

SECTION 33 01 30.72 – CURED-IN-PLACE PIPE LINING – THERMAL CURE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes rehabilitation of sanitary and storm sewer pipelines using cured-in-place pipe (CIPP) lining, thermally cured through steam or hot water methods. The flexible tube type material will be resin-impregnated and installed into the existing conduit or host pipe.

1.2 SCOPE OF WORK

- A. The scope of work shall include, but not be limited to:
 - 1. Pre-cleaning and inspection.
 - 2. Traffic control and permitting.
 - 3. Public relations and notifications.
 - 4. Sewage flow control and/or bypass pumping.
 - 5. Installation and curing of CIPP.
 - 6. Reinstatement of laterals and service connections.
 - 7. Post cleaning and inspection.
 - 8. Delivery of final inspection videos
 - 9. Delivery of product test results.

1.3 REFERENCES

- A. The following documents form a part of this specification to the extent stated herein and shall be the latest editions thereof. Where differences exist between codes and standards, the requirements of these specifications shall apply. All references to codes and standards shall be to the latest revised version.
 - 1. ASTM F1216 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
 - 2. ASTM F1743 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pull in and Inflate and Curing of a Resin-Impregnated Tube
 - 3. ASTM D543 - Standard and Practice for Evaluating the Resistance of Plastics to Chemical Reagents
 - 4. ASTM D638 - Standard Test Method for Tensile Properties of Plastics
 - 5. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - 6. ASTM D2990 - Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
 - 7. ASTM D5813 - Standard Specification for Cured-in Place Thermosetting Resin Sewer Pipe
 - 8. ASCE MOP 145 – Design of Close-Fit Liners for Rehabilitation of Gravity Sewers
- B. The City of Grand Junction (City) standards and specifications for sanitary sewer main construction, storm drain construction, CCTV video inspection, street cut and excavation repairs, and environmental controls are applicable to this project.

1.4 SUBMITTALS

- A. General Submittals:
 - 1. Project schedule and CIPP lining installation plan with major milestones identified
 - 2. Contractor and superintendent experience documentation (as provided with submitted bid)
 - 3. List of subcontractors
 - 4. Permits
 - 5. Contractor safety plan

6. Applicable traffic control plans
7. Contractor Quality Control Plan (QCP)
8. Mobilization spill response plan, odor control plan, styrene mitigation plan
9. Draft public relations homeowner/ business notification flyer
10. NASSCO PACP Operator Certificates
11. Flow management and/or bypass plans for handling of sewerage during CIPP lining
12. CCTV inspection videos and quality control documentation submittals following installation

B. Product Submittals:

1. Fabric Tube – including the manufacturer and description of product components such as felts and reinforcing materials
2. Flexible membrane (coating) material – including materials specific to the proposed curing method and recommended repair (patching) procedure if applicable
3. Manufacturers' shipping, storage, and handling recommendations for all components of the CIPP system
4. ISO-9001 CIPP liner manufacturer certification
5. All Safety Data Sheets (SDS) for all materials to be furnished for the project.
6. CIPP tube wet-out & cure method including:
 - a. A complete description of the proposed wet-out procedure for the proposed CIPP lining system with applicable resin information.
 - b. The Manufacturer's recommended cure method for each diameter and thickness of liner to be installed. Submittal shall contain a detailed curing procedure outlining the curing medium, the method of application and how the curing temperatures will be monitored.
 - c. Wet out report for each liner to be installed.
7. Liner thickness calculations for each pipe segment to be rehabilitated, stamped by a Colorado Registered Professional Engineer, designed in accordance with the latest version of ASTM F1216 - Appendix X1 or ASCE MOP 145.

1.5 PLANS

- A. Included in the project bid documents package is a drawing of each of the pipelines to be rehabilitated. These drawings include approximate lengths of pipe and depths of manholes. CCTV videos of the lines to be rehabilitated are available upon request.
- B. The quality of the CCTV video information is not guaranteed and provides a general visual depiction of pipe condition that may not be representative of the actual conditions encountered during the project. This data (if available) is provided by the City for informational purposes only.

