

SECTION F1

SEWER AND DRAIN PIPE LINING (NON-MAN ENTRY)

GENERAL

This section describes requirements for furnishing all labor, materials, transportation, and equipment necessary for the rehabilitation of existing deteriorated sewers and drains as listed in contract documents by means of the installation of cured-in-place pipe (CIPP) or "fold and form" pipe lining; thus rendering each unit free of infiltration/inflow and structural defects. Liners, including all thermosetting liners, must take the shape of the existing pipe after installation and shall not leave a gap or annular space between the liner and the pipe. The pipe rehabilitation method shall not require excavation for installation of the liner or to re-open existing service connections. Cured-in-place liners and fold and form liners shall be cured using hot water, steam or ultra violet light.

THE CONTRACTOR SHALL REFER TO THE SPECIAL CONDITIONS SECTION OF THESE SPECIFICATIONS FOR THE SPECIFIC REQUIREMENTS AND RESTRICTIONS IMPOSED BY THIS PROJECT CONCERNING THE APPLICABLE REHABILITATION TECHNIQUES TO BE CONSIDERED.

REFERENCES

The tube material, resin system and all other materials and installation procedures shall conform to the following documents as applicable:

ASTM F-1216 Standard Practice for the Installation of Cured-in-Place Pipe (CIPP) by Inversion Lining.

ASTM F-1743 Rehabilitation of existing pipelines and conduits by pulled-in-place installation of cured-in-place thermo-setting resin pipe.

ASTM F-1867 Standard Practice for Installation of Folded/Formed Poly (Vinyl Chloride) (PVC) Pipe Type A for Existing Sewer and Conduit Rehabilitation.

ASTM F-1871 Standard Specification for Folded/Formed Poly (Vinyl Chloride) Pipe Type A for Existing Sewer and Conduit Rehabilitation.

MATERIALS

All materials used in the liner installation shall be industry-accepted materials for sewer/drain pipe rehabilitation and to the satisfaction of the Engineer. Liners for cured-in-place pipe shall be felt or fiberglass based or fiberglass based for ultra-violet curing. The lining shall be chemically resistant to internal exposure to sewage containing gases at normal levels for domestic sewage of hydrogen sulfide, carbon monoxide, carbon dioxide, methane, dilute sulfuric acid, external exposure to soil bacteria and any other chemical attack which may be due to materials in the surrounding ground.

The lining shall be continuous over the entire length between adjacent manholes and free from visual defects such as foreign inclusions, dry spots, air bubbles, pinholes, pimples, wrinkles and delamination. The lining shall be impervious and free of any leakage from the surrounding ground or from the ground to the inside of the rehabilitated pipe. Connections to manholes shall be water-tight. Any defects which will affect, in the foreseeable future as determined by the Engineer, the integrity or strength of the lining, shall be repaired or the lining replaced at the Contractor's expense and to the satisfaction of the Engineer.

REQUIRED SUBMITTALS AND CALCULATIONS

THE FOLLOWING MUST BE PROVIDED PRIOR TO AWARD OF THIS CONTRACT:

1. A statement containing the lining contractor's name, address, and years of experience in installing the type of lining proposed, and at least three references relating to the lining projects of the same type being proposed here.
2. A statement identifying the rehabilitation process/product by trade name as well as by the industry known generic name. This statement shall include a brief description of the material composition, physical properties, and manufacturer's recommendation for handling, storing and repair of pipe and fittings, as well as the process used to install and cure the liner.

3. A certification that the Contractor is an approved licensed installer of the rehabilitation method.
4. A letter of certification from the liner manufacturer in which all physical and chemical properties of the material to be used shall be certified. These properties shall at least include the following:

Instantaneous Tensile Strength (yield) psi
Long Term* Tensile Strength (yield) psi

Instantaneous Tensile Strength (break) psi
Long Term* Tensile Strength (break) psi

Instantaneous Flexural Modulus psi
Long Term* Flexural Modulus** psi

- * Long Term is defined as 50-yr. loadings
** Long Term Flexural Modulus is defined as smaller of creep modulus or continuous loading modulus of elasticity (50 year).
5. Name and address of the resin manufacturer. List of proposed resins, along with all applicable MSDS, curing schedule and temperature.
 6. Submit an Emergency Response Plan in the event of a Sewer System Overflow onto public or private property or a resin spill.

