

## **SECTION 02737**

### **CURED-IN-PLACE PIPE (CIPP)**

#### **PART 1 - GENERAL**

##### **1.01 WORK INCLUDED**

###### **A. Scope**

1. This section covers the work necessary to furnish and install, complete in place, a cured-in-place pipe (CIPP) for rehabilitation of existing sanitary sewers as specified herein. The Contractor shall provide all materials, labor, equipment, and services necessary for bypass pumping of sewage flows in mains and services, cleaning and pre-television inspection of sewer to be lined, complete installation, inversion, and curing process of cured-in-place pipe, re-connection of service laterals, pipe sealing at manholes, and final television inspection and testing of the lined pipe sewer system. Cured-in-place pipe shall be as specified herein and installed at the locations shown on the Drawings.

###### **B. Process Description**

1. The rehabilitation of existing sanitary sewer lines by Cured-In-Place process includes reconstruction of the existing lines by forming a new pipe within the existing, structurally deteriorated pipe which has generally maintained its original shape. Installation of the Cured-In-Place Pipe shall be accomplished by the use of an inversion process or a winched-in application. The reconstruction of the existing line shall be accomplished by installing a flexible tube which is first impregnated with a thermosetting resin. The tube is either inverted into the pipeline by using hydrostatic head (water pressure), compressed air pressure or some other approved inversion method, or pulled into the pipeline from manhole to manhole using mechanical equipment (winch). After full insertion, the tube is cured by circulating hot water or introducing controlled air or steam throughout the length of the tube to cure it into a hard, impermeable pipe. This "pipe" shall extend the full length of the original sewer, and shall provide a structurally sound, joint less, tight-fitting, water-tight pipe within a pipe.
2. Cleanup and Restore Existing Surface Condition and structures.
3. Repair Defective Work per Engineer's Final Inspection.
4. The Contractor is responsible for proper and accurate installation of the new sewer pipe regardless of the method described in this section and the following subsections. The Contractor shall ensure that the new pipe's vertical and horizontal alignment is as indicated on the plans and in accordance with these specifications.
5. Supplying all labor, materials, equipment and apparatus not specifically mentioned herewith or noted on the plans, but which are incidental and necessary to complete the work specified.

## **1.02 APPLICABLE PUBLICATION**

- A.** The following documents form a part of these specifications to the extent stated herein and shall be the latest edition thereof. Where differences exist between codes and standards, the one affording the greatest protection shall apply.

American Society for Testing and Materials (ASTM):

ASTM D 256	Standard Test Methods for Impact Resistance of Plastics and Electrical Insulating Materials.
ASTM D 543	Resistance of Plastics to Chemical Reagents.
ASTM D 638	Tensile Properties of Plastics
ASTM D 732	Standard Test Method for Shear Strength of Plastics by Punch Tool.
ASTM D 790	Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
ASTM F 1216	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of Resin-Impregnated Tube (1991 Revision).
ASTM D 2990	Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics.

Federal Water Pollution Control Act of 1972 (FWPCA): As Amended.

National Association of Sewer Service Companies (NASSCO): Recommended Specifications for Sewer Collection System Rehabilitation.

## **1.03 WARRANTY AND QUALITY ASSURANCE**

- A.** General Bid Requirements:

1. The curing and installation methods of the liner shall be described and included with the Bid. The Contractor shall demonstrate that the method is applicable and that his/her experience in using the method is proven.
2. The bidder, or his/her Sub-contractor, shall be properly licensed and trained to a cured-in-place pipe lining process having at least
3. Thirty (30,000) lineal feet of successful installation in the United States within the last 2 years, in pipelines ranging from 4 to 48 inches. Documentation of the licensing and details of two years minimum training of the on-site foreman of the Contractor, or his/her CIPP Sub-contractor, who will perform the actual lining process, shall be provided.

