

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT			1. CONTRACT ID CODE	PAGE OF PAGES 1 26
2. AMENDMENT/MODIFICATION NO. 0002	3. EFFECTIVE DATE 16-Dec-2015	4. REQUISITION/PURCHASE REQ. NO.		5. PROJECT NO.(If applicable)
6. ISSUED BY NAVFAC MID ATLANTIC PWD CRANE FEAD 300 HIGHWAY 361 NSA BLDG 2516 CRANE IN 47522	CODE N40085	7. ADMINISTERED BY (If other than item 6) See Item 6		
8. NAME AND ADDRESS OF CONTRACTOR (No., Street, County, State and Zip Code)		X	9A. AMENDMENT OF SOLICITATION NO. N40085-16-R-2800	
		X	9B. DATED (SEE ITEM 11) 20-Nov-2015	
			10A. MOD. OF CONTRACT/ORDER NO.	
			10B. DATED (SEE ITEM 13)	
CODE	FACILITY CODE			
11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS				
<input checked="" type="checkbox"/> The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offer <input type="checkbox"/> is extended, <input checked="" type="checkbox"/> is not extended. Offer must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing Items 8 and 15, and returning <u>1</u> copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.				
12. ACCOUNTING AND APPROPRIATION DATA (If required)				
13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.				
A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.				
B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(B).				
C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:				
D. OTHER (Specify type of modification and authority)				
E. IMPORTANT: Contractor <input type="checkbox"/> is not, <input type="checkbox"/> is required to sign this document and return _____ copies to the issuing office.				
14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.) N40085-16-R-2800 UNDERGROUND UTILITIES SERVICES AT THE NAVAL SUPPORT ACTIVITY CRANE IN Amendment 0002 is issued to replace the original specification 22 05 83.63 CURED IN PLACE PIPE LINING and replace with CIPP SPECIFICATION_DEC2015. THE EXHIBIT LINE ITEM SCHEDULE IS ALSO REVISED REMOVING LINE ITEM 674. ALL AMENDMENTS MUST BE ACKNOWLEDGED WITH THE PRICE PROPOSAL				
Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.				
15A. NAME AND TITLE OF SIGNER (Type or print)		16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print) R ANNETTE TAYLOR		
		TEL: 812-854-2673 EMAIL: annette.taylor@navy.mil		
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA		16C. DATE SIGNED
_____ (Signature of person authorized to sign)		BY _____ (Signature of Contracting Officer)		16-Dec-2015

Attachment B

TECHNICAL SPECIFICATIONS
CURED-IN-PLACE PIPE (CIPP) FOR MAINLINE RENEWAL

PART 1 - PRODUCTS

1.1 GENERAL

- A. It is the intent of this specification to provide for the reconstruction of pipelines and conduits by the installation of a resin-impregnated flexible tube that is either inverted or pulled into the original pipeline/conduit and expanded to fit tightly against said pipeline by the use of water or air pressure. The resin system shall then be cured by elevating the temperature of the fluid (water/air) used for the inflation to a sufficient enough level for the initiators in the resin to effect a reaction. The finished pipe shall be such that when the thermosetting resin cures, the total wall thickness shall be a homogeneous and monolithic felt and resin composite matrix that will be chemically resistant to withstand internal exposure to domestic sewage or storm water.

1.2 QUALIFICATIONS

A. Product

1. The system proposed (materials, methods, workmanship) must be proven through previous successful installations to an extent and nature satisfactory to the Contracting Officer that is consistent with the size of the project being proposed. Since CIPP is intended to have a minimum 50-year design life, only products deemed to have this performance will be accepted.
2. CIPP liner material shall be as manufactured by Inliner Technologies, LLC or Insituform, Inc.
3. All CIPP lining products shall comply with the latest versions of ASTM D5813, ASTM F1216 or ASTM F1743, including appendices.
4. The product shall have been successfully in service in an application similar to this for a minimum of 10 years.

B. Installation Contractor

1. The Contractor shall be an approved installer of the CIPP material as determined by the material Manufacturer.
2. The installation Contractor shall have installed within the United States a minimum of 150,000 lineal feet of the same product being represented by the bidder.
3. The actual installation superintendent shall have installed a minimum of 50,000 lineal feet and shall have 5 years of installation experience of the same product being represented by the bidder.

Failure to meet these minimum requirements shall render the bidder non-responsive for purposes of award.

1.3 STRUCTURAL REQUIREMENTS

- A. Each CIPP shall be designed to withstand internal and/or external loads as dictated by the site and pipe conditions. When not specified by the Contracting Officer in the contract documents, the design thickness of the CIPP shall be arrived at using standard engineering methodology as found in ASTM F1216, Appendix X1. The long-term modulus shall not exceed 50 percent of the short-term value for the resin system and shall be verifiable through testing. The thickness calculations, signed and sealed by a registered professional engineer, shall be submitted to the Engineer prior to CIPP installation.

The layers of the finished CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or such that the knife blade moves freely between the layers. If separation of the layers occurs during testing of the field samples, new samples will be cut from the work. Any reoccurrence may be cause for rejection of the work.

The cured liner shall meet the following minimum strength requirements:

MINIMUM PHYSICAL PROPERTIES

Property System	ASTM Test Method	Polyester System	Filled Polyester System	Vinyl Ester System
Flexural Strength	D790	4,500 psi	4,500 psi	5,000 psi
Flexural Modulus (initial)	D790	250,000 psi	350,000 psi	300,000 psi
Flexural Modulus (50-year)	D790	125,000 psi	175,000 psi	150,000 psi
Tensile Strength ⁽¹⁾	D638	3,000 psi	3,000 psi	4,000 psi

⁽¹⁾ For pressure piping applications only

1.4 MATERIALS

A. Liner Tube

1. The tube shall consist of one or more layers of a flexible needled felt or an equivalent nonwoven or woven material, or a combination of nonwoven and woven materials, capable of carrying resin, withstanding installation pressures and curing temperatures. The tube should be compatible with the resin system to be used on this project. The material should be able to stretch to fit irregular pipe sections and negotiate bends. Projected changes in groundwater level, temperature and other loading factors shall cause no significant changes in the service characteristics or service life of the CIPP.
2. The liner shall be fabricated from materials which when cured, will be chemically resistant to reagents as defined in ASTM F1216 or ASTM F1743.
3. The tube should be fabricated under controlled conditions to a size that, when installed, will tightly fit the internal circumference and the length of the original conduit.

