbery, sod or topsoil, including lime, fertilizer, seed and mulch; replacement of non-paved surfaces with similar materials and for other work in accordance with Section 107.12 of the Specifications.

3.05 Gravity sewer pipe connecting to existing manholes at new or existing elevations shall be connected by coring the existing manhole to a minimum diameter 1-inch larger than the outside diameter of the proposed connecting pipe. The gravity sewer pipe shall be installed such that it terminates flush with the inside face of the manhole. A boot shall be installed whenever possible. If a boot is not installed, a rubber gasket shall be installed around the PVC/DI pipe at the manhole connection to act as a water stop. The entire annular space shall then be sealed with a non-shrink hydraulic cement grout to produce a watertight connection. The grout shall be troweled flush with the inside face of the manhole. Brick manhole collars shall be installed around the outside of the manhole walls to ensure stability of the pipe connection.

3.06 Manholes - Shall be constructed using manhole brick with mortar - ASTM C270, "Type S, Mortar for Unit Masonry," or precast reinforced concrete manhole sections, ASTM C478. Install manhole frames and covers and manhole steps using materials specified under products. Construct brick manholes and precast reinforced concrete manholes in accordance with City of Virginia Beach Department of Public Utilities Standard Details.

- (A) On new, adjusted or reconstructed sanitary sewer manholes, metal riser rings will not be permitted. Final adjustment of cover and frame shall be by use of bricks and/or mortar under the frame. Concrete rings, 4-inch minimum to 12-inch maximum, will be permitted for adjustment or reconstruction of existing manholes.
- (B) Precast reinforced concrete storm sewer conflict structure shall be constructed in accordance with VDOT Road and Bridge Standards, and as shown on the Contract Drawings.

### 3.07 Sanitary Sewer Benches and Inverts

- (A) Sanitary sewer benches and inverts shall be formed out of brick and a cement/mortar mixture. Inverts may also be built out of concrete.
- (B) Inverts and channels may be formed out of brick and the cement/mortar mixture, be 3/4 the diameter of the effluent pipe, be surfaced with the cement/mortar mixture 1/2-inch thick, and be trowel finished. Any influent lines entering the manhole less than 180 degrees from the effluent line shall be formed in a continuous curve. Benches shall be formed out of brick and surfaced with the cement/mortar mixture and be trowel finished with a 2-inch positive slope from the top of the invert channel. Each layer of brick used in the benches and inverts shall be set in a full bed of the cement/mortar mixture. All voids shall be filled with the cement/mortar mixture before the next layer is applied.
- (C) The cement mortar mixture shall consist of one part Type II Portland cement, one part Type S masonry cement, 2 1/2 parts fine aggregate (masonry sand), and sufficient water to produce a stiff mixture or one part Type M masonry cement, 2 1/2 parts fine aggregate (masonry sand), and sufficient water to produce a stiff mixture.

### 3.08 Sanitary Sewer Point Repairs and Replacements:

- (A) Sanitary Sewer Point Repairs shall be defined as any repairs and/or replacements made at specified locations on a main line sanitary sewer regardless of size. Point repairs shall be performed at locations shown on the Contract Drawings.

Pertinent information required for the main line sewer such as line size, approximate depth at manholes, description of the line location, the number of points to be repaired, and the location of each point will be listed and shown in the contract drawings. The depths shown do not necessarily reflect the excavation depth required to make the repair but is for reference only.

- (B) Method of Repair - For Conventional Excavation and Replacement

- (1) Excavation shall be in accordance with Section 520 of these Specifications.
- (2) Excavate repair pit as detailed on the Contract Drawings and uncover the main line sewer a minimum of one foot clearance all around at the damaged section or as directed by the Owner, and remove damaged pipe by power saw cutting to a flat vertical surface. A snap ring cutter is permitted on clay pipe only, provided a flat vertical surface is obtained.
- (3) New sanitary sewer pipe to be used in the replacement shall be power saw cut to a flat vertical surface.
- (4) Reshape and compact the bottom of the trench as required so that the grade for the new pipe will match that of the existing main line sewer.
- (5) Repair and replace a minimum of the length of pipe specified in the Contract Drawings with new pipe of the same inside diameter.

- (6) Connect newly installed sewer main pipe to existing sewer main pipe, to provide a watertight connection. When applicable, the main line sewer shall be severed so that a smooth plain-end spigot exists at both ends of the trench and reconnected by means of an adapter or solid sleeve. Clay pipe adapters (flexible couplings), Fernco or approved equal, shall only be used for clay to PVC pipe or clay to DI pipe; otherwise, solid sleeves with transition gaskets shall be used. The adapters or solid sleeves shall be installed per the manufacturer's recommendations. All mated pipe ends shall be flush to each other across the face with no gaps or offsets and matched inverts on inside diameter. The Contractor must use extreme care when bedding and backfilling the pipe to satisfy these requirements.
- (7) Where more than one pipe section is to be replaced consecutively, the conventional bell and spigot joint will be utilized with a rubber gasket on the interior pipe sections. The entire replacement length will then be joined to the existing line by means of adapters or sleeves. Clay pipe adapters (flexible couplings), Fernco or approved equal, shall only be used for clay to PVC pipe or clay to DI pipe; otherwise, solid sleeves with transition gaskets shall be used. The adapters or solid sleeves shall be installed per the manufacturer's recommendations.
- (8) The pipe shall be bedded, backfilled and compacted in accordance with Section 520 of these Specifications. Grading and surface restoration shall also be completed in accordance with Sections 107 and 520 of these Specifications.

3.09 Sewer House Connection Renewals:

- (A) Remove existing house connection appurtenance.
  - (1) During the terms of the Contract, the Contractor shall maintain an emergency crew fully equipped and capable of reactivating sewer house connections and responding to customer problems after normal work hours. Costs incurred because of an emergency response will be the responsibility of the Contractor.
  - (2) The exact location and number of service connections shall be determined from dye test method, TV tapes or other methods approved by the Owner. It shall be the Contractor's responsibility to accurately field locate all existing service connections whether in service or not.
- (B) The Contractor shall reconnect all service connections which have been determined as live connections to the replaced and/or lined sewer main. The Contractor shall notify the Owner before reconnecting any services to vacant lots. The Contractor shall be responsible for restoring/correcting, without any delay, all missed or faulty reconnections, as well as for any damage caused to property owners for not reconnecting the services soon enough or for not giving notice to the owners. All services which are reconnected to the sewer main shall be shown on the "As Built Drawings" with the exact distance from the nearest downstream manhole and offset distances to the service lateral cleanouts.

- (C) The Contractor shall replace all active sanitary sewer laterals from the rehabilitated and/or replaced sewer main to the public right-of-way-line. Contractor shall also locate and replace or install new City of Virginia Beach service cleanouts at the right-of-way for all active laterals, unless otherwise directed.
- (D) Contractor shall be responsible for supplying sewer service to affected parcels during reconnection activities.
- (E) The Contractor shall isolate the section to be repaired from the remainder of the sewer in a manner approved by the Owner. Such method may include bypassing the flow from the section or temporarily plugging the upstream manhole. The Contractor shall conduct operations so as to prevent backflow into residences. Flow control/bypassing shall be completed in accordance with Section 01501.
- (F) The main line sewer at the house connection shall be sawcut on both sides of the damaged connection to a flat vertical surface and remove old pipe. If pipe with bell end is removed, spigot end of pipe shall be saw cut and removed a minimum length of the bell depth.
- (G) Provide appropriate sleeves and/or adaptors and new PVC or ductile iron pipe to reconnect to the existing sewer house service pipe. Clay pipe adapters (flexible couplings) shall only be used for connection to clay pipe; otherwise, a solid sleeve with transition gaskets shall be used. All mated ends shall be flush to each other across the face with no gaps or offsets and matched inverts on inside diameter.
- (H) House Connection Renewal for Replaced Sewer Main Sections (refer to the paragraph below for connections to a rehabilitated main): The Contractor shall install a new PVC or ductile iron all bell Tee or T-wye in existing main line sewer utilizing new PVC or ductile iron pipe and appropriate sleeves and/or adaptors as required for a watertight seal, and as directed by the Owner. Clay pipe adapters (flexible couplings) shall only be used for connection to clay pipe; otherwise, a solid sleeve with transition gaskets shall be used.
- (I) Additional Requirements for Reconnection to a Rehabilitated Main by Inserta Tee Method:
  - (1) The Contractor shall allow the liner to normalize to ambient temperature and recover from imposed stretch. For cured-in-place and fold and form liners, verify that the liner is completely cured.
  - (2) Immediately following liner installation and curing, the Contractor shall cut a relief hole at each service connection. The relief hole shall be 85% of the diameter of the service connection.
  - (3) The Contractor shall excavate and remove a portion of the existing sanitary sewer main or carrier pipe to expose the liner pipe. Provide sufficient working space to install an inserta tee.
  - (4) The Contractor shall precisely cut a circular hole, per the manufacture's recommendations, in the liner pipe that will form a tight fit between the liner pipe, PVC hub and rubber boot.

- (5) The rubber boot shall be installed into the cored hole, making sure the boot is properly oriented to the mainline. The rubber boot shall be lubricated with a special solution provided by the inserta tee manufacturer. The Contractor shall make sure the upper and lower ribs of the rubber boot are correctly seated against the inside and outside diameter of the liner pipe.
  - (6) The PVC hub shall be inserted into the rubber boot, per manufacturers recommended instructions. The stainless steel band shall be placed around the top of the rubber boot and tightened to form a watertight seal.
  - (7) The service lateral shall be replaced as required.
- 3.10 Pipe Plugs: Should the Contractor be unable to complete the installation of a segment of new pipe within the workday limits, the newly installed pipe shall be sealed at the termination of the workday with standard plugs normally used for the size and pipe material required on this project and the Contractor shall provide the appropriate flow control equipment and labor to re-establish the system in useful service at the end of the day.
- 3.11 Sewer Cleanout Plugs: Sewer cleanout plugs shall be manufactured, watertight, and removable of a size suitable for the existing opening.
- 3.12 Repair Pipe Connection
- (A) Pipe connections in manholes designated for repair as scheduled on the Contract Drawings shall be repaired as follows:

The annular space surrounding the pipe connection shall be cleaned of all debris, grease, loose aggregate, etc. by high pressure water blast. Following cleaning operations, gaps adjacent to existing incoming or outgoing pipes shall be sealed by inserting jute and grout (Scotch Seal 5600 or approved equivalent) prior to any chemical grout sealing if required. The annular space shall then be filled with a fast setting corrosion resistant non-shrink hydraulic cement to create a long lasting water tight seal. The grout shall be troweled flush with the manhole walls and connecting pipe.
- 3.13 Manhole, Cleanout and Pipeline Abandonment:
- (A) When underground utilities are to be abandoned in place, permanently plug, cap, or seal with concrete at the "construction limits" or at points shown.
  - (B) Remove underground utilities indicated on the Drawings to be removed, and backfill resulting excavation with suitable material compacted as specified. Permanently plug, cap, or seal utilities with concrete at the construction limits or at points shown.
  - (C) Refer to Section 520.05, Shutdowns, for additional requirements.
  - (D) Manholes, Cleanouts and Sanitary Sewer Pipeline segments to be abandoned shall be filled with flowable fill. Sewer lines and services that are not removed

during construction shall be securely plugged and appropriately vented to ensure complete filling of the abandoned system.

- (E) Flowable Fill: Mixture design for flowable fill shall be in accordance with Section 217 of VDOT specification. Flowable fill shall have a design compressive strength of 30 to 200 psi at 28 days when tested in accordance with ASTM C-39. Mixture design shall result in a fluid product having an 8 in to 10 in slump at time of placement.
  - (1) Mixing and transporting shall be in accordance with Section 217 of VDOT specifications.
  - (2) Placement shall be in accordance with Section 217 of VDOT specifications. Pumping of the flowable fill material will be required to fill the abandoned pipeline segments.
- (F) Manhole frames and covers shall be removed and the remainder of the manhole shall be filled with flowable fill.
- (G) Backfill and surface restoration shall be in accordance with Section 520 of these Specifications.

#### 3.14 Pavement Patches of Utility Trenches

- (A) Pavement patches of utility trenches shall include, but not be limited to, replacement of paved or finished surfaces with similar materials and for other work, in accordance with Sec. 107.12 of the Specifications, and as shown on the Project Drawings.
- (B) Where adjacent pavements are to be retained, pavement removed for pipe line trenches shall be replaced in kind with equal or better material.

#### 3.15 Acceptance Tests for New Gravity Sewer Lines and Manholes:

- (A) All new sanitary sewer lines shall be tested as the work progresses by infiltration or exfiltration. New, replaced and rehabilitated manholes shall also be tested separately for final acceptance, using either the infiltration or exfiltration method, as directed by the Inspector. Tests shall be conducted on short sections of sewer line; i.e., between structures. Installation of sewers will not be permitted at a point more than 2,000 feet ahead of any section of sewer or any manhole which has not been given the final test and accepted. The Contractor shall provide all labor, materials, tools, and equipment necessary to make the tests. All equipment and methods used shall be acceptable to the Inspector. The Contractor shall notify the Owner at least 48 hours in advance of the test and perform tests in the presence of the Inspector. All monitoring gages shall be subject to calibration, if deemed necessary by the Inspector. All sewer lines, regardless of size, that cross under streams shall be tested from manhole to manhole for infiltration and exhibit zero infiltration.
  - (1) Infiltration and Exfiltration Test
    - i After placement of the backfill, test for leakage of gravity sewers and manholes using either the infiltration or exfiltration test.

Maximum allowable leakage shall be limited to 100 gallons per day per inch diameter per mile, except that all sewers that cross under streams shall be tested for and exhibit zero leakage. New and rehabilitated manholes shall be tested separately and shall exhibit no leakage.

- ii. The Inspector shall make the determination of whether a particular section is tested using the infiltration or exfiltration method. The Contractor may be required to dig test holes along the line of construction at the direction of the Owner to resolve disputes pertaining to the groundwater level.
  - iii. Use infiltration test when groundwater is at least 4 feet above top of pipe for the entire length of line to be tested. Isolate the sections to be tested by plugging the upper and lower manholes. The test will be conducted from the lowest manhole by measuring the change in the level of water collected over the test period. At the end of the test period, water will be removed from the manhole until the level is the same as the start of the test period. The water removed will be placed in a container suitable to measure the volume of water collected.
  - iv. Use exfiltration test when groundwater is less than 4 feet above top of the pipe at the upstream end of the test section. Plug the pipe at the lower manholes as necessary to isolate the line(s) to be tested. Fill the system with water until the level in the upstream manhole reaches 4 feet above top of pipe or top of manhole, whichever is less. Let the water stand until the system has stabilized and all trapped air has escaped. To start the test, refill manhole to original level. At the end of the test period, determine the amount of water that must be added to bring the level back to that at the start of the test.
- (B) When testing new and rehabilitated manholes, follow same procedures as above except that all outlets shall be plugged. No change in level of water shall be accepted.
- (C) Deflection Tests - PVC gravity sewer mains will be subject to a pass/fail test for diametric deflection. Deflection shall not exceed 5 percent of the inside diameter of the pipe. After installation and backfill of sewers, tests will be conducted by pulling a rigid gauge through the sewer from manhole to manhole or manhole to main line cleanout. Any section of sewer which fails to pass the gauge along its entire length is deemed to have failed the test. Gauge used is subject to approval by the Inspector. The Contractor will conduct the tests, witnessed by the Inspector.
- (D) Mirror Tests - Gravity sewers shall have an internal visual test for proper grade and alignment. The test will consist of directing light through the sewer from manhole to manhole to visually inspect grade, alignment, materials, and defects. Lines are subject to failure for vertical or horizontal misalignment, improper materials, or visible defects. Tests will be conducted by the Inspector with the assistance of the Contractor.
- (E) Repairs - When sewers or manholes fail to meet test requirements, or when leaks, crooked pipe, or other defects are visible by inspection, the Contractor shall repair or rebuild at his expense those portions of the sewers and/or manholes

which are faulty. Methods and materials used for repairs shall be approved by the Owner. The tests and repairs shall be continued until the system meets all test requirements.

- (F) Cleaning and Closed-Circuit Television Inspection (for new or replaced sewer mains) - The Contractor shall, in the presence of the Owner's inspector, clean and inspect new and replaced sewer mains using closed-circuit television equipment. The cleaning shall be conducted in accordance with Section 02741, and the inspection shall be completed in accordance with Section 02742.
  - (1) Acceptance: Any section of pipe that is found defective in material, alignment, grade of joints, or visible leakage shall be corrected to the satisfaction of the Owner at the Contractor's expense. These defects may be located by the Post Television inspection or by other techniques specified by the Owner.

### 3.16 Acceptance Tests for Sanitary Sewer Repairs:

- (A) Acceptance Tests for Conventional Excavation and Replacement Point Repairs
  - (1) Alignment Test: Prior to backfilling, the Contractor and Inspector shall visually inspect the repair to ensure that there are no visible defects, including broken, cracked, offset, leaking, or sagging pipe. Extreme care shall be taken by the Contractor during installation and backfilling to ensure that the existing and new pipe is adequately bedded and aligned to provide smooth inverts, free of offset or gaps. Couplings and gasketed joints shall be properly installed to ensure watertight conditions.
  - (2) Cleaning and Closed-Circuit Television Inspection: The Contractor shall, in the presence of the Owner's inspector, clean and inspect the repaired line using closed-circuit television equipment. The cleaning shall be conducted in accordance with Section 02741, and the inspection shall be completed in accordance with Section 02742.
  - (3) Acceptance: Any section of pipe that is found defective in material, alignment, grade of joints, or visible leakage shall be corrected to the satisfaction of the Owner at the Contractor's expense. These defects may be located by the Post Television inspection or by other techniques specified by the Owner.

## 4. Measurement and Payment:

### 4.01 Method of Measurement

General: Work covered by the contract documents consists of providing all work indicated on drawings or required by project manual complete-in-place. The term "complete-in-place" shall mean that the item of work shall be furnished and installed in accordance with the specifications complete with all appurtenances necessary for the item to be used for its intended function. Where appropriate, this means that payment for the item includes, but is not necessarily limited to, testing, removal, demolition and disposal of spoils, cleanup, and restoration of all disturbed areas to original condition unless specified otherwise.

Measurement and Payment: Measurement of pay items will be made by the Owner. The measurement of all items is based upon their satisfactorily being installed and complete-in-place in accordance with the terms of the contract documents. Measurement and payment will not be made for those items which require Owner approval prior to placement if approval has not been obtained. Only the items specified in this article "Measurement and Payment" shall be defined to be pay items except as otherwise expressly provided for under the terms of the contract documents.

The following items are classified as incidental work and will not be measured for separate payment. The cost thereof shall be included in the lump sum or unit prices bid for the other items of work.

- i. Traffic Control. When traffic control is required at a signalized intersection within the project limits, the flagger shall be an off duty City of Virginia Beach police officer. This service is classified as incidental and will not be measured for payment.
- ii. Noise control.
- iii. Flow control. Sewage flow control including by-pass pumping and other equipment needed to control or reroute sewage flow to facilitate construction of the different pay items will not be measured for payment.
- iv. Topsoil or gravel shoulder replacement or repair.
- v. Miscellaneous replacement or repair is required of sidewalks, curb and gutter, driveways, drainage pipe, drainage structures, or similar items.
- vi. General site preparation; clearing and grubbing; disposal of trees, stumps, shrubs, brush, logs, broken pavement and spoil material, protection, transplanting and/or trimming of vegetation; and disposal of sewer pipe, manholes, cleanouts, or other similar material removed during the performance of work.
- vii. Trench and excavation dewatering.
- viii. General earthwork, such as stripping of topsoil, excavation and backfilling, site restoration, top soiling, fertilizing, and seeding.
- ix. Erosion and sediment control, including material and labor.
- x. Bedding material used for the installation of manholes, cleanouts, and related appurtenances.
- xi. Root removal and disposal.
- xii. Excavation and disposal of unsuitable material.
- xiii. Temporary Utilities.
- xiv. Restoration of property.
- xv. Landscaping.
- xvi. Removal of existing piping, cleanouts, manholes, and plugging of pipes, etc. shown on the Project Drawings to be removed and/or plugged when such removals are necessary for the installation of new or relocated water or sewer facilities.
- xvii. Hydrant service signs on existing hydrants being temporarily taken out of service.