- B.** The Contractor shall provide to the City a warranty to be in force and effect for a period of ONE (1) year from the date of acceptance by the City. The warranty shall cause the Contractor to repair or remove and replace the liner should failure result from faulty materials or installation.
- C.** Correction of failed liner or liner pipe deemed unacceptable, as a result of the post video inspection and/or test reports for structural values, thickness, chemical resistance, etc., shall always be the responsibility of the Contractor, at no extra cost to the City. Method of correction/repair shall be approved by the City with prior field demonstration, if required. It shall be understood that minimum criteria of the specification shall not be lowered to compromise with lower than the required test values, unless approved in writing.
- D.** The finished liner shall be continuous over the entire length of run between two manholes and shall be free from visual defects. The finished liner shall meet or exceed the requirements of Section 2.01-D.2 of this specification, "Finished and Cured Liner Properties."
- E.** Wrinkles in the finished liner pipe which exceed 5% of the pipe diameter are unacceptable; Contractor shall remove either the liner or the wrinkled segments which exceed 5% of the pipe diameter. Repair of the removed sections shall be proposed by the Contractor and approved by the Engineer.
- F.** The Contractor shall carry out the operations in strict accordance with all applicable OSHA regulations. Particular attention is called to those safety requirements involving work on an elevated platform and entry into a confined space.
- G.** Delivery, Storage and Handling

  1. Transport, handle, and store pipe and fittings as recommended by manufacturer.
  2. If pipe and fittings become damaged before or during installation, it shall be repaired as recommended by the manufacturer or replaced as required by the Engineer at the Contractor's expense, before proceeding further.
  3. Deliver, store, and handle other materials as required to prevent damage.
- H.** Only those tools designed for the aforementioned procedures, and approved by the pipe manufacturer or supplier and the ENGINEER, shall be used for assembly of pipe fittings to ensure proper installation.
- I.** The CONTRACTOR shall televise the installed pipe after existing services have been reconnected and manhole work has been completed. The original television inspection video tape shall be provided to the ENGINEER. The CONTRACTOR shall repair all damages found during the reviewing of these final TV inspection video tapes. The damages shall include but not limited to sags, leaks, cracks, unsecure joints, visual defects, and others which in the opinion of the ENGINEER are not acceptable and would impair the serviceability of the new piping system.

#### **1.04 SUBMITTALS**

- A.** The Contractor shall submit for approval by the Engineer the following information:
- B.** Certification by the manufacturer that all pipe and fittings furnished under this specification were manufactured, sampled, tested, and inspected in accordance with ASTM F1216-91. Certification shall be signed by an authorized agent of the manufacturer. Verification of product conformance with the chemical resistance and physical testing requirements of the latest edition of Green Book, Section 210-2.3.3 AND 500-1.4.2 - ASTM test methods D638, D790 and D2990) shall also be provided to the Engineer for approval a minimum of 15 days prior to the commencement of the scheduled work. A report of test results shall be furnished for the Engineer's review. The date the pipe was manufactured shall be included in the Certification.
- C.** Manufacturer's recommendations for the installation of the CIPP including resin application, curing process details (including temperature control), storage procedures, service connection methods, trimming and finishing, and quality control measures to be used for cured-in-place pipe lining of main-lines and services.
- D.** Certification from the Manufacturer(s) that the installer is licensed to perform the work.
- E.** Certification from the manufacturer(s) that the resin material complies with the required application, meets the intended service condition, and that the resin will meet the physical requirements set forth in this specification. Information from the resin manufacturer shall include specifications, characteristics and properties of the resin, methods of application, curing temperatures, and duration of temperature (step cooking temperatures/hours at each and final stages).
- F.** Grout and design mixes and grout testing reports.
- G.** Recommended grout and equipment to seal any open area in the reconnected (cut) service laterals AND the annular space between the cured-in-place pipe and the existing pipe at the manholes.
- H.** Television inspection reports and video tapes made prior to and after pipe insertion. (See Section 02732 for details of submittals).
- I.** The CONTRACTOR shall submit a sewage bypass pumping and/or diversion plan for review by the ENGINEER at least 10 days prior to pipe installation. The sewage bypass pumping and/or diversion plan shall include an emergency response plan to be followed in the event of a failure of the bypass pumping and/or diversion system. The CONTRACTOR shall notify the ENGINEER 24 hours prior to commencing the bypass pumping operation. The CONTRACTOR'S plan for sewage bypass pumping and/or diversion shall be satisfactory to the ENGINEER before the CONTRACTOR shall be allowed to commence sewage bypass pumping and/or diversion.
- J.** The Contractor shall submit to the Engineer a detailed plan of construction including the installation procedures, equipment set-up, and the locations of the proposed access points for approval. The Contractor shall have an approved plan of construction prior to commencing any construction.