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Allowances should be made for the longitudinal and circumferential stretching that occurs during placement of the tube. Maximum stretching allowances shall be as defined in ASTM F1216 or ASTM F1743. The Contractor shall verify the lengths in the field before cutting the liner to length. Individual liners can be made over one or more manhole-to-manhole sections.

4. The tube shall be uniform in thickness and when subjected to the installation pressures shall meet or exceed the designed wall thickness.
5. Any plastic film applied to the tube on what will become the interior wall of the finished CIPP shall be compatible with the resin system used, translucent enough that the resin is clearly visible, and shall be firmly bonded to the felt material.
6. At time of manufacture, each lot of liner shall be inspected and certified to be free of defects. The tube shall be marked for distance at regular intervals along its entire length, not to exceed five feet. Such markings shall also include the Manufacturer's name or identifying symbol.
7. The reinforcing material of the liner shall be of a needle interlocked Terylene felt formed into sheets of required thickness or other material approved by the manufacturer.
8. Liners may be made of single or multiple layer construction where any layer must not be less than 1.5 mm thick. A suitable mechanical strengthener membrane or strip may be placed in between layers where required to control longitudinal stretching.

B. Resin Components

1. The resin system shall be a corrosion resistant polyester, vinyl ester, or epoxy and catalyst system that when properly cured within the tube composite meets the minimum requirements given herein or those that are to be utilized in the design of the CIPP for this project.
2. The resin used shall not contain non-strength enhancing fillers.
3. The Contractor shall submit the resin characteristics, including filler identification and Material Safety Data Sheets (MSDS) to the Contracting Officer for approval prior to lining activities.

PART 2 - EXECUTION

2.1 GENERAL

- A. The Contractor shall deliver the liner to the site and provide all equipment required to insert and cure the liner within the host pipe. The Contractor shall designate a location where the tube will be vacuum impregnated prior to installation. The Contractor shall notify the Contracting Officer at least 48 hours prior to wet out to allow the Contracting Officer to observe the materials and wet out procedure. All procedures to prepare the liner for installation shall be in strict accordance with the Manufacturer's recommendations.
- B. The liner shall be impregnated with resin not more than 120 hours before the time of installation and stored out of direct sunlight at a temperature of less than 70° F.

2.2 NOTIFICATION AND PREPARATION

- A. Permission to interrupt any utility service shall be requested in writing a minimum of 15 working days prior to the desired date of interruption. Contractor shall make every effort to maintain service usage throughout the duration of the project.
- B. The Contractor shall perform cleaning, videotaping, and inspection prior to installation of the CIPP. The Contractor, when required, shall remove all debris from within the pipe that will interfere with the installation of the CIPP. The Government shall provide a dumpsite for such debris removed during the cleaning operations.
- C. It shall be the responsibility of the Contractor to notify the Contracting Officer of line obstructions, offset joints or collapsed pipe that will prevent the insertion of the tube or significantly reduce the capacity of the sewer. The Contracting Officer, with input from the Contractor shall determine the method of pipe repair required and shall address these concerns on a case-by-case basis.
- D. Protruding laterals or services shall be trimmed flush with the inside of the main sewer wall prior to lining. Trimming shall not cause damage to the lateral or service beyond the inside face of the main sewer.

2.3 BYPASS PUMPING

- A. The Contractor, when required, shall provide for the flow of sewage around the section or sections of pipe designated for repair. When possible, the bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. The Contractor shall furnish all necessary pumping equipment, conduit, etc. to adequately, safely, and environmentally divert sewage flow around the work.
- C. The Contractor shall submit a general bypass plan.

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2.4 TELEVISION INSPECTION

- A. The Contractor shall provide television equipment capable of properly documenting the conditions as found within the pipe. Lighting for the camera shall illuminate the entire periphery of the sewer. The camera shall be radial view type capable of viewing 360° within the pipe and shall provide an unobstructed view of the full pipe.
- B. The taping shall begin with a clear identification of the televising location, upstream and downstream manhole designation, and pipe diameter. The televising tapes shall provide an accurate length measurement of the entire segment and of the distance to each lateral connection. The Contractor shall pan all lateral connections on both the pre and post televising tape.
- C. Reverse televising set-ups shall be utilized when line obstructions prevent full segment televising from the initial set-up direction.
- D. Both a pre-lining and post-lining tape shall be submitted to the Contracting Officer for approval. The videotapes shall be clearly and properly labeled.

2.5 INSTALLATION

- A. The CIPP shall be installed in accordance with the practices given in ASTM F1216 (for direct inversion installations) or ASTM F1743 (for pulled-in-place installations). The quantity of resin used for the tube's impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances being made for polymerization shrinkage and the loss of any resin through cracks and irregularities in the original pipe wall. A vacuum impregnation process shall be used in conjunction with a roller system to achieve a uniform distribution of the resin throughout the tube.
- B. A scaffold or elevated platform shall be erected at the access point. The resin-impregnated tube shall be installed into the host pipe by methods approved by the Manufacturer and proven through previous successful installations. The insertion method shall not cause abrasion or scuffing of the tube. Hydrostatic or air pressure shall be used to inflate the tube and mold it against the walls of the host pipe. There will be no use of sewage in place of clean water for insertion of the tube, or for the curing of the liner.
- C. The tube is to be installed in a controlled manner at a rate sufficient to prevent damage to the tube. The installation rate shall not exceed 32 feet per minute. The installation head shall be such that, allowing for minor impact, at no time shall the hoop tension in the felt exceed 500 psi or the hoop stress in the polyurethane membrane exceed 8,000 psi.