1.6 QUALIFICATIONS

- A. **Manufacturer:** Company specializing in the manufacturing of CIPP lining products as specified in this section with a minimum of 3 years of production experience prior to bid acceptance. ISO-9001 manufacturer certification is required.
- B. **Installer:** Company specializing in performing the work of this section and who is licensed and approved by the Manufacturer. Company shall have experience with projects of similar size and complexity as this project, minimum of 100,000 feet of installed CIPP product with a minimum size of 8" within the last 5 years, or otherwise allowed prior to bid acceptance.
- C. **Project Superintendent:** Project Superintendent shall have a minimum of 3 years of experience as a Superintendent on CIPP lining projects, and will have supervised the installation of at least 50,000 feet of installed CIPP lining product within the last 5 years, or otherwise allowed prior to bid acceptance.

1.7 PERMITS

- A. The Contractor will be required to pay for and obtain all necessary permits and shall provide copies of all permits prior to the start of construction.

1.8 PUBLIC RELATIONS

- A. The Public Information and Notification program shall, as a minimum, require the Contractor to be responsible for contacting each home or business connected to the sanitary sewer and informing them of the work to be done, when the sewer will be out of service, and the following:
 - 1. Written notice to be delivered to each home or business describing work, schedule, how it affects them, and a local telephone number of the contractor they can call to discuss the project or problems.
 - 2. At no time shall sewer service be interrupted for more than 8 hours.
 - 3. Personal contact on the day of pre-installation inspection of the sewer.
 - 4. Personal contact and written notice no more than 2 working days and no less than 24 hours prior to beginning reconstruction of the section of sewer to which the property is connected.
 - 5. Personal contact with any residence or business which cannot be reconnected within the time stated in the written notice.
 - 6. If required by a served business or homeowner, portable toilets for use by the occupants will be furnished and serviced by the Contractor. This is considered pertinent to the project and therefore no additional payment will be made.

1.9 QUALITY CONTROL

- A. The Contractor shall be responsible for the quality and protection of work until accepted by the City.
- B. A detailed Quality Control Plan (QCP) shall be submitted by the Contractor to the City that fully represents and conforms to the requirements of these specifications.
- C. The QPC shall include a discussion of the proposed quality controls to be performed by the contractor during installation including material protection and handling, equipment operation and documentation requirements. The contractor personnel, including names and cell phone numbers for those that are responsible for assuring that all quality requirements are met, shall be identified and submitted.
- D. Defined responsibilities, of the Contractor's personnel, for assuring that all quality requirements for this contract are met. These shall be assigned, by the Contractor, to specific personnel.
- E. Proposed procedures for quality control, product sampling and testing shall be defined and submitted as part of the plan. Curing methods and expected cure times for each liner, thermocouple temperature logs, cure monitoring system readings, and cool-down information shall be provided.
- F. Proposed methods for product performance controls, including method of and frequency of product sampling and testing both in raw material form and cured product form.
- G. Scheduled performance and product test result reviews between the Contractor and the City at a regularly scheduled job meeting.
- H. Styrene mitigation and environmental protection plan for the project shall be prepared and submitted to the City for approval. Odor mitigation methods shall be used as directed by the City during lining activities, if required.

- I. Inspection forms and guidelines for quality control inspections shall be prepared in accordance with the standards specified in this contract and submitted with the QCP.

1.10 SAFETY

- A. All work under this contract shall be performed in accordance with OSHA regulations, and the Contractor shall secure the site for the working conditions in compliance with these regulations.
- B. The Contractor shall erect such signs and other devices as are necessary for the safety of the work site.
- C. The Contractor shall perform all work in accordance with applicable OSHA standards. Emphasis shall be placed upon the requirements for entering confined spaces and with the equipment being utilized for pipe renewal.
- D. The Contractor shall submit a proposed Safety Plan to the City, prior to beginning any work, identifying all competent persons. The plan shall include a description of a daily safety program for the job site and all emergency procedures to be implemented in the event of a safety incident. All work shall be conducted in accordance with the Contractor's submitted Safety Plan.