## 1.05 JOB CONDITIONS

- A. Note and conform to conditions and requirements indicated and specified under Section 02202 of these Specifications.
- B. Contractor shall conduct operations and schedule cleanup in a manner to cause the least possible obstruction and inconvenience to traffic, pedestrians and to adjacent property owners or tenants.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. The liner pipe material shall be designed for use in gravity sanitary sewers and shall be in strict conformance with all applicable sections of ASTM F1216 specifications. All materials and procedures used in the cured-in-place pipe rehabilitation process shall be equal to or exceed the manufacturer's standards.
- B. **Tube:** The liner tube shall be fabricated to meet performance requirements as specified in section 1.03.04, Finished and Cured Liner Properties, of this specification. Two different types of systems shall be considered for cured-in-place pipe rehabilitation:

#### 1. Fiber Felt Tube System:

- a. The felt tube shall be a thermoplastic polyester or acrylic tube consisting of one or more layers of flexible needled felt or an equivalent woven and/or non-woven material capable of carrying resin, and with sufficient needling and cross lapping and strength to withstand the installation pressures and curing temperatures. The felt tube to be furnished shall be compatible with the resin and catalyst systems to be utilized.
- b. The tube shall be free of tears, holes cuts, foreign materials and other defects and will be subject to inspection by the City.
- c. The finished lining shall consist of inner polyurethane and outer polyester felt layer (or layers) impregnated with a thermosetting resin and fabricated to fit tight against the existing pipe wall. An allowance shall be made for circumferential stretching during inversion.
- d. Contractor shall determine the minimum tube length necessary to effectively span the designated run between manholes, unless otherwise specified. Contractor shall field verify the lengths in the field prior to impregnation of the tube with resin, to insure that the tube will have sufficient length to extend the entire length of run.

**OR**

#### 2. Fiberglass Mat System:

- a. The tube shall be composed of a high strength, fiberglass mat system

capable of retaining resin, contained within a system of polyethylene film. The tube shall have sufficient needling and cross lapping to yield a minimum burst strength of 800 pounds per square inch in transverse directions (hoop stress), and strength to withstand the installation pressures and curing temperatures. The tube shall be free from tears, holes cuts, foreign materials and other defects, and will be subject to inspection by the City.

**C. Resin/Catalyst**

1. The resin used shall be compatible with the rehabilitation process used, and designed for a wastewater environment. The resin shall be able to cure in the presence or absence of water, and the initiation temperature for cure shall be as recommended by the resin manufacturer and approved by the Engineer. The resin shall have sufficient thixotropic properties to obtain non-draining characteristics when impregnated into the fiber fabric.
2. Unless otherwise specified or approved by the Engineer, the resin shall be an epoxy vinyl ester system and shall be able to meet the service conditions specified for the tube system.
3. The Engineer shall also be informed in advance, for verification and inspection of the resin material at the “wet out” of the tube. The inspection shall be at the discretion of the Engineer, which shall not relieve the Contractor of his responsibilities. The wet-out procedure shall utilize the resin and catalyst in sufficient quantities to ensure complete impregnation of the liner and provide the properties specified in Section, Finished and Cured Liner Properties.
4. The catalyst system shall be compatible with the resin and other materials to be utilized in the rehabilitation process. Quantity and type of catalyst shall be selected based on the curing conditions and recommendations of the resin manufacturer.

**D. Liner Design Criteria**

1. The Cured-In-Place Pipe thickness shall be calculated and designed upon the following physical conditions of the existing pipe to be rehabilitated:
  - a. All pipes shall be considered fully deteriorated.
  - b. All pipes shall be subjected to a soil load of 120 lbs./cu. Ft., with applicable live load, and water table two (2) feet below the top of the ground.
  - c. Pipes in good condition shall have a minimum of 2% ovality in the circumference. A higher value of ovality shall be used if the pipe is deteriorated.
  - d. Factor of safety (N) of 2.0 shall be used for calculations.