Unless specifically stated otherwise on the Project Drawings, measurement and payment for adjustment of existing facilities shall be one time only for each item adjusted. Interim adjustments and/or re-adjustments to facilitate contractor's construction practices shall be included in the amount bid for each item.

- (A) Gravity Sanitary Sewer Lines (6-Inches and Larger) - Shall be measured in-place for each size and material in the horizontal plane, from center to center of

structure through service wyes and tees, and shall be paid for at the unit price per linear foot according to the average depth between structures. The average plan depth is defined as the average of the plan depth (rim to invert) of the upstream and downstream structure on a pipe run. The applicable depth categories are as follows: 0-6', 6-12', 12-16', 16-20', and 20' and over. Where the average depth between structures is determined to be exactly equal to the upper and lower limits of two categories, the depth shall be classified in the category of greater depth.

- (B) Gravity Sanitary Sewer Point Repairs (6-inches and larger) - Shall be measured in place for each size and material in the horizontal plane, from end to end of the point repair performed. Payment shall be at the unit price per linear footage, and shall be based upon the average plan depth for each repair. The average plan depth is defined as the average of the plan depth (surface elevation to pipe invert) of the upstream and downstream end on the repair run. The applicable depth categories are as follows: 0-6', 6-12', 12-16', 16-20', and 20' and over. Where the average depth between ends is determined to be exactly equal to the upper and lower limits of two categories, the depth shall be classified in the category of greater depth.
- (C) Service Wyes or Tees - Shall be measured in place for each service wye or tee installed.
- (D) Sewer Inserta Tee Connections (To Rehabilitated Mains Only) - Shall be measured in place for each Inserta Tee installed.
- (E) Lateral Service Connections (4-inch and 6-inch) - Shall be measured in-place in the horizontal plane for each size and material, from the manhole or the wye at the mainline sewer to the sewer cleanout assembly, and shall be paid for at the unit price per linear foot.
- (F) Sanitary Sewer Cleanout Assemblies on New Main or Lateral (mainline or lateral) - Shall be measured in place per each assembly installed.
- (G) Sanitary Sewer Cleanout Assemblies on Existing Main or Lateral (mainline or lateral) - Shall be measured in place per each assembly installed.
- (H) Standard Sanitary Sewer Manholes - Shall be measured in place based upon the vertical linear footage, from the invert at the center of the sewer manhole to the bottom of the manhole frame, for each standard manhole installed.
- (I) Large Sanitary Sewer Manholes (larger than standard 4-foot inside diameter) - Shall be measured in place based upon the vertical linear footage, from the invert at the center of the sewer manhole to the bottom of the manhole frame, of each diameter manhole installed.
- (J) Shallow Manholes Built in Place with Brick and Mortar - Shall be measured in place for each shallow manhole constructed.
- (K) Formed-in-Place Concrete Manhole with Plastic Composite Liner - Shall be measured in place based upon the vertical linear footage, from the invert at the center of the sewer manhole to the bottom of the manhole frame, for each formed-in-place concrete manhole with plastic composite liner installed.

- (L) Storm Sewer Conflict Structures - Shall be measured in place based upon the vertical linear footage, from the invert at the center of the sewer manhole to the bottom of the manhole casting, of each conflict structure installed.
- (M) Changing from an Outside Drop Manhole to an Inside Drop Manhole Connection - Shall be measured for each complete and in-place according to size, 4-inch and larger.
- (N) Inside Drop Connection - Shall be measured for each connection complete and in-place according to size, 4-inch and larger.
- (O) Pipe Connection to Existing Manholes (Sewer Mains Only) - Shall be measured for each connection complete and in-place.
- (P) Special Design Sanitary Sewer Manholes - Shall be measured for each special design installed in accordance with Contract Documents.
- (Q) Standard Manhole Frames and Covers - Shall be measured for each frame and cover and dust cover installed.
- (R) Watertight Sanitary Sewer Manhole Frame and Cover - Shall be measured for each watertight frame and cover installed.
- (S) Manhole Dust Covers - Shall be measured for each dust cover installed.
- (T) Manhole Inserts - Shall be measured for each insert installed.
- (U) Installation of Sanitary Sewer Valve Extension Stem on Existing Valves - Shall be measured in units of each extension installed.
- (V) Adjustment of Existing Sanitary Sewer Manhole Frame and Cover - Shall be measured in units of each adjusted.
- (W) Reconstruction of Existing Sanitary Sewer Manholes - Shall be measured for each manhole reconstructed.
- (X) Adjustment of Existing Sanitary Sewer Cleanouts (Mainline or Lateral) - Shall be measured in units of each adjusted.
- (Y) Removal of Existing Sanitary Sewer Cleanouts (Mainline or Lateral) (Only when the existing sewer cleanout is not being replaced with a new cleanout) - Shall be measured in units of each removed.
- (Z) Removal of Existing Sanitary Sewer Manholes (Only when the existing manhole is not being replaced with a new manhole) - Shall be measured in units of each removed.
- (AA) Relocation of Existing Sanitary Sewer Cleanouts - Shall be measured in units of each relocated.
- (BB) Abandonment of Existing Sanitary Sewer Manholes - Shall be measured in units of each abandoned.

- (CC) Abandonment of Existing Sanitary Sewer Force Mains, Gravity Sanitary Sewer Mains and Laterals - Shall be measured for each size in the horizontal plane, from center to center of structure and shall be paid for by the linear foot.
- (DD) Pipe Bedding - Shall be measured in linear feet and shall include bedding material required from 6-inch below bottom of pipe to the springline of pipe as shown on the Project Drawings, when directed by the Inspector, for the full width of the trench.
- (EE) Coarse Aggregate Fill (VDOT #57 Aggregate) required to replace unsuitable material in sanitary sewer pipe trenches below any required pipe bedding - Shall be furnished, when directed by the Inspector, to the full width of the trench. It shall be measured in linear feet per each 6-inch increment of depth in-place.
- (FF) Select Material Used in Trench Backfilling - Shall be measured in cubic yards. To determine the volume, length shall be measured in the horizontal plane through fittings, valves or between the center of structures. Depth and width will be determined as described below. Select material used for sanitary sewer laterals will not be measured for payment. Depth categories are: 0-6', 6-12', 12-16', 16-20' and 20' and deeper. The maximum trench width shall vary as a function of depth:

<b>Depth from Existing Ground to Invert</b>	<b>Pay Width</b>
0-6'	4.0'
6-12'	5.5'
12-16'	7.0'
16-20'	7.5'
Greater than 20'	8.0'

The volume for payment is determined by the amount of select material displaced by gravity sewer pipes and storm drain systems deducted from the total trench volume and any on site suitable material deducted from the total trench volume.

- (GG) Pavement Patching of Utility Trenches - Shall be measured in units of linear feet. Pavement shall be measured and paid for one time only. Additional pavement patching required for testing purposes and temporary connections for sanitary sewer service lines will not be measured for payment. Measurement shall be made continuous through structures.
- (HH) Allaying Dust - Shall be measured in numbers of hours allaying dust is performed.

#### 4.02 Basis of Payment

- (A) Gravity Sanitary Sewer Lines (6-inches and larger) - Shall be paid for at the unit price for each size and depth bid and shall include the cost of removing and disposing existing sewer pipe, disposal of surplus or unsuitable material, furnishing and installing the pipe, appurtenances, dead end caps or plugs, clay

cutoff collars at 100-foot intervals along the trench, sewage flow control, dewatering, excavating, temporary sheeting and bracing, testing, backfilling, compacting, inspection, top soiling, seeding, and other site restoration and cleanup. Cleaning/televising and pavement patching of utility trenches shall be paid for separately.

Note: CBR-15 backfill material shall be used for trenches made in the subgrade of proposed or existing pavement, and all trenches outside of the subgrade where the inner edge of the trench is closer than two feet to the edge of the proposed pavement, stabilized shoulder, curb, bike path, or sidewalk, whether such backfill material supplied from onsite or offsite. Pipe bedding, when directed by the Inspector, shall be paid for under pipe bedding. Coarse aggregate fill, when directed by the Inspector, shall be paid for under coarse aggregate fill.

- (B) Gravity Sanitary Sewer Point Repairs (6-inches and larger) - Shall be paid for at the unit price for each size and depth bid and shall include the cost of removing and disposing existing sewer pipe, disposal of surplus or unsuitable material, furnishing and installing the pipe, appurtenances, dead end caps or plugs, sewage flow control, dewatering, excavating, temporary sheeting and bracing, testing, backfilling, compacting, inspection, top soiling, seeding, and other site restoration and cleanup. Cleaning/televising and pavement patching of utility trenches shall be paid for separately.

Note: CBR-15 backfill material shall be used for trenches made in the subgrade of proposed or existing pavement, and all trenches outside of the subgrade where the inner edge of the trench is closer than two feet to the edge of the proposed pavement, stabilized shoulder, curb, bike path, or sidewalk, whether such backfill material supplied from onsite or offsite. Pipe bedding, when directed by the Inspector, shall be paid for under pipe bedding. Coarse aggregate fill, when directed by the Inspector, shall be paid for under coarse aggregate fill.

- (C) Service Wyes or Tees - Shall be paid for at the Contract unit price and shall include the cost of furnishing and installing the fittings, stone bedding, and plugs. Excavation and backfill, sheeting and bracing, dewatering, testing, compaction, top soiling, seeding and other site restoration for service wyes or tees shall be included in the measurement and payment for gravity sanitary sewer lines. Price for service wye or tee shall be in addition to the footage payment for the main line pipe.
- (D) Sewer Inserta Tee Connection (to Rehabilitated Mains Only) - Shall be paid for at the Contract unit price and shall include furnishing and installing the fittings, appurtenances, stone bedding, plugs, excavation, sheeting and bracing, dewatering, testing, backfill and compaction, top soiling, seeding, and other site restoration.
- (E) Lateral Service Connections (4-inch and 6-inch) - Shall be paid for at the Contract unit price and shall include the cost of removing and disposing of existing cleanouts and piping, furnishing and installing all pipe, appurtenances, connection to existing manholes, dewatering, excavating, sheeting and bracing, testing, backfilling with suitable material, pipe bedding, compacting, pavement patching for utility trenches, top soiling, seeding, disposing of surplus or unsuitable material, and other site restoration and cleanup. Wye, tee, or Inserta

Tee at main sanitary sewer line and sewer cleanout assembly shall be measured and paid for separately.

- (F) Sanitary Sewer Cleanout Assemblies on New Main or Lateral (mainline or lateral) - Shall include furnishing and installing the wye, riser pipe, cleanout cap or plug, the cast iron cleanout cover, brick or concrete inspection box structure, stone bedding, dewatering, excavating, backfilling with suitable material, compacting, top soiling, seeding, removal and disposal of any existing cleanouts, disposing of surplus or unsuitable material, and other restoration and cleanup.
- (G) Sanitary Sewer Cleanout Assemblies on Existing Main or Lateral (mainline or lateral) - Shall include furnishing and installing the wye, riser pipe, cleanout cap or plug, the cast iron cleanout cover, brick or concrete inspection box structure, stone bedding, dewatering, excavating, backfilling with suitable material, compacting, top soiling, seeding, locating existing main or lateral, disposing of surplus or unsuitable material, and other restoration and cleanup.
- (H) Standard Sanitary Sewer Manholes - Shall be paid based upon the vertical linear footage for standard manhole installed. Depth for payment purposes shall be from the invert at the center of the sewer manhole, to the bottom of the manhole casting. The Contract unit price for each vertical linear foot shall include the cost of removing and disposing of existing manholes or main line cleanouts (for replacement manholes only), excavating, coarse aggregate fill, backfilling with suitable material, compacting, temporary sheeting and bracing, dewatering, interior and exterior applied coatings, concrete base, benches, walls, inverts, disposing of surplus or unsuitable material, testing, connection of sanitary sewer lines (including the lateral service connections) to the manhole, and final surface grading. The manhole frame and cover shall be measured and paid for separately.
- (I) Large Sanitary Sewer Manholes (larger than standard 4-foot inside diameter) - Shall be paid based upon the vertical linear footage of each diameter manhole installed, with payment as set forth above for standard sewer manholes. The contract unit price for each vertical linear foot shall include the cost of removing and disposing of existing manholes or main line cleanouts (for replacement manholes only), excavating, coarse aggregate fill, backfilling with suitable material, compacting, temporary sheeting and bracing, dewatering, interior and exterior applied coatings, benches, walls, inverts, disposing of surplus or unsuitable material, testing, connection of sanitary sewer lines (including the lateral service connections) to the manhole, and final surface grading. The manhole frame and cover shall be measured and paid for separately.
- (J) Shallow Manholes Built in Place with Brick and Mortar - Shall be paid based upon the unit price for each shallow manhole constructed and shall include the cost of removing and disposing of existing manholes or main line cleanouts (for replacement manholes only), excavating, coarse aggregate fill, backfilling with suitable material, compacting, temporary sheeting and bracing, dewatering, interior and exterior applied coatings, concrete base, benches, walls, inverts, disposing of surplus or unsuitable material, testing, connection of sanitary sewer lines (including the lateral service connections) to the manhole, and final surface grading. The manhole frame and cover shall be measured and paid for separately.

- (K) Formed-in-Place Concrete Manhole with Plastic Composite Liner - Shall be paid based upon the vertical linear footage for formed-in-place concrete manhole with plastic composite liner installed. Depth for payment purposes shall be from the invert at the center of the sewer manhole, to the bottom of the manhole frame. The Contract unit price for each vertical linear foot shall include the cost of removing and disposing of existing manholes or main line cleanouts (for replacement manholes only), excavating, coarse aggregate fill, backfilling with suitable material, compacting, temporary sheeting and bracing, dewatering, interior and exterior applied coatings and liners, concrete base, benches, walls, inverts, disposing of surplus or unsuitable material, testing, connection of sanitary sewer lines (including the lateral service connections) to the manhole, and final surface grading. The manhole frame and cover shall be measured and paid for separately.
- (L) Storm Sewer Conflict Structures - Shall be paid based upon the vertical linear footage of each conflict structure installed, with payment as set forth above for standard sewer manholes. The contract unit price for each vertical linear foot shall include the cost of removing and disposing of existing structures (for replacement structures/manholes only), excavating, coarse aggregate fill, backfilling with suitable material, compacting, temporary sheeting and bracing, dewatering, interior and exterior applied coatings, benches, walls, inverts, disposing of surplus or unsuitable material, testing, connection of sanitary sewer lines to the conflict structure, and final surface grading.
- (M) Changing from an Outside Drop Manhole to an Inside Drop Manhole Connection - Shall be paid for at the contract unit price for each transition (from outside to inside) and shall include excavating, all materials for construction of drop connection, removing and disposing the existing drop connections, sheeting and bracing, dewatering, backfilling with suitable material, compacting, testing, disposing of surplus or unsuitable material, connection of main sewer lines, patching manhole wall due to existing pipe connection, reshaping of bench and channel invert, and final surface grading.
- (N) Inside Drop Connection - Shall be paid for at the contract unit price for each inside drop connection and shall include excavating, all materials for construction of drop connection, removing and disposing any existing drop connections, sheeting and bracing, dewatering, backfilling with suitable material, compacting, testing, disposing of surplus or unsuitable material, connection of main sewer lines, and final surface grading.
- (O) Pipe Connection to Existing Manholes (Sewer Mains Only) - Shall be paid for at the contract unit price for each pipe connection to an existing manhole and shall include furnishing and installing the pipe, fittings, appurtenances, boot or rubber gasket water stop, stone bedding, excavation, sheeting and bracing, dewatering, testing, backfill and compaction, top soiling, seeding, and other site restoration.
- (P) Special Design Sanitary Sewer Manholes - Shall be paid for at the contract unit price for each special design in accordance with the Contract Documents.
- (Q) Standard Sanitary Sewer Manhole Frame and Cover - Shall be paid for at the contract unit price for each frame and cover and dust cover installed including adjustment to final grade.

- (R) Watertight Sanitary Sewer Manhole Frame and Cover - Shall be paid for at the contract unit price for each watertight frame and cover installed including adjustment to final grade.
- (S) Manhole Dust Covers - Shall be paid for at the contract unit price for each dust cover installed.
- (T) Manhole Inserts - Shall be paid for at the contract unit price for each manhole insert installed.
- (U) Installation of Sanitary Sewer Valve Extension Stem on Existing Valves - Shall be paid for at the contract unit price per each. The unit price shall be full compensation for excavating, stem additions, removing and replacing valve box, adjusting to final grade, backfilling with suitable material, compacting, disposing of surplus or unsuitable materials, top soiling, seeding, pavement patching for utility trenches and for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work as shown on the Project Drawings.
- (V) Adjustment of Existing Sanitary Sewer Manhole Frame and Cover - Shall be paid for at the contract unit price per each. The unit price shall be full compensation for excavating, removing of frame and cover, adding or removing material from manhole tower, replacing frame and cover, top soiling, seeding, backfilling with suitable material, compacting, adjusting to final grade, disposing of surplus or unsuitable materials, pavement patching for utility trenches and for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work as shown on the Project Drawings.
- (W) Reconstruction of Existing Sanitary Sewer Manholes - Shall be paid for at the contract unit price per each. The unit price shall be full compensation for excavating, removing of frame and cover, adding or removing material from manhole tower, adding or removing cone or chamber sections, adding or removing steps as necessary, replacing frame and cover, backfilling with suitable material, compacting, adjusting to final grade, disposing of surplus or unsuitable materials, pavement patching for utility trenches and for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work as shown on the Project Drawings.
- (X) Adjustment of Existing Sanitary Sewer Cleanouts (Mainline or Lateral) - Shall be paid for at the contract unit price per each. The unit price shall be full compensation for excavating, removing of frame and cover, adding or removing material supporting frame, adding or removing pipe, replacing plug, replacing frame and cover, backfilling with suitable material, compacting, adjusting to final grade, disposing of surplus or unsuitable materials, top soiling, seeding, pavement patching for utility trenches or concrete, as needed. This price shall include furnishing all materials, labor, tools, equipment and incidental necessary to complete the work as shown on the Project Drawings.
- (Y) Removal of Existing Sanitary Sewer Cleanouts (Mainline or Lateral) (Only when the existing cleanout is not being replaced with a new cleanout) - Shall be paid for at the contract unit price per each. The unit price shall be full compensation for all dewatering, excavating, backfilling with suitable material, compacting, disposing of surplus or unsuitable material, top soiling, seeding, pavement patching for utility trenches and for furnishing all materials, labor, tools,

equipment and incidentals necessary to complete the work as shown on the Project Drawings. Where existing cleanouts are to be removed, the wye of the cleanout shall be removed and a plug installed in its place.

- (Z) Removal of Existing Sanitary Sewer Manholes (Only when the existing manhole is not being replaced with a new manhole) - Shall be paid for at the contract unit price per each. The unit price shall be full compensation for all dewatering, excavating, backfilling with suitable material, compacting, removing and disposing existing manholes, disposing of surplus or unsuitable material, top soiling, seeding, pavement patching for utility trenches and for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work as shown on the Project Drawings.
- (AA) Relocation of Existing Sanitary Sewer Cleanouts - Shall be paid for at the contract unit price per each. The unit price shall be full compensation for all dewatering, excavating, backfilling with suitable material, compacting, pavement patching for utility trenches, necessary cutting or joining to other sections of pipe, additional sections of pipe as needed, coarse aggregate fill, testing, disposing of surplus or unsuitable material, top soiling, seeding, restoration of property, and for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work as shown on the Project Drawings.
- (BB) Abandonment of Existing Sanitary Sewer Manholes - Shall be paid for at the contract unit price per each. The unit price shall be full compensation for excavating, demolishing, filling with flowable fill, removal of manhole frame and cover, plugging of any pipes, backfilling with suitable material, compacting, pavement patching for utility trenches, disposing of surplus or unsuitable material, top soiling, seeding, restoration and cleanup of property and for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work as shown on the Project Drawings.
- (CC) Abandonment of Existing Sanitary Sewer Force Mains, Gravity Sanitary Sewer Mains, and Laterals - Shall be paid for at the contract price per linear foot for each pipe size. The unit price shall be full compensation for excavating, filling with flowable fill, capping or plugging, backfilling with suitable material, compacting, pavement patching for utility trenches, disposing of surplus or unsuitable materials, handling of hazardous materials (i.e., asbestos), top soiling, seeding, restoration and clean up of property, and for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work as shown on the Project Drawings.
- (DD) Pipe Bedding - Shall be paid for at the contract unit price and shall include the cost of furnishing and installing the pipe bedding as detailed on the Plans, the cost of additional excavation, dewatering, temporary sheeting and bracing, and disposing of the unsuitable material which is replaced by the pipe bedding.
- (EE) Coarse Aggregate Fill (VDOT #57 aggregate) - Shall be paid for at the contract unit price per 6-inch depth and shall include the cost of furnishing and installing the fill as detailed on the Plans, the cost of additional excavation, dewatering, temporary sheeting and bracing, and disposing of unsuitable excavated material which is replaced by the coarse aggregate fill.