1.11 FLOW CONTROL PRECAUTIONS

- A. Precautions must be taken to ensure that sanitary sewer flow control operations do not cause flooding, Sanitary Sewer Overflows, or damage to public or private property. In the event of a Sanitary Sewer Overflow or damage to public or private property, the contractor will notify the City within the first hour of discovery. Contact information will be provided at the preconstruction conference. The Contractor shall be liable for any damages caused by sewer blockages resulting from Contractor's activities or lack of action to prevent. The Contractor shall be liable for triple punitive damages should the City be fined by any regulatory agency because of the Contractor's failure to control sewage flow.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Tube - The tube material shall meet the requirements of the latest addition of ASTM Designation: F1216, with the exception that only non-woven material will be accepted. The tube shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe, and stretch to fit irregular pipe sections.
- B. The tube shall be fabricated to a size that, when installed, will tightly fit the internal circumference and length of the host pipe. Allowance should be made for circumferential stretching during inversion. A pre-liner may be used as needed at the discretion of the Contractor, with no additional cost to the City.
- C. The outside layer of the Tube (before wet out) shall be coated with an impermeable, flexible membrane that will contain the resin and facilitate saturation monitoring during the resin impregnation (wet out) procedure.
- D. The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No materials shall be included in the tube that are subject to delamination in the cured CIPP.

- E. The wall color of the interior pipe surface of the CIPP after installation shall be a light reflective color so that a clear detailed examination with pan and tilt CCTV television inspection equipment may be made.
- F. Seams in the tube shall be stronger than the non-seamed felt material.
- G. Resin - The resin system shall meet the requirements of the latest addition of ASTM F1216 and ASTM D5813. After review of individual projects, the Contractor shall determine what resin is required for each line section based on specific conditions, i.e. freeze, thaw, etc.
- H. Resin Impregnation - The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the host pipe wall. A vacuum impregnation process shall be used. A roller system shall be used to uniformly distribute the resin throughout the tube.
- I. The CIPP shall be designed as per the latest addition of ASTM F1216 – Appendix X1 or ASCE MOP 145. The CIPP design shall assume no bonding to the host pipe wall. All CIPP liner designs shall be stamped by a Colorado Registered Professional Engineer.
- J. Layers of the CIPP shall be uniformly held together. It shall not be possible to separate any two layers of cured CIPP with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers, nor shall separation of the layers occur during testing performed under the requirements of this specification.
- K. The tube shall have a uniform thickness that, when compressed at installation pressure, will equal the specified tube thickness.
- L. The design thickness of the CIPP shall be based on the following design parameter table and actual field conditions. Should the Contractor performing pre-installation inspections reveal sewers to be in substantially different conditions than those evidenced by the design parameter criteria, the Contractor shall report such difference to the Project Manager prior to manufacturing of the CIPP.

PARAMETER	CIPP SYSTEM
Pipe condition	Fully deteriorated
Soil Type	Saturated clay or as site conditions warrant
Design Thickness	Felt tube (all tube types): Calculated thickness rounded up to next higher multiple or 1.0 millimeters.
Ovality of Pipe	2% of circumference or as required by review of video tapes.
Soil Density	125 lbs /cubic ft
Traffic Loads	HS-20 for all installations unless E-80 railroad loading is required. Per AASHTO - HS-20-44 Highway Loading - 16,000lbs, 2200psf for R/R loading, if required

Design Life	50 years
Modulus of Soil Reaction	1000 psi
Long-Term Flexural Strength	50% of initial (ASTM D-790)
Long-Term Flexural Modulus	50% of initial (ASTM D-790) of elasticity
Minimum Safety Factor	2.0
Minimum allowable short-term flexural modulus for design (Test method ASTM D790)	400,000 psi (Enhanced Resin)
Minimum allowable short-term flexural strength for design (Test method ASTM D790)	5,000 psi
Groundwater over invert	To ground surface level

- M. Contractor shall determine the actual lengths of the CIPP liner material needed and verify invert depths of manholes on each segment by field verification.
- N. The Contractor shall provide engineering data on actual material to be furnished.