2.6 CURING

- A. After tube installation is completed the Contractor shall supply suitable heat source and recirculation equipment. The equipment shall be capable of delivering hot water or steam throughout the section to uniformly raise the temperature above the temperature required to affect a cure of the resin. This temperature shall be determined by the resin/catalyst system employed.

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- B. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing heat supply. Thermocouples shall be placed between the tube and the host pipe in downstream manholes at or near the bottom to determine the liner temperature during cure. Water or air temperature in the pipe during the cure period shall be as recommended by the resin Manufacturer.
- C. Initial cure shall be deemed to be completed when inspection of the exposed portions of cured pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exothermic. The cure period shall be of a duration recommended by the resin Manufacturer, as modified for the installation process, during which time the recirculation of the heat and cycling of the heat exchanger to maintain the temperature continues. The heat source shall be shut down during the post cure.

2.7 COOL DOWN

- A. Cool down may be accomplished by the introduction of cool water or air into the installation standpipe to replace water or pressurized air being relieved from the manhole. The Contractor shall cool the hardened pipe to a temperature below 100° F before relieving the static head. A minimum period of post cure shall be maintained under a static head to provide a minimum hoop tension on the tube felt. Care shall be taken in the release of the static head so that a vacuum will not be developed.

2.8 FINISH

- A. The finished lining shall be continuous over the entire length of an insertion run between two manholes and be as free as commercially practical from visual defects such as foreign inclusions, dry spots, pinholes, and delamination. The lining shall be homogeneous, impervious, and free of any leakage from the surrounding ground to the inside of the lined pipe.
- B. Where liner is installed through a manhole uninterrupted, the invert shall be maintained smooth through the manhole, with approximately the bottom half of the liner continuous through the manhole. The invert of the manhole shall be shaped and grouted as necessary to support the liner. The cost of this work shall be included in the CIPP unit price.
- C. During the warranty period, any defects which will affect the integrity or strength of the liner, collect solids, or reduce hydraulic flow capabilities of the product shall be repaired at the Contractor's expense in a manner mutually agreed upon by the Owner and the Contractor.

2.9 REINSTATE LATERALS AND SERVICES

- A. Accurate location of the lateral and service connections shall be made by inspection of the pre-installation videotape or sewer walk.
- B. After the liner has been installed, all existing active lateral sewers and services shall be reinstated unless otherwise indicated by the Contracting Officer or on the plans. The reinstatement of laterals and services shall be done without excavation unless otherwise specified by the Engineer. Reinstatement of laterals and services will be accomplished from the interior of the pipeline by means of a television camera

directed cutting device or by direct man entry when feasible. All cut lateral and service connections shall be free of burrs, frayed edges, or any restriction preventing free flow of wastewater. Laterals shall be reinstated to a minimum of 90% of their original diameter and no more than 100% of their minimum diameter. The CIPP liner shall be tightly sealed at the cut openings with no gaps. All coupons cut from the liner as a result of reopening the lateral connections shall be retrieved from the sewer and accounted for by the Contractor.

2.10 QUALITY ASSURANCE PROCEDURES

- A. For every Task Order or every two thousand five hundred (2,500) lineal feet of liner installed, two (2) flat plate samples shall be processed and tested. The flat plate samples shall be taken directly from the wet out tube, clamped between flat plates, and cured in the downtube. As an alternative, restrained end samples may be used for pipes eight to 18 inches in diameter.
- B. Testing shall be completed by an accredited, independent laboratory at the Contractor's expense. The Contractor shall submit the chosen laboratory with appropriate accreditation documentation for approval by the Contracting Officer prior testing. Testing results shall be provided to the Contracting Officer within seven (7) days of receipt.
- C. Samples shall be conditioned and prepared in accordance with ASTM D618 and ASTM D5813 to ensure consistency in laboratory results.
- D. Thickness shall be measured in accordance with ASTM D5813, latest version, with only the structural portion of the CIPP being measured.
- E. Flexural testing shall be in accordance with ASTM D790, latest version, with only the structural portion of the CIPP being tested.
- F. For pressure application, tensile testing shall be in accordance with ASTM D638, latest version, with only the structural portion of the CIPP being tested.

SECTION A-1C
TECHNICAL SPECIFICATIONS
CURED-IN-PLACE PIPE (CIPP) FOR LATERAL RENEWAL

PART 1 - PRODUCTS

1.1 GENERAL

- A. It is the intent of this specification to provide for the reconstruction of sewer service laterals by the installation of a resin-impregnated flexible tube and, *if required* a mainline/lateral connection seal. The tube is either inverted or pulled into the original service lateral through a newly installed (during lateral lining) or opened (by means of limited excavation) cleanout, basement drain, or similar access point and then expanded to fit tightly against the lateral by the use of water or air pressure. The resin system shall then be cured by elevating the temperature of the fluid (water/air) used for the inflation to a sufficient enough level for the initiators in the resin to effect a reaction. The finished pipe shall be such that when the thermosetting resin cures, the total wall thickness shall be a homogeneous and monolithic felt and resin composite matrix that will be chemically resistant to withstand internal exposure to domestic sewage.

Should it be determined after lateral lining that an interface seal is required or if directed by the contract documents, the system shall then be provided with a seal at the mainline/lateral interface. The seal shall consist of a polyester impregnated fiberglass insert with an epoxy component and shall be installed from inside of the sewer main and cured via application of ultraviolet light. The finished seal shall be such that when the thermosetting resin cures, the seal bonds to the lateral liner forming an airtight and watertight interface and will provide chemical resistance to domestic sewage.