- e. The Contractor shall measure the inside diameter of the existing pipe in the field so that the liner can be lined in a tight fitted condition.
- f. Conditions (a) and/or (b) above may change after the initial TV report, if approved by the Engineer. The Engineer shall have the right to modify/change the required liner thickness, depending upon field conditions evident from the video tape(s).
- g. **The minimum material wall thickness derived using design criteria for the City shall be equivalent to SDR-34.** The calculated wall thickness derived using the above design criteria shall be compared to the specified (bidded) pipe thickness (SDR-34). The Engineer then has the right to either keep the specified pipe thickness (SDR-34) or change to the calculated pipe thickness for installation. Material cost shall be adjusted accordingly.

2. Finished and Cured Liner Properties

- a. The finished cured-in-place pipe liner shall fit tightly and neatly against the existing pipe walls. The liner shall be fabricated from materials which, when cured, will be suitable for continuous service in sewerage environments containing hydrogen sulfide, carbon monoxide, carbon dioxide, methane, dilute (10%) sulfuric acid at an average wastewater temperature of 80°F, dilute (10%) phosphoric acid, petroleum hydrocarbons, gasoline, vegetable oil, tap water (pH 6.5 - 9), up to 1 hour per day exposure to 5 percent sodium hydroxide up to a pH of 11, moisture saturation, and external exposure to soil bacteria and chemical attack which may be due to materials in the surrounding ground or sewage within.

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The cured-in-place pipe system shall conform to and comply with the requirements above and with the minimum standard physical properties as follows:

<b>STRUCTURAL/ MECHANICAL PROPERTY</b>	<b>ASTM TEST METHOD</b>	<b>ASTM MINIMUM SHORT TERM VALUE</b>	<b>ASTM MINIMUM LONG TERM VALUE</b>
Tensile Strength (@ yield)	D-638	4,000 psi.	
Tensile Modulus	D-638	250,000 psi.	125,000 psi.
Flexural Strength	D-790	5,000 psi.	
Flexural Modulus	D-790	300,000 psi.	150,000 psi.
Shear Strength	D-732	5,5000 psi.	
Impact Strength	D-256	1.9 in. -lb.	

The initial stiffness factor shall conform to the following table:

<b>Nominal ID of Original Pipe (inches)</b>	<b>Stiffness Factor (EI)<sup>1</sup> (in<sup>3</sup>-lbf/in<sup>2</sup>)</b>	<b>Maximum Allowable Depth of Groundwater Above Invert .2 (Feet)</b>
6	328	238
8	328	96
10	328	48
12	328	27
12	1109	96
15	1109	48
18	1109	27
18	2628	67

Stiffness factor shall be determined in accordance with ASTM D2412.

- E.** Liner pipe material shall be homogeneous throughout and free of:
1. Serious abrasion, cutting, or gouging of the outside surface extending to more than 10 percent of the wall thickness in depth.
  2. Cracks
  3. Kinking (generally due to excessive or abrupt bending)
  4. Flattening
  5. Holes
  6. Blisters



## 7. Other injurious defects

They shall be uniform in color, opacity, density, and other physical properties. Any pipe and fittings not meeting these criteria shall be rejected.

### 2.02 SANITARY SEWER LATERALS

- A. Contractor shall verify location and diameter of all active laterals.
- B. Sanitary sewer lateral shall be installed to conform to the City's Standard Details or modified herein as shown in the Contract Drawings. Lateral to main connections shall be performed using strap-on wye rubber saddles.
- C. Lateral to main connection shall be backfilled with controlled density fill to provide concrete support to strap-on wye rubber saddle.
- D. Connections to the existing sewer house connection pipe shall be made using sleeved stainless steel flexible couplings. All flexible couplings shall conform to ASTM C425 and be manufactured by Fernco Joint Sealer Co., DFW Plastics, Inc. or approved equal.
- E. The sewer lateral connection shall have a slope equal to the existing or a minimum of two-percent.
- F. For laterals shown to be constructed using pipe bursting method, the Contractor shall conform to details specified under Section 02734, Pipe Bursting. For laterals shown to be constructed using open cut method, the Contractor shall conform to Specification Section 02730 Sanitary Sewers.

