



# DENVER

## THE MILE HIGH CITY

CITY AND COUNTY OF DENVER  
DEPARTMENT OF PUBLIC WORKS | ENGINEERING DIVISION

## Storm Drainage and Sanitary Sewer Construction Detail and Technical Specifications

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### 10.7 Cured In Place Pipe

#### 10.7.1 General

This section outlines the guidelines & requirements for the reconstruction of pipelines and conduits by the Cured in Place Pipe Method (CIPP). CIPP is the installation of a resin-impregnated flexible tube which is inserted into an existing conduit and cured by the use of pressurized steam or circulated water under a hydrostatic head. When complete, the CIPP is continuous and fits tightly to the existing pipe.

#### 10.7.2 Referenced Standards

This section references American Society for Testing and Materials (ASTM) standards, which are made a part of this specification by such reference. All standards shall be the latest edition and revision. The materials, manufacturing, operations, testing, inspection and production of cured in place pipe shall conform to the following standards.

- ASTM D638 Standard Test Method for Tensile Properties of Plastics
- ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- ASTM D2122 Determining Dimensions of Thermoplastic Pipe & Fittings
- ASTM D2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastic
- ASTM D5813 Standard Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems

ASTM F1216 Standard Practice and Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

ASTM F1743 Practice of Rehabilitation of Existing Pipelines and Conduits by Pulled-In-Place

### 10.7.3 Submittals

Unless otherwise specified, the Contractor is responsible to have all submittals transmitted to the Project Construction Engineer in sufficient time to allow two weeks for review and acceptance prior to starting the construction or any work by the Contractor.

#### 10.7.3.1 Installation

Prior to installation by Inversion or the Pulled-in-Place method, the Contractor shall provide the Project Construction Engineer with the following as applicable to the specific installation method:

- a. The minimum pressure required to hold the tube against the existing conduit and maximum pressure to avoid damaging the tube. A complete log of the pressure (or head level) shall be maintained on the site and be furnished to the Project Construction Engineer after each installation.
- b. The maximum allowable force that can be used in pulling the tube into the existing pipeline for each size of line. A complete log of the pulling force used for each line shall be maintained on site by the Contractor and be furnished to the Project Construction Engineer after each installation.
- c. Minimum temperature and time required for cure on each size of line, based on installation method.
- d. For CIPP segments which are wet out on site, the Contractor must also submit (in spreadsheet form) information on allowable head pressure, roller spacing and gallons of resin to felt length with respect to diameter so the procedure can be verified on site.

#### 10.7.3.2 Health and Safety Plan

Prior to site work, the Contractor shall provide the Project Construction Engineer with a Health and Safety Plan which includes (at a minimum) the following:

##### I) Introduction

- a. Provide project description and location and summary of key work activities.

##### II) Scope and Applicability

- a. Describe the scope of work for the General Contractor and 1<sup>st</sup> tier subcontractors performing the work
- b. Detail the planned site activities

- c. Describe who must adhere and abide by the Health and Safety plan
- d. Detail how site visitors will be addressed

### III) Key Personnel, Responsibilities and Authority

- a. In relation to Health and Safety, describe the role of project managers, health and safety managers, technical supervisors (10.7.3.4), and other contractor and subcontractor staff.
- b. Identify the name, title, and contact information (phone, email, address) for key personnel.
- c. Identify the name, location, and contact numbers for ambulance, fire, police, hospital, Health and Safety managers (contractor and/or subcontractors), and other key personal or support contacts.

### IV) Task/Operation Health and Safety Risk Analysis

- a. Identify, on a task specific basis the individual hazard elements that are present including chemical, physical, and biological.

### V) Qualifications and Training Requirements for all Personnel

- a. Detail specific qualifications and training that are required.
- b. Discuss the frequency of safety and training refreshers.
- c. Detail the requirement for site personnel to read and acknowledge, in writing, their understanding of the Health and Safety plan.

### VI) Engineering and Administrative Controls

- a. Describe in detail how engineering and administrative controls will be used to protect worker and public safety by preventing chemical exposure, injury, or illness.
- b. List controls in conjunction with each activity identified in the Task/Operation Health and Safety Risk Analysis section above.

### VII) Personal Protective Equipment

- a. When site hazards cannot be controlled through the use of engineering and administrative controls, detail personal protective equipment (PPE) requirements.
- b. PPE requirements should be listed in conjunction with each activity identified in the Task/Operation Health and Safety Risk Analysis.
- c. Detail applicable standards (e.g., ANSI, NIOSH, ACGIH, etc)

### VIII) Health and Safety Monitoring

- a. Detail instruments, samples, and monitoring that will occur both on the jobsite and in response to complaint(s) or inquiries.

- b. Detail who is responsible for performing monitoring
- c. Detail frequency of monitoring
- d. Define the appropriate action levels and thresholds
- e. Describe standard operating procedures for Health and Safety monitoring

IX) Site control

- a. Describe work zones, buddy systems, and site security
- b. Address policies including drug and alcohol policies, personal hygiene requirements, heat and cold stress prevention
- c. Describe task specific site control (e.g., confined space entry, trenching, etc.)