The following must be submitted at the Pre-Construction meeting:

1. Detailed design calculations, including assumptions upon which the calculations are based. The calculations shall consider traffic loading; earth loads, hydrostatic loads, and shall be based on a long-term basis and shall include applicable technical data sheets. It shall be assumed that the existing conduit will contribute no appreciable strength to the completed lining. These calculations must be stamped by a Registered Professional Engineer in Massachusetts.
2. The selected "liner pipe" shall be designed based upon the following applicable criteria:
 - a. The dead load and live loads for the actual depth of cover.

- b. Saturated soil conditions using a soil weight of 120 pounds per cubic foot and a coefficient of friction $Ku^1=0.130$.
 - c. Groundwater levels above the top of the pipe equal to actual conditions or stated conditions as indicated in the contract documents. Otherwise, it shall be to a height of 1/2 of the height distance from the crown of the pipe to the street or surface grade.
 - d. Loss of hydraulic capacity shall not exceed 10%.
- 3. For Fold and Form type liners: the type of seal to be used At the manhole entry point.
 - 4. The manufacturer's heating requirements and curing guidelines.

The following criteria are required for all liners:

1.) Cured-in Place Liners

The following standards are required by BWSC. All CIPP liners shall be manufactured and installed in accordance with ASTM F1216, latest version or ASTM F 1743 latest version:

Tensile Strength	3,000 Psi (ASTM D638)
Flexural Stress	4,500 Psi (ASTM D790)
Modulus of Elasticity	250,000 Psi, (ASTM D790)

2.) Fold and Form Liners

	Materials	Criteria	Standard
A)	Polyvinylchloride (PVC) ASTM D-1784	Tensile Strength psi (ASTM D638)	3,500
B)	High Density Polyethylene (HDPE) ASTM D-1248	Flexure Stress psi (ASTM D790)	4,100
		Flexural Modulus Psi (ASTM D790)	135,000

At the pre-construction meeting, the Contractor shall submit detailed design calculations of the liner including liner material, sizes of material, specification of materials, shop drawings including any special methods or procedures or any other information deemed necessary by the Engineer. Liners shall be designed in accordance with ASTM F1216 for fully deteriorated pipe.

TUBE SECTIONS

Acceptable Materials

- a. Fiberglass (cured with ultra-violet light)
- b. Felt (cured with hot water)

Tube Characteristics & Standards

At the time of manufacture, each lot of glass fiber or felt tube liner shall be inspected for defects and tested in accordance with applicable ASTM standards. At the time of delivery, the liner shall be homogeneous throughout, uniform in color, free of cracks, holes, foreign materials, blisters, and deleterious faults.

For testing purposes, a production lot shall consist of all liner having the same marking number. It shall include any and all items produced during any given work shift and must

be so identified as opposed to previous or future production.

The ENGINEER may at any time direct the manufacturer to obtain compound samples and prepare test specimens in accordance with applicable ASTM standards.

An "inner liner" and "outer liner" film must be used for resin control (to prevent resin migration and contamination). The "inner film" and "outer film" must both be certified styrene gas barriers. The "inner liner" film must be removed during the installation process unless it is a permanent part of the system and is made an integral part of the carrier tube by bonding or fusing to the carrier tube.

The material shall be manufactured in such a manner as to result in a tight-fitting, continuous liner after installation.

No "over the hole" or "on-site" wet-out is allowed without prior permission from the Engineer. For products that are cured with hot water, the wet-out must be conducted within 300 miles of the job site considering the time-sensitive characteristics of thermal-cured products.