1.2 QUALIFICATIONS

- A. Product
1. The system proposed (materials, methods, workmanship) must be proven through previous successful installations to an extent and nature satisfactory to the Government that is consistent with the size of the project being proposed. Since CIPP is intended to have a minimum 50-year design life, only products deemed to have this performance will be accepted.
 2. CIPP lateral liner material shall be Inserv[®] as manufactured by Inliner Technologies, LLC or Insituform, Inc. The interface seal shall be Inseal[®] as provided by Inliner Technologies, LLC or equal.
 3. All CIPP lining products shall comply with the latest versions of ASTM F1216 or ASTM F1743, including appendices.
 4. The lateral lining product shall have been successfully in service in an application similar to this for a minimum of one year.

5. The CIPP liner Manufacturer shall be ISO certified.

B. Installation Contractor

1. The Contractor shall be an approved installer of the CIPP material as determined by the material Manufacturer.
2. The installation Contractor shall have successfully installed within the United States a minimum of 150,000 lineal feet of cured-in-place pipe product, mainline or otherwise.
3. The Contractor shall demonstrate successful experience with lateral lining.
4. The Contractor shall be ISO certified.

Failure to meet these minimum requirements shall render the bidder non-responsive for purposes of award.

1.3 STRUCTURAL REQUIREMENTS

- A. Each CIPP shall be designed to withstand internal and/or external loads as dictated by the site and pipe conditions. When not specified by the Engineer in the contract documents, the design thickness of the CIPP shall be arrived at using standard engineering methodology as found in ASTM F1216, Appendix X1. In no case shall the finished thickness of the cured liner be less than three millimeters. The long-term modulus shall not exceed 50 percent of the short-term value for the resin system and shall be verifiable through testing. The thickness calculations, signed, sealed and dated by a registered professional engineer, shall be submitted to the Engineer prior to CIPP installation.

When multiple layers are present, the layers of the finished CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or such that the knife blade moves freely between the layers. If separation of the layers occurs during testing of the field samples, new samples will be cut from the work. Any reoccurrence may be cause for rejection of the work.

The cured liner shall meet the following minimum strength requirements:

MINIMUM PHYSICAL PROPERTIES

Property Value	ASTM Minimum Test Method
Flexural Strength 4,500 psi	D790
Flexural Modulus (Initial) 250,000 psi	D790
Flexural Modulus (50-year) 125,000 psi	D790

1.4 MATERIALS

C. Lateral Liner Tube

1. The tube shall consist of one or more layers of a flexible needled felt or an equivalent nonwoven or woven material, or a combination of nonwoven and woven materials, capable of carrying resin, withstanding installation pressures and curing temperatures. The tube should be compatible with the resin system to be used on this project. The material should be able to stretch to fit irregular pipe sections and negotiate bends. Projected changes in groundwater level; temperature and other loading factors shall cause no significant changes in the service characteristics or service life of the sewer pipe liner.
2. The liner shall be fabricated from materials which when cured, will be chemically resistant to reagents as defined in ASTM F1216, ASTM F1743, and ASTM D543.
3. The tube should be fabricated under controlled conditions to a size that, when installed, will tightly fit the internal circumference and the length of the original conduit. Allowances should be made for the longitudinal and circumferential stretching that occurs during placement of the tube. Maximum stretching allowances shall be as defined in ASTM F1216 or ASTM F1743. The Contractor shall verify the lengths in the field before cutting the liner to length.
4. The tube shall be uniform in thickness and when subjected to the installation pressures shall meet or exceed the designed wall thickness.
5. Any plastic film applied to the tube on what will become the interior wall of the finished CIPP shall be compatible with the resin system used, translucent enough that the resin is clearly visible, and shall be firmly bonded to the felt material.
6. At time of manufacture, each lot of liner shall be inspected and certified to be free of defects. The tube shall be marked for distance at regular intervals along its entire length, not to exceed five feet. Such markings shall also include the Manufacturer's name or identifying symbol.

7. Liners may be made of single or multiple layer construction where any layer must not be less than 1.5 mm thick. A suitable mechanical strengthener membrane or strip may be placed in between layers where required to control longitudinal stretching.

D. Resin Components

1. The resin system shall be a corrosion resistant polyester, vinyl ester, or epoxy and catalyst system that when properly cured within the tube composite meets the minimum requirements given herein or those that are to be utilized in the design of the CIPP for this project. The catalyst system may be accelerated to promote curing.
2. The resin used shall not contain non-strength enhancing fillers.
3. The Contractor shall submit the resin characteristics, including filler identification, to the Owner for approval prior to lining activities.

E. Interface Seal

1. The interface seal shall be a polyester impregnated, corrosion resistant fiberglass insert with an epoxy component. The seal shall be of one-piece construction and shall be designed such that when expanded shall tightly fit both T and Y connections at the interface between the mainline and lateral sewer. The seal shall extend into the mainline a minimum of four inches (4") and shall provide a minimum of a three-inch (3") overlap inside the lateral pipe.
2. The epoxy sealant rated for piping applications shall be applied to the seal to ensure that any gap between the interface between the mainline pipe and the CIPP lateral lining is air and watertight.

PART 2 - EXECUTION

2.2 GENERAL

- A. The Contractor shall deliver the liner to the site and provide all equipment required to insert the liner into the host pipe and cure it in place. The Contractor shall designate a location where the tube will be vacuum impregnated prior to installation. The Contractor shall notify the Contracting Officer at least 48 hours prior to wet out to allow the Contracting Officer to observe the materials and wet out procedure. All procedures to prepare the liner for installation will be in strict accordance with the Manufacturer's recommendations. Any material not properly prepared shall be rejected and replaced with acceptable materials at the Contractor's expense.
- B. The liner shall be impregnated with resin not more than 120 hours before the time of installation and stored out of direct sunlight at a temperature of less than 70° .