### 2.03 SANITARY SEWER CLEANOUTS

- A. Install sanitary sewer cleanouts per project details and specifications.
- B. Wye branches and risers for sanitary sewer cleanouts shall conform to the City's project details.
- C. Cleanout box shall be Christy concrete type F08 Curb Valve Box with F08R lid marked "SEWER" when installed in location not subject to vehicular loading.
- D. When installed in location subject to vehicular loading, cleanout box shall be Christy concrete type G05T Traffic Valve Box with G05CT Traffic Lid marked "SEWER" and shall be provided with 8" concrete base.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. This section is intended to provide the Contractor with general guidance on the methods to be used to install the sewer pipe using cured in place pipe lining rehabilitation method. Nothing contained herein shall relieve the Contractor from completing the pipe rehabilitation in the most feasible, efficient and safe manner, using required materials to the lines and grades shown on the plans and to the requirements of these specifications.

### **3.02 SITE INVESTIGATION**

- A.** Prior to pipe rehabilitation, the Contractor shall perform a careful site investigation to locate and record possible surface obstructions, locate and mark active and inactive sewer laterals; and formulate and submit plans to replace the pipe, to reconnect all sewer laterals, and to restore all structures and plants that would be damaged by the project work.

### **3.03 PREPARATION**

#### **A. Preliminary Site Work**

1. Installation of by-pass pumping equipment shall be complete and operational. Layout of a temporary by-pass pumping system to isolate the working area should take into account the location of pumps and pipes, possible pump failure contingency and avoidance of blocking entrances to homes, driveways, bus stops, etc. Equipment used should be selected to give minimum noise levels and emission of fumes. All costs for this time are included in the bid price per linear foot of replacement.
2. Verification of all active and in-active house connection laterals shall be completed before the insertion of the new pipe. Manhole positions along the line of insertion shall be used to check progress as the liner passes these points.
3. Any heavy concrete reinforcement present along the line of insertion shall be broken out prior to the operation to allow steady and free passage of the liner.
4. Support equipment used to perform the work shall be located away from buildings so as not to create a noise impact. Provide silencers or other devices to reduce machine noise as required to meet local requirements.

#### **B. By-Pass Sewage**

1. The Contractor shall furnish, install, and operate pumps, plugs, conduits, and other equipment to divert the flow of sewage around the pipeline reach in which work is to be performed. The plug shall be provided with a tag line. The pumping system shall be of sufficient capacity to handle existing flow plus additional flow that may occur during a rainstorm. If pumping is required on a 24-hour basis, engines shall be equipped in a manner to keep noise to a minimum. Standby pumps shall be provided as required. Pumping shall be done by the Contractor in such manner as will not damage public or private property or create a nuisance or health menace. The pumped sewage shall be in an enclosed hose or pipe and shall be reinserted into the sanitary sewer system. Sewage shall not be allowed to free flow in gutters, streets or over sidewalks, etc. Nor shall any sewage be allowed to flow into the storm inlets or conduits. After the work has been completed, flow shall be restored to normal.
2. The Contractor shall be responsible for continuity of sanitary sewer service (i.e. building laterals) to each facility connected to the section of sewer during

the execution of the work. **Building laterals shall not be disconnected or plugged overnight**; that is continuing service on the laterals should not be interrupted during the peak flow period from 5 P.M. the day before to 9 A.M. the next day. **Plugging of laterals is therefore allowed only from 9 A.M. to 5 P.M. of the same day.**

**C. Cleaning and Closed Circuit TV Inspection for Sewer Pipe**

1. Prior to pipe rehabilitation, the Contractor shall perform an initial sewer cleaning and closed circuit television (CCTV) inspection according to Section 02732 of this Specification to determine the general condition of the sewer, to remove any obstruction and debris, to determine defective pipe sections for point repairs, to log the location of all house laterals and to verify location of active house laterals.

**D. Point Repairs**

1. Point repairs are work required to prepare defective sections of existing sewer lines for rehabilitation.
2. Work shall be performed per Section 02733 of this Specification. The work shall include verifying the location of the point repair, locating all interfering utilities, temporary flow bypassing, traffic control, excavation, shoring, dewatering, pipe repairs or replacement, backfilling, and surface restoration.