- (FF) Select Material Used in Trench Backfilling - Payment shall be made at the contract unit price bid per cubic yard of select material. The unit price includes disposing of unsuitable material. Placement of the select material used for trench backfilling is included within other items of work.
- (GG) Pavement Patching for Utility Trenches - Shall be paid for at the contract unit price per linear foot of pavement and stone aggregate base replaced. The unit price shall be full compensation for all labor, tools, equipment, materials and incidentals necessary to complete the work.
- (HH) Allaying Dust - Shall be paid for at the unit price per hour that this task is performed and shall include full compensation for materials, labor, tools, equipment and incidentals necessary to complete the work as required.

END OF SECTION

Section 02731 - Pipe Rehabilitation - General Requirements  
for Cured-in-Place and Fold and Form Pipe Methods

1. General:

- 1.01 These specifications include requirements for all design, materials, transportation, equipment and labor necessary to rehabilitate deteriorated sections of sewer listed in the contract documents. This specification is intended to identify the minimum requirements of the Owner.
- 1.02 The proposed locations for sewer rehabilitation are shown on the drawings.
- 1.03 The Contractor shall furnish all material, labor and special equipment required to accomplish the work in accordance with these specifications. The installation shall affect the complete interior relining of the existing sanitary sewer piping and shall result in a smooth, hard, strong and chemically inert interior finish, and closely following the contours of the existing piping. The Contractor shall provide a completed system with mainline sewer and all active lateral connections in operational condition.
- 1.04 The Contractor shall be responsible for all work pertaining to the abandonment and/or removal of existing manholes and sewer lines, as shown on contract drawings, and where it has been determined by the Owner that the lines and/or manholes cannot be rehabilitated.
- 1.05 Contractor Experience
- (A) The prospective Contractor must be approved, in writing, by the Owner prior to the award of contract. The Contractor shall provide any information or documentation which the Owner may require as proof of the Contractor's competency to perform work of the type herein specified.
  - (B) The Contractor for the pipe rehabilitation of sewers must either have a minimum of two years experience using the product proposed and have installed at least 10,000 linear feet of the proposed product or have ten years general contracting experience completing sewer construction and rehabilitation projects acceptable to the Owner. All workers performing work on the pipe rehabilitation of sewer must be certified by the pipe rehabilitation system supplier as qualified to perform work with the proposed product.
  - (C) The superintendent for the job must have supervised jobs in which at least 10,000 feet of pipe has been rehabilitated using the product proposed in the bid. The superintendent for the job shall be on-site during all phases of the work involving the insertion and processing of the liner pipe.
  - (D) The Contractor shall be licensed by the liner process manufacturer.
- 1.06 Product Experience
- The product proposed for the pipe rehabilitation of sewers must have been in use for at least two years, and a minimum of 20,000 linear feet of the product must have been installed.

1.07 Water Use

Potable water to be used for pipe lining and cleaning processes may be obtained from the City fire hydrants, at the Contractor's expense. The Contractor shall obtain a hydrant meter from the City. No water shall be drawn from a public fire hydrant except through a meter. The Contractor shall be responsible for paying a deposit fee for the hydrant meter and paying for the quantity of water used during construction. The Contractor shall contact the Public Utilities Business Division at (757) 385-4631 for information on obtaining a hydrant meter and associated costs. The Contractor shall provide all piping, hoses, valves, or connections necessary to complete the work.

1.08 Submittals - Prior to Award of Project

After the opening of bids, the Purchasing Officer shall notify the apparent low bidder to submit the following information:

- (A) Manufacturer's published literature and published data for the proposed pipe liner system.
- (B) The pipe rehabilitation system supplier's letter of certification for each worker who will perform pipe rehabilitation work.
- (C) Independent test report showing that the physical properties of the proposed pipe system meet the requirements of these specifications and the requirements published in the manufacturer's literature.
- (D) The manufacturer's certification that the proposed pipe system for the project meets the requirements of these specifications and will meet or exceed the physical properties given in the manufacturer's published literature submitted as required by Part A of this subsection.
- (E) Documentation of Contractor's experience. This shall include references for all jobs within the last two years that were either completed or under construction using the proposed rehabilitation method. References for a minimum of ten jobs shall be provided. If there are less than ten jobs completed or under construction using the proposed pipe rehabilitation method within the last two years, the Contractor shall provide references for jobs completed within the last ten years for general contracting experience for sewer construction and rehabilitation projects. Information provided shall include a description of the job, the location of the job, the value of the job, the Owner, and the contact for the job including name, title, address, and phone number.
- (F) Documentation of Product experience. This shall include references for jobs completed with the proposed pipe rehabilitation method. The jobs submitted shall show that at least 20,000 linear feet of the product has been installed by the Contractor or other Contractors. The documentation shall include at least ten jobs which have been completed, preferably within the last two years. Information provided for each job shall include a description of the job, the location of the job, the value of the job, the Owner, and the contact for the job including name, title, address, and phone number.
- (G) References for the project superintendent documenting experience as required by these specifications.

- (H) Calculations supporting recommended liner thicknesses. The calculations shall be sealed by a registered Professional Engineer.

1.09 Submittals - After Award of Project

After the award of the Project contract, the Contractor shall submit the following information for review and approval:

- (A) Shop drawings and product data for the rehabilitation method including:
  - (1) A report outlining the process to be used in the rehabilitation of the sewer line. The report shall also include information specific to the job, such as coordination issues, access, timing, manufacturer's installation instructions and flow control.
- (B) All measurements made by the Contractor to verify length and diameter of pipe prior to ordering of material.
- (C) Quality assurance and quality control information from product manufacturer.
- (D) Samples of the liner material shall be provided for prior approval of the Owner.
- (E) Results of testing for materials provided for this job, as specified in Paragraph 3. of the respective rehabilitation Specification Section (Section 02732 and 02735).
- (F) Two complete sets of video tapes from each of the television inspections performed (Pre and Post Installation TV Inspection), as specified in Section 02742, Television Inspection.

2. Products:

- 2.01 All materials and equipment used in the lining and in the insertion process shall be of their best respective kinds and shall be as approved by the Owner. Any materials not approved by the Owner prior to insertion into the piping shall be rejected and shall be removed and replaced with approved materials at the Contractor's expense.
- 2.02 Design Thicknesses: The Owner reserves the right to change specified thicknesses based on new information. The bid prices will be adjusted to increase or decrease unit prices as liners are thickened or thinned at the Owner's direction.
- 2.03 Flow Capacity: Maintenance of flow capacity of existing pipes is essential. Rehabilitated pipe shall have minimum of no change in capacity. An increase in flow capacity following rehabilitation is preferred, and in no case shall the flow capacity of rehabilitated pipes be reduced.
- 2.04 Liner Sizing: The liner shall be fabricated to a size that when installed will neatly fit the internal circumference of the pipe to be lined. Allowance for longitudinal and circumferential stretching of the liner during installation shall be made by the Contractor.
- 2.05 Length: The length of the liner shall be that which is deemed necessary by the Contractor to effectively carry out the insertion and seal the liner at the inlet and outlet of the

manhole. Individual inversion runs may be made over one or more manhole to manhole sections as determined.

2.06 The Contractor shall provide a liner exhibiting the previously described properties. Prior approval of shop drawings related to any or all materials or methods of installation shall not relieve the Contractor of this responsibility.

2.07 Manufacture Information

(A) It shall be necessary for the Contractor to obtain the Owner's prior approval for all materials or processes and the Owner shall have the power at any time to order the Contractor to modify or discontinue any practice. All such orders shall be given in writing.

3. Execution:

3.01 Inspections

(A) Prior to preparing actual bids, the Contractor should thoroughly review all piping to be relined. Video tapes of all piping to be lined shall be made available to the Contractor for inspection during the bidding period.

(B) Prior to beginning insertion of the liner, the Contractor shall inspect the cleaned line by use of closed-circuit T.V. cameras, and shall confirm to his own satisfaction that the lines are adequately cleaned. Insertion of the liner by the Contractor shall serve as evidence of his acceptance of the condition of the piping and the suitability of the liner insertion within the host pipe. Failure of the liner system due to inadequately cleaned host pipes shall be repaired by the Contractor at no cost to the Owner.

(C) During the process of manufacture and impregnation, the Owner shall have the reasonable opportunity to examine all operations where the manufacture and impregnation (when applicable) of the liner is being carried out. The Contractor shall give appropriate prior notice in order that the City's inspector may be on hand to observe the various processes.

(D) No work shall be performed by the Contractor except in the presence of the City inspection personnel, unless otherwise approved. The Contractor shall coordinate his work schedule and give timely prior notice regarding his intentions to perform any and/or all parts of the work, in order that the City's inspector may be on hand. Any work performed in the absence of the City's inspector is subject to removal and replacement at the Contractor's expense.

(E) Upon substantial completion of the work the Contractor shall, in the presence of the City's inspector, inspect the line using closed-circuit television equipment. The video tape thus produced shall be accompanied by a simultaneously produced, narrated sound tape. The sound narration shall draw attention to all recognizable defects, imperfections, etc., and the location along the length of the piping shall be accurately noted. Also, the locations and all pertinent details regarding the entrance of service laterals into the main trunk sewer shall be accurately noted on the sound tape. One copy of the sound and video tapes shall become the property of the Owner. Televising shall be performed as specified in Section 02742, Television Inspection.

### 3.02 Preparatory Procedures

- (A) Notification of Residents: Prior to starting Work, it is the responsibility of the Contractor to notify all residents that could be affected by the lining process. This notification shall consist of written information and verbal communication that outlines the pipe process and timing of the project.
- (B) The utilities must be marked by "Miss Utility" prior to construction layout.
- (C) The actual sizes, lengths and materials of the pipes to be relined shall be as indicated on the plans, but shall be verified by the Contractor prior to commencing with the work.
- (D) Cleaning: Cleaning of sewer lines and manholes shall be performed as specified in Section 02741, Sewer Line Cleaning.
- (E) TV Inspection: Inspection of sewer lines shall be performed as specified in Section 02742, Television Inspection.
- (F) Flow Control: When required for acceptable completion of an insertion process, the Contractor shall provide for adequate flow control including but not limited to required pumping and bypassing as stipulated in Section 01501, Flow Control, of the Contract Documents.
- (G) Obstruction Removal: The line shall be cleared of obstructions such as solids, dropped joints, intruding service connections or collapsed pipe that may prevent liner installation. If inspection reveals an obstruction that cannot be removed by conventional remote sewer equipment, then a point repair excavation shall be made to remove or repair the obstruction. NOTE: Point repairs shall be made only after cleaning methods were performed and shall be approved in advance by the Owner. Such point repairs shall be reimbursed as additional work at contract unit prices.
- (H) Root Removal: Roots shall be removed in the designated sections where root intrusion is a problem. Special attention should be used during the cleaning operation to assure almost complete removal of roots from the joints. Procedures may include the use of mechanical equipment such as rodding machines, bucket machines and winches using root cutters and porcupines, and equipment such as high-velocity jet cleaners. Chemical root treatment, including inhibitors, shall be used at the direction of the City. Root treatment shall be reimbursed as additional work.
- (I) Material Removal: Refer to Section 02741, Sewer Line Cleaning, for material removal.
- (J) Disposal of Materials: Refer to Section 02741, Sewer Line Cleaning, for disposal of materials.
- (K) Visible Leaks: The Contractor shall seal all leaks that will prevent the liner from curing properly and meeting the requirements specified in this Specification Section and Sections 02732 and 02735.

### 3.03 Sealing at Manholes after Lining

- (A) The Contractor shall provide a watertight seal between the liner and wall of the manhole. The seal shall consist of a resin mixture, non-shrinking waterproof grout or hydrophilic seal, compatible with the liner system manufacturer's recommendations. A hydrophilic gasket may be placed between the host pipe and pipe liner. Finish off the seal with a non-shrink grout or cementitious liner material placed around the pipe opening from inside the manhole in a band at least 4 inches wide. Complete the sealing procedure for each liner segment immediately after the liner is cured to produce a watertight seal.

### 3.04 Service Connections

- (A) The exact location and number of service connections shall be determined from TV tapes and/or in the field. It shall be the Contractor's responsibility to accurately field locate all existing service connections whether in service or not. Immediately following the liner installation and curing, the Contractor shall cut a relief hole at each service connection. The relief hole shall be 85% of the diameter of the service connection.
- (B) The Contractor shall reconnect all service connections which have been determined as live connections to the liner pipe. The Contractor shall notify the Owner before reconnecting any services to vacant lots. The Contractor shall be responsible for restoring/correcting, without any delay, all missed or faulty reconnections, as well as for any damage caused to property owners for not reconnecting the services soon enough or for not giving notice to the owners. All services which are reconnected to the rehabilitated liner shall be shown on the "As Built Drawings" with the exact distance from the nearest downstream manhole and offset distances to the service lateral cleanouts.
- (C) Existing, active service connections shall be completely replaced, from the main to the property line as shown on the plans, complete with City of Virginia Beach standard property line cleanouts. Restore and install service reconnections as specified in Section 02730, Sanitary Sewer System, and as shown on the Contract Drawings.
- (D) Connection of Service Laterals to the Rehabilitated Main: Tests for compliance shall be as specified in Section 02730, Sanitary Sewer System and Section 02742, Television Inspection.
- (E) Reconnection of the service lateral at the property line shall be the responsibility of the Contractor. Work shall include but not be limited to service line connections, property line cleanouts and restoration.

### 3.05 Defective Work

- (A) Any defects which, in the judgement of the Owner, will affect the integrity or strength of the lining, shall be repaired or the liner replaced at the Contractor's expense. Obtain approval of the Owner for method of repair, which may require field or workshop demonstration.

3.06 Final Acceptance

- (A) Upon completion and before acceptance by the Owner, the Contractor will reinspect the rehabilitated pipeline by the use of closed-circuit TV cameras and shall submit color VHS tapes of the rehabilitated pipeline to the Owner for approval/acceptance of the work in accordance with Section 02742, Television Inspection, of the Contract Documents.

4. Measurement and Payment:

- 4.01 Not applicable. See Sections 02732, Pipe Rehabilitation by Cured-in-Place Method, and 02735, Pipe Rehabilitation by Fold and Form Pipe method for payment.

END OF SECTION

Section 02732 - Pipe Rehabilitation by Cured-in-Place Method (CIPP)

1. General:

1.01 Submittals - After Award of Project

After the award of the Project contract, the Contractor shall submit the following information for review and approval:

- (A) Infrared spectrum for proposed resin and confirmation of the resins meeting ASTM D 5813.
- (B) Detailed description of lubricant proposed for inversion process. Lubricant shall be compatible with HRSD's wastewater treatment plant operations and pretreatment program.
- (C) Certification of resin volume and required 5 to 10% addition.
- (D) Certification from resin manufacturer regarding approval of resin dye quantity and type.
- (E) Information on the maximum allowable tensile stress for the tube from the felt manufacturer.

2. Products:

- 2.01 The liner shall generally consist of a polyester, vinyl ester, or epoxy thermosetting resin, or approved equal, impregnated flexible polyester felt or fiberglass fiber. The liner shall fit tightly to the internal circumference of the existing pipe, and a membrane integrally bonded to the internal circumference of the felt, thus forming a smooth, chemically inert internal flow surface. The membrane shall be a minimum of 0.25 mm +5% and shall not be considered to impart any structural strength of the liner.
- 2.02 The resin volume shall be adjusted by adding 5 to 10% excess resin for the change in resin volume due to polymerization and to allow for any migration of resin into the cracks and joints in the original pipe.
- 2.03 Wall Thickness: The required structural CIPP wall thickness shall be designed in accordance with the guidelines in Appendix X1 of ASTM F-1216-93. The minimum acceptable wall thickness shall be 8 mm. In cases where ovality exceeds 10%, or where pipes are egg or oval shaped, alternative methods of design may be considered by the Engineer. The categories of design parameters noted in Tables 02732-1, 02732-2, and 02732-3 shall be used, unless otherwise directed by the Owner.
- 2.04 Wall Color: The wall color of the interior pipe surface of the cured-in-place pipe after installation shall be a light reflective color so that a clear detail examination with closed circuit television inspection equipment may be made.
- 2.05 Common Design Parameters: Design inputs generally considered to be the same from site to site for a particular project are provided in Table 02732-1.

Table 02732-1 Common Design Parameters	
Safety Factor <sup>(1)</sup>	2.0
Soil Modulus <sup>(2)</sup>	700 psi
Soil Density <sup>(3)</sup>	120 pcf

Notes - Table 02732-1:

1. The safety factor may be reduced to 1.5 at the discretion of the Engineer, normally in the case where there is accurate and detailed information known about the existing pipe and soil conditions.
  2. In the absence of site-specific information, the Owner assumes a soil modulus of 700 psi.
  3. In the absence of site-specific information, the Owner assumes a soil density of 120 lb/ft<sup>3</sup>.
- 2.06 Site Specific Parameters: The information listed in Table 02732-2 is specific to each manhole to manhole run of pipe. The Contractor shall use for design the information provided by the Owner and information the Contractor collects during site visits for each manhole to manhole run.

Table 02732-2 Site-Specific Design Parameters	
Ovality	Notes 1, 2
Ground Water Depth Above Invert	Notes 1, 3
Soil Depth Above Crown	Note 1
Live Load	Notes 1, 4
Design Condition (Fully Deteriorated)	Notes 1, 5
CIPP Thickness	Notes 1, 6, 7, 8

Notes - Table 02732-2:

1. Design thicknesses and complete site-specific designs, in accordance with ASTM F-1216-93 (Appendix XI), shall be submitted with the bid and attached as Appendix A.
2. The Contractor shall estimate the ovality by viewing the videotapes and other information provided by the Owner. If tapes are not available, the Contractor shall assume an ovality of 3%. In cases where the ovality exceeds 10%, the Contractor may consider employing alternative design methods (such as beam design methods) to determine the pipe thickness.

3. In the absence of accurate water table information or high water elevation observed during the site visit (stream, ponds, etc.), the Contractor shall assume a seasonal groundwater elevation variation of 0 to 6 feet below the ground surface.
4. CIPP is subjected to traffic live loads as calculated by AASHTO Standard Specifications for Highway Bridges, HS-20-44 Highway Loading.
5. The Contractor shall assume the pipe segments are fully deteriorated.
6. Thicknesses specified (designed by the Contractor and approved by the Owner) are the final, in-ground thicknesses required. Measured sample thicknesses will not include polyurethane or polyethylene coatings, any layer of the tube not fully and verifiably impregnated with resin, or any portion of the tube not deemed by the Owner to be a structural component of the composite.
7. The Contractor must consider any factors necessary to ensure the final, cured-in-place pipe thickness is not less than specified (designed by the Contractor and approved by the Owner) above. These factors include any stress applied to the material during transportation, handling, installation and cure; the host pipe's material type, condition, and configuration; weather (including ambient temperature conditions); and any other factors which are reasonably expected to be found in existing sanitary sewer systems.
8. Design thicknesses provided by the Contractor at the time of bid shall be evaluated by the Owner prior to award.