2.2 INSTALLATION

- A. CIPP installation shall be in strict accordance with the latest version of ASTM F1216. The following is supplemental to the ASTM F1216 standard.
- B. The tube shall be positioned in the pipeline using either inversion or a pull-in method as defined within relevant ASTM standards previously stipulated. If pulled into place, a power winch or its equivalent should be utilized, and care should be exercised not to damage the tube as a result of pull-in friction. The tube should be pulled-in or inverted through an existing manhole or approved access point and fully extend to the next designated manhole or termination point. A pre-liner may be used as needed at the discretion of the Contractor, with no additional cost to the City.
- C. Infiltration - Minor infiltration is a normal condition sometimes encountered during the CIPP process. It is not a "changed condition" and should not be regarded as a reason for change orders. If, in the opinion of the Project Representative, infiltration is significant enough to adversely affect the curing process, chemical grouting or other remedies may be required.
- D. Temperature gauges or cure monitoring system shall be placed between the tube and the host pipe's invert position to monitor the temperatures during the cure cycle. Temperatures shall be recorded every 30 minutes on cure logs throughout curing and cool down process.
- E. Curing shall be accomplished by utilizing hot water under hydrostatic pressure or steam pressure in accordance with the manufacturer's recommended cure schedule. A cool-down process shall be conducted that complies with the resin manufacturer's specifications.
- F. Contractor shall terminate and seal end of CIPP liner to manhole structures using the following approved method:
 - 1. Expanding Hydrophilic Rubber Joint Seal – LMK Insignia End Seal or equal.

- a. The rubber joint seal shall be an extended hydrophilic rubber compounded from chloroprene (Neoprene) rubber and a hydrophilic resin, which expand on contact with water.
 - b. The rubber joint seal shall be bonded with adhesive on one face to hold it in place during assembly.
 - c. On contact with water, the rubber shall swell by up to 10 times its original volume if necessary and mold itself to completely fill any gaps and exert pressure evenly to ensure the seal. High compression or bolt up forces shall not be necessary to affect a complete and watertight seal.
- G. Workmanship: Refer to ASTM F1216, Section 7, para.7.8: The finished pipe shall be continuous over the entire length of an inversion run and be free of dry spots, lifts, and delamination. If these conditions are present, remove and replace the CIPP in these areas. Any conventional replacement by excavation or any other means due to any of these conditions shall be at the Contractor's expense.

PART 3 - EXECUTION

3.1 TRAFFIC CONTROL

- A. The Contractor shall follow all City and state codes and regulations. The Contractor shall submit a written traffic control plan and diagram by a licensed professional for each location that is deemed necessary. This shall be in accordance with previously mentioned codes and manuals.
- B. Driveway closures will be coordinated with property owners as needed. Property owners shall be notified 24 hours in advance of driveway closure.
- C. Access to individual residences or businesses shall be maintained even during road closures.
- D. Traffic control plans must be approved by the City prior to the commencement of any work.

3.2 ACCESS

- A. It shall be the responsibility of the City to locate and designate all manhole access points for the work and provide rights of access to these points.
- B. The City does not provide free access to water hydrants and contractor will be responsible for providing a water source.
- C. Temporary water lines laid in or across traffic areas shall be protected by approved traffic pads. This reduces the potential of damage to the water main lines. Any damages resulting from the Contractor's failure to protect the water lines will result in the contractor paying for repairs of that line. The Contractor will not be allowed to perform these repairs.

3.3 PUMPING AND BYPASSING

- A. At the preconstruction conference, the Contractor shall submit a written plan and map proposing an arrangement for each project that requires bypass pumping. Plans shall describe the pumping logistics according to each section of the sanitary sewer or storm drain. Plans shall address contingency activities in the event of a rainstorm, equipment malfunction, or other potential disruptions. Bypass pumping plans must be reviewed and approved by the City.
- B. When pumping and bypassing is required, the Contractor shall supply the pumps, conduits, and other equipment to divert the flows around the manhole section in which work is to be performed. The bypass system shall be of sufficient capacity to handle existing peak flow plus additional flow

that may occur during a rainstorm. A minimum redundancy factor of 1.5 X peak flow shall be used in bypass system design, based on historic flow information. The bypassing system shall be watertight. The Contractor shall be responsible for furnishing the necessary labor and supervision to set up, monitor and operate the pumping and monitoring of the bypassing system. At no time will the bypass operation be unattended. Engines shall be equipped in a manner to keep noise to a minimum. Standby equipment shall be available to allow continuous operation of bypass pumping despite equipment, pump, or generator failure.