**3.04 INSTALLATION**

- A.** The Contractor's shall retain the services of a licensed installer of the manufacturer of the cured-in-place pipe rehabilitation system to assist the Contractor during preparation and installation of the system to certify that the work has been performed in accordance with the manufacturer's recommendations. The Contractor shall obtain detailed installation instruction and procedures from the manufacturer for the actual installation of the cured-in-place liner system.
- B.** The host pipeline shall be cleaned and televised in accordance with Section 02732. The outside diameter of the tube being inserted shall be properly sized to allow for expansion so that the CIPP liner can fit tightly against the host pipe.
- C.** The tube shall be installed through the existing manholes, in accordance with the manufacturer's recommendations and procedures. The finished pipe on mainline reaches shall be continuous over the entire length between manholes. A seal, recommended by the installer, shall be installed at the entrance to each manhole between the tube and the existing pipe.
- D.** During the curing process, the Contractor shall keep logs, charts and/or graphs of the liner temperatures at the upstream and downstream manholes to insure that proper temperatures and cure times have been achieved. These documents may be required by the Engineer at any time during and after the curing process.
- E.** Immediately after curing of the cured-in-place pipe and after testing, within the same working day, the Contractor shall reinstate all existing active service connection per City standard details. Rough edges, string or other pipe defects that would prevent solids from free flowing shall be removed.

- F. The Contractor shall also have a remote control cutting and grouting device on site to reinstate house lateral connections. There will be no initial relief hole; all cut shall be finish cut to the approximate original size and shape of the service lateral. Rough edges, strings or other pipe defects that would prevent solids from free flowing shall be removed. The Contractor shall have a back-up remote control cutting device on site in case of malfunction.
- G. Any evidence of infiltration between the service connection and the existing pipe shall be corrected by the Contractor. The method of correction shall be submitted and approved by the Engineer.
- H. The beginning and end of the cured-in-place pipe shall be cut flush at the inlet and outlet points in the manhole by using a rotary cutter, and the ends shall be sealed to the rehabilitated pipeline. The sealing material shall be compatible with the cured-in-place liner pipe and shall provide a watertight seal.

### **3.05 SEALING AT MANHOLES**

- A. The cured-in-place CIPP shall make a tight seal at the manhole opening with no annular gaps. Under all circumstances, the liner shall be sealed to the manhole and host pipe with appropriate type of sealant. The sealing material shall be compatible with the cured-in-place liner pipe and shall provide a watertight seal.

### **3.06 SEWER HOUSE CONNECTIONS**

- A. All active laterals shall be verified. Sanitary sewer lateral shall be installed to conform to the City's Standard Details. See specifications Section 02730 and 02734 for more details regarding lateral installation.

### **3.07 FIELD TESTING**

- A. Sanitary sewer systems including laterals, and sanitary sewer mains shall be tested for tightness after completion of all backfilling and prior to request for final inspection. Contractor shall notify the Engineer at least two (2) working days in advance of proposed testing dates. Tests of gravity sewers shall be made from end or manhole to manhole unless grades are flat enough to permit testing two or more sections at one time. Sections which fail to pass the tests shall be repaired or replaced, and the section retested until it falls within specified allowances.
- B. All water for sanitary sewer testing shall be provided and the tests performed by the Contractor in conformance with the following requirements:
  - 1. Mandrell Test
    - a. Pipes shall be tested for deflection by passing a mandrel through the pipe without obstruction.
    - b. The size of the mandrel shall be set at 92.5% of the base inside diameter of the pipe, as defined in ASTM 3034.
- C. Air Leakage Tests shall be performed per City Standard Specification Section 02730, "Sanitary Sewers" - Subsection 3.07, "Testing Sanitary Sewer".