2.07 Product-Specific Design Parameters: Certain design inputs vary by manufacturer, processes design, or installation technique. These variables are listed in Table 02732-3 with explanatory notes that follow.

Table 02732-3 Minimum Product-Specific Design Parameters	
Minimum Enhancement Factor, $K^{(1)}$	$K = 7$
Minimum Initial Flexural Strength (ASTM D 790) <sup>(2)</sup>	$\sigma_s = 4500 \text{ psi}$
Minimum Initial Flexural Modulus of Elasticity (ASTM D 790) <sup>(2)</sup>	$E_s = 300,000 \text{ psi}$
Minimum Retention of Properties to Account for Long-Term Effects <sup>(3)</sup>	50%
Maximum Long-Term Flexural Modulus of Elasticity <sup>(3)</sup>	$E_L = 150,000 \text{ psi}$

Notes - Table 02732-3:

1. Enhancement factor (K) is the additional buckling or load resistance of the rehabilitation product due to the restraining action of the host pipe. The tighter the fit of the product within the host pipe, the greater the value of K. Third party testing of external hydrostatic loading capacity of restrained pipe samples shall be conducted to verify the enhancement factor, K. The minimum values provided are based on the "Long-Term Structural Behavior of Pipeline Rehabilitation Systems," Trenchless Technology Center, 1994.

2. Initial values are defined in ASTM D 790. The Owner may, at any time prior to installation, direct the Contractor to make cured samples (according to ASTM F-1216-93) and test them in accordance with the listed ASTM standards to verify initial values of physical properties. In such tests the Contractor's samples must achieve a 95% pass-rate.
3. The initial flexural modulus is multiplied by the creep factor (or percentage retention) to obtain the long-term values used for design. Long-term values shall be verified by long-term external pressure testing of circular lengths of the pipe material by third-party labs prior to bid (e.g. Trenchless Technology Center - TTC). It is understood that the material's modulus of elasticity will not change over time; however, by convention the modulus is reduced for design purposes for all plastic pipe sections to account for the reduced ability of plastic pipe to carry loads due to the changes in pipe geometry resulting from the effects of creep over time.

#### 2.08 Resin Content

- (A) The resin content of the liner shall be 10-15% by volume greater than the volume of felt in the liner bag.
- (B) The resin used shall not contain fillers, except those required for viscosity control, fire retardance, or as required to obtain the necessary pot life. Thixotropic agents which will not interfere with visual inspection may be added for viscosity control.
- (C) Dye shall be added to resins to improve visual inspection of the cured liner. The types and quantities of dyes added shall have prior approval from resin manufacturer.

2.09 Chemical Resistance: The corrosion resistance of the resin system shall be tested by the resin manufacturer in accordance with ASTM D543. The result of exposure to the chemical solutions listed below shall produce loss of not more than 20 percent of the initial physical properties when tested in accordance with ASTM D543 for a period of not less than 1 year at a temperature of 73.4 °F plus or minus 3.6 °F. For applications other than municipal wastewater, conduct chemical resistance tests with actual samples of the fluid to be transported in the pipe and in accordance with procedures approved by the Owner.

<b>CONCENTRATIONS OF CHEMICAL SOLUTIONS FOR CHEMICAL RESISTANCE TEST</b>	
<b>CHEMICAL SOLUTION</b>	<b>CONCENTRATION, %</b>
Tap Water (pH 6-9)	100
Nitric Acid	5
Phosphoric Acid	10
Sulfuric Acid	10
Petroleum Hydrocarbon Based Fuels (e.g. Gasoline, diesel, etc.)	100
Vegetable Oil <sup>1</sup>	100
Detergent <sup>2</sup>	0.1
Soap <sup>2</sup>	0.1
Domestic Sewage	100

<sup>1</sup> Cotton seed, corn, or mineral oil

<sup>2</sup> As per ASTM D543

#### 2.10 Manufacture Information

- (A) The Contractor shall deliver the uncured resin impregnated liner bag to the site. The bag may not be impregnated at the site. The liner bag shall be impregnated with resin not more than 72 hours before the proposed time of installation and stored out of direct sunlight at a temperature of less than 30 °F. The Contractor shall provide all appropriate transport, handling and protection equipment including refrigerated, or otherwise suitably cooled, transport equipment.
- (B) All fabricating and Contractor testing shall be carried out under cover and no materials shall be exposed to the weather until they are ready to be inserted. All materials should be protected from the weather and exposure to ultra-violet light as practicable during the manufacture and installation process.
- (C) Each liner shall be accompanied by suitable documentation indicating time and date of manufacture, felt thickness, number of layers, length of liner, resin types, resin content, catalyst, relevant batch numbers, etc.

### 3. Execution:

#### 3.01 Lining Procedures

- (A) The liner shall be installed in accordance with ASTM F 1216-93.
- (B) The Contractor shall conduct operations in accordance with applicable OSHA standards, including those safety requirements involving work on an elevated platform and entry into a confined space. Make suitable precautions to eliminate

hazards to personnel near construction activities when pressurized air is being used.

- (C) In the event of insertion being delayed after impregnation by unexpected site conditions but prior to the start of the insertion process, the Contractor shall store, at his own cost, the liner, for a further period of at least 72 hours, below 30 °F for use when conditions allow.
- (D) The liner shall be inverted into the pipeline from a suitable platform located above the manhole or other approved point of inversion. The Contractor shall be allowed to insert the liner using another process which has been approved by the Owner. The free open end of the liner bag shall be firmly secured to the platform and the folded liner passed down a suitably reinforced column to a shute or bend leading to the opening of the pipe to be lined. Clean water at ambient temperature shall be supplied to the platform at a rate sufficient to cause controlled installation of the liner into the pipeline.
- (E) Liner inversion rate shall not exceed 32 feet per minute and the tail of the liner or the tail tag rope shall be suitably restrained to prevent liner run away, if applicable.
- (F) The Contractor shall supply a suitable heat source and recirculation equipment capable of delivering required curing temperature to the far end of the liner to quickly and uniformly raise the water temperature in the entire liner, once inverted in the pipeline, above the temperature required to commence the exothermic reaction of the resin as determined by the catalyst system employed.
- (G) The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply to determine when uniform temperature is achieved throughout the length of the liner. Another such gage shall be placed between the impregnated tube and the pipe invert at the termination to determine the temperatures during cure. Install thermocouples at the top and bottom (12 and 6 o'clock positions) of the liner between the liner and the host pipe.
- (H) Initial cure will occur during temperature heat-up and shall be completed when exposed portions of the new pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm or cure in the resin. After initial cure is reached, the temperature shall be raised to the post-cure temperature recommended by the resin manufacturer. The post-cure temperature shall be held for a period as recommended by the resin manufacturer, during which time the recirculation of the water and cycling of the boiler to maintain the temperature shall continue. The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).
- (I) The curing period shall be carried out under an inversion head to maintain a minimum hoop tension in the liner felt of 1 lb/in<sup>2</sup>.
- (J) The Contractor shall maintain a curing log of CIPP temperatures at the upstream and downstream manholes during the curing process to document that proper temperatures and cure times have been achieved.

- (K) Invert through Manholes. The invert shall be continuous and smooth through all manholes. If a liner is installed through a manhole, the liner shall be cut out and removed down to the springline of the liner and the bench of the manhole shall be grouted and shaped as necessary to support the liner. If the liner terminates on either side of a manhole, the invert shall be built up to remove any flow restrictions and to form a continuous invert through the manhole. The cost of this work shall be included in the unit price bid for the liner.
- (L) The finished pipelining shall be continuous over the entire length of an insertion run between two manholes or structures and be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, air bubbles, pinholes, dimples and delamination. The lining shall be impervious and free of any leakage from the pipe to the surrounding ground or from the ground to the inside of the lined pipe.
- (M) The inner surface shall be free of cracks and crazing with smooth finish and with an average of not over two pits per 12 inch square, providing the pits are less than 0.12 inch in diameter and not over 0.04 inch deep and are covered with sufficient resin to avoid exposure of the inner fabric. Some minor waviness, that in the Owner's opinion will not appreciably decrease the flow characteristics or be the cause of a possible blockage, shall be permissible.

### 3.02 Testing

- (A) The Contractor shall collect coupon samples/specimens as described below. A coupon shall be collected for each pipe diameter that is lined, unless otherwise specified in the Contract Documents. The Contractor shall stamp or mark the test pieces with the date of manufacture and batch number. These samples shall be paid for under the Pay Item for sanitary sewer rehabilitation, for the respective diameter sizes.
- (B) Should the Owner desire to make additional independent tests, the Contractor shall, upon request of the Owner, furnish any reasonable number of test pieces of raw material samples as the Owner may require, stamped or marked with the date of manufacture and batch number if applicable.
- (C) Tests shall be made on specimens of resin, catalyst and felt as supplied or pieces of cured liner cut from waste areas when possible. Otherwise, the specimens shall be cut from a piece of cured liner representative of the material inserted and prepared and cured in a similar technique to the process employed.
- (D) The test specimen shall be conditioned in accordance with procedure 'A' of ASTM Designation D618-61, Standard Methods for Conditioning Plastics and Electrical Materials for Testing.
- (E) The test specimen shall be prepared and physical properties tested in accordance with ASTM F1216, Section 8.1. The properties shall meet or exceed the values identified in Table 1 of ASTM F1216.
- (F) In addition to the testing requirements specified above, the Contractor shall verify that installed thickness of the CIPP is within minus 5 percent and plus 10 percent of the specified thickness. The Contractor shall hire an independent testing laboratory for the purpose of taking samples to determine the installed

liner thickness. The results of the liner thickness measurements shall be submitted to the Owner. Samples shall be taken from each liner thickness at each liner insertion. The costs for thickness testing shall be included in the bid price for rehabilitation.

- (G) The Contractor shall, in preparation for insertion of the liner bag, and in placing of stops within the terminal manholes of an insertion run, allow sufficient length to facilitate the cutting out of 1 full size cured liner section, for each thickness of liner installed, from the waste portion at the end of an insertion run. The lengths of the full size section thus provided shall be as practicable, in order to facilitate load testing if desired by the Owner.

4. Measurement and Payment:

- 4.01 Method of Measurement: Shall be measured based upon the linear footage of pipe rehabilitated. Measurement for rehabilitation shall be the actual distance measured from manhole to manhole/cleanout, of each size pipe, excluding manhole diameter.
- 4.02 Basis of Payment: Payment shall be made at the contract unit price bid per linear foot of pipe rehabilitated. The unit prices includes all labor, incidentals, materials, flow control, sediment and root removal, chemical root treatment, removal of protruding service connections, dewatering, traffic control, erosion and sediment control, excavation pits, reinstatement of active service connections, pre- and post-cleaning and television inspection, sealing the liner in the manholes, resident notification, the cost of a water meter and municipal water obtained from a City fire hydrant, necessary permits, compliance tests, and all other rehabilitation work, not included under other items, necessary to complete the rehabilitation as specified.

END OF SECTION

## Section 02735 - Pipe Rehabilitation by Fold and Form Pipe Method

### 1. General:

#### 1.01 Submittals - After Award of Project

After the award of the Project contract, the Contractor shall submit the following information for review and approval:

- (A) Manufacturer's recommended pull forces.
- (B) The lb/ft ratio for the proposed product.

### 2. Products:

2.01 PVC fold and form liner pipe shall be manufactured from polyvinyl chloride (PVC) compound which meets all the requirements for cell classification 12111-C as defined in Specification ASTM D-1784.

2.02 Installation and material tests of fold and form pipe shall meet the minimum requirements demonstrated in ASTM F-1871, Standard Specification for Folded/Formed Poly (Vinyl Chloride) (PVC) Pipe Type A for Existing Sewer and Conduit Rehabilitation.

2.03 The pipe shall be marked at 5-foot intervals or less with identification number of manufacturer, diameter, dimension ratio, material and length.

2.04 The liner material must exhibit excellent resistance to chemicals normally found in domestic sewage, including petroleum-based products and animal-grade grease.

2.05 The design thickness shall have a minimum SDR of 35.

### 3. Execution:

#### 3.01 Lining Procedures

(A) Installation of fold and form pipe shall meet the minimum requirements demonstrated in ASTM F-1867, Standard Practice for Installation of Folded/Formed Poly (Vinyl Chloride) (PVC) Pipe Type A for Existing Sewer and Conduit Rehabilitation.

(B) The Contractor shall conduct operations in accordance with applicable OSHA standards. The Contractor shall make suitable precautions to eliminate hazards to personnel near construction activities when pressurized air is being used.

(C) The spool of folded PVC pipe shall be heated to make the PVC pipe flexible for insertion into the host pipe.

(D) After the folded pipe is inserted into the host pipe, it shall be cut at each end and equipped with fittings to allow for the controlled introduction and release of steam and pressure.

- (E) Thermocouples shall be placed in the invert of the sewer at both the upstream and downstream end to monitor installation temperatures. If the liner is installed through manhole structures, thermocouples shall also be placed at each structure.
- (F) Through the use of steam, the folded pipe shall be fully expanded from the insertion point to the termination point. Temperature and pressure shall be sufficient to overcome the extrusion memory of the thermoplastic material. The manufacturer shall be consulted for recommended temperature and pressure.
- (G) After the PVC is completely rounded, the Contractor shall cool the pipe to a temperature as directed by the manufacturer before relieving the pressure required to hold the PVC pipe against the host pipe. In no case shall this temperature be in excess of 100 °F.
- (H) Cut-Off: The Contractor will cut the PVC pipe free at the upstream manhole and the downstream manhole. The Contractor shall ensure that the PVC pipe is cut off neatly and smoothly at each end of the host pipe to preclude snagging and shoaling of debris.
- (I) Invert through Manholes. The invert shall be continuous and smooth through all manholes. If a liner is installed through a manhole, the liner shall be cut out and removed down to the springline of the liner and the bench of the manhole shall be grouted and shaped as necessary to support the liner. If the liner terminates on either side of a manhole, the invert shall be built up to remove any flow restrictions and to form a continuous invert through the manhole. The cost of this work shall be included in the unit price bid for the liner.
- (J) The finished pipelining shall be continuous over the entire length of an insertion run between two manholes or structures and be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, air bubbles, pinholes, dimples and delamination. The lining shall be impervious and free of any leakage from the pipe to the surrounding ground or from the ground to the inside of the lined pipe.

### 3.02 Testing

- (A) The Contractor shall collect coupon samples/specimens as described below. A coupon shall be collected for each pipe diameter that is lined, unless otherwise specified in the Contract Documents. The Contractor shall stamp or mark the test pieces with the date of manufacture and batch number. These samples shall be paid for under the Pay Item for sanitary sewer rehabilitation, for the respective diameter sizes.
- (B) Should the Owner desire to make additional independent tests, the Contractor shall, upon request of the Owner, furnish any reasonable number of test pieces of raw material samples as the Owner may require, stamped or marked with the date of manufacture and batch number if applicable.
- (C) Tests shall be made on pieces of cured liner cut from waste areas when possible. Otherwise, the specimens shall be cut from a piece of cured liner representative of the material inserted and prepared and cured in a similar technique to the process employed.

- (D) The compound samples shall be prepared in accordance with ASTM D-3034. These specimens shall be tested independently and shall comply with the minimum property values identified in ASTM F-1871.
- (E) The Contractor shall in preparation for insertion of the liner, and in placing of stops within the terminal manholes of an insertion run, allow sufficient length to facilitate the cutting out of 1 full size cured liner section, for each thickness of liner installed, from the waste portion at the end of an insertion run. The lengths of the full size section thus provided shall be as practicable, in order to facilitate load testing if desired by the Owner.

4. Measurement and Payment:

- 4.01 Method of Measurement: Shall be measured based upon the linear footage of pipe rehabilitated. Measurement for rehabilitation shall be the actual distance measured from manhole to manhole/cleanout, of each size pipe, excluding manhole diameter.
- 4.02 Basis of Payment: Payment shall be made at the contract unit price bid per linear foot of pipe rehabilitated. The unit prices includes all labor, incidentals, materials, flow control, sediment and root removal, chemical root treatment, removal of protruding service connections, dewatering, traffic control, erosion and sediment control, excavation pits, reinstatement of active service connections, pre- and post-cleaning and television inspection, sealing the liner in the manholes, resident notification, the cost of a water meter and municipal water obtained from a City fire hydrant, necessary permits, compliance tests, and all other rehabilitation work, not included under other items, necessary to complete the rehabilitation as specified.

END OF SECTION

## Section 02737 - Manhole Rehabilitation

### 1. General:

#### 1.01 Description:

- (A) This work shall consist of furnishing all labor, material, equipment and supplies and the performance of all work necessary to rehabilitate the designated sanitary sewer manholes as described herein and shown on the Project Drawings. The work shall consist of, but not necessarily be limited to, performing the following tasks: flow control, cleaning, televising, sealing, and rehabilitation. All deficiencies shall be corrected to the Owner's satisfaction by the Contractor at no additional cost to the Owner. All such costs shall be included in the unit price bid for such work.

#### 1.02 Submittals - Prior Award of Project

- (A) Submit the following information:

- (1) Shop drawings and product data for the manhole rehabilitation method including:

A report outlining the process to be used in the rehabilitation of the sewer manholes. The report shall also include information specific to the job, such as coordination issues, access, timing, manufacturer's installation instructions, curing operations and procedures and flow control.

- (2) All measurements made by the Contractor to verify manhole depths, prior to ordering of material.

- (3) Manufacturer's published literature and published data for the proposed manhole rehabilitation system.

- (4) The manhole rehabilitation system supplier's letter of certification for each worker who will perform rehabilitation work.

- (5) Independent test report showing that the physical properties of the proposed system meet the requirements of these specifications and the requirements published in the manufacturer's literature.

- (6) The manufacturer's certification that the proposed rehabilitation system for the project meets the requirements of these specifications and will meet or exceed the physical properties given in the manufacturer's published literature submitted as required by part 3 of this subsection.

- (7) Documentation of Contractor's experience. This shall include references for all jobs within the last two years that were either completed or under construction using the proposed rehabilitation method. References for a minimum of five jobs shall be provided. Information provided shall include a description of the job, the location of the job, the value of the

job, the owner, and the contact for the job including name, title, address, and phone number.

- (8) Documentation of Product experience. This shall include references for jobs completed with the proposed rehabilitation method. The jobs submitted shall show that at least 1,000 vertical feet of the product has been installed by the Contractor or other Contractors. The documentation shall include at least ten jobs which have been completed, within the last two years. Information provided for each job shall include a description of the job, the location of the job, the value of the job, the owner, and the contact for the job including name, title, address, and phone number.
- (9) Manhole Patching Mix
- (10) Manhole Infiltration Control Mix
- (11) Manhole Sealer
- (12) Manhole Liner Mix
- (13) Manhole Cured-in-Place Fiberglass Insert Liner
- (14) Manhole Epoxy Coating
- (15) Formed-in-Place Concrete with Plastic Composite Liner
- (16) Internal and External Manhole Frame Seals
- (17) Internal and External Manhole Frame Sealants

2. Products:

2.01 Contractor's Equipment

(A) Cast-in-place Manhole Rehabilitation Forms

- (1) Stackable forms possessing a variety of necessary shapes and diameters to form fit the existing structure. Forms shall also possess sufficient stiffness to avoid any distortion of the intended shape during the placement process. The system shall possess means to prevent the forms from shifting during the pour thereby yielding non-uniform wall thicknesses.
- (2) Detachable external vibrators shall be used to consolidate the concrete from the interior of the manhole.

## 2.02 Patching and Infiltration Control Materials

Contractor may use the following products in conjunction with the liner material to facilitate manhole rehabilitation. Material compatibility testing of the products must be prior to commencement of work.