- C. In the event that there is a sanitary sewer overflow, a spill, leak or a discharge to anywhere other than the sanitary sewer system, the contractor will notify the City within the first hour of discovery. Contact information will be provided at the preconstruction conference.
- D. All bypassed sanitary sewage flow shall be returned to the sanitary sewer system. All bypassed stormwater flow shall be returned to the storm drain system.
- E. The Contractor shall submit a mobilization spill response plan, styrene mitigation plan and odor control plan at the preconstruction meeting. No work, including setup, will begin until the Project Manager approves these plans.
- F. Any bypass piping must accommodate traffic and be approved by the City's Traffic Control Department. No interruptions of the normal flow of sewage from residences and businesses are expected.

3.4 CLEANING OF SEWER LINES

- A. The Contractor shall remove all internal debris from the sewer line that will interfere with the installation of CIPP lining. This will include obstructions that leave the interior of the completed line rough or uneven. The Contractor shall rely on existing CCTV video information as a baseline for expected conditions and extent of cleaning needed for each pipe segment. The Contractor shall be responsible for disposal of all debris removed from the sewers during the cleaning operation.
- B. Any damage to pipes, manholes or other infrastructure as a result of cleaning shall be reported to the City within one hour of damage. Damages shall be repaired to the satisfaction of the City's representative at the Contractor's cost by point repair, cured-in-place pipe or any other method as accepted by the City.

3.5 LINE OBSTRUCTIONS

- A. It shall be the responsibility of the Contractor to clear the line of obstructions such as solids, roots and protruding sewer taps that will prevent the insertion of the liner.
- B. Protruding service taps shall be cut off to within 1/2 inch of the interior wall of the main line pipe. The Contractor shall be responsible for all damage repairs to service lines and main lines caused by the cutting off of protruding taps.
- C. By review of the CCTV videos and/or inspection information furnished with the proposal documents, the Contractor will determine what sewer taps will require cutting off. Cost associated with the cutting of protruding sewer taps will be included in the proposed price of the specific line section. (SECTION 00130, BID COST SCHEDULE.)

3.6 PRE- INSPECTION OF PIPELINES

- A. All CCTV inspection work shall conform to NASSCO-PACP Standards Version 7.0.4. The Contractor shall provide PACP operator certifications at the preconstruction meeting.

- B. Prior to lining the pipe, the Contractor shall clean and TV inspect the sewer line. The Contractor shall inspect the sewer line with a pan and tilt CCTV television camera. At the time of this inspection, the Contractor shall produce a video and written log of the line. The Contractor shall be responsible for any bypass pumping of sewer to perform this work.
- C. During the inspection of the line, the Contractor shall be responsible for locating all service connections to the sanitary sewer line. Sewer service lines will be notated on the CCTV video and written logs. Accuracy of the service locations will be within one foot. All measurements will originate from the center of the manhole. (Do not originate service line locates from the start of pipe in the manhole.)
- D. The City's Project Representative will review all CCTV pre-inspection videos and will provide the Contractor with approval to proceed with CIPP lining, as long as the pipeline cleaning is acceptable. The Contractor shall provide pre-inspection videos to the Project Representative no less than 24 hours prior to scheduled CIPP installation. The City's Project Representative shall have final authority in approvals and has the right to stop work as deemed necessary. Video quality and written logs will be monitored closely. Submitted videos with poor picture quality or inaccurate logs will be rejected and the Contractor shall be required to repeat the inspection of the sewer line. Electronic correspondence is acceptable. (Minimum video quality is MPEG2, 640 X 480, 25 FPS)

3.7 MANHOLE CUT OUTS

- A. CIPP cut-outs in terminal manholes shall maintain a smooth flow line. Flow line is considered the lowest portion of the pipe.
- B. The CIPP shall be cut back to within one (1) inch at the top of the existing pipe at the manhole wall. This distance shall be maintained on both sides down to the spring line or the existing manhole bench.
- C. Where the CIPP has been installed through an intermediate sanitary sewer manhole, it shall be cut out down to the spring line or the existing bench, leaving a CIPP flow line through the manhole. The Contractor shall make sure that the CIPP does not lift or rise up during the installation or curing procedures.