Fiberglass Tube (Ultraviolet Light Curing Application)

The tube shall be fiberglass including an exterior and interior film that protects and contains the resin used in the liner. The exterior film shall be provided with a UV light blocker foil.

1. Tube

- a. The Tube shall be fiberglass and be using a seam, stitched seam, stitch free overlap or seamless spirally wound. The tube shall be constructed to withstand installation pressures and have sufficient strength to bridge missing pipe sections and holes.
- b. The impregnated Tube shall have a uniform thickness, that when compressed at installation pressures will meet or exceed the Design thickness. If voids are present in the host

pipe, the design wall thickness must still be met or exceeded.

- c. The tube shall be sized such that when installed, it will tightly fit the internal circumference and length of the original pipe.
- d. The glass fiber tube shall be saturated with the appropriate resin using a resin bath or vacuum suction impregnation. An inner and outer material shall be added that are both impervious to airborne styrene, with the outer material also having UV blocking characteristics. The inner membrane shall be removed after the installation and curing processes are completed.
- e. The wall color of the interior pipe surface of CIPP after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made.
- f. The manufacturer shall test the raw materials and liner materials at various stages of manufacturing on every liner, including taking samples of every finished liner and conducting tests for e-modulus, tensile, wall thickness and porosity.
- g. Fiberglass materials shall be "direct sized" to enhance the fiberglass/resin bond. Certification of this coating and its compatibility with the resin system used is required.
- h. Liner to manhole connection shall be made water-tight. The method used by the Contractor to seal the connection shall be submitted to the Engineer for approval.

Felt Tube (Hot Water Curing Application)

The Tube shall consist of one or more layers of absorbent felt fabric and meet the requirements of ASTM F1216 or ASTM F1743, Section 5.

- 1. Tube:

- a. For work performed under this specification, the following felt-based carrier tube materials shall be used: Non-woven polyester felt and Non-woven fiberglass filament reinforced polyester felt.
- b. The tube shall be constructed to withstand installation pressures and have sufficient strength to bridge missing pipe while meeting or exceeding the design wall thickness at all pipe locations during installation conditions and pressures.
- c. The tube shall be sized such that when installed will tightly fit the internal circumference and length of the original pipe. Overlapped layers of felt in longitudinal seams that cause lumps in the final product shall not be utilized.
- d. The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated electrometric layers. No material shall be included in the tube that may cause delaminating in the cured liner (CIPP). No dry or unsaturated layers shall be evident.
- e. The wall color of the interior pipe surface of CIPP after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment shall be made.
- f. Seams in the felt tube shall be allowed, but the seams must be stronger than the non-seamed felt. Third-party test data documenting the strength of the seam is required.
- g. The manufacturer shall test the raw materials and liner materials at various stages of manufacturing on every liner, including taking samples of every finished liner and conducting tests for e-modulus, tensile, wall thickness and porosity.
- h. The outside of the tube shall be marked for distance at regular intervals along its entire length, not to exceed 5 ft. Such markings shall

include the Manufacturers name or identifying symbol.

CONSTRUCTION METHODS

GENERAL

The liner shall be fabricated to a size that when installed will neatly fit the internal circumference of the conduit to be rehabilitated as specified by the Engineer. The Contractor shall make allowance for any longitudinal or circumferential stretching of the liner during installation. The length of the liner shall be that deemed necessary by the Contractor to efficiently carry out the lining process at the inlet and outlet of the respective manholes. The Contractor is responsible for verifying all lengths, exact pipe dimensions and sizes in the field before installation. Individual liner runs may be made over manhole to manhole sections as determined in the field by the Contractor and approved by the Engineer. The pipe sizes indicated on the contract documents are normal pipe sizes. The Contractor shall be solely responsible for determining all sizes; shapes, lengths and all other information needed to fabricate the liner. No Additional Payment Shall Be Made if the Engineer deems removal of the liner necessary or if the liner is unable to be installed due to incorrect sizing by the Contractor.

SAFETY

The Contractor shall carry out his operations in strict accordance with all OSHA and manufacturer's safety requirements.