- (A) Patching Mix: A quick-setting cementitious material shall be used as a patching mix and is to be mixed and applied according to manufacturer's recommendations and shall have the following minimum requirements:

Compressive Strength	ASTM C-109	6 hr 1,400 psi
Shrinkage	ASTM C-596	0% at 90% relative humidity
Bond	ASTM C-321	28 day 150 psi
Cement		Sulfate resistant
Density, when applied		105 ±5 pcf

- (B) Infiltration Control Mix: A rapid-setting cementitious product specifically formulated for leak control shall be used to stop minor water infiltration and shall be mixed and applied according to manufacturer's recommendations and shall have the following minimum requirements:

Compressive Strength	ASTM C-109	1 hr	600 psi
Compressive Strength	ASTM C-579 B	24 hr	1,000 psi
Bond	ASTM C-321	1 hr	30 psi
Bond	ASTM C-321	24 hr	80 psi

- (C) Manhole Sealer

- (1) The manhole sealer material shall be an Acrylamide or Urethane Base Gel as specified in Specification Section 02738, Sanitary Sewer Pipe Joint Testing and Sealing.

- (D) Other Materials: No other material shall be used with the above mixes without prior approval or recommendation from the manufacturer.

## 2.03 Liner Mix

- (A) The liner mix shall be a cement-based, fiber-reinforced calcium aluminate mortar specifically designed to prevent infiltration and restore structural integrity, and to be spray applied to form the structural/structurally enhanced monolithic cementitious liner covering all interior manhole surfaces. The material shall be applied at a minimum ½ inch thickness; but application must be at a thickness to ensure a structurally stable manhole, while forming an infiltration barrier to water and gases.
- (B) The material shall be premixed and specially formulated to withstand hydrogen sulfide bacterial corrosion and abrasion in municipal sanitary sewer systems.

- (C) The standard material shall have the following minimum requirements at 28 days.

Compressive Strength	ASTM C-109	8,000 psi
Flexural Strength	ASTM C-293	700 psi
Shrinkage @ 90% Humidity	ASTM C-596	0%
Tensile Strength	ASTM C-496	> 600 psi
Sulfide Resistance	ASTM C-267	No visible attack @ pH 2 or greater.

- (D) The high performance material shall have the following minimum requirements at 28 days.

Compressive Strength	ASTM C-109	9,000 psi
Flexural Strength	ASTM C-293	1,200 psi
Shrinkage @ 90% Humidity	ASTM C-596	0%
Tensile Strength	ASTM C-496	> 800 psi
Sulfide Resistance	ASTM C-267	No visible attack @ pH 2 or less

- (E) The Strong-Seal System provided by Strong Systems, Inc., Permacast Process provided by AP/M Permaform, and ThoRoc SP15 provided by ThoRoc, Inc. generally meet the intent of this Specification.

- (F) The liner mix shall have a one-year labor and materials, non-prorated warranty to stop infiltration and further deterioration of the structure.

#### 2.04 Cured-in-Place Fiberglass Insert Liner

- (A) The cured-in-place fiberglass insert liner shall consist of multiple structural fiberglass layers with a non-porous membrane bonded between layers of fiberglass, with a minimum fabric weight of 56 ounces per square yard, saturated with 100% solids epoxy, cured-in-place, and bonded to the existing structure. The liner shall be a Poly-Triplex Liner System or equal. The cured-in-place fiberglass insert shall have a one-year labor and materials, non-prorated warranty to stop infiltration and further deterioration of the structure.

- (B) The fiberglass insert liner shall have the following minimum requirements:

<b>Test</b>	<b>Property</b>	<b>Results</b>
ASTM-D-790	Flexural Strength	24,853 psi
ASTM-D-790	Flexural Modulus	9.41 mpsi
ASTM-D-695	Compressive Strength	11,531 psi
ASTM-D-695	Compressive Modulus	11.11 mpsi
ASTM-D-638	Tensile Strength	9,878 psi
ASTM-D-638	Tensile Modulus	9.52 mpsi
ASTM-D-638	% Elongation @ Max Load	1.54%
---	Minimum Thickness	0.16 inches

- (C) The insert liner shall have the following minimum requirements after seven day curing:

Test	Property	Results
ASTM-D2240-75	Hardness, Shore D	80
ASTM-63860	Ultimate Elongation	6%

- (D) Chemical Resistance: The corrosion resistance of the resin system shall be tested by the resin manufacturer in accordance with ASTM D543. The result of exposure to the chemical solutions listed below shall produce loss of not more than 20 percent of the initial physical properties when tested in accordance with ASTM D543 for a period of not less than 1 year at a temperature of 73.4 °F plus or minus 3.6 °F. For applications other than municipal wastewater, conduct chemical resistance tests with actual samples of the fluid to be transported through the manhole and in accordance with procedures approved by the Owner.

CONCENTRATIONS OF CHEMICAL SOLUTIONS FOR CHEMICAL RESISTANCE TEST	
Chemical Solution	Concentration, %
Tap Water (pH 6-9)	100
Nitric Acid	5
Phosphoric Acid	10
Sulfuric Acid	25
Petroleum Hydrocarbon Based Fuels (e.g. Gasoline, diesel, etc.)	100
Vegetable Oil <sup>1</sup>	100
Detergent <sup>2</sup>	0.1
Soap <sup>2</sup>	0.1
Domestic Sewage	100

<sup>1</sup> Cotton seed, corn, or mineral oil

<sup>2</sup> As per ASTM D543

## 2.05 Epoxy Coating

- (A) The monolithic high-build epoxy coating shall consist of a 100% solids epoxy formulated with exceptionally high physical strengths and broad range chemical resistance. The epoxy coating shall be Raven 405 ultra high build coating system or equal. The coverage shall be a minimum of 100 mils and shall be determined by the manufacturer. The manufacturer shall provide documentation for the recommended thickness. The epoxy coating shall have a one-year labor and materials, non-prorated warranty to stop infiltration and further deterioration of the structure.
- (B) The epoxy coating shall have the following minimum requirements:

<b>Test</b>	<b>Property</b>	<b>Results</b>
ASTM-D-790	Flexural Strength	12,440 psi
ASTM-D-695	Compressive Strength, Yield	12,870 psi
ASTM-D-638	Tensile Strength	6,640 psi
ASTM-D-638	% Elongation @ Max Load	1.53%
ASTM-D-2240	Hardness, Shore D	80
ASTM-D-256	Impact, IZOD	0.345 ft. lb/in of notch

(C) The epoxy coating shall have the following minimum requirements after seven day curing:

<b>Test</b>	<b>Property</b>	<b>Results</b>
ASTM-D2240-75	Hardness	80 Shore D
ASTM-63860	Ultimate Elongation	1.53%

(D) Chemical Resistance: The corrosion resistance of the epoxy coating shall be tested by the coating manufacturer in accordance with ASTM D543. The result of exposure to the chemical solutions listed below shall produce loss of not more than 20 percent of the initial physical properties when tested in accordance with ASTM D543 for a period of not less than 1 year at a temperature of 73.4 °F plus or minus 3.6 °F. For applications other than municipal wastewater, conduct chemical resistance tests with actual samples of the fluid to be transported through the manhole and in accordance with procedures approved by the Owner.

<b>CONCENTRATIONS OF CHEMICAL SOLUTIONS FOR CHEMICAL RESISTANCE TEST</b>	
<b>Chemical Solution</b>	<b>Concentration, %</b>
Tap Water (pH 6-9)	100
Nitric Acid	5
Phosphoric Acid	10
Sulfuric Acid	25
Petroleum Hydrocarbon Based Fuels (e.g. Gasoline, diesel, etc.)	100
Vegetable Oil <sup>1</sup>	100
Detergent <sup>2</sup>	0.1
Soap <sup>2</sup>	0.1
Domestic Sewage	100

<sup>1</sup> Cotton seed, corn, or mineral oil

<sup>2</sup> As per ASTM D543

## 2.06 Plastic Composite Liner

(A) Plastic Liner: Liner shall be AGRU Sure Grip Concrete Protective Liner (CPL), or equal, made from either High-Density Polyethylene (HDPE) or Polypropylene

Random Copolymer (PP-R) with a minimum thickness of 2 mm. Liner sheets shall be extruded with a large number of anchoring studs, a minimum of 420/m<sup>2</sup>, 39 ft<sup>2</sup>, manufactured during the extrusion process in one piece (integral) with the sheet so there is no welding and no mechanical finishing work to attach the studs to the sheet. The liner shall have a minimum pull out of 112.5 lbs./anchoring stud.

- (B) Flat Liner Sheet: Liner sheet shall be used for overlapping joints, and shall have a minimum thickness of 3mm. All joints shall be sealed by means of thermal welding performed by manufacturer certified welders.
- (C) The lining shall have good impact resistance, shall be flexible, and shall have an elongation sufficient to bridge up to a 1/4" settling crack, without damage to the lining. The liner shall be able to bridge any expansion cracks that may occur.
- (D) The lining shall be repairable at any time during the life of the structure.
- (E) Only manufacturer certified fabricators may be used to custom fit the liner to the formwork in order to protect the concrete surfaces from sewer gases. The interior surfaces to be protected shall include the walls, floor, ceiling, and pipe entries.
- (F) The plastic composite liner shall have the following minimum requirements:

<b>Test</b>	<b>Property</b>	<b>Results</b>
ASTM-D-792-86	Density	0.945 g/cm <sup>3</sup>
ASTM-1238-88	Melt Flow Index	0.7 - 1.0 g/10 min. (190/5)
ASTM-D-1637-83	Heat Reversion (Dimensional Stability)	< 2%
ASTM-638-89	Yield Stress	≥ 2.320 psi
ASTM-D638-89	Elongation of yield	≥ 12%
ASTM-D638-89	Elongation at Break	> 400%
ASTM-D4833	Minimum Abrasion Resistance	160 lbs
Not Applicable	Maximum Working Temperature	140° F or 60° C
UL-94	Fire Classification	V2

#### 2.07 Cast-in-Place Manhole Rehabilitation

- (A) Portland cement concrete shall have 4000 psi 28 day compressive strength, with 3/4 inch and smaller coarse aggregate, shall utilize plasticizers to produce slump of 6 inches or greater and shall contain fiber reinforcement. Calcium chloride is not permitted. A corrosion resistant coating or lining shall be applied to the inside surface of the cast-in-place manhole walls.

#### 2.08 Internal and External Manhole Frame Seals and Sealants

- (A) An internal seal or sealant shall be installed with all manholes to be lined.

- (B) Internal and External Manhole Frame Seals: Internal and external manhole frame seals shall be Cretex, or equal, and shall be composed of flexible, pleated, high quality rubber gland with stainless steel bands, and shall be designed to conform to the interior and exterior of the chimney area of the manhole frames.
- (1) The rubber gland material compound shall conform to the applicable requirements of ASTM C 923, with a minimum tensile strength of 1,500 psi, a maximum compression set of 18 percent, and a durometer hardness of 48 (plus/minus 5).
  - (2) The internal manhole frame seals shall be contained in-place on the inside of the manhole frame chimney area through the use of stainless steel expansion bands designed to expand to form a compression seal between the rubber gland and the manhole chimney area surface.
  - (3) The external manhole frame seal shall be placed on the outside of the manhole frame base flange through the use of stainless steel compression bands designed to compress the rubber sleeve against the edge of the manhole frame base flange while extending both over and under this flange to lock the sleeve in place and provide a positive watertight seal.
  - (4) The bands shall be fabricated of 16 gauge Type 304 stainless steel conforming to ASTM A 240
    - i The internal bands shall be an expansion band equipped with locking tabs and tab slots.
    - ii The external bands shall be a compression band equipped with an adjustment slot and self locking stainless steel studs.
- (C) Internal and External Manhole Frame Sealant: Internal and external manhole frame sealant shall be Flex-Seal, or equal, and shall be composed of a corrosion resistant aromatic flexible urethane resin coating to be applied to the internal or external wall of the adjustment ring area.

- (1) The Aromatic Urethane Resin Liner Primer shall have the following minimum requirements:

Test	Property	Results
ASTM-D-1004	Tear Resistance	210 lb. l/in
ASTM-D-903	Adhesive Strength	400 lb. l/in
ASTM-D-412	Tensile Strength	3,200 psi
ASTM-D-442	Elongation	400%
ASTM-D-2240	Hardness	85

- (2) The Aromatic Urethane Resin Liner Final Coat shall have the following minimum requirements:

Test	Property	Results
ASTM-D-1004	Tear Resistance	155 lb. l/in
ASTM-D-903	Adhesive Strength	175 lb. l/in
ASTM-D-412	Tensile Strength	1,150 psi
ASTM-D-442	Elongation	800%
ASTM-D-2240	Hardness	75

3. Execution:

- 3.01 Site conditions may preclude the Contractor from mobilizing the sealing, coating and/or lining equipment near the manhole. If the manhole is inaccessible, as determined by the Contractor and the Owner, the Contractor shall hand apply the sealers, coatings and/or liners per the manufacturer's instructions and recommendations. Hand application shall be completed at no additional cost to the Owner.
- 3.02 All materials shall be delivered to the job site in the manufacturer's original sealed containers that bear identifying labels. All materials shall be used in strict accordance with the sealers, coatings, liners and equipment manufacturer's printed directions.
- 3.03 The Contractor shall be licensed by the sealer, coating and liner process manufacturer.
- 3.04 The Contractor shall conduct operations in accordance with applicable OSHA standards, including those safety requirements involving entry into a confined space. Make suitable precautions to eliminate hazards to personnel near construction activities when pressurized air is being used.
- 3.05 Preparation of Surfaces to Receive Coating and Lining
- (A) Throughout the entire surface preparation process, any nearby installations, equipment vehicles, structures, etc. shall be protected from blasting grit and dust.
- (B) Sludge or other surface impurities shall be removed by fresh water blasting (3,000 psi minimum). Should this operation be insufficient to remove surface impurities, abrasive blasting shall be performed. An environmentally acceptable detergent may be used in conjunction with the water blast as long as it is thoroughly rinsed out with fresh water after application.
- (C) Loose and protruding brick, mortar, and concrete shall be removed using a mason's hammer and chisel and/or scraper.
- (D) Concrete or brick to be coated shall be prepared by fresh water or abrasive blasting using properly graded, clean, sharp angular abrasive blast media to produce a sound surface, with no evidence of latence, loose concrete contaminants or debris, and shall display a surface profile suitable for coating. Previously applied coatings, if any, shall be completely removed during abrasive blasting operations.
- (E) Prior to application of the coating, all apparent leaks in structural section joints around pipe penetrations, minor cracks or leaks in other areas of the structure, shall be plugged or repaired with an approved patching mix, or infiltration control mix in accordance with this Specification. Major cracks or leaks shall be plugged or repaired with an approved chemical grout in accordance with this Specification and Section 02738, Sanitary Sewer Pipe Joint Testing and Sealing. The patching mix, infiltration control mix, and chemical grout shall be mixed and applied per the manufacturer's recommendations. Any excessive cavities in wall area and around pipe penetrations shall be filled with an approved patching mix or chemical grout. Remove all protruding pipe ends no longer in use after approval is obtained from Owner. Remove all excess expansion joint material prior to application of coating system.

- (F) Iron pipe surfaces shall be dry abrasive blast cleaned to a “near white” condition per SSPC SP-10, with a minimum 1.5 to 2.5 mil surface profile or anchor pattern. Cleaned pipe surfaces shall not exhibit any evidence of flash rust prior to coating application.
- (G) All masonry surfaces will be washed to clean blast dust out of the pores of the brick or cement substrate.
- (H) Structure walls will be sprayed with a chlorine solution to kill any bacteria growth in the substrate and rinsed just prior to the application of the coating and liner.
- (I) The walls will be tested for pH and brought to a neutral state prior to application of coating and liner.
- (J) Areas of manholes that are found to be structurally damaged and in need of repair beyond the scope of this specification shall be brought to the attention of the Owner. A suitable repair method shall be developed for each area and submitted to the Owner for review prior to commencing the repair.
- (K) Any bench, channel, or service line repairs shall be made at this time using the quick-setting patching mix, and shall be used per the manufacturer’s recommendations.
- (L) Manhole benches and inverts shall be prepared and cleaned in the same manner as prescribed above.

### 3.06 Manhole Sealer

- (A) Sealing cracks shall mean that the entire wall surface is sealed by permeation grouting the soil surrounding the manhole. Grout shall extend from manhole base to top of cone section and will include the cone-to-frame joint and where pipes enter and exit the manholes.
- (B) Chemical grout material shall conform to the requirements specified in Specification Section 02738, Sanitary Sewer Pipe Joint Testing and Sealing.
- (C) Chemical grout shall be applied to exterior manhole surfaces through application holes drilled in manhole walls, which are to be located in a staggered configuration to assure adequate distribution of grout into the soil. Location of holes shall typically be at 2 feet vertical intervals, with four holes per level. Locations will depend on actual field conditions. Chemical grout shall be applied through threaded connections into lower holes until grout is freely flowing from the next highest set of holes and a thorough grout zone is established as determined by the Owner. The Contractor shall be fully responsible for damage caused to the existing manhole due to his operations. Chemical grout injection pressures shall not exceed 25 psi at the inlet. Holes shall be filled with a quick setting infiltration control mix once chemical application is completed and prior to the liner application.

### 3.07 Manhole Coating

(A) Application of Liner Mix

- (1) The Contractor shall take precautions to keep overspray or excess material from entering the newly installed liner pipe and any other pipes in the manhole.
- (2) Prior to liner application onto walls, manhole bench area shall be covered with plywood sections, which conform to the internal dimensions of the manhole, to prevent accumulation of liner material on bench. No application shall be made to frozen surfaces or if freezing is expected to occur inside the manhole within 24 hours after application. If ambient temperatures are in excess of 95 °F, precautions shall be taken to keep the mix temperature at the time of application below 90 °F. The mix water temperature shall not exceed 85 °F. Chill with ice if necessary.
- (3) Mixing: For each bag of product, use the amount of water specified by the manufacturer and mix per the manufacturer's instructions and recommendations.
  - i The Contractor shall empty the mixed material into the holding hopper and prepare another batch with timing such that the nozzleman can spray in a continuous manner without interruption until each application is complete.

(4) Spraying

- i Low pressure spray liner mix shall be applied to the manhole ceiling, wall and bench surfaces and allow liner to cure in accordance with the product manufacturer's instructions and recommendations.
- ii Liner application shall be 0.5 inch minimum thickness. The application shall be completed with a minimum of two coats. The first coat shall be applied at a thickness adequate to cover the substrate and be troweled to compact the material into voids and set the bond. The second coat shall be applied to achieve complete coverage at the specified minimum thickness.
  - a First Application: The surface prior to spraying shall be damp without noticeable free water droplets or running water, but totally saturated. Materials shall be spray applied from the bottom of the wall to the top, to a minimum uniform thickness to ensure that all cracks, crevices, and voids are filled and a relatively smooth surface remains after light troweling. The light troweling is performed to compact the material into voids and to set the bond.
  - b Second Application: A second application is to be applied after the first application has begun to take an initial set to assure a minimum total finished thickness of 0.5 inches. Application shall be from the bottom up. The surface is then troweled to a smooth finish being careful not to over trowel so as to bring additional water to the surface and weaken it. Manufacturer's

recommendations shall be followed when more than 24 hours have elapsed between applications.

iii Bench Application: The plywood covers shall be removed and the bench sprayed such that a gradual slope is produced from the walls to the invert with the thickness at the edge of the invert being no less than 0.5 inches. The wall bench intersection shall be rounded to a uniform radius equal to the full circumference of the intersection.

(5) Inverts shall be lined with patching mix, trowel applied in one coat to 0.5 inch minimum thickness.

(6) Curing

i Caution should be taken to minimize exposure of applied product to sunlight and air movement. If application of second coat is to be longer than 15 minutes after completion of application of first coat, the manhole cover shall be set back in place. At no time should the finished product be exposed to sunlight or air movement for longer than 15 minutes before replacing the manhole cover.

ii The final application shall have a minimum of 4 hours cure time before being subjected to active flow. Total cure times shall be determined by the manufacturer.

iii Traffic shall not be allowed over manholes during or immediately after the rehabilitation. Traffic shall be allowed over the manholes after a period of time. This duration shall be determined by the manufacturer.

(7) Prepare, label and submit daily or per lot test specimens for testing.

### 3.08 Cured-in-Place Fiberglass Insert Liner and Epoxy Coating

(A) The installation of the approved liner system shall be in strict accordance with the manufacturer's written instruction. This shall include re-grouting all inlet and outlet lines and benches as needed, plus the preparation, installation, curing, and finish operation, for the completion of the rehabilitation process.