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2.2 PREPARATION

- A. Permission to interrupt any utility service shall be requested in writing a minimum of 15 working days prior to the desired date of interruption. Contractor shall make every effort to maintain service usage throughout the duration of the project.
- B. The Contractor shall perform cleaning, videotaping, and inspection prior to installation of the CIPP. The Contractor, when required, shall remove all internal debris out of the pipeline that will interfere with the installation of the CIPP. The Government shall provide a dumpsite for all debris removed during the cleaning operations.
- C. It shall be the responsibility of the Contractor to notify the Contracting Officer of line obstructions, offset joints, or collapsed pipe that will prevent the insertion of the tube or significantly reduce the capacity of the lateral. The Contracting Officer, with input from the Contractor, shall determine the method of pipe repair required and shall address these concerns on a case-by-case basis.
- D. Protruding laterals or services shall be trimmed flush with the inside of the mainline sewer wall prior to lining. Trimming shall not cause damage to the lateral or service beyond the inside face of the main sewer.
- E. Cleanouts shall be installed per the Governments requirements and specifications.

2.3 BYPASS PUMPING

- A. When the flow demand on the lateral dictates that bypass pumping is required, the Contractor shall furnish all necessary pumping equipment, conduit, etc. to adequately and safely divert sewage flow around the work in a manner approved by the Contracting Officer. No flow shall be discharged on the surface, into storm sewers, in ditches, or in waterways.

2.4 TELEVISION INSPECTION

- A. The Contractor shall provide television equipment capable of properly documenting the conditions as found within the lateral. The camera equipment shall be capable of launching into the full length of each lateral and providing an accurate picture of the lateral to be lined. Lighting for the camera shall illuminate the entire periphery of the lateral.
- B. Both a pre-lining and post-lining tape shall be submitted to the Contracting Officer for approval. The Contractor shall launch into each lateral connection on both pre and post tape. When a cleanout is available or when the connection configuration at the mainline prevents the launching from inside the main, the Contractor may choose to televise from the cleanout into the mainline. The videotapes shall be clearly and properly labeled.

2.5 CIPP LINER INSTALLATION

- A. The CIPP shall be installed in accordance with the practices given in ASTM F1216 (for direct inversion installations) or ASTM F1743 (for pulled-in-place installations). The quantity of resin used for the tube's impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances being made for polymerization shrinkage and the loss of any resin through cracks and irregularities in the original pipe wall. A vacuum impregnation process shall be used in conjunction with a roller system to achieve a uniform distribution of the resin throughout the tube.
- B. The resin-impregnated tube shall be installed into the host pipe by methods approved by the Manufacturer and proven through previous successful installations. The insertion method shall not cause abrasion or scuffing of the tube. Hydrostatic or air pressure shall be used to inflate the tube and mold it against the walls of the host pipe. There will be no use of sewage in place of clean water for insertion of the tube, or for the curing of the liner.
- C. The tube is to be installed at a rate sufficient to cause controlled installation of the tube into the conduit. The tube shall be installed in such a manner that no damage is done to the tube.

2.6 CURING

- A. After tube installation is completed the Contractor shall supply suitable heat source and recirculation equipment. The equipment shall be capable of delivering heat throughout the section to uniformly raise the temperature above the temperature required to effect a cure of the resin. This temperature shall be determined by the resin/catalyst system employed.
- B. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing heat supply. Thermocouples shall be placed between the tube and the host pipe to determine the liner temperature during cure. The water or air temperature in the pipe during the cure period shall be as recommended by the resin Manufacturer.
- C. Initial cure shall be deemed to be completed when inspection of the exposed portions of cured pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exothermic. The cure period shall be of a duration recommended by the resin Manufacturer, as modified for the installation process, during which time the recirculation and cycling of the heat exchanger to maintain the temperature continues. The heat source shall be shut down during the post cure.

2.7 COOL DOWN

- A. Cool down may be accomplished by the introduction of cool water or air into the installation standpipe to replace the initial heating agent. The Contractor shall cool the hardened pipe to a temperature below 100° F before relieving the pressure in the pressure apparatus. A minimum period of post cure shall be maintained under a

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static head to provide a minimum hoop tension on the tube felt. Care shall be taken in the release of the static head so that a vacuum will not be developed.

2.8 FINISH

- A. The finished lining shall be continuous over the entire length of the lateral and be as free as commercially practical from visual defects such as foreign inclusions, dry spots, pinholes, and delamination. The lining shall be homogeneous, impervious, and free of any leakage from the surrounding ground to the inside of the lined pipe. The lateral CIPP shall not inhibit the post video televising of the mainline or the service lateral pipes.
- B. During the warranty period, any defects which will affect the integrity or strength of the liner, collect solids, or reduce hydraulic flow capabilities of the product shall be repaired at the Contractor's expense in a manner mutually agreed upon by the Contracting Officer and the Contractor.

2.9 INTERFACE SEAL INSTALLATION

- A. The interface seal between the mainline and the lateral shall be installed by remote device from inside of the sewer main. The seal shall be properly expanded with air pressure to tightly fit the lateral interface.
- B. Ultraviolet light applied for a timeframe directed by the Manufacturer shall be used to cure the seal. The installation device shall be equipped with light control and properly calibrated timing device.
- C. The finished seal shall be continuous over the entire interface and be as free as commercially practical from visual defects such as foreign inclusions, dry spots and pinholes. The seal shall be homogeneous, impervious, and free of any leakage from the surrounding ground to the inside of the lined pipe. The interface seal shall not inhibit the post video televising of the mainline or the service lateral pipes.
- D. During the warranty period, any defects which will affect the integrity or strength of the seal, collect solids, or reduce hydraulic flow capabilities of the product shall be repaired at the Contractor's expense in a manner mutually agreed upon by the Contracting Officer and the Contractor.

2.10 QUALITY ASSURANCE PROCEDURES

- A. For every week (defined as five working days) of installation or for every thirty laterals installed, whichever comes first, two (2) flat plate samples shall be processed and tested.
- B. Testing shall be completed by an accredited, independent laboratory at the Contractor's expense. The Contractor shall submit the chosen laboratory with appropriate accreditation documentation for approval by the Contracting Officer prior testing. Testing results shall be provided to the Contracting Officer within seven (7) days of receipt.