HOUSEKEEPING

Containment of sewage and site cleanliness is the responsibility of the Contractor. Fines levied by State and Federal agencies in the event of a spill or unapproved discharge shall be the responsibility of the Contractor. Spill cleanup as well as site cleanup shall be conducted by and paid for by the Contractor. All cleanup and associated costs are part of acceptance of the project, without which final payment will not be made.

PREINSTALLATION

The following procedures prior to lining shall be adhered to according to the lining method submitted or as deemed necessary by the Engineer:

- a) Cleaning of Sewer Line: Prior to lining, it shall be the responsibility of the Contractor to clean debris out of the pipe in order to install the liner.
- b) Inspection of Pipelines: The Contractor shall inspect by closed circuit TV, the section to be rehabilitated. Inspection of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles and service connections by closed circuit television. The interior of the pipeline shall be carefully inspected to determine the location of any conditions, which may prevent proper installation, and it shall be noted so that these conditions can be corrected. The inspection log shall note the precise location of all services. The Boston Water and Sewer Commission shall receive a video inspection, per Section TV1, and suitable log for later reference. In some instances it is unclear whether a service connection is active. The Contractor will be responsible for dye testing services to determine whether they are active. There is no additional payment associated with dye testing of services.
- c) Sewage Flow Control: The Contractor shall bypass the flow around the sections of pipe to be lined or as deemed necessary by the Engineer. A line plug shall be inserted into the pipe upstream of the section to be lined. The plug shall be so designed that all or any portion of the sewage can be released. After the work has been completed, flow shall be restored to normal. The by-pass shall be made by plugging an existing upstream manhole if necessary and pumping the sewage into a downstream manhole or adjacent system. When pumping and bypassing is required, the Contractor shall supply the pumps, conduits, and other equipment to divert the flow of sewage around the manhole section in which work is to be performed. The by-pass system shall

be of sufficient capacity to handle existing flow plus additional flow that may occur.

The Contractor will be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and by-pass system. If pumping is required on a 24-hour basis, engines shall be equipped in a manner to keep noise to levels below or equal to those required by the City of Boston Environment Department. All bypass systems shall be approved by the Engineer. Approval of the by-pass system by the Engineer shall in no way be construed as relieving the Contractor of any responsibility under this Contract as related to protection of the interest of the Boston Water and Sewer Commission and the general public.

At the end of each working day, temporary tie-ins shall be made between the rehabilitated section and the existing system and the by-pass plug removed, unless the temporary system is to remain in place as approved by the Engineer.

When flow in a sewer line is plugged, blocked, or bypassed, sufficient precautions must be taken to protect the sewer lines from damage that might result from sewer surcharging. Further, precautions must be taken to insure that sewer flow control operations do not cause flooding or damage to public or private property being served by the sewers involved.

Under no circumstances will the dumping of raw sewage on private property or in city streets be allowed.

Unless an item for bypass pumping is included in the specifications, all costs associated with flow control except for the cleaning and video inspection shall be incidental to the pipe lining and no separate payment shall be due.

- d) Line Obstructions: It shall be the responsibility of the Contractor to clean the line of any obstructions, solids, protruding services, hanging gaskets or collapsed pipe that will prevent the installation of the liner to the satisfaction of the Engineer. If pre-construction inspection reveals an obstruction, such as a badly mis-aligned joint, then the Contractor shall make a point repair excavation to uncover and remove or

repair the obstruction. Such excavations shall be approved in writing by the Engineer prior to the commencement of the work and shall be considered as a separate pay item under Point Repairs.

Protruding laterals shall be ground down to the face of the pipe to allow for a tight fitting liner. Payment for removal of protruding laterals will be made under payment item F1-3.

INSTALLATION

Tube Insertion (for fiberglass/UV cured products)

A slip sheet shall be installed on the bottom half of the pipe prior to liner insertion, for the purpose of smoothing out the bottom of the liner to increase flow characteristics.