### 3.09 Plastic Composite Liner

(A) The installation of the approved liner system shall be in strict accordance with the manufacturer's written instruction. This shall include re-grouting all inlet and outlet lines and benches as needed, plus the preparation, installation, curing, and finish operation, for the completion of the rehabilitation process.

(B) Welding and Fabricating

(1) All welding must be done in accordance with the manufacturer's requirements. Welding will be only by welders who are trained and certified by the manufacturer. When the welding is completed and tested, the finished product will be a one piece, monolithic, concrete structure that will provide excellent resistance to Microbial Induced

Corrosion (MIC) and will not pull off the wall in the event that infiltration occurs.

- (2) The following welding techniques are acceptable: Extrusion Welding; Wedge Welding; Butt Welding; Hot Air Welding.
- (3) Testing and supervision of the installation and welding shall only be performed by manufacturer trained and certified personnel and must be checked when completed by visually checking and by Spark Testing all welded joints. Spark Testing shall be performed in accordance with the equipment manufacturer's recommendations.

### 3.10 Cast-in-Place Manhole Rehabilitation

- (A) Preparation: Clean the manhole walls as specified herein. Remove existing steps which might interfere with the erection of the forms. Take precautions to prevent foreign materials (including concrete and bricks) from entering active lines. Eliminate or reduce to an acceptable level infiltration which may adversely affect placement of the concrete.
- (B) Installation
  - (1) Place pipe extensions and plugs throughout the manhole to enable the liner to be placed. The diameter and integrity of all entries into the manhole shall be preserved at all times. The Contractor shall maintain flow during the procedure.
  - (2) Size and erect the form to conform to the existing interior dimensions and shape. The space between the forms and the existing wall shall be 4 inches or greater. The finished manhole opening shall have a minimum clearance of 20 inches.
  - (3) Position, seal and finish the form at the manhole base to ensure that concrete does not enter the sewer.
  - (4) Place concrete in such a manner as to prevent segregation of aggregate. Consolidate concrete to fill all pockets, seams and cracks within the existing wall.
  - (5) Forms shall not be removed less than three days after the time of placement.
  - (6) If a plastic liner is employed, it shall be fitted securely to the exterior of the steel forms during their erection within the manhole. When the forms are removed any joints in the liner shall be welded and tested.
  - (7) If a corrosion resistant manhole coating is used it shall meet the requirement of the manhole coating section of this Specification.
- (C) The concrete interior wall shall be smooth and free of honeycomb and areas of segregated aggregate.

- (D) Upon completion, the Contractor shall clean up the work site and properly dispose of any excess material or debris.
  - (E) The new interior shall be inspected by the Contractor in the presence of the Owner's representative to its integrity. Any defects shall be promptly repaired and reinspected.
- 3.11 Manhole Frame Seals: The manhole frame and the chimney above the cone shall be sealed in accordance with the manufacturer's recommendations.
- 3.12 Manhole Frame Sealant:
- (A) The Contractor shall be certified by the sealant manufacturer.
  - (B) The ring adjustment area and the lower 3 inches on the casting frame and top 3 inches of the cone/slab shall be prepared in accordance with the manufacturer's instructions.
  - (C) Internal Application:
    - (1) The adjustment ring area under the casting shall receive a thickened flexible urethane to achieve a minimum thickness of 120 mils.
    - (2) The liner shall be applied by spray, brush, or trowel 3 inches above the bottom of the frame, and shall cover the entire adjustment ring area to 3 inches below the bottom adjustment ring.
  - (D) External Application
    - (1) The adjustment ring area under the casting shall receive a thickened flexible urethane to achieve a minimum thickness of 120 mils.
    - (2) The liner shall be applied by spray, brush, or trowel 2 inches wide over the flange of the frame, and shall cover the entire adjustment ring area to 3 inches below the bottom adjustment ring.
- 3.13 Manhole Step Removal: The Contractor shall remove all steps, as identified on the Drawings.
- 3.14 Replace or Reset Manhole Frame and Cover
- (A) The Contractor shall remove and dispose of the existing manhole frames and covers, as specified on the Drawings. It shall be the responsibility of the Contractor, at no additional cost to the Owner, to repair any damage to the chimney or corbel caused by the removal of the existing manhole frame.
  - (B) Technique of Repair
    - (1) Remove the existing pavement or other surface area adjacent to the manhole. Excavate a maximum 6' x 6' area. Excavate to expose the entire frame and a minimum of 16-inches of the existing manhole wall.

- (2) Unless otherwise directed, replace the 2 to 3 courses of brick on brick manholes and if the manhole is made of precast concrete, remove the brick grade adjustment to top of cone.
- (3) Clean all joint surfaces between the frame, adjustments and existing manhole wall to insure a watertight seal.
- (4) Unless otherwise directed, obtain proper grade by using not less than 4 inches or more than 12 inches of either:
  - i Brick and mortar;
  - ii Solid precast concrete adjustment rings. Rings shall be a minimum of four-inches thick. No more than two rings shall be used to achieve the proper grade. The precast concrete adjustment rings shall be set in full beds of Type M mortar not less than 1/4-inch thick nor more than 1-1/4 inch thick. Frame elevation shall be set at finished grade in traffic areas and as directed by Owner in other areas. All horizontal, circumferential, and vertical mortar joints inside and outside of the structure shall be pointed for their full width. Depth of pointing shall not exceed 3/8-inch.
- (5) Newly installed grade ring transition section shall be completely coated on the inside and top with a protective coating, overlapping a minimum of 6-inches down on the existing manhole structure. The protective coating shall be in accordance with the coating specified for the precast reinforced concrete manhole sections, as specified in Paragraph 2. of this Specification (Section 02737). Cure entire adjustment ring transition section for a minimum of 24 hours prior to backfilling.
- (6) Furnish and install a new frame and cover, or reuse the existing ones, as specified on the Contract Drawings and in accordance with Specification Section 02730, Sanitary Sewer System. Also, furnish and install new frame and cover where manhole replacement is specified on the Contract Drawings and in accordance with Specification Section 02730, Sanitary Sewer System.

3.15 Manhole Bench/Channel Reconstruction:

- (A) Repairs shall be performed on all benches/channels with visible damage or infiltration.
- (B) The Contractor shall construct the manhole channel with smooth semicircular bottoms matching the inside diameters of the connecting sewers. Change directions of flow with a smooth curve of as large a radius as the manhole size will permit. Change size and grade of channels gradually and evenly. Channels may be formed directly in the concrete manhole bottom, made of channel pipe, laid in concrete, or constructed by laying full section sewer pipe through the manhole and breaking out the top half when the surrounding concrete has hardened.
- (C) Manhole floors outside the channels shall be smooth and shall have a slope between 2 and 4 inches per foot toward the channels.

- (D) Prior to initiating base reconstruction efforts, clean manhole bases and with high pressure water blast. Loose materials, including spalled or broken concrete shall be removed and resulting surface made suitable for bonding to new manhole base. Solid debris resulting from cleaning operation shall be removed from manhole prior to reconstruction. The Contractor shall remove existing channel obstructions where shown on the Contract Drawings or as directed by the Owner based on actual field conditions.
- (E) Mortar shall be used to build up deteriorated base and channel to original elevations or to effect a smooth transition between incoming and outgoing pipes. Bricks may be used to build-up the manhole base if desired.
- (F) After placing the new bench and channel, the Contractor shall apply a surface of quick set mortar to serve as a sacrificial, protective surface for the newly reconstructed manhole base. The protective surface shall be placed once underlying mortar has firmly set, and shall have sufficiently hardened prior to release of back-up sewage into the manhole so as to prevent disruption to the reconstructed base.
- (G) Sewage released into the manhole shall be in a controlled fashion without surcharging or flooding onto the new bench.

#### 3.16 Inspection and Quality Control

- (A) The Owner shall have the right to inspect work at all times. Failure of the Owner to provide inspection services does not relieve the Contractor of his responsibility to perform the work in accordance with these Specifications.

#### 3.17 Clean-up and Disposal

- (A) The Contractor shall not allow waste or debris to accumulate. He shall have it removed from the job site at frequent intervals.

#### 3.18 Quality Assurance

- (A) The Contractor shall use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

#### 3.19 Testing and Inspection

- (A) All rehabilitated manholes shall be tested for final acceptance, using either the infiltration or exfiltration method, as directed by the Inspector. The testing method shall be completed in accordance with Specification Section 02730, Sanitary Sewer System
- (B) Liner Mix:
  - (1) At the direction of the Owner's representative, the Contractor may be directed to verify coating thickness at any random point of the new

interior surface. Any areas found to be thinner than minimum tolerances shall immediately receive additional material.

- (2) The Contractor shall cast four 3-inch by 6-inch test cylinders or six 2-inch cubes each day or from every 50 bags of product used. The test specimen shall be properly labeled and sent in for testing in accordance with the manufacturer's directions for compression strength testing as described in ASTM C-495.

(C) Epoxy Coating

- (1) During application, a wet film thickness gage meeting ASTM D-4414, Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used to ensure a monolithic coating and uniform thickness during application.
- (2) At the direction of the Owner's representative, the Contractor may be directed to verify coating thickness at any random point of the new interior surface. Any areas found to be thinner than minimum tolerances shall immediately receive additional material.
- (3) Measurement of bond strength of the protective coating to the substrate shall be measured in accordance with ASTM D-4541. Any areas detected to have inadequate bond strength shall be evaluated by the Owner. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded areas, and repairs shall be made by the Contractor in strict accordance with the manufacturer's recommendations.

(D) Plastic Composite Liner

- (1) Sample welds shall be taken from each jobsite during the field welding process and submitted to the quality assurance department for testing. The following tests shall be performed: Shear and Peel Test. Shear weld test results shall meet or exceed at least 80% strength of parent material in a destructive test that pulls the sample apart to test the strength and integrity of the extrusion weld. The peel test pulls the weld apart from the backside of the weld using a peeling type motion. The results of this test shall meet or exceed 70% of the value of the parent material.

3.20 Final Acceptance

- (A) The Owner reserves the right to inspect the rehabilitated manholes during the warranty period. Any leakage or defects in the work found by visual inspection or watertightness testing shall be corrected by the Contractor within 30 days from notice, at no additional cost to the Owner.

4. Measurement and Payment:

4.01 Method of Measurement:

- (A) Manhole Rehabilitation - Shall be measured based upon vertical linear foot of manhole rehabilitated, measured from the bottom of the frame to the invert of the channel at the center of the manhole.
- (B) Rebuild Bench and Channel (When Manhole Rehabilitation/Lining is Not Required) - Shall be measured for each bench and channel repaired and approved.
- (C) Internal Manhole Frame Sealant - Shall be measured for each internal manhole frame sealed and approved.
- (D) External Manhole Frame Sealant - Shall be measured for each external manhole frame sealed and approved.
- (E) Internal Manhole Frame Seal - Shall be measured for each internal manhole frame seal installed and approved.
- (F) External Manhole Frame Seal - Shall be measured for each external manhole frame seal installed and approved.

#### 4.02 Basis of Payment

- (A) Manhole Rehabilitation - Shall be paid for at the contract unit price bid per vertical linear foot of manhole rehabilitated. The unit price includes all labor, materials, equipment, tools and incidentals for cleaning, root removal, repairing, and sealing of all surfaces including walls, chimney, inverts and benches, liner application, testing, traffic control, flow control, site restoration, and other incidental work, and step removal.
- (B) Rebuild Bench and Channel (When Manhole Rehabilitation/Lining is Not Required) - Shall be paid for at the contract unit price for each bench and channel repaired and approved. Payment for rebuilding of benches and channels will be considered incidental if completed in coordination with manhole rehabilitation.
- (C) Internal Manhole Frame Sealant – Shall be paid for at the contract unit price for each internal manhole frame sealed (typical depth of 6- to 12-inches) and includes all labor, materials, equipment, tools and incidentals for preparing the internal frame/cone area, sealant application, testing, traffic control and other incidental work.
- (D) External Manhole Frame Sealant - Shall be paid for at the contract unit price for each external manhole frame sealed (typical depth of 6- to 12-inches) and includes all labor, materials, equipment, tools and incidentals for preparing the external frame/cone area, sealant application, testing, traffic control, site restoration, and other incidental work.
- (E) Internal Manhole Frame Seal - Shall be paid for at the contract unit price for each internal manhole frame seal installed and includes all labor, materials, equipment, tools and incidentals for preparing the internal frame/cone area, seal installation, testing, traffic control and other incidental work.
- (F) External Manhole Frame Seal - Shall be paid for at the contract unit price for each external manhole frame seal installed and includes all labor, materials, equipment, tools and incidentals for preparing the external frame/cone area, seal installation, testing, traffic control, site restoration, and other incidental work

END OF SECTION

## Section 02738 - Sanitary Sewer Pipe Joint Testing and Sealing

### 1. General:

#### 1.01 Description:

- (A) This work shall consist of furnishing all labor, material, equipment and supplies and the performance of all work necessary for the testing and sealing of sanitary sewer joints as described herein and shown on the Project Drawings. The work shall consist of, but not necessarily be limited to, performing the following tasks: flow control, line cleaning, televising, line joint testing, and line grout sealing. All deficiencies shall be corrected to the Owner's satisfaction by the Contractor at no additional cost to the Owner. All such costs shall be included in the unit price bid for such work.

### 2. Products:

#### 2.01 Contractor's Equipment

##### (A) General:

- (1) The Contractor shall certify that back-up equipment is available and can be delivered to the site within 48 hours and shall submit an equipment list to the Owner for approval before commencement of work.
- (2) Before commencement of work, the Contractor shall allow the Owner 48 hours to inspect the equipment to be used and allow the Owner to measure the internal dimensions of the tanks from which the sealing materials will be pumped. The Contractor shall demonstrate an acceptable technique for measuring the volume of the sealing materials in the tanks.
- (3) No work shall be performed or accepted if the Contractor's measurement equipment and/or measuring techniques are unacceptable to the Owner.

(B) Cleaning Equipment: Shall be in compliance with Section 02741, Sewer Line Cleaning.

(C) Video Inspection Equipment: Shall be in compliance with Section 02742, Television Inspection.

##### (D) Chemical Grout Equipment

- (1) Equipment shall be a remote controlled grout injection rig type with inflatable diaphragms or packers at each end and other suitable approved devices which can be positioned to completely isolate each joint or break in the pipe and simultaneously permit sewage flow.
- (2) The Contractor shall perform a test demonstration to verify the accuracy of calibrations of pump pressures and liquid amounts injected per stroke prior to commencing sealing operations. If this test demonstration fails to show that readings are accurate, the Contractor shall be required to

make required repair or adjustments to the equipment and gauges, and retest until the results are satisfactory to the Owner. This test demonstration may be required at any time during the sealing operation.

(E) Air Test Equipment

- (1) When requested by the Owner, the test equipment shall be positioned on a section of sound sewer pipe and a demonstration performed as described herein. This procedure will demonstrate the authenticity of the air test equipment and verify that test requirements are within the pipe capability. If the test is not performed successfully, the Contractor shall be required to repair or otherwise modify his equipment, and re-test until the results are successful and satisfactory to the Owner. Test requirements will be adjusted to within the pipe integrity limits. This test may be required at any time during the Contract period.
- (2) The basic equipment used shall consist of a television camera, joint testing device (such as a packer), and test monitoring equipment. The equipment shall be constructed in such a way as to provide means for introducing the test medium (air), under pressure, into the void area created by the expanded ends of the joint testing device and means for continually measuring the actual static pressure of the test medium at and within the void area only.
- (3) Void pressure data shall be transmitted electrically from the void to the monitoring equipment. Example: via a TV picture of a pressure gauge located at the void, or via an electrical pressure transducer located at the void.
- (4) All test monitoring shall be above-ground and in a location to allow for simultaneous and continuous observation of the television monitor and test monitoring equipment by the Owner's representative.

2.02 Materials

(A) Grout Materials for Joint Sealing and House Connections

- (1) General: The Contractor shall select an acrylamide base or urethane base gel as described in the paragraphs to follow.
- (2) All mixtures for acrylamide base gel quantities shall be submitted to the Owner for approval prior to beginning the grouting operation. Additives to increase the strength adhesion, solution density, and viscosity shall be approved by the Owner prior to their use. Bulk fillers such as diatomaceous earth may be added to the grout mix up to ten percent by weight of the total mix.

- (B) Acrylamide Base Gel: The acrylamide base gel shall be based on a two-part chemical grout that is mixed within the isolated area formed by the grouting rig or packer and shall be AV-100 acrylamide chemical grout as manufactured by Avanti International, or equal approved by the Owner. The material shall have the following minimum properties:

- (1) A minimum of 10 percent and a maximum of 14 percent acrylamide base material by weight in the total sealant mix. A higher concentration of acrylamide base material shall be used, when directed by the Owner, to increase strength or offset dilution during the induction period.
  - (2) A controllable reaction of from ten seconds to no more than one hour.
  - (3) Viscosity that can be made near 1.5 centipoise water and in no case exceed 2.5 centipoise.
  - (4) Viscosity to remain constant throughout the induction period.
  - (5) The ability to tolerate some dilution and react in moving water.
  - (6) The final reaction shall produce a continuous, irreversible, impermeable, nonporous still gel in pure form, or a stabilized soil in the ground that will not become rigid or brittle.
  - (7) Root inhibitors, such as dichlobenil, shall be incorporated in the mix when roots are present in the house connections and joints. The Contractor shall incorporate BARRIER 50W by Avanti International or approved equal into the grout mix in a quantity and manner directed by the Owner. The Contractor specifically covenants and agrees that he shall make no claim against the Owner for any damages that may occur as a result of any adverse effect the chemical root inhibitors may have upon the Contractor's equipment or personnel.
    - i. The active component for destroying intruding roots shall be a potent nonsystemic toxin that kills contacted roots at low concentration but does not permanently affect contacted parts of the plant a distance from the treated roots. The active ingredient must be spontaneously detoxified by natural chemical or biochemical processes in a relatively short time following its use. The active ingredients shall have no adverse effect on the performance of a wastewater treatment plant, and shall be registered with the Environmental Protection Agency.
  - (8) Latex additive to increase the strength, adhesion, solution density and viscosity, shall be used when directed by the Owner.
  - (9) Use of catalyst containing dimethyl amino propionitrile (DMAPN) is prohibited.
  - (10) The specified materials are considered toxic and irritants to the skin and eyes. Therefore, mixing, handling, and pumping of the chemicals shall be done by personnel thoroughly familiar with the handling of the chemicals involved. Proper protective outerwear, including eye protection and respirators for dust inhalation protection, shall be used while mixing or when otherwise exposed by close contact.
- (C) Urethane Base Gel: Urethane base gel shall be a liquid of low enough viscosity to be easily pumped to the site of a leaking joint and shall react quickly to seal the joint against infiltrating ground water, capable of holding occurring heads of up

to 20-feet of water and normal pipe movements without leaking and able to withstand the environment of a sewage collection system.

- (1) None of the materials in the grouting system shall present undue hazard to contract site personnel. Mixing, handling and pumping chemicals shall be done by personnel familiar with the handling of the chemicals involved. Proper protective outerwear including eye protection and respirators for inhalation protection shall be used while mixing or when otherwise exposed to close contact. Materials such as Scotch-Seal chemical grout 5610 (gel) manufactured by the 3M Corporation, or equal, shall have the following minimum properties.
  - i One part urethane prepolymer thoroughly mixed with between five and ten parts of water by weight. The recommended mix ratio is one part urethane prepolymer to eight parts of water (11 percent prepolymer).
  - ii A liquid prepolymer having a solids content of 77 percent to 83 percent, specific gravity of 1.04 (8.65 pounds per gallon), and flash point of 20 °F.
  - iii A liquid prepolymer having a viscosity of 600 to 1,200 centipoise at 70 °F that can be pumped through 500 feet of ½-inch hose with a 1,000 psi head at a 1 ounce/second flow rate.
  - iv The water used to react the prepolymer should be in the pH range of five to nine.
  - v A cure time of 80 seconds at 40 °F, 55 seconds at 60 °F, and 30 seconds at 80 °F when one part prepolymer is reacted with eight parts of water only.
  - vi A cure time that can be reduced five to ten seconds for water temperatures of 40 °F to 80 °F when one part prepolymer is reacted with eight parts of water containing gel control agent CR-251.
  - vii A relatively rapid viscosity increase of the prepolymer/water mix. Viscosity increases from about 10 to 60 centipoise in the first minute for one to eight prepolymer/water ratio at 50 °F.
  - viii A reaction (curing) which produces a chemically stable, non-biodegradable, tough, flexible gel.
  - ix The ability to increase mix viscosity, density, gel strength and resistance to shrinkage by the use of additives to the water is required.
  - x The amount of material necessary for various sizes and types of pipe joints shall be predictable.
  - xi The material shall be impermeable to water under varying pressures up to 15 psi.
  - xii Quantities must be approved by the Owner.