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- C. Samples shall be conditioned and prepared in accordance with ASTM D618 and ASTM D5813 to ensure consistency in laboratory results.
- D. Thickness shall be measured in accordance with ASTM D5813, latest version, with only the structural portion of the CIPP being measured.
- E. Flexural testing shall be in accordance with ASTM D790, latest version, with only the structural portion of the CIPP being tested.
- F. For pressure application, tensile testing shall be in accordance with ASTM D638, latest version, with only the structural portion of the CIPP being tested.

**TECHNICAL REQUIREMENTS AND SPECIFICATIONS
REHABILITATION OF CONCRETE AND MASONRY
MANHOLES OR UNDERGROUND VAULTS
WITH A PROTECTIVE COATING**

FOREWORD

This specification covers work, materials and equipment required for protecting and/or rehabilitating concrete and masonry manholes and other underground vaults by monolithic spray-application of a high-build, solvent-free epoxy coating to eliminate infiltration, provide corrosion protection, repair voids and enhance structural integrity. Procedures for surface preparation, cleaning, application and testing are described herein.

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements for surface preparation, repairs and solvent-free epoxy coating application to specified surfaces.

1.02 RELATED SECTIONS

- A. Concrete Repair.
- B. Environmental, Health and Safety.

1.03 REFERENCES

- A. ASTM D638 - Tensile Properties of Plastics.
- B. ASTM D790 - Flexural Properties of Unreinforced and Reinforced Plastics.
- C. ASTM D695 - Compressive Properties of Rigid Plastics.
- D. ASTM D4541 - Pull-off Strength of Coatings Using a Portable Adhesion Tester.
- E. ASTM D2584 - Volatile Matter Content.
- F. ASTM D2240 - Durometer Hardness, Type D.
- G. ASTM D543 - Resistance of Plastics to Chemical Reagents.
- H. ASTM C109 - Compressive Strength Hydraulic Cement Mortars.

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- J. ACI 506.2-77 - Specifications for Materials, Proportioning, and Application of Shotcrete.
- K. ASTM C579 - Compressive Strength of Chemically Setting Silicate and Silica Chemical Resistant Mortars.
- L. ASTM - The published standards of the American Society for Testing and Materials, West Conshohocken, PA.
- M. NACE - The published standards of National Association of Corrosion Engineers (NACE International), Houston, TX.
- N. SSPC - The published standards of the Society of Protective Coatings, Pittsburgh, PA.

1.04 SUBMITTALS

- A. The following items shall be submitted:
 - 1. Technical data sheet on each product used, including ASTM test results indicating the product conforms to and is suitable for its intended use per these specifications.
 - 2. Material Safety Data Sheets (MSDS) for each product used.
 - 3. Project specific guidelines and recommendations.
 - 4. Applicator Qualifications:
 - a. Manufacturer certification that Applicator has been trained and approved in the handling, mixing and application of the products to be used.
 - b. Certification that the equipment to be used for applying the products has been manufactured or approved by the protective coating manufacturer and Applicator personnel have been trained and certified for proper use of the equipment.
 - c. Five (5) recent references of Applicator (projects similar size and scope) indicating successful application of a high-build solvent-free epoxy coating by plural component spray application.
 - d. Proof of any necessary federal, state or local permits or licenses necessary for the project.
 - 5. Design details for any additional ancillary systems and equipment to be used in site and surface preparation, application and testing.

1.05 QUALITY ASSURANCE

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- A. Applicator shall initiate and enforce quality control procedures consistent with applicable ASTM, NACE and SSPC standards and the protective coating manufacturer's recommendations.
- B. (OPTIONAL) A NACE Certified Coating Inspector shall be provided by Owner. The Inspector will observe surface preparation, application and material handling procedures to ensure adherence to the specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Materials are to be kept dry, protected from weather and stored under cover.
- B. Protective coating materials are to be stored between 50 deg F and 90 deg F. Do not store near flame, heat or strong oxidants.
- C. Protective coating materials are to be handled according to their material safety data sheets.

1.07 SITE CONDITIONS

- A. Applicator shall conform with all local, state and federal regulations including those set forth by OSHA, RCRA and the EPA and any other applicable authorities.
- B. Method statements and design procedures are to be provided by the Contractor when confined space entry, flow diversion or bypass is necessary in order for Applicator to perform the specified work.

1.08 WARRANTY

- A. Applicator shall warrant all work against defects in materials and workmanship for a period of one (1) year, unless otherwise noted, from the date of final acceptance of the project. Applicator shall, within a reasonable time after receipt of written notice thereof, repair defects in materials or workmanship which may develop during said one (1) year period, and any damage to other work caused by such defects or the repairing of same, at his own expense and without cost to the Government.

PART 2 – PRODUCTS

2.01 EXISTING PRODUCTS

- A. Standard Portland cement or new concrete (not quick setting high strength cement) must be well cured prior to application of the protective coating. Generally, 28 days is adequate cure time for standard Portland. If earlier application is desired, compressive or tensile strength of the concrete can be tested to determine if acceptable cure has occurred. (Note: Bond strength of the coating to the concrete surface is generally limited to the tensile strength of the concrete itself. Engineer may require Elcometer pull tests to determine suitability of concrete for coating)
- B. Cementitious patching and repair materials should not be used unless their manufacturer provides information as to its suitability and procedures for top coating with an epoxy coating. Project specific submittals should be provided including application, cure time and surface preparation procedures, which permit optimum bond strength with the epoxy coating.
- C. Remove existing coatings prior to application of the new protective coating. Applicator is to maintain strict adherence to applicable NACE and SSPC recommendations with regard to proper surface preparation and compatibility with existing coatings.

2.02 MANUFACTURER

- A. Raven Lining Systems, Inc. or equal, Tulsa, Oklahoma 800-324-2810 or 918-584-2810 or FAX 918-582-4311.