The lining tube, or outer film, must be inserted into the pipe prior to inserting the liner, unless it is manufactured on the exterior of the liner, which is a normal characteristic of most fiberglass CIPP liners.

A constant tension winch should be used to pull the glass fiber liner into position in the pipe. Once inserted, end plugs shall be used to cap each end of the glass fiber liner to prepare for pressurizing the liner. The end plugs shall be secured with straps to prevent them from being expelled due to pressure. Liner restraints should be used in manholes.

The glass fiber liner shall be cured with UV light sources at a constant inner pressure. When inserting the curing equipment in the liner, care should be taken to not damage the inner film material.

The UV light sources shall be assembled according to the manufacturer's specifications for the liner diameter. For the liner to achieve the required water tightness and specified mechanical properties, the following parameters must be controlled during the entire curing process, giving the Engineer a record of the curing parameters over every segment of the entire length of the liner. This demonstrates that the entire liner is cured properly. The recording shall include:

- Curing speed

- Light source working & wattage
- Inner air pressure
- Exothermic (curing) temperatures
- Date and time
- Length of liner

This shall be accomplished using a computer and data base that are tamper proof. During the curing process, infrared sensors will be used to record curing data that will be submitted to the Engineer with a post CCTV inspection to the BWSC CCTV_Upload Sharepoint website.

The parameters for curing speed, inner air pressure and wattage are defined in the Quality Tracker UV curing protocol issued by the manufacturer. The optimal curing speed, or travel speed of the energized UV light sources, is determined for each length of liner based on liner diameter, liner thickness, and exothermic reaction temperature.

The inner film material should be removed and discarded after curing to provide optimal quality of the final product.

Flushing of the cured fiberglass/UV cured CIPP liner (to reduce styrene residual) is required for fiberglass/UV cured CIPP products.

Tube Insertion/Inversion (for felt/hot water cured products)

The resin impregnated tube shall be transported and stored in a refrigerated truck until it is installed in an existing pipe by using an application of water, air, or cable and winch to properly place the tube between the upstream and downstream manholes.

The preline's tube, or outer film, shall be inserted into the pipe prior to inserting the liner.

The wet out felt tube shall be inserted, or inverted, through an existing manhole or other approved access. Liner installation head pressures as provided by the manufacturer (minimum and maximum for hot and cold conditions) shall not be exceeded, regardless of which

method of installation (stand pipe, pressure unit, etc.) is used.

Using the "Inversion Procedure", the tube end shall initially be turned inside out and attached to a platform ring, standpipe, or as approved. The addition of water will be adjusted to sufficient height/pressure to cause the impregnated tube to invert from manhole to manhole, and hold the tube tight against the existing pipe wall.

Using the "Insertion Procedure", the tube is winched into position according to manufacturer's recommendations. The addition of water will be adjusted to sufficient height/pressure to cause the calibration hose to invert from manhole to manhole and hold the tube tight against the existing pipe wall.

Liner restraints should be used in manholes.

After the installation of the liner is completed, the Contractor shall use hot water system capable of providing the required amount of heat uniformly throughout the section for a complete cure of the resin. All water obtained from a BWSC fire hydrant shall be metered. An air gap shall be provided between pipes/hoses connected to a fire hydrant and a storage tank/equipment used by the Contractor.

The curing temperature and duration schedule shall be as recommended by the resin/catalyst system manufacturer. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing heat supply. Additionally, the Contractor is required to utilize a remote temperature sensing method to ensure adequate curing for every foot of liner in the pipe, considering the possibility of heat sinks. Temperatures monitored at the manholes do not guarantee an adequate representation of the temperatures for every foot of liner. Temperatures from each remote sensing device shall be recorded by a strip-chart recorder on a continuous video record. Graphs of the video record shall reflect readings from start of cure to completion of cure/draining of line. Video records for each segment shall be submitted upon completion of each section. Initial cure may be considered complete when the remote sensing device(s) reflect that the cure temperatures, as recommended by the resin/catalyst system manufacturer,

have been achieved. Curing temperatures and duration shall comply with submitted data and shall include an adequate "cool down" as recommended by the resin manufacturer.