### 3.08 FIELD SAMPLING, LABORATORY TESTING and ACCEPTANCE TESTING

- A. The physical properties of the installed CIPP shall be verified through field sampling and laboratory testing, as approved by the Engineer. Following the curing and cooling of the installed pipe, the Contractor with or without the aid of the independent lab field personnel hired by the City, shall remove pipe samples at locations determined by the Engineer and/or City inspector. The samples shall be clearly labeled with the date, time of day, duration of curing, and location of the sample. The sample shall be tested by an independent third party testing laboratory hired by the City for the following parameters:

Average Outside Diameter  
ASTM D 2122

Average Inside Diameter  
ASTM D 2122

Minimum Wall Thickness  
ASTM D 2122

Pipe Stiffness at 5%  
ASTM D 2412

Tensile Strength at Yield  
ASTM D 638

Tensile Modulus  
ASTM D 638

Flexural Strength  
ASTM D 790

Flexural Modulus  
ASTM D 790

Impact Strength  
ASTM D 256

The Lab shall provide the Engineer for approval, with certified test results of the short term properties of the CIPP pipe liner material from the actual installed liner at a minimum of two samples taken at a random locations, and with no more than three (3) samples, per each project area of lining set-up. Locations of sample shall be as directed by the Engineer.

CIPP liner pipe samples shall be submitted to a certified laboratory which has been approved by the Engineer and tested to confirm that the liner pipe conforms to the requirements of the latest edition of Green Book , Section 500-1.4.2, 210-2 and ASTM F1216.

- B. Field sample preparation for Cured-In-Place lining method shall be according to ASTM F-1216, item 8.1.1.
- C. The testing costs are to be paid by the City and therefore, should not be included in the bid. However, if the work should fail to pass the tests, it is the Contractor's responsibility to correct the work and re-test at the Contractor's expense. The City shall not pay for these re-installations and re-tests.
- D. If within the warranty period, any section of the sewer system is not acceptable due to subsequent excessive leakage or any other defects, although originally accepted, the Contractor shall repair or replace the affected portion at no cost to the Agency. It is understood that if the Contractor fails to do such work as required, the Surety shall be liable for said costs of repair or replacement.

**3.09 MANHOLE INSPECTION**

- A. Manholes will be inspected after completion and within the guarantee period. Leakage and other defects that were a result of the Contractor's work shall be eliminated and repaired by the Contractor as required by the Engineer, at the Contractor's expense.

**3.10 FINAL CLEANING AND CLOSE CIRCUIT TELEVISION INSPECTION (CCTV) REQUIREMENTS**

- A. Upon completion of the cured-in place sewer lining operations, all lines, manholes, and other structures shall be thoroughly cleaned of dirt, rubbish, debris and obstructions of any kind to the satisfaction of the Engineer, and the entire work site shall be cleaned of all waste, rubbish, and construction debris of any nature.
- B. Prior to acceptance of any rehabilitated sanitary sewer line, a closed circuit television (CCTV) inspection shall be performed using Wincan Version 8 inspection software recorded digitally to an external drive.
- C. Defects such as high and low spots, joint separations, offset joints, chipped ends, cracked or damaged pipe, infiltration points and debris in lines shall be corrected to the satisfaction of the Engineer. For joint separations, low spots and chipped ends, the following maximum acceptable limits will apply for 6-10 inch pipes:

Joint separations	1/2 inch
Low spots	1 inch maximum depth
Chipped ends	1/4 inch

- D. For pipe larger than 10 inch, maximum limits will be specified by the Engineer for each project.
- E. The complete job is ready for television inspection when the following work has been completed:
  1. All sewers pipelines are installed and backfilled.

2. All structures are in place, all channeling is complete and pipelines are accessible from structures.
  3. All other underground facilities, utility piping and conduits are installed.
  4. Final street grading is complete and ready for asphaltic concrete surfacing.
  5. Pipelines to be inspected have been preliminarily balled and flushed or cleaned by a high pressure cleaner.
  6. Final leakage test has been completed and approved.
  7. Flood and drain the sewer system just prior to video inspection.
- E.** When the above work is completed, the Contractor shall arrange with the Engineer for close circuit television (CCTV) inspection.
- F.** The Contractor shall repair or replace failed sections as required by the Engineer.
- G.** Those portions of the pipeline system that have been corrected must be re-televised.
- H.** Refer to specification Section 02732 for additional details regarding close circuit television video (CCTV) inspection.

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