3.8 REINSTATEMENT OF SEWER SERVICES

- A. City will identify and confirm all connections and determine whether connections are active or abandoned and provide results to Project Representative prior to liner insertion. Project Representative and Contractor shall agree prior to CIPP liner insertion which services are to be reopened. Only reopened services will be paid for.
- B. Sewer service connections shall be reopened without excavation, utilizing a remotely controlled cutting device, monitored by a pan and tilt television camera. The location of each service connection shall appear on the final inspection video and on the corresponding written log.
- C. The Contractor shall certify that a minimum of two (2) complete working cutters are on the project site before each inversion.
- D. No additional payment will be made for excavations required to reopen service connections that cannot be remotely cut out. The Contractor will be responsible for all cost and liability associated with such excavation and restoration work.
- E. No service connection shall remain out of service for more than 8 hours without the Contractor providing some means of temporary facilities or hotel accommodations for the occupants.

- F. Service lines will be reconnected with 100% of their original capacity. Overcutting of service lines shall not be acceptable and may result in requiring the Contractor to excavate and physically reconnect the service per City specifications.
- G. Service line cut out coupons shall be removed from the service line and/or main line. Failure to do so will result in the contractor paying for removal and any resulting damages.

3.9 INSPECTION

- A. CCTV television inspection of completed CIPP lining sections shall be performed by the Contractor. At the time of this inspection, the Contractor shall produce an unedited, recorded color video of the entire lined segment, in the presence of the Project Representative, following installation of the CIPP liner and reinstatement of any lateral or side sewer connections. A radial view (pan and tilt) TV camera shall be used. The finished CIPP shall be continuous over the entire length of the installation and shall be free of significant visual defects, damage, deflection, holes, leaks, improperly reinstated service connections, and other defects.
- B. This video will be delivered to the City for review within one business day following the completion of the inspection of each line section. The video shall be accompanied by a written log with the inspection date, service tap locations, debris, as well as any defects in the CIPP, including, but not limited to, gouges, cracks, wrinkles, fins, bumps, discoloration, or bulges. The video and log shall be returned to the Contractor following review by the Project Manager. If post-installation inspection documentation (CCTV video and corresponding inspection log) is not submitted within one business day following the CIPP installation, or the inspection documentation is of unacceptable quality, the City, at its sole discretion, will suspend any further installation of CIPP lining until sufficient post-installation documentation is submitted. As a result of this suspension, no additional working days will be added to the contract, nor will any adjustment be made for increase in cost.
- C. The Contractor shall maintain bypassing operations during video inspection so that the entire inside circumference of the pipe can be viewed. If applicable, prior to conducting the CCTV inspection, the Contractor shall thoroughly clean the newly installed CIPP liner, removing any debris that may have accumulated and could inhibit a complete visual inspection at no additional cost to the City.
- D. Poor quality video and inaccurate logs will not be acceptable.
- E. The accuracy of sewer service lines on submitted video shall be within one foot. All measurements shall be from the center of the manhole.
- F. Final post-installation CCTV videos, curing logs and inspection documentation for the project shall be provided in a format acceptable to the City. Between substantial completion and request for final payment, the Contractor shall deliver all the final inspection videos and information to the City. All inspection videos and files shall be named by corresponding pipe segment and presented in an organized manner that is acceptable to the City. No final payment will be processed until these items are received.
- G. Prior to expiration of two years from Date of Substantial Completion, the City, will perform a televised inspection of the project to determine whether corrective work is required. The Contractor shall attend such inspection if required by the City.