### 3. Execution:

#### 3.01 Maintaining Existing Sewage Flows:

- (A) Maintaining existing sewage flows during the entire rehabilitation operations shall be the responsibility of the Contractor. Precautions and methods to prevent sewage back-ups shall be employed as required. Sewage back-up damage and/or

clean-up required due to the Contractor's operations shall be the responsibility of the Contractor.

- (B) Sewage flow control shall be in accordance with Specification Section 01501, Flow Control.

### 3.02 Cleaning Operations

#### (A) Cleaning of the Main Line Sewers

- (1) Cleaning of the sewer lines shall be performed as specified in Section 02741, Sewer Line Cleaning.

- (B) Recleaning: If a pipeline is found not to be properly cleaned in the opinion of the Owner, the television and grouting equipment shall be removed and the sewer recleaned at no additional expense to the Owner.

### 3.03 Sewer Line Joint Sealing

#### (A) Joint Air Tests

- (1) At the direction of the Owner, the Contractor shall air test sanitary sewer line joints prior to any grouting to determine if the potential for joint leakage exists. The air testing equipment and monitoring system to be used by the Contractor shall be tested as specified herein, before air testing begins. The air testing procedures shall be as described herein.
- (2) The testing device shall be positioned within the line in such a manner as to straddle the pipe joint to be tested.
- (3) The testing device ends (end element, sleeves) shall be expanded so as to isolate the joint from the remainder of the line and create a void area between the testing device and the pipe joint. The ends of the testing device shall be further expanded against the pipe with a sufficient pressure to contain a minimum of 10 psi within the void without leakage past the expanded ends.
- (4) Air shall then be introduced into the void area until a pressure equal to 0.5 psi per vertical foot of pipe depth (not exceeding a test pressure of 10 psi) is observed with the void pressure monitoring equipment. If the required test pressure cannot be developed (due to joint leakage), the joint will have failed the test and shall be sealed as specified herein.
- (5) After the void pressure is observed to be equal to or greater than the required test pressure, the air flow shall be stopped. If the void pressure decays by more than 2 psi within 15 seconds (due to joint leakage), the joint will have failed the test and shall be sealed as specified herein.
- (6) Upon completing the air testing of each individual joint tested, the packer shall be deflated with the void pressure meter maintaining the established air test pressure. Should the void pressure meter fail to drop to zero, the Contractor shall be instructed to clean his equipment of residual grout

material or make the necessary equipment repairs to provide for an accurate void pressure reading.

- (7) Any joint failing the air test prior to grouting shall be sealed as specified herein and retested by the same void pressure method and procedures to verify the effectiveness of the sealing. This procedure will be repeated until the joint passes the test. Additional sealing and retesting after the initial sealing and retesting shall be at no cost to the Owner.
- (8) During the joint testing work, the contractor shall record the following information on prepared testing logs:
  - i Identification of the line segment tested.
  - ii The depth of the line segment as measured from the downstream manhole.
  - iii The test pressure used.
  - iv Location (footage) of each joint tested.
  - v A statement indicating the test results (passed or failed) for each tested.

#### 3.04 Sealing Joints

- (A) At the direction of the Owner, the Contractor shall be required to seal any or all pipe joints within a sewer line, defects, breaks, holes and other sources of possible ground water infiltration as may be observed or recorded by television inspection in existing sanitary sewers of the size stated in the Bid Schedule, and as described herein. In addition thereto, the Contractor shall be required to seal any or all pipe joints, defects, breaks, or other portions of a sewer line, as directed by the Owner. Any joint or defect that is sealed shall subsequently be tested by air testing procedures described herein. Costs related to the air test following the sealing will not be measured for payment nor constitute additional cost to the Contract Price, and shall be considered as incidental to the Contract.
- (B) All pipe joints and defects directed to be sealed shall be sealed by internal chemical grouting. The method used shall not damage, break, move or cause settlement of sewer pipe or manhole structures, and shall be such that the original cross-sectional area and shape of the interior of the sewer shall not be permanently reduced or changed. Any sewer that the Owner may deem damaged as a result of the Contractor's operations shall be promptly repaired to the Owner's satisfaction at no expense to the Owner.
- (C) Sealing materials that set to a hard, rigid product capable of intrusion into the sewer line will not be acceptable. Areas of severely broken, crushed, eroded, misaligned, or otherwise damaged pipe or manholes which require excavation and replacement will be repaired within this Contract; or their exact location shall be determined and recorded by the Contractor during the conduct of the work.
- (D) If roots were detected during the initial television inspection, these roots shall be removed immediately prior to any grouting operations. Cost related thereto will not be measured for payment nor constitute additional cost to the Contract Price, and shall be considered as incidental to the Contract. Roots must be cut. Foaming is not permitted

(E) Application of Chemical Grout

- (1) Provide chemical grouting of sewer joints, leaks, and breaks in the pipe when directed by the Owner by forcing sealing materials into and through any or all pipe line joints, leaks or defects from within the sewer pipe. If grouting operations restrict or prevent simultaneous sewage flow passage, the Contractor shall provide an approved plug and/or by-pass pumping system and shall be responsible for damage caused by sewage backup that may occur during the sealing operation. Maximum interruption of existing flows shall be limited to one hour.
- (2) The grouting injection rig shall be positioned over the sewer joint, leak, or defect in the pipe by means of a closed circuit television camera in the line. Accurate measurement of the location of the joint to be sealed shall be made, using a portion of the grouting rig as a "Datum" or measurement point. Such measurement or point shall also be used to record measurement of the repaired joint. An approved agitator shall be used during the entire sealing operation. The grouting device shall be a cylindrical casing type of a size less than the pipe diameter with two cables connected to both ends to pull it back and forth for positioning it in the line. Continuous air impervious inflatable sleeves shall be mounted front and back on the casing exterior. The ends of the sleeves which are not airtight and may require extreme pressures to "seat" against the periphery of the pipe will not be allowed. The sleeves shall be pneumatically expanded from the center to both ends. When in an inflated state, two widely spaced annular bladders shall have been formed, each of an elongated shape and producing an annular void around the center portion of the casing. Expansion shall be regulated by precise pressure gauges and controls. No device which is expanded mechanically will be allowed. The pneumatically expanded sleeves shall seat against the inside periphery of the pipe in such a way as to form a void area completely isolated from the remainder of the line. A tight seal shall be obtained before the grouting process begins. If a tight seal is not obtained, the Contractor shall remove the equipment and make such adjustments as are required to obtain a tight seal. The sealing material shall pass throughout one end of the casing and shall be adapted to supply the sealing material, under pressure, to the space at the center of the casing. Into this isolated area, through hose lines leading from above-ground, the chemical sealants shall be pumped with instant reading, metered flow controlled, proportioning pumps with pressures in excess of ground water pressures.
- (3) The pumping and mixing of the chemical grout material shall be performed in accordance with the manufacturer's recommendations. The void pressure monitoring equipment described herein shall be operating during the sealing operations. The television, grout pumping and air pressure monitoring equipment shall be integrated so that proportions, quantities, and void pressures for materials and sealing can be instantly monitored and regulated in accordance with the type and size of the joint and/or break in the pipe or leak.
- (4) In the event that large voids are encountered on the outside of the sewer, including the possibility of "piping" holes to the ground surface which

could cause excessive use of grout, a change in operating pressures and pumping rates shall be made as directed by the Owner. In such instances, changes in operating procedures shall be accomplished by reducing pressures and pumping rates followed by a termination of pumping until a temporary "set" of the gel is obtained on the outside of the pipe. After a sufficient lapse of time, followed by an increase in pressure, resumption of pumping will occur until a proper seal of the joint is obtained.

- (5) Upon completion of the injection, the grouting rig shall be moved forward and backward, wiping away the excess grout and allowing the television camera to move to a suitable position for inspection and/or air test. Each joint, crack or hole shall then be again air tested as specified hereinbefore. Should any joint or defect fail to pass the air test, it shall be resealed and retested until the test requirement can be met. No additional payment shall be made for multiple attempts to seal a joint or defect. No payment will be made for grouted joints (joint sealing plus joint sealing material) that do not meet test requirements.
- (6) The excess grouting material removed from the joint or break by the grouting equipment shall be flushed or pushed forward to the next downstream manhole, removed from the sewer system and disposed of by the Contractor, and as recommended by the chemical grout manufacturer and in accordance with local, State and Federal regulations. In no case shall excess grout material from succeeding sections be allowed to accumulate and be flushed down the sewer.

3.05 Monitoring Operations: Shall be in compliance with Specification Section 02742, Television Inspection.

3.06 Photographs

- (A) Furnish all equipment and film required to take Polaroid photographs of the views which appear on the monitor. In the course of the inspection, the Owner will indicate the specific views which are to be photographed as a permanent record.

3.07 Records

- (A) For each section of sewer grouted, complete, accurate and legible records of the grouting operations shall be kept by the Contractor, and copies in triplicate furnished to the Owner. A representative of the Owner shall be present during testing and sealing operations.
- (B) These records shall show the location of each operation or point of information relative to the centerline distance from adjacent manholes clearly defined. Measurement of location shall be readable at ground level by means of a measuring device. Marking on cable or the like will not be allowed. As each repair is accomplished, notations shall be made on the pertinent location record showing the amount of grout solution used, and any other pertinent information relative to the repair or as directed by the Owner.

3.08 Obstructions

- (A) Obstructions may be encountered during the course of the sealing operations that prevent the travel of the packer and camera. Should an obstruction not be passable, the Contractor shall withdraw the equipment and begin sealing operations from the opposite end of the sewer reach.

Should additional obstructions be encountered after the equipment is reset and no means are available for passing the obstructions without damage to the equipment, these locations shall be noted and corrected by the Contractor as directed by the Owner in accordance with the bid items. Passing material from section to section which could be detrimental to pumping equipment or cause accumulations in wet wells will not be permitted. An approved dam, weir or screening device shall be constructed in the downstream manhole in such a manner that construction debris and solids will be trapped, retained and removed from the sewer.

### 3.09 Quality Assurance

- (A) All sewer line joint sealing performed shall be guaranteed against faulty workmanship and/or materials for a period of one year after the completion and acceptance of the project.
- (B) Prior to the expiration of the guarantee period, an initial retest area consisting of specific line segments may be selected by the Owner. Line segments to be retested shall be randomly selected throughout the project area and shall be representative of the majority of the sealing work originally performed. The initial test area shall consist of at least 5%, but not exceed 10%, of the linear feet contained in the original project.
- (C) At the Owner's option, within the initial retest area, the Contractor shall retest all previously sealed joints as specified. Any joints failing the retest shall be resealed. If the failure rate of the retested joints is less than 5% of the joints retested, the work shall be considered satisfactory and no further retesting will be required. Payment for retesting the initial area shall be at the unit price bid for each item of work required (e.g.: cleaning, TV inspection, testing, etc.). No compensation shall be provided for resealing (grouting) joints that fail.
- (D) If, in the initial retest area, the failure rate of the retested joints exceeds 5% of the joints retested, an additional retest area of equivalent size shall be selected and all previously sealed joints shall be retested. This additional retesting and sealing, if necessary, will continue until a failure rate of less than 5% is met. Any additional testing/sealing required beyond the initial retest area shall be accomplished at no cost to the Owner.

## 4. Measurement and Payment:

### 4.01 Method of Measurement

- (A) Joint Testing - Shall be measured in place per each joint tested and sealed, per pipe diameter.

- (B) Pipe Sealing and Verification Testing - Shall be measured on the volume, in gallons, of grout pumped per joint in accordance with the Contract Documents and this Section.

#### 4.02 Basis of Payment

- (A) Joint Testing - Joint testing will be paid on a per joint basis for the initial test. Any joint testing performed in association with verifying joint sealing shall be incidental to the joint sealing work.
- (B) Pipe Sealing and Verification Testing - Payment shall be made at the contract unit price bid per gallon of grout pumped. The unit price includes all labor, incidentals, materials, setups, flow control, sediment and root removal, chemical root treatment, dewatering, traffic control, excavation pits, pre- and post-cleaning and television inspection, sealing, necessary permits, testing, and all other work, not included under other items, necessary to complete the sealing and testing as specified. No additional payment shall be made for verification testing of any joints. This cost shall be included in the sealing of joints.

END OF SECTION

## Section 02741 - Sewer Line Cleaning

### 1. General:

The work covered by this section consists of providing all labor, equipment, material and supplies and performing all operations required to clean sewer lines and manholes prior to the internal television inspection(s) and repair operations.

#### 1.01 Sewer Line Cleaning

The intent of sewer line cleaning is to remove foreign materials from the pipes and manholes and to prepare the lines for television inspection and repair operations.

### 2. Products:

#### 2.01 Equipment

##### (A) General

- (1) The Contractor shall certify that backup equipment is available and can be delivered to the site within 24 hours.

##### (B) Cleaning Equipment

- (1) The Contractor shall provide all equipment necessary for proper rodding, bucketing, brushing, root cutting and flushing of the sewers in the sizes indicated in the Bid Schedule. The equipment used for cleaning shall be that of a heavy duty power rodding machine which is capable of rodding distances of up to 1,000 feet in one setup. It shall have the ability to spin the rod either clockwise or counterclockwise, be able to be pushed straight out or pulled back without rotating the machine. It shall also be capable of pulling pipe-size swabs or brushes back through the pipeline for cleaning and flushing purposes.
- (2) The Contractor shall also provide heavy-duty bucket machines, as necessary, for use on dragline work to clean the pipeline with buckets, brushes, scrapers, swabs or other similar devices in order to effectively remove the debris and provide a clean sewer for the inspection. The equipment used will be subject to approval by the Owner.
- (3) Hydraulic high pressure sewer cleaners used for sanitary sewer cleaning shall be specifically designed and constructed for such cleaning. The sewer cleaner shall have a minimum usable water capacity of 600 gallons and a pump capable of delivering at least 30 gallons per minute (gpm) at 100 psi. Pressure to the nozzle shall be regulated by a relief valve adjustable from 1-1500 psi minimum. The equipment will be subject to approval by the Owner.
- (4) Satisfactory precautions shall be taken to protect the sewer lines from damage that might be inflicted by the improper use of cleaning equipment. Sewers damaged as a result of the Contractor's improper operations shall be promptly repaired by the Contractor at no cost to the Owner.

- (5) All equipment, devices, and tools required for this Contract shall be owned (or leased) and operated by the Contractor.

3. Execution:

3.01 General

- (A) The designated sewer manhole sections shall be cleaned using hydraulically propelled, high-velocity jet, or mechanically powered equipment. The equipment shall be capable of removing dirt, grease, rocks, sand, and other materials and obstructions from the sewer lines and manholes. If cleaning of an entire sewer section cannot be successfully performed from one manhole, the equipment shall be set up on the other manhole and cleaning again attempted. If, again, successful cleaning cannot be performed or the equipment fails to traverse the entire sewer section, it will be assumed that a major blockage exists and the cleaning effort shall be abandoned.
- (B) Cleaning shall be performed immediately before lining of the sanitary sewer line.
- (C) Existing flows shall not be interrupted for periods longer than one hour. The Contractor shall take necessary precautions to prevent sewage backup and shall be responsible if damage results therefrom. Sewage diverted during cleaning operations shall be returned to the sanitary system and not discharged into the streams or storm drain system.

3.02 Cleaning Precautions

- (A) During all cleaning and preparation operations, all necessary precautions shall be taken to protect the sewer from damage. During these operations, precautions shall be also taken to insure that no damage is caused to public or private property adjacent to or served by the sewer or its branches. Any damage cause to public or private property as a result of such cleaning and preparation operations shall be restored to preexisting conditions by the Contractor at no additional costs to the Owner.
- (B) Satisfactory precautions shall be taken in the use of cleaning equipment. When hydraulically propelled cleaning tools (which depend upon water pressure to provide their cleaning force) or tools which retard the flow in the sewer line are used, precautions shall be taken to insure that the water pressure created does not damage or cause flooding of public or private property being served by the sewer. When possible, the flow of sewage in the sewer shall be utilized to provide the necessary pressure for hydraulic cleaning devices. When additional water from fire hydrants is necessary to avoid delay in normal work procedures, the water shall be conserved and not used unnecessarily. Access to fire hydrants for the purpose of fire protection shall be maintained at all times.

### 3.03 Root Removal

- (A) Roots shall be removed in the designated sewer sections and manholes where root intrusion is a problem and where authorized by the Owner. Special attention should be used during the cleaning operation to assure almost complete removal of roots from the joints. Any roots which could prevent the proper seating and application of the liner shall be removed. Procedures may include the use of mechanical equipment such as rodding machines, bucket machines and winches using root cutters and porcupine, and equipment such as high-velocity jet cleaners. Chemical root treatment shall be used before or following the root removal operation, depending on the manufacturer's recommendation.

### 3.04 Chemical Root Treatment

To aid in the removal of roots, sewer sections that have root intrusion shall be treated with an acceptable herbicide, as approved and specified by the Owner. The application of the herbicide to the roots shall be done in accordance with the manufacturer's recommendations and specifications in such a manner to preclude damage to surrounding vegetation. The active ingredients shall have no adverse effect on the performance of a wastewater treatment plant, and shall be registered with the Environmental Protection Agency. Any damaged vegetation so designated by the Owner shall be replaced by the Contractor at no additional cost to the Owner. All safety precautions as recommended by the manufacturer shall be adhered to concerning handling and application of the herbicide.

### 3.05 Waste Material Removal and Disposal

- (A) All sludge, dirt, sand, rocks, grease, roots, and other solid or semisolid waste material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. When hydraulic cleaning equipment is used, a suitable dam or weir shall be placed in the downstream manhole to trap all such materials. Passing material from manhole section to manhole section, which could cause line stoppages, accumulations of sand in wet wells, or damage pumping equipment, shall not be permitted.
- (B) Under no circumstances shall sludge or other debris removed during these operations be dumped or spilled into streets, ditches, storm drains or other sanitary sewers. All solids or semisolids resulting from the cleaning operations shall be removed from the site and disposed of as specified in Section 106.04, Disposal Areas.
- (C) The Contractor shall keep his haul route and work area(s) neat and clean and reasonably free of odor, and shall bear all responsibility for the cleanup of any spill which occurs during the transport of cleaning/surface preparation by-products and the cleanup of any such material which is authorized by or pursuant to this Contract and in accordance with applicable law and regulations. The Contractor shall immediately clean up any such spill or waste material release. Refer to Section 107, Laws to be Observed, for additional requirements.
- (D) The routes used by the Contractor for the conveyance of this material on a regular basis shall be subject to approval by the governing authority having jurisdiction over such routes.

3.06 Acceptance of Cleaning Operation

- (A) Acceptance of sewer line cleaning shall be made upon the successful completion of the television inspection and shall be to the satisfaction of the Owner. If the television inspection shows the cleaning to be unsatisfactory, the Contractor shall be required to reclean and reinspect the sewer line until the cleaning is shown to be satisfactory. In areas where television inspection is not performed, the Owner may require the Contractor to pull a double squeegee (with each squeegee the same diameter as the sewer) through each manhole section as evidence of adequate cleaning.
  
- (B) In addition, on all sewer lines which have sags or dips to an extent that the television camera lens becomes submerged for 3 or more feet during the television inspection, the Contractor shall pull double squeegee and/or sponges through the line in order to remove the water from the dips or sags. Water removal through squeegees and/or sponges shall be performed until the television camera lens will no longer be submerged. This requirement may be waived by the Owner if the water in which the camera lens is submerged, is clear enough to allow the identification of pipe defects, cracks, holes and location of service connections.