Cool Down

The Contractor shall cool the hardened liner to a temperature less than 100 degrees Fahrenheit, in accordance with the resin manufacturer's recommendation, before relieving the water column or pressure. Cool water may be added to the water column while maintaining circulation as water is drained from a small hole at the opposite end of the cured-in-place pipe, so that a constant water column height is maintained until cool-down is completed. Care shall be taken in the release of the water column so that a vacuum will not develop that could damage the newly installed liner. Coupon samples shall be obtained for testing (Section 5.0/Testing).

Since styrene is considered a volatile organic compound and a carcinogen, care must be taken to ensure that styrene levels are below U.S.E.P.A. standards for airborne, surface and water contamination. The EPA has set the maximum contaminant level at 0.1 ppb for drinking water and other water sources that impact drinking water. For sanitary sewerage flow to a sewerage treatment plant, styrene contamination must be kept below 2.1 ppm so as to not interfere with the effectiveness of the plant.

If EPA or wastewater treatment levels are exceeded on the surface of the liner for storm water or sanitary sewer pipes (respectively), the Contractor must flush the line until styrene levels in flush-water are brought within the appropriate standard.

The Contractor shall provide whatever measures are required to prevent the movement or discharge of gases, liquids or solids associated with the liner material and process into adjacent buildings upstream or downstream of the sewer/drain being rehabilitated. The Contractor shall be responsible and liable for any damages or violations associated with such actions. The Contractor shall also be responsible for monitoring and protecting as required the discharge of any by products caused by the installation of the liner or the lining process.

Discharge of Curing Water

The discharge of process water from the installation of a cured-in-place pipe (CIPP) liner or Fold and Form (FF) liner into a pipeline as part of a sewer rehabilitation project into the Municipal or MWRA sewerage system is prohibited, unless authorized by the MWRA. Process water discharged from the lining operation into a pipeline must comply with MWRA Sewer Use Regulations, 360 C.M.R. 10.021-10.024, prior to mixing with any other streams. Authorization to discharge wastewater from CIPP liner into a pipeline operation shall be obtained from the Authority at least thirty (30) calendar days prior to beginning the discharge.

The Commission is required to submit the following information to the Authority: scope of the project, materials to be used, equipment necessary, transportation information, handling and disposal methods of the discharge water, estimated amount of water to be used in the curing process, process flow diagram, pretreatment proposed, proposed monitoring procedures, sampling results, construction schedule, and all contractors' names, telephone numbers and addresses.

Prior to the Commission issuing a Notice to Proceed for the contract, the Contractor will be required to meet with the Commission to provide the required information for the MWRA questionnaire.

The Contractor will be required to treat all process water to comply with the MWRA Sewer Use Regulations whether by treatment or off-site disposal. This information is required for submittal to the Commission at the pre-construction conference.

The treatment or disposal of the process water from the lining process is to be included in the unit price cost for the installation of the liner.

Post Installation

For Fold and Form type liners: After installation of the liner a mechanical type sealing device capable of providing a watertight seal shall be installed at the manhole to seal the liner to the manhole wall. Grouting alone is not acceptable. The type of seal

must be submitted as a shop drawing at the preconstruction meeting and approved by the Engineer. All end seals shall be guaranteed leak-proof for 2 years after completion of the entire contract.

For cured-in-place liners the ends shall be sealed using a sealant approved by the Engineer. All end seals shall be guaranteed leak proof for 2 years after the completion of the entire contract.

Liner Samples

The Contractor shall cut out a sample of the completed liner for each pipe section, label the sample and give each sample to the Engineer.

SERVICE CONNECTIONS

After the liner has been completely installed all existing active services shall be reopened. The contractor shall keep precise information from the pre-lining video inspection of the location of all services. The contractor shall review the pre and post construction video inspection to ensure that all services have been opened. All existing inactive services shall not be reopened. The decision not to reconnect an existing service shall be approved by the Commission in writing only after the Engineer oversees and approves TV and dye testing logs.

