

**LEE COUNTY, FLORIDA
TECHNICAL SPECIFICATIONS
FOR
STORM WATER DRAINAGE PIPE LINING
Attachment A**

LINE CLEANING & VIDEO INSPECTION

The Contractor shall furnish all labor, materials, equipment and tools necessary for high-pressure cleaning and vacuum cleaning solids from storm water & sanitary sewer lines and the accompanying closed circuit TV inspection system.

Cleaning refers to the removal of enough material to ensure that at least ninety-five (95%) of the pipe capacity is restored. The Cleaning might include the removal of larger objects such as masonry pieces, calcite/concrete deposits, roots, trash or any other piece of debris.

This item will be billed, at a minimum in 10 foot increments. The Contractor will provide certification that at least ninety-five percent (95%) of the pipe capacity is restored. Video inspection may be requested by Project Manager.

1. EXECUTION

- A. Cleaning of Storm Sewer: The Contractor shall clear storm sewers of all debris, roots and other foreign materials.
- B. Television Inspection: The Contractor shall inspect sewer sections with a video recording device which is capable of recording all locations where obstructions occur. All obstructions shall be called to the attention of the County Project Manager to determine the method for their removal.
- C. Deliverables: After the storm sewer line cleaning is completed, the Contractor shall provide the County with video CD showing the completed work. **NO INVOICE SHALL BE APPROVED FOR PAYMENT WITHOUT THE ACCOMPANYING VIDEO CD.**

2. TELEVISION INSPECTION

The Contractor shall adhere to a system of classifying and coding sewer defects. At a minimum, the Contractor shall code the following descriptions and a copy of the applicable code shall be furnished to the County with each video.

- A. Root intrusion at joints or cracks in the mainline and at lateral connections. Root mass is 50% or greater of the pipe diameter (each) R2-5 code is used when 50% of pipe diameter is filled with roots.
- B. Flow observed entering from a joint (each).

- C. Flow observed entering from a crack (each).
- D. Flow observed entering from a root intrusion (each).
- E. Sag in the line, minor: sag is less than one-half of the pipe diameter in depth (feet).
- F. Sag in the line severe: sag is greater than one-half of the pipe diameter in depth (feet).
- G. Pipe deflection or pipes out of round, severe: major pipe wall deflection noticed and the pipe wall appears to be in near state of collapse (each).
- H. Broken Pipe: broken pipe that has obvious outward or inward deflection of the pipe wall from cracks (each).
- I. Collapsed Pipe: pipe fragments missing out of pipe wall and the original pipe will still exist (feet).
- J. Crushed Pipe: pipe is crushed and the original shape of the pipe has been destroyed and the void filled (feet)

RICIPP

MATERIALS

1. The RICIPP shall be fabricated to a size that when installed will fit the internal circumference of the conduit specified. Allowance shall be made for circumference/radial stretching during insertion.
2. The finished RICIPP shall be fabricated from materials which, when cured, will be chemically resistant to withstand internal exposure to contaminants associated with storm water.
3. The outside layer of the tube (before inversion) shall be plastic coated with a transparent flexible material that is compatible with the resin system used. The plastic coating shall not be subject to delaminating in the cured pipe.
4. The tube shall contain no intermediate or encapsulated layers. No materials shall be included in the tubes that are subject to delaminating in the cured pipe.
5. The wall color of the interior pipe surface of the RICIPP after installation shall be a light reflective color so that a clear detail examination with closed circuit television inspection equipment may be made.
6. The resin system shall be a corrosion resistant polyester resin modified to contain no fumed silica, fillers or solid theology modifying agents, with a suitable catalyst system and thickening agent that when properly cured within the tube composites meets the requirements of American Society for Testing and Materials (ASTM) F-1216 and other requirements of this specification. The resin manufacturer shall certify that the resin described above will have viscosity 1.5 million centipoises or greater when installed or the manufacturer shall certify that the resin will not drain from slugs and mix with water.
7. Hydraulic capacity calculations shall support the CIPP requirement for 100% of the full flow capacity of the original pipe as installed.
8. The bidder shall submit liner thickness calculations to the County Project Manager for review to be signed and sealed by a professional Engineer in the State of Florida. The RICIPP shall be designed in accordance with the applicable provisions of ASTM F1216 and shall meet the following design conditions:
 - a. AASHTO H-20 Live Load with two trucks passing for RICIPP in streets.