3.10 TESTING REQUIREMENTS

- A. CIPP liner samples shall be prepared for every line section between manholes. Samples shall be laboratory tested in accordance with the latest addition of ASTM F1216 as required by City. Results of these tests shall be submitted to the City within 30 days after installation.
- B. Portions of the newly rehabilitated sanitary sewer line may be put into service if approved by the City, once inspection activities and applicable liner test samples have been obtained.
- C. Testing will be required for each insertion of CIPP lining. The layers of the cured CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe so that the layers separate cleanly. If separation of the layers occurs during testing of field samples, new samples will be cut and analyzed accordingly. Any reoccurrence may be cause for rejection of the work. Contractor shall provide all labor and materials necessary to produce samples for laboratory and or field testing. Contractor to contract directly with certified laboratory for testing as required. Contractor shall contact testing lab prior to first insertion and determine sample size requirements. Samples shall be large enough to perform wall thickness test, flexural strength, and modulus of elasticity test.
- D. Sample Preparation:
 - 1. Samples will be submitted by the Contractor to an independent third-party laboratory. The cured sample shall be tested by an independent testing laboratory approved by the City. Contractor is responsible for payment of laboratory testing.
 - 2. Test results for each line section shall be delivered to the City within 30 days of the completion of the installation. The test reports will include the project number and the line section manhole numbers. Final payment will not be made until acceptable test results are received by the City
 - 3. The Contractor shall be responsible for any deviation from the specified physical properties. Failure to meet the specified physical properties will result in the liner being considered defective work. The Contractor shall be responsible for all costs associated with repair of defective work.
 - 4. Samples used for testing shall be individually labeled to record the following:
 - a. Contract number and title
 - b. Sample number
 - c. Date of installation
 - d. Location of installation
 - e. Contractor Name including person responsible for collecting samples
 - f. Upstream and downstream manhole numbers from where the sample was taken
 - g. Type of restraint used
- E. The wall thickness will be measured in accordance with the applicable sections of ASTM Test Method D5813. Flexural strength and flexural modulus of elasticity shall be determined in accordance with ASTM D790. For pipe 15-inch and smaller, a constrained sample will be obtained by inverting through a like diameter inverted half-section of pipe which has been held in place by a suitable heat sink, such as sandbags. Sample location can be either the receiving manhole or an intermediate manhole provided a straight through channel exists. For pipe greater than 15-inch but no greater than 24-inch, a constrained sample will be obtained from an intermediate manhole, if one exists.
- F. Non-conforming work - Penalties will be assessed for the following liner installation defects:
 - 1. Wrinkle height within the installed liner shall not exceed 5% of the host pipe diameter. Wrinkles exceeding 5% in size will incur a minimum of a 10% reduction in payment for that insertion. If it is determined that the wrinkle will cause significant disruption to the flow, the City, at its sole discretion, may require the Contractor to remove the wrinkle and repair the affected area of the liner at no additional cost to the City.

2. Unremoved debris that was lined over exceeding 5% of the host pipe diameter will incur a minimum 10% reduction in payment for that insertion.
 3. Reinstatement of lateral connections that were not previously identified by City to be reopened in accordance with Part IV- Section 2 Reinstatement of Sewer Services will incur a \$1,000 penalty per connection for pipelines under 18-inch diameter, and a \$5,000 penalty per connection for pipelines 18-inch and larger. Any damage to the liner shall be repaired using an acceptable point repair method at no cost to the City. Lateral connections that were previously identified but were not properly reinstated following installation of the CIPP liner shall be subject to a \$1,000 penalty per missed connection for all pipe diameters.
- G. Non-conforming work based on laboratory test results:
1. If the measured wall thickness of the installed CIPP liner is more than 5% less than specified, a minimum of 5% reduction in payment for that insertion will occur. Deduction of payment will be commensurate with measured percentage below wall thickness specified. An additional liner sufficient to make up the deficiency may be installed, at the determination of the City, if measured wall thickness deficiency of the installed liner exceeds 25%.
 2. If the flexural strength and/or flexural modulus of elasticity values are more than 5% less than specified, a minimum of 5% reduction in payment for that insertion will occur. Deduction of payment will be commensurate with measured percentage below values specified. An additional liner sufficient to make up the deficiency may be installed, at the determination of the City, if measured flexural strength and/or flexural modulus deficiencies of the installed liner exceeds 25%.
 3. For all instances where the CIPP liner is deemed unacceptable, the Contractor shall submit a method of repair or replacement for review and approval by the City.
 4. All Work required to remedy non-conforming work shall be at the sole cost of the Contractor.