4. Measurement and Payment:

4.01 Method of Measurement: This item will not be measured.

4.02 Basis of Payment: Payment for sewer line cleaning will be considered incidental and the cost for cleaning shall be included in other bid items. See Section 02742, Television Inspection, for payment.”

END OF SECTION

## Section 02742 - Television Inspection

### 1) General:

The Contractor shall furnish all labor, equipment, material, and supplies, and perform all operations necessary to conduct the internal closed-circuit television inspection (CCTV) of sanitary sewer lines designated in the contract documents or directed by the Owner. Television inspection and sanitary sewer line assessments shall be in accordance with NASSCO PACP standards and performed by a NASSCO certified operator.

#### Related Work Specified in Other Sections Include:

Section 01500 Flow Control

Section 02741 Sewer Line Cleaning

#### 1.01 Definitions

- (A) NASSCO - National Association of Sewer Service Companies.
- (B) PACP - Pipeline Assessment Certification Program.
- (C) Neztex DEU - Neztex Data Exchange Utility (DEU) is a software package capable of transferring data from Hansen IMS to the CCTV inspection equipment.
- (D) Television Inspection - is a video inspection performed by the Contractor of sanitary sewer lines to confirm cleaning and to assess the condition of the line.
- (E) Television Inspection Report - Information collected and recorded by each television operator for any Television Inspection effort that is submitted to the Owner.
- (F) Inspection codes and Sanitary Sewer Line Assessment codes shall be in accordance with NASSCO PACP standards.
- (G) Pre-Installation TV Inspection - Pre-installation TV is a video inspection by the Contractor of sanitary sewer lines specified for rehabilitation to confirm cleaning, location of service connections, and constructability of line rehabilitation according to the Drawings and Project Manual.
- (H) Post-Installation TV Inspection - Post-installation TV is a video inspection to determine that rehabilitation and/or replacement of sanitary sewers has been completed according to the Drawings and Project Manual.

#### 1.02 Submittals:

- (A) Certifications:
  - (1) Contractor shall submit PACP certifications for all operators who will work on the contract.
  - (2) Contractor shall submit PACP and Neztex DEU certifications for the closed circuit television inspection software.

- (B) Contractor shall provide Television Inspection Reports in hard copy and digital format to the Owner as specified herein.
- (C) Contractor shall provide Television Inspection Reports, Video Recordings and Photographs to the Owner in digital format on DVD.

## 2) Products:

### 2.01 Closed Circuit Television Equipment and Software:

- (A) The Contractor shall select and use closed-circuit television equipment that will produce a color video recorded in digital format on DVD. The pipe inspection camera shall be a high-resolution color chip camera capable of producing a minimum 500-line resolution colored video picture. Picture quality and definition shall be to the satisfaction of the Owner. Video tape recordings shall not be accepted.
- (B) The CCTV inspection software shall be Neztek DEU certified and PACP certified. The Contractor shall be required to update software applications in order to stay current with software upgrades from Neztek DEU, Hansen IMS, and the City of Virginia Beach.
- (C) The software/hardware for the camera truck shall be capable of autolinking digital JPEG still images to PACP observation codes in a format compatible with Hansen IMS.
- (D) The Contractor shall provide pipeline assessment data transferable to Hansen IMS using the PACP Condition Grading System. Structural grades and O&M grades as identified in the Appendices to the PACP Handbook shall be utilized. Software and hardware for performing television inspections shall be capable of automatically supplying this data.
- (E) The television inspection software shall be Microsoft Access database compatible. The Owner will provide the Contractor with a Microsoft Access database and the Contractor shall populate this database for all inspection work. The intent of the Owner is to generate a Microsoft Access database using the Neztek DEU in conjunction with the Hansen Formula Based CCTV Inspection Module. The Owner will be responsible for integrating the Contractor populated Microsoft Access Database with the City of Virginia Beach's Hansen IMS.

### 2.02 Pipe Inspection Camera

- (A) The Contractor shall produce video using a pan-and-tilt, radial viewing, pipe inspection camera that pans  $\pm 275$  degrees and rotates 360 degrees. The television camera used for the inspection shall be specifically designed and constructed for such inspection. The camera shall operate in 100% humidity and submerged conditions. The Contractor shall use a camera with an accurate footage counter, which displays on the monitor the exact distance of the camera from the centerline of the starting manhole. The Contractor shall use a camera with camera height adjustment so that the camera lens is always centered at one-half the inside pipe diameter, or higher, in the pipe being televised. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. A reflector in front of the camera may be required to enhance lighting in dark or large diameter pipe. The television equipment shall be capable of showing on the video the City name, Service Area name, Contractor name, date, line size and material, line identification (City's manhole

numbers at both ends) and ongoing footage counter. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Owner; and if unsatisfactory, equipment shall be removed and replaced with adequate equipment. No payment will be made for an unsatisfactory inspection.

### 2.03 Digital Recordings

- (A) Digital video shall be supplied for all television work. All recordings shall be submitted to the Owner recorded on DVD discs.
- (B) The Contractor shall index all video inspection logs to the DVD containing the video segment.
- (C) The current version of the video reader software used for reading and viewing digital video recordings shall be provided to the Owner on one disc.
- (D) A label shall be placed on the face of the DVD. Permanently label each disc with the following information.
  - (1) City Name
  - (2) Contractors Name
  - (3) Service Area
  - (4) Inspection Type (Pre-Installation, Post-Installation )
  - (5) Disc Number
  - (6) Date Televised
  - (7) Date Submitted
- (E) A DVD jacket label shall be affixed to the reverse side of the jewel box. The jacket label shall include the following information:
  - (1) Label sanitary sewer pipelines by manhole number to manhole number.
  - (2) Pipe diameters.
  - (3) Pipe Lengths.
  - (4) Street Names.

### 3) Execution:

#### 3.01 Pre-Installation Inspection for Sanitary Sewer Lines to be Rehabilitated

- (A) Procedure
  - (1) Notification: Notify the Owner 24 hours in advance of any CCTV inspection so that the Owner may observe inspection operations.
  - (2) Perform pre-installation TV inspection immediately after line cleaning and before line rehabilitation work, as appropriate. Verify that the line is clean and ready to accept the line rehabilitation. Prepare the Television Inspection Reports. Maintain copies of the TV inspection reports and video recordings for reference by the Owner for the duration of the project. Note that Pre-installation TV inspection is not required for sanitary sewer lines designated as being replaced.

- (3) Prior to any rehabilitation work, the entire sanitary sewer line (from manhole to manhole) shall be televised. The Pre-installation inspection shall be used to determine whether the line has been cleaned sufficiently; to confirm the location and nature of defects; to confirm the location of service connections; and to confirm that the proposed method of repair is proper for the defects observed.
- (4) The camera shall be moved through the line at a moderate rate, stopping when necessary to permit proper documentation of the sanitary sewer's condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sanitary sewer conditions shall be used to move the camera through the pipe.
- (5) If during the inspection operation, the television camera will not pass through the entire pipe section due to blockage or pipe defect, the Contractor shall set up his equipment so that the inspection can be performed from the opposite manhole. If, again, the camera fails to pass through the entire pipe section, the inspection shall be considered complete and no additional inspection will be required at that time. Improper cleaning will not be a reason for incomplete televising of a line section.
- (6) When manually operated winches are used to pull the television camera through the line, hand operated radios, telephones, or other suitable means of communication shall be set up between the two manholes of the section being inspected to insure good communication between members of the crew.
- (7) During the internal inspection, the television camera shall be temporarily stopped at each defect along the line. The nature and location of the defects and observations shall be recorded by the Contractor in accordance with NASSCO, PACP standards. The camera shall also be stopped at all service connections. Service connections shall be inspected by use of the pan/tilt feature of the pipe camera. Focus of inspection shall include the connection to the sanitary sewer main and zooming up the service pipe, recording all defects found in the service connection, including infiltration sources.
- (8) All defects and lateral locations shall be labeled and imbedded on the video and audio tracks by the operator.
- (9) The operator shall slowly pan and tilt the camera at beginning and ending manhole connections, service connections, joints, visible defects, and at pipe material transitions.
- (10) Television inspection video shall be continuous for pipeline segments between manholes. Do not leave gaps in the video taping of a line segment between manholes and do not show a single line segment on more than one DVD, unless specifically approved by the Owner.

(B) Flow Control

- (1) Perform flow control as specified in Section 01501, Flow Control, of these Contract Documents.

- (2) If during television inspection of a sanitary sewer line section, the wastewater flow depth exceeds 20 percent of the inside pipe diameter, the Contractor shall reduce the flow depth to an acceptable level by performing the television inspection during minimum flow hours, bypass pumping, plugging, or by pulling the camera with swab, high-velocity jet nozzle or other acceptable dewatering device. Video inspection made while floating the camera is not acceptable unless approved by the Owner.

(C) Documentation of Television Inspection

- (1) The television inspection shall be documented using a digital data logger and reporting system in a format compatible with the Access database.
- (2) Television Inspection Reports: For each CCTV inspection provide a completely printed inspection report generated by the Nezteck compliant CCTV inspection acquisition software that clearly identifies the location of defects and all recorded observations indexed in relation to adjacent manholes. Defects and observations that shall be recorded include structural deficiencies, service connections with estimations of extraneous flows, joints, infiltration sources, unusual conditions, material transitions, roots, storm sewer connections, fractured, cracked or collapsed sections, the presence of scale and corrosion, signs of previous leakage, pipes that the camera failed to pass through and reasons for failure, and other discernible features and data of significance. A hard copy of these records shall be supplied to the Owner.
- (3) Digital Photographs: All recorded observations shall be documented as digital still images and formatted to autolink with PACP observations codes for importation to Hansen IMS.
- (4) Digital Video Recordings: The purpose of digital recording shall be to supply a visual and audio record of problem areas of the lines that may be replayed. Video recordings shall include an audio track recorded by the inspection technician during the actual inspection work. An audio and graphic label shall be imbedded in the recording describing the parameters of the line being inspected (i.e. location, depth, diameter, pipe material), as well as describing connections, defects and unusual conditions observed during the inspection. Video recording playback shall be at the same speed that it was recorded. Slow motion or stop-motion playback features may be supplied at the option of the Contractor. Once recorded, the DVD discs shall be labeled and become the property of the Owner. The Contractor shall have all DVD's and necessary playback equipment readily accessible for review by the Owner during the project.
- (5) Pipeline Condition Rating Form: Provide each inspection report with a Pipeline Condition Rating Form. The Pipeline Condition Rating Form shall include the following:
  - (a) List the number of structural defects and the number of operation and maintenance defects per condition grade (Condition Grades 1 through 5)
  - (b) List the Structural Pipe Rating, Operations and Maintenance Pipe Rating, Overall Pipe Rating, and Pipe Rating Index.

- (6) Manhole Observations: Manhole observation videos are required for each televised sanitary sewer line. The operator shall pan beginning and ending manholes to demonstrate that all debris has been removed and that pipe connections, inverts, benches, and sidewalls of the manholes are not leaking or defective.

### 3.02 Post-Installation Inspection:

#### (A) Procedure

- (1) Post-Installation TV inspection shall not be completed until all work, including service lateral replacement and/or reactivation, and manhole restoration is complete on a section of line. The post-installation TV inspection reports and video recordings shall be submitted to the Owner prior to substantial completion, or when requested.
- (2) The post-installation TV inspection shall be completed to confirm completion of rehabilitation and replacement work and to verify that the work conforms to the requirements of the Drawings and Project Manual. Provide a color video recording showing the completed work, including the condition of restored service connections. Prepare and submit Television Inspection Reports providing location of service connections along with location of any discrepancies. Manhole work, including benches, inverts and pipe penetrations into manhole, shall be complete prior to post-installation TV work.
- (3) For post-installation TV inspection, exercise the full capabilities of the camera equipment to document the completion of the rehabilitation and replacement work and the conformance of the work to the Drawings and Project Manual. Provide a full 360 degree view of pipe, joints, and service connections.
- (4) Flow Control and Documentation of Television Inspection shall be conducted as specified in Paragraph 3.01 of this specification.

### 4) Measurement and Payment:

#### 4.01 Method of Measurement

- (A) General: Work covered by the Contract Documents consists of providing all work indicated on Drawings or required by Project Manual complete-in-place.
- (B) Measurement and Payment: Only the items specified in this article "Measurement and Payment" shall be defined to be pay items except as otherwise expressly provided for under the terms of the Contract Documents.
  - (1) The following items are classified as incidental work and will not be measured for separate payment. The cost thereof shall be included in the lump sum or unit prices bid for the other items of work.
    - (a) Traffic Control.
    - (b) Mobilization and demobilization to service area of equipment, labor and materials.

- (c) Noise control.
- (d) Flow control. Sewage flow control including by-pass pumping and other equipment needed to control or reroute sewage flow to facilitate construction of the different pay items will not be measured for payment.
- (e) Removal and disposal of solid or semisolid waste material from the cleaning and televising operations.
- (f) Restoration of property.
- (g) Inspection reports, video recordings, photographs in hard copy and digital format.

(C) Pre-Installation and Post-Installation Televising for Rehabilitated Pipeline - Pre- and post-cleaning and television inspection for rehabilitated lines will not be measured for payment.

(D) Post-Installation Televising of New and Replaced Pipeline and Point Repairs - This item shall be measured based upon the linear footage of pipe cleaned and televised for new or replaced line sections. For Point Repairs, the entire sanitary sewer line segment, manhole to manhole, shall be cleaned and televised.

#### 4.02 Basis of Payment

(A) Pre-Installation and Post-Installation Televising for Rehabilitated Pipeline - Payment for pre and post cleaning and television inspection of rehabilitated pipelines shall be included in other bid items.

(B) Post-Installation Televising of New and Replaced Pipeline and Point Repairs- Payment shall be made at the contract unit price bid per linear foot for pipe cleaned and televised.

END OF SECTION

Section 02745 - General Requirements for Transfer of Service Connections from  
An Easement to a Right-of-Way

1. General:

- 1.01 These specifications include requirements for all materials, transportation, equipment and labor necessary to transfer plumbing from a mainline sewer located in an easement to a mainline sewer located in a Right-of-Way. This specification is intended to identify the minimum requirements of the Owner.
- 1.02 The Contractor shall furnish all material, labor and special equipment required to accomplish the work in accordance with these specifications. The Contractor shall provide active lateral connections, from the residence or commercial building to the mainline sewer, in operational condition. The installation shall include a clean out within 5 feet of the commercial or residential structure, a cleanout every 100 lineal feet of service connection, and cleanouts at all bends greater than 45-degree in the service connection.
- 1.03 The Contractor shall be responsible for all work pertaining to the abandonment and/or removal of existing service laterals, as shown on contract drawings or specified in the field by the Owner.
- 1.04 Contractor Experience
  - (A) The Contractor who completes the work shall be a certified licensed plumbing contractor.

2. Products:

- 2.01 Pipe materials shall be Schedule 40 PVC with glued joints.

3. Execution:

- 3.01 Permits: Contractor shall be responsible for applying for and payment of permits for each connection transferred. Contractor is also responsible for scheduling site inspection and approvals by City Plumbing Inspectors.
- 3.02 Pre-video of Site: The contractor shall videotape and provide original copy to the City's Construction Representative of the intended routing of the service connection from the structure to the property line prior to initiating work on the private property.
- 3.03 The exact location and number of service connections along the pipeline to be abandoned shall be determined from TV tapes and/or in the field. It shall be the Contractor's responsibility to accurately field locate all existing service connections.
- 3.04 The Contractor shall transfer and connect to the main line all service connections which have been determined as live connections to the main sewer line or manhole, as shown on the Drawings. The Contractor shall notify the Owner before transferring any services to vacant lots. The Contractor shall be responsible for transferring, without any delay, all missed or faulty connections, as well as for any damage caused to property owners for not transferring and connecting the services soon enough or for not giving notice to the owners. All services which are transferred and connected to the main line shall be shown

on the “As Built Drawings” with the exact distance from the nearest downstream manhole and offset distances to the service lateral cleanouts.

- 3.05 Transferred service connections shall be completely installed, from the main to the property line as shown on the plans, complete with City of Virginia Beach standard property line cleanouts, and shall tie into the existing plumbing. Install service connections as specified in Section 02730, Sanitary Sewer System Rehabilitation and Replacement, and as shown on the Contract Drawings.
- 3.06 The location of the sanitary laterals shall be field coordinated with the Owner.
- 3.07 Any driveway areas, sidewalks, aprons, patios, etc. shall be restored in kind as a full section from construction joint to construction joint. Decks and fences shall be replaced fully with new wood to a finish to match the existing structure appearance.
- 3.08 Transferring Services on a Crawl Space - Plumbing shall be turned under buildings with a crawl space as shown on the contract drawings, at the structure owner’s request, or as directed by a City of Virginia Beach Construction Representative. Turning of services shall be subject to City requirements and the latest edition of the International Plumbing Code.
- 3.09 Transferring Services Slab-on-grade – Plumbing shall be connected within 5-feet of the residence structure, at the existing lateral. A cleanout shall be installed at the connection per paragraph 1.02 of this specification section.
- 3.10 The size, slope, alignment, material of construction, the methods to be used in excavating, placing of the pipe, jointing, testing, and backfilling the trench, shall all conform to the requirements of the latest edition of the International Plumbing Code and other applicable rules and regulations of the City.
- 3.11 Connection of Service Laterals to the Rehabilitated or Replaced Main: Tests for compliance shall be as specified in Section 02730, Sanitary Sewer System Rehabilitation and Replacement and Section 02742, Television Inspection.
- 3.12 Transferring and connection of the service lateral from the main to the commercial or private residence shall be the responsibility of the Contractor. Work shall include but not be limited to service line connections, necessary cleanouts, necessary plumbing appurtenances, and restoration.
- 3.13 Existing connections shall be abandoned (capped per City requirements) and/or removed as specified on the Drawings or by the Owner, in accordance with Section 02730, Sanitary Sewer System Rehabilitation and Replacement.
- 3.14 The Contractor is responsible for maintaining protective fencing around open trenches that are left overnight or unsupervised. Any injuries or claims to third parties as a result of the open trenches shall be the sole responsibility of the Contractor.

3.15 Defective Work – Connection to a Rehabilitated Main

- (A) Any defects which, in the judgement of the Owner, will affect the integrity or strength of the lining, shall be repaired or the liner replaced at the Contractor's expense. Obtain approval of the Owner for method of repair, which may require field or workshop demonstration.

3.16 Warranty

- (A) Work is subject to a one-year, non-prorated warranty for materials and labor covered by the Performance Bond. The Contractor shall repair defects within 30 days of notification of the defect. Method(s) of repair shall be approved by the Owner prior to the initiation of the repair.

4. Measurement and Payment:

- 4.01 Method of Measurement: Shall be measured per each connection transferred, installed, and connected to the main pipeline or manhole. Three categories of measurement will be utilized based on the presumed length from the connection at the property line cleanout to the structure (or the existing private lateral connection from the structure): 0 to 50 linear feet; 51 to 100 linear feet; 101 to 150 linear feet, and 151 linear feet and longer.
- 4.02 Basis of Payment: Shall be paid for at the Contract unit price and shall include the cost of pre-video taping, removing and disposing or abandoning existing cleanouts and piping, furnishing and installing all pipe, cleanouts and appurtenances, necessary permits and related fees, turning plumbing at the commercial or private residence, necessary cutting or joining to other sections of pipe, additional sections of pipe as needed, connection to existing manholes or main sanitary sewer line, stone bedding, excavation, backfilling with suitable material, disposing of surplus or unsuitable material, sheeting and bracing, dewatering, testing, compaction, stone aggregate base, pavement and concrete restoration, borings, top soiling, seeding, site restoration, restoration of property, cleanup, and sediment and erosion control for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work as shown on the Contract Drawings and specified in the Project Manual. Wye, tee, or Inserta Tee at main sanitary sewer line and sewer cleanout assembly shall be measured and paid for separately.

END OF SECTION