- b. A solid modulus of elasticity of 700 psi shall be used. A soil weight 120 lbs. per cubic foot and a coefficient of friction of $K_u = 0.130r$ shall be used for the installed depths.
 - c. The long-term flexural modulus used in the design calculations shall be estimated by multiplying the lowest short-term flexural modulus specified in the ASTM standards by a retention factor of 0.50.
 - d. Safety factor of 2.0 shall be used.
 - e. Groundwater levels shall be estimated to be at the ground surface.
 - f. Service temperature range shall be 40 to 140 degrees F.
 - g. Maximum long-term deflection shall be 5%.
9. The minimum length shall be that deemed necessary to effectively span the footage that is requiring repair.

STRUCTURAL REQUIREMENTS

- A. The RICPP shall be designed per ASTM-1216 with the following additional requirements:
- 1. The design shall assume no bonding to the original pipe wall.
 - 2. External hydraulic design based on acceptable third party testing and verification of the enhancement factor, K, shall be submitted for review.
 - 3. The bond between the RICIPP layers shall be strong and uniform. All layers, after cure, shall form one homogeneous structural pipe wall with no part of the tube left unsaturated.
 - 4. The cured pipe material (RICIPP) shall conform to the following structural properties:

| <u>Property Results</u> | <u>Test Method</u> | <u>Minimum Test Result</u> |
|--------------------------------|---------------------------|-----------------------------------|
| Modulus of Elasticity | ASTM D-790 | 250,000 psi |
| Flexural Strength | ASTM D-790 | 4,500 psi |

- 5. Design parameters shall be in accordance with ASTM F-1216. Design parameters shall be for a fully deteriorated pipe with a long term flexural modulus of 50% of the short –term modulus and the design safety factor for two (2) remaining unchanged.
- B. If required by the County, RICIPP field tube samples shall be cured in the hot water contained in the inversion column contained within steel plates and Mylar sheeting. These sample pieces shall be at least 20” in length with enough width for a test laboratory to run a minimum of three samples from each specimen. A testing laboratory acceptable to the County shall produce the tests, noting thickness and enough strength as specified without a laboratory post cure. Post cure shall be accomplished in the initial in-ground curing cycle.

EXECUTION

Prior to Liner Installation:

- 1. Cleaning of the lines: It shall be the responsibility of the contractor to remove all internal debris/sediments from the lines, unless the contractor is directed otherwise by the County Project Manager. The Contractor shall clear the line of obstruction such as solids, dropped joints or collapsed pipe that will prevent the insertion of RICIPP.

2. Television Inspection: The Contractor shall perform video inspection of pipelines prior to lining. The interior of the pipeline shall be carefully inspected to determine the location of any conditions, which may prevent proper installation of the RICIPP into the pipelines and it shall be noted so that these conditions can be corrected. Video CD and a suitable log of inspection shall be provided to the County Project Manager.