The Contractor shall be required for a period of two years after the accepted completion of this work, to correct any improperly reopened services or any services which were not reopened.

TESTING

The water tightness of the liner shall be gauged during the installation under a positive head. After the work is completed, the Contractor shall provide the Commission with video record showing the completed work including the restored conditions.

GAS AND ODOR CONTROL

The contractor is responsible for the control of all odors and gases produced as part of the installation and curing of the liner. He is required to have an Emergency Response Plan in place in the event of complaints of styrene gas entering a building

that includes the proper testing equipment and air removal system. The following items shall be addressed by the contractor:

- a) The contractor shall flush out all pipes affected by the work with clean water immediately after the liner is cured.
- b) The contractor shall have at least three 16-inch smoke ejectors available including an external power source.
- c) If a service is being bypassed, then all openings on the service will be plugged during the curing process.

VIDEO RECORDS

After work is completed, the Contractor shall supply the Commission with CCTV video record, per Section TV1, showing the rehabilitated section before and after rehabilitation including the location of all service connections. No payment will be made until review of the video records by the Commission and subsequent acceptance of the liner. Refer to Section TV1 for requirements for all closed-circuit video inspection requirements. Utilization of SCREAM codes as described in TV1 is not required. Use of PACP codes is required.

CERTIFICATION OF MATERIALS

The Contractor shall supply the Engineer with a certified statement from each material supplier that the material supplied meets or exceeds the requirements of these specifications. The certification shall identify by name the project and specification.

The Contractor shall furnish, install and test all materials specifically all liner joints or fittings if necessary in accordance with these specifications.

GUARANTEE

The Contractor and manufacturer shall guarantee all liners installed for a period of three years from the date of acceptance. During this period, all serious defects discovered in the liner as determined by the Engineer, shall be removed and replaced in a satisfactory manner at no cost to the Commission.

televising of the existing sewers and drains. A log will be prepared and submitted to the Engineer verifying the address, station, quadrant location and time of closure and reopening of each connection. Each connection reopened or left closed will be documented in the log form and indicated in the screen of the final video record. No payment will be made for any attempted reconnection not authorized by the Engineer in writing.

The unit price for service and lateral connections reopened shall constitute full compensation for labor, tools and equipment necessary to reopen such connections to the satisfaction of the Engineer.

Item: F1-3 Protruding Lateral Connection
Removal)..... Each

The number of protruding lateral connections which require removal with an appropriate cutter will be the actual number removed and shown in the television inspection video , indicating size, location and time of removal.

The unit price bid for protruding lateral connections shall constitute full compensation for all labor, materials, tools and equipment necessary to remove such connection. The contractor shall request written authorization from the Engineer prior to exceeding the amount specified.

Item: F1-4 Reconnection of Service Connections
(with excavations..... Each

The quantity of service connections and laterals to be paid for under this item shall be the actual quantity excavated and reconnected (reopened) after the liner has been installed in place. The Contractor shall identify all connections to be reopened during his initial cleaning and CCTV inspection of the existing sewers and drains. A log will be prepared and submitted to the Engineer verifying the address, station, quadrant location and time of closure and reopening of each connection. Each connection reopened or left closed will be documented in the log form and indicated in the screen of the final color video inspection. No payment will be made for any attempted reconnection not authorized by the Engineer in writing.

For each connection to the liner, the price shall constitute full compensation for all labor, tools and equipment necessary to excavate access pits to the sewer for lateral connections, including cutting and disposal of pavement, earth excavation to the depth required for the sewer grades indicated on the drawings, furnishing and installing sheeting, dewatering, furnishing, laying and jointing of all pipe and fittings including but not limited to wyes, tees and couplings, reconnecting with new materials in part or in whole, sewer service connections, furnishing and installing screened gravel where required, by-pass pumping of existing flows, furnishing, placing and compacting bank gravel refill and cleaning up the site and all other work necessary to complete this item to the satisfaction of the Engineer.

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