3.11 CLEAN UP

- A. Upon acceptance of the CIPP lining installation and testing, the Contractor shall restore the project area to its original state. Disposal of waste material which is deemed not reusable by the Project Manager shall be the responsibility of the Contractor.
- B. Care shall be taken throughout project to avoid damage to private property (i.e. sprinkler stems, lawn areas). If damage occurs, any repairs shall be completed as soon as possible. Costs associated with repairs shall be the responsibility of the Contractor.

PART 4 - CLOSED-CIRCUIT VIDEO

4.1 CCTV INSPECTION REQUIREMENTS

- A. Initial Closed-Circuit Video (CCTV) Inspection and Repair:
 1. Use a swivel-head CCTV camera, capable of looking directly up a service connection. Camera speed shall not exceed 2 feet per second. Video quality shall be adequate to clearly identify problems that may inhibit insertion.
 2. Determine condition of existing piping, degree of offset of joints, and locations of any defects, deformations and obstructions.
 3. Determine and record sizes and locations of service laterals and connections.
 4. Clear obstructions, service piping protrusions, and/or other materials from the existing pipe to ensure that inserted pipe liner directly contacts existing pipe wall. Presence of solids and roots are considered to be incidental to the work and are not reason for a change order.
 5. Project Inspector and Contractor shall both be present in-person during pre-insertion inspection to view pipeline condition prior to CIPP liner installation.
 - a. Pipeline shall be dry during the pre-insertion inspection.

- b. Contractor to provide at least 2 hours advance notice to Project Inspector for inspection. Inspection shall take place between 7:00 a.m. and 6:00 p.m. of the same day unless permitting restrictions dictate otherwise.
 - c. If flow is resumed in pipe prior to lining insertion, a second televising shall be performed with Project Inspector present to ensure no debris has been reintroduced into the pipe.
 - d. Project Inspector shall approve cleaning and pipe condition prior to liner insertion.
 - e. CCTV video pre-installation inspection shall be recorded and submitted to the Project Engineer for record keeping purposes within 10 business days of liner installation.
 - 6. If pre-insertion inspection reveals a condition that will prevent the CIPP liner insertion process or will result in an unacceptable installation, and it cannot be removed by conventional means, defined as high-pressure jetters, remote operated grinders and root cutters, consult with the Project Inspector and Project Engineer before proceeding with the appropriate remedy.
 - a. If the proposed remedy results in extra effort by the Contractor and condition was not shown on the drawings or revealed to the Contractor at the time of the bid, the work shall be considered as a separate pay item by Change Order.
- B. Post-Installation Closed-Circuit Video (CCTV) Inspection:
- 1. Closed-circuit video (CCTV) inspection of completed CIPP lining work shall be performed, indicating no visual defects, including foreign inclusions, dry spots, pinholes, cracks, or delamination.
 - a. Provide video recording (DVD or thumb drive) in .mp4 format and corresponding CCTV log in a NASSCO PACP format or other format acceptable to the Project Engineer within 10 business days of recording.
 - b. If defects are found during the post-installation inspection, consult with Project Inspector and Project Engineer to determine next steps for appropriate remedies or potential payment deductions.
 - 2. The CIPP lined pipe must be dry and clean throughout the CCTV post-installation inspection process.
 - 3. Camera speed shall not exceed two feet per second.
 - 4. High quality, high-definition video footage is required for all CCTV inspections throughout project. Project Inspector has the right to reject low quality CCTV inspection videos or incomplete information.
 - 5. Project Inspector and Contractor shall both be present in-person during the post-installation inspection to view lined pipeline condition.
 - a. Provide at least two hours advance notice to Project Inspector. Inspection to take place between 7:00 a.m. and 6:00 p.m. of the same day unless permitting restrictions dictate otherwise.
 - b. Flows may be reinstated into the rehabilitated pipe segment at the direction of the Project Inspector, following the post-installation CCTV inspection review.

END OF SECTION