INSTALLATION

- A. The method of installation of the RICIPP shall be in accordance with design criteria supplied by the manufacturer and approved by the County Project Manager or designee.
- B. The finished RICIPP shall be continuous over the entire length of the repair and be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes and delaminating.
- C. The County shall locate and designate all manhole access points for the work and provide rights of access to these points.
- D. The pipeline to be rehabilitated with the RICIPP liner shall be rendered free of accumulated debris. If cleaning of the pipe is required, the County shall provide a location for disposal. Any hazardous waste material encountered during this contract shall be considered as a changed condition.
- E. The Contractor, when required, shall provide for the flow around or through the section or sections of pipe designated for RICIPP rehabilitation. Plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system shall make a bypass. The primary pump, standby pump and the piping shall be of adequate capacity and size to handle the maximum flow experienced in the line. The Contractor shall be responsible for the continuity of the system during the execution of the work of any resulting contract. In the event that backup occurs, the Contractor shall be responsible for cleanup, repair and property damage costs and claims.
- F. The pipe to be RICIPP lined shall be video inspected. The inspection shall verify that the pipe is ready to be lined and a copy of the CD of the pipe condition shall be retained for review and given to the County. If any condition is found to exist that prevents the lining of the pipe, or that can't be removed with conventional line cleaning equipment, the contractor shall notify the County of the condition and review the CD with the County Project Manager. If an excavated point repair is necessary the County shall make the appropriate repair or the County shall issue written authorization to the contractor to make the necessary repairs and the work shall be paid for as a separate item.
- G. Resin Impregnation: The quality of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube assuring no resin loss through cracks and irregularities in the original pipe wall with viscosity control. A vacuum impregnation process shall be used. A roller system shall be used to uniformly distribute the resin throughout the tube.
- H. Thermocouples shall be placed between the RICIPP tube and the existing pipe wall at the inversion and discharge locations to monitor the liner temperature. Readings shall be entered on logs that are submitted to the County at the end of each lining. For every five installations, the County Project Manager or designee shall perform a miscibility test demonstrating that water will not mix with the resin system.
- I. A Contractor's representative shall remove a small amount of catalyzed resin from the saturated liner, when requested and in the presence of the County Project Manager prior to inversion. The material shall exhibit the characteristic of an elastic gel. A water mix test shall be performed on site, catalyzed resin shall be placed in a jar and equal amounts of water added, the jar sealed and

shaken vigorously. The material shall not mix or form an emulsion. If the resin material mixes, the saturated liner tube shall be rejected and shall be removed from the site. The rejected liner shall be disposed of in accordance with Federal, State and Local requirements. A pre-liner shall be required and the thickness of the entire circumference of the line shall have to meet or exceed the minimum thickness required by the County.

- J. At the County's request, no more than five(5) times per 10 inversions, a video camera shall be inserted into the pipe to be lined and positioned within one to two(1 – 2) feet of the inverting tube in the presence of the County Project Manager. The County Project Manager shall view the inversion of the tube from the video monitor in the Contractor's CCTV truck. If resin discharge from the tube is observed the Contractor shall immediately stop the inversion and remove the tube from the pipe. The rejected liner shall be removed from the site and disposed of in accordance with Federal, State and local requirements.
- K. Reforming: After insertion is completed, the contractor shall supply a suitable heat source. The equipment shall be capable of delivering hot fluids throughout the section to uniformly raise the temperature of the liner mass to the temperature required to cure the liner. The heat source shall be fitted with monitors to gauge the temperature and pressure of the fluid injected.
- L. Cool down shall be accomplished by the introduction of cool water and air or another approved method.
- M. During the warranty period, any defects that will affect the integrity or strength of the liner shall be repaired at the Contractor's expense in a manner mutually agreed upon by the County and the Contractor.

SEALING RICIPP AT MANHOLES/INLETS

- A. Leakage testing of the pipe shall be accomplished during the cure while under positive head.
- B. If the RICIPP fails to make a leak tight seal, the Contractor shall apply a sealing material at that point. The seal shall be of a resin mixture compatible with the RICIPP.
- C. There shall be no visible leaks in the completed system. During the warranty period, any defects that will affect the integrity or strength of the RICIPP or any visible leaks shall be repaired at the Contractor's expense.