2.03 REPAIR MATERIALS

- A. Repair materials shall be used to fill voids, structurally reinforce and/or rebuild surfaces, etc. as determined necessary by the engineer and protective coating applicator. Repair materials must be compatible with the specified epoxy coating and shall be applied in accordance with the manufacturer's recommendations.
- B. The following products may be accepted and approved as compatible repair basecoat materials for epoxy top coating for use within the specifications:
 - 1. 100% solids, solvent-free epoxy grout specifically formulated for epoxy top coating compatibility. The epoxy grout manufacturer shall provide instructions for trowel or spray application and for epoxy top coating procedures.
 - 2. Factory blended, rapid setting, high early strength, fiber reinforced, non-shrink repair mortar that can be trowel led or pneumatically spray applied may be approved if specifically formulated to be suitable for epoxy top coating. Such repair mortars should not be used unless their manufacturer provides information as to its suitability for top coating with an epoxy coating. Project specific submittals should be provided including application, cure time and surface preparation procedures, which permit optimum bond strength with the epoxy coating.

2.04 PROTECTIVE COATING MATERIAL

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- A. Raven 405 Lining System epoxy coating system or equal - a 100% solids, solvent-free two-component epoxy resin system thixotropic in nature and filled with select fillers to minimize permeability and provide sag resistance acceptable to these specifications. (up to {depends on product} mils in a single coat).

Product type	Amine cured epoxy
Color	White
Solids Content (vol %)	100
Mix Ratio	1:1 Aquatapoxy 3:1 Raven or equal
Compressive Strength	ASTM D695 (18,000psi)
Tensile Strength, psi	ASTM D638 (7,600psi)
Tensile Elongation, %	ASTM D638 (1.5%)
Flexural Modulus, psi	ASTM D790 (13,000psi)
Hardness, Type D	ASTM D2240 (88)
Bond Strength - Concrete	>Tensile Strength of Concrete

2.05 PROTECTIVE COATING APPLICATION EQUIPMENT

- A. Manufacturer approved heated plural component spray equipment shall be used in the application of the specified protective coating.

2.06 REPAIR MORTAR SPRAY APPLICATION EQUIPMENT (if spray applied)

- A. Spray applied repair mortars shall be applied with manufacturer approved equipment.

PART 3 - EXECUTION

3.01 ACCEPTABLE APPLICATORS

- A. Repair mortar applicators shall be trained to properly apply the cementitious mortar according to manufacturer's recommendations.
- B. Protective coating must be applied by a Certified Applicator of the protective coating manufacturer and according to manufacturer specifications.

3.02 EXAMINATION

- A. All structures to be coated shall be readily accessible to Applicator.
- B. Appropriate actions shall be taken to comply with local, state and federal regulatory and other applicable agencies with regard to environment, health and safety.
- C. Any active flows shall be dammed, plugged or diverted as required to ensure that the liquid flow is maintained below the surfaces to be coated. Flows should be totally plugged and/or diverted when coating the invert. All extraneous flows into the manhole or vaults at or above the area coated shall be plugged and/or

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diverted until the epoxy has set hard to the touch. As an option, hot air may be added to the manhole to accelerate set time of the coating.

- D. No leaks may be present prior to commencing and during work.
- E. Installation of the protective coating shall not commence until the concrete substrate has properly cured in accordance with these specifications.
- F. Temperature of the surface to be coated should be maintained between 40 deg F and 120 deg F during application. Prior to and during application, care should be taken to avoid exposure of direct sunlight or other intense heat source to the structure being coated. Where varying surface temperatures do exist, care should be taken to apply the coating when the temperature is falling versus rising (i.e. late afternoon into evening vs. morning into afternoon).

3.03 SURFACE PREPARATION

- A. Applicator shall inspect all surfaces specified to receive a protective coating prior to surface preparation. Applicator shall notify Contracting Officer of any noticeable disparity in the surfaces, which may interfere with the proper preparation, or application of the repair mortar and protective coating.
- B. All contaminants including: oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.
- C. All concrete or mortar that is not sound or has been damaged by chemical exposure shall be removed to a sound concrete surface or replaced.
- D. Surface preparation method(s) should be based upon the conditions of the substrate, service environment and the requirements of the epoxy protective coating to be applied.
- E. Surfaces to receive protective coating shall be cleaned and abraded to produce a sound surface with adequate profile and porosity to provide a strong bond between the protective coating and the substrate. Generally, this can be achieved with high-pressure water cleaning using equipment capable of 5,000 psi at 4 gpm. Other methods such as high-pressure water jetting (refer to NACE Standard No. 5/SSPC-SP12), abrasive blasting, shot blasting, grinding, scarifying or acid etching may also be used. Detergent water cleaning and hot water blasting may be necessary to remove oils, grease or other hydrocarbon residues from the concrete. Whichever method(s) are used, they shall be performed in a manner that provides a uniform, sound clean neutralized surface that is not excessively damaged.
- F. Infiltration shall be stopped by using a material, which is compatible with the specified repair mortar and is suitable for top coating with the specified epoxy protective coating.

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- G. The area between the manhole and the manhole ring and any other area that might exhibit movement or cracking due to expansion and contraction, shall be grouted with a flexible grout or gel.
- H. Castings can be abrasive blasted and coated to prevent corrosion if desired.
- I. All surfaces should be inspected by the Inspector during and after preparation and before the repair material is applied.