INSPECTION

- A. The contractor shall inspect all piping to ensure that the RICIPP is free from defects in materials and workmanship.
- B. A video CD shall be provided to the County showing the completed work. The video CD shall include the pre-installation footage, the inversion/installation footage (when required) and the post-installation footage. NO INVOICE SHALL BE APPROVED FOR PAYMENT WITHOUT ACCOMPANYING VIDEO.
- C. RICIPP samples shall meet or exceed the specified structural properties of:

| <u>Property Results</u> | <u>Test Method</u> | <u>Minimum Test Result</u> |
|-------------------------|--------------------|----------------------------|
| Modulus of Elasticity | ASTM D-790 | 250,000 psi |
| Flexural Strength | ASTM D-790 | 4,500 psi |

- D. Visual inspection of wet out facility and process parameters noted/ inspected (i.e. gap setting).
- E. Visual inspection of the RICIPP shall be in accordance with ASTM F-1216.
- F. At least one (1) Miscibility Test shall be performed on-site for each five installations.
- G. No payments shall be made for rejected liner tubes not meeting these specification requirements, including testing.

CHEMICAL THICKENED SYSTEM MISCIBILITY GUIDELINES

- A. The purpose shall be to define properties that the resin//resin-impregnated flexible tube must have to perform effectively and consistently in all field conditions.
- B. All resin/resin-impregnated flexible tube materials used shall have the following properties (greater than 1.5 million centipoises):
 - 1. Must react/perform in the presence of water.
 - 2. Must withstand submergence in water without degradation (pre-cure and post-cure).
 - 3. Must prevent the passage of water through the pipe joint (infiltration).
 - 4. Must stay at a constant viscosity during reaction period.
 - 5. Must stay in the confines of the host pipe being rehabilitated.
 - 6. Must not produce slugs that require excavation.
 - 7. Shall meet liner thickness per contract/design specifications (0% to +10%) measured eight times around the perimeter.
 - 8. Residual must not impede on downstream lines or water tables.

MISCIBILITY TEST PROCEDURE

- A. Resin + Chemical Thickener + premixed at wet-out facility. Test tube/glass-pint jars shall be filled half full with material. When mixed in the proper proportions and stored at temperatures above 40 degrees F, thickening shall be complete in 18 – 24 hours. Once thickening is complete invert test /tube/jar: non-flowing, the container shall be filled with water. The lid shall be replaced and the contents shall be mixed by shaking, Resin system shall be immiscible.
- B. Resin + Chemical Thickener. Mix a 50/50 by volume, mixture of resin + thickener in a glass test tube/glass jar. The mixture shall thicken to 1.5mm cps in short time (approximately 15 minutes). Once thickening is complete (invert test tube /jar: non-flowing) fill the container full with water, replace lid/seal top and mix by shaking. Resin system shall be immiscible.

All samples/waste shall be disposed of properly and in accordance with Federal, State and Local requirements. For a more scientific approach – quantifying rate of thickening, see Time-Test Viscosity Method(ASTM D – 1545).

SLIP-LINING

MATERIALS

- ~~A. The liner pipe shall be fabricated from materials which are chemically resistant to withstand internal exposure to stormwater.~~
- ~~B. The following material is approved for installation in lines:

The liner pipe and fittings shall be manufactured from polyethylene, high density polyethylene, polyvinyl chloride, fiberglass, steel, or aluminum pipe. The outside diameter shall be fabricated to a size that when installed will neatly fit the internal circumference of the conduit. The outside diameter of the liner shall be at least equal, preferably larger, than the inside diameter of the conduit. Allowance shall be made for misaligned and missing conduit. The standard dimension ration (SDR) of the liner pipe shall be based on the evaluation of the design considerations.~~
- ~~C. These considerations normally include an evaluation of:
 - 1. Flow capacity
 - 2. External loads (hydrostatic pressure and/or static and dynamic earth loads)
 - 3. Internal pressure, if applicable. The Contractor shall recommend liner SDR based on an evaluation~~
- ~~D. The contractor shall determine the minimum length for each section to provide at least two (2) feet excess at both ends of the liner pipe section to be processed. The Contractor shall verify the lengths in the field before insertion. Individual insertion runs can be made over one or more manhole sections as determined in the field by the Contractor and approved by the County Project Manager.~~