3.04 APPLICATION OF REPAIR MATERIALS

- A. Areas where structural steel has been exposed or removed shall be repaired in accordance with the Contracting Officer's recommendations.
- B. Repair materials shall meet the specifications herein. The materials shall be trowel or spray applied utilizing proper equipment on to specified surfaces. The material thickness shall be 150 mils.
- C. If using approved cementitious repair materials, such shall be trowel led to provide a smooth surface with an average profile equivalent to coarse sandpaper to optimally receive the protective coating. No bugholes or honeycomb surfaces should remain after the final trowel procedure of the repair mortar.
- D. The repair materials shall be permitted to cure according to manufacturer recommendations. Curing compounds should not be used unless approved for compatibility with the specified protective coating.
- E. Application of the repair materials, if not performed by the coating certified applicator, should be inspected by the protective coating certified applicator to ensure proper finishing for suitability to receive the specified coating.
- F. After abrasive blast and leak repair is performed, all surfaces shall be inspected for remaining laitance prior to protective coating application. Any evidence of remaining contamination or laitance shall be removed by additional abrasive blast, shot blast or other approved method. If repair materials are used, refer to these specifications for surface preparation. Areas to be coated must also be prepared in accordance with these specifications after receiving a cementitious repair mortar and prior to application of the epoxy coating.
- G. All surfaces should be inspected during and after preparation and before the protective coating is applied.

3.05 APPLICATION OF PROTECTIVE COATING

- A. Application procedures shall conform to the recommendations of the protective coating manufacturer, including material handling, mixing, environmental controls during application, safety, and spray equipment.
- B. The spray equipment shall be specifically designed to accurately ratio and apply the specified protective coating materials and shall be regularly maintained and in proper working order.
- C. The protective coating material must be spray applied by a Certified Applicator of the protective coating manufacturer.
- D. Specified surfaces shall be coated by spray application of moisture tolerant, solvent-free, 100% solids, epoxy protective coating as further described herein. Spray application shall be to a minimum dry film thickness of 150 mils.
- E. Airless spray application equipment approved by the coating manufacturer shall be used to apply each coat of the protective coating. Air assisted spray application equipment may be acceptable, especially for thinner coats (<10 mils), only if the air source is filtered to completely remove all oil and water.
- F. If necessary, subsequent top coating or additional coats of the protective coating should occur as soon as the basecoat becomes tack free, ideally within 12 hours but no later than the recoat window for the specified products. Additional surface preparation procedures will be required if this recoat window is exceeded.
- G. Fiberglass woven-roving fabric may be rolled into the resin or chopped glass spray applied with the resin for added tensile and flexural strength where desired. Sloped surfaces of the floor may be made non-skid by broadcasting aluminum oxide or silica sand into the surface prior to gelation.
- H. Depending on flow levels and how long flow can be stopped, inverts may be lined with an approved 100% solids, fast setting epoxy coating material.

3.06 TESTING AND INSPECTION

- A. During application a wet film thickness gage, such as those available through Paul N. Gardner Company, Inc. meeting ASTM D4414 - 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.
- B. (Optional – Note that this procedure is sometimes difficult or impossible to perform in tight manhole or vault structures) After the protective coating has set hard to the touch it shall be inspected with high-voltage holiday detection equipment. Surface shall first be dried; an induced holiday shall then be made on to the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark tester shall be initially set at 100 volts per 1 mil (25 microns) of film thickness applied but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO188-99). All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional protective coating material can be hand applied to the repair area. All touch-up/repair procedures shall follow the protective coating manufacturer's recommendations.
- C. Measurement of bond strength of the protective coating to the substrate can be measured in accordance with ASTM D4541. The Contracting Officer shall evaluate any areas detected to have inadequate bond strength. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by Applicator in strict accordance with manufacturer's recommendations.
- D. Manhole Testing - Type A: Manholes lined in their entirety may be vacuum tested. All pipes entering the manhole should be plugged, taking care to securely place the plug from being drawn into the manhole. The test head shall be placed and the seal inflated in accordance with the manufacturer's recommendations. A vacuum pump of ten (10) inches of mercury shall be drawn and the vacuum pump shut off. With the valves closed, the time shall be measured for the vacuum to drop to nine (9) inches. Following are minimum allowable test times for manhole acceptance at the specified vacuum drop:

DEPTH (FEET)	TIME (SECONDS)		
	<u>48" diameter</u>	<u>60" diameter</u>	<u>72" diameter</u>
4	10	13	16
8	20	26	33
12	30	39	49
16	40	52	67
20	50	65	81
24	59	78	97

Add for 2ft. more depth: 5 6.66 8

Note: These numbers have been taken from ASTM C 1244-93 (reapproved 2000).

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If the manhole fails the initial test, repairs and adjustments necessary due to extenuating circumstances (i.e. pipe joint, liner, plug sealing) should be made. Retesting shall proceed until a satisfactory test is obtained.

Manhole Testing - Type B: Manholes lined in their entirety (including invert) may be subjected to an exfiltration test. Incoming and outgoing sewer and service lines shall be plugged, the plugs restrained and the manhole filled with water to the top of the manhole frame. A soaking period of up to 1 hour will be allowed if bypassing of the sewage is not required or has been provided for. At the end of this optional soaking period, the manhole shall be refilled with water and the test begun. If the water loss exceeds that shown in the following table, the manhole will have failed the test. Repairs and adjustments necessary due to extenuating circumstances (i.e. pipe joint, liner, plug sealing) should be made. Retesting shall proceed until a satisfactory test is obtained. Maximum Allowable Loss is determined assuming a standard 4-foot diameter manhole.

<u>Depth of Manhole</u>	<u>Maximum Allowable Loss</u>
Under 8 feet deep	1 inch in 5 minutes
Over 8 feet deep	1/8" per foot of depth in 5 minutes

- E. A final visual inspection shall be made by the Inspector and Applicator. Any deficiencies in the finished coating shall be marked and repaired according to the procedures set forth herein by Applicator.
- F. The municipal sewer system may be put back into non-severe operational service as soon as the final inspection has taken place. However, for severe corrosion duty such as high concentrations of acids, bases or solvents, 3 to 7 days and/or force cure by heat induction to the coated surfaces may be necessary prior to returning to service. Consult coating manufacturer for further details.

PART 4-PAYMENT

4.0 Unit price shall be per vertical foot of line item as installed. The unit price shall include all incidentals such as bypass pumping, mobilization and demobilization, and sample testing in the line item vertical foot price.

END OF SECTION