X) Decontamination plan

- a. Eye and hand wash (if applicable)
- b. Site cleanup

XI) Emergency Contingency Plan

- a. Medical services
- b. Emergency phone numbers
- c. Personnel Injury
- d. Fire/Explosion
- e. Evacuation
- f. Emergency signals and communication
- g. First aid
- h. Emergency equipment list
- i. Map(s), addresses, and phone numbers of nearest medical facilities

XII) Appendices

- a. Safety forms (as needed)
- b. Supporting documentation and information
- c. Material safety data sheets (MSDS)

**10.7.3.3 Weekly Installation Schedule**

The Contractor shall submit a weekly construction schedule, 7 calendar days in advance of the work, to the Project Construction Engineer including the following information:

1. The specific line number and related manhole numbers as designated in the project plans. The line length and service connection count information must also be included from the preliminary video investigation.
2. The specific date and timeframe each installation will occur. Night and weekend work must be approved by the Project Construction Engineer a minimum of 24 hours prior to the proposed commencement of the work.
3. The Technical Supervisor's name for the crew(s) that will be doing each specific installation.
4. The method of installation planned for each line in accordance with ASTM F1216.
5. The location and schedule of the "wet-outs" in order to permit inspection of the materials and procedures. This information may be submitted separately.

#### **10.7.3.4 Technical Supervision**

Due to the technical aspects and complexity of the products used during the installation of CIPP, the Contractor is required to maintain a full time employee with a minimum of five years experience in the CIPP process of rehabilitation. This employee should be at the superintendent level or higher. This employee must be the direct, first line contact for all aspects of the project construction management. Resume and references, and copies of applicable required OSHA training certificates of this employee shall be submitted to the Project Construction Engineer for review and acceptance prior to the start of the project

#### **10.7.3.5 Long Term Performance Studies**

Submittals shall include long term performance studies of the materials from the specific supplier to be used on the project from industry recognized universities, research institutes, and/or independent laboratories, using applicable ASTM standards. The CIPP liner material must meet the requirements of ASTM F1216 and ASTM D5813 Sections 6 and 8( Appendix X.1). The resin shall produce CIPP, which will comply with the structural and chemical resistance requirements of ASTM F1216. CIPP samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical testing requirements. The long term performance studies must show the proposed material consistently meets the required minimum nominal thickness with a -5% tolerance and strength requirements of the Contract Documents and Project Plans and Specifications. The finished CIPP shall be fabricated from materials which when cured will be chemically resistant to withstand internal exposure to domestic sewage. The Contractor must identify an industry recognized laboratory to be used for Laboratory Tests that will test and certify that CIPP installed on this project meets the strength requirements of ASTM D5813 and chemical resistance requirements of ASTM F1216, Appendix X2. The Long Term Performance Studies must be submitted and accepted prior to bidding to pre-qualify the prospective bidder. The CIPP liner material used for the project must be the exact same composition of the material used in the Long Term Performance Studies as outlined in this Section. Any deviation in the composition will

require a new Long term Performance Study to be completed, submitted and accepted prior to installation.

#### **10.7.3.6 Laboratory Testing**

As outlined in this specification, CIPP samples shall be submitted for testing to a Certified Independent Laboratory accepted by the Project Construction Engineer. Samples will be selected from the first week's installation on the project and the Contractor must expedite Laboratory Testing so that the results will be submitted to the Project Construction Engineer prior to the first pay estimate. The Contractor must identify an industry recognized laboratory to be used for the Laboratory Testing that will test and certify that CIPP installed on this project meets the strength requirements of ASTM D638 and ASTM D790. All test results shall be submitted to the Project Construction Engineer no later than one week after completion of the tests.

#### **10.7.3.7 Public Notice**

A complete Public Information and Notification Program shall be submitted in writing to the Project Construction Engineer for review and acceptance (see also 10.7.6). The Contractor shall provide up to date information for the Public Information and Notification program prior to any construction and submit review copies of the Public Notice to be delivered to each home or business describing work to be done as outlined in these specifications.

#### **10.7.3.8 Traffic Control Plans**

The Contractor shall submit, at least 5 business days in advance of the work, copies of the approved traffic control plans as per the requirements set forth by the City and County of Denver, Transportation Engineering Division.

#### **10.7.3.9 Written Log Sheets and Digital Video Logs**

The Contractor shall submit two (2) sets of written log sheets and digital video disks for the pre and post inspections the week following completion of each work segment so they can be reviewed for quality assurance by the Project Construction Engineer. Written log sheets and digital video disks not submitted at least 5 business days prior to a pay estimate cut-off date will not be considered for that month's pay estimate.

### **10.7.4 Materials**

#### **10.7.4.1 Textile Tube**

1. The tube shall meet the requirements of ASTM F1216 and ASTM D5813 Sections 6 and 8. The textile tube shall be continuous in length for the associated run. The wet-out textile tube shall meet ASTM F1216, 7.2 as applicable, have sufficient strength to bridge missing pipe segments and have a uniform thickness that when compressed at installation pressure will equal the specified nominal tube thickness, with a -5% manufacturing tolerance allowed. The tube shall be fabricated to a size that when installed will tightly fit the internal circumference and length of the original pipe.

Allowance should be made for circumferential stretching during installation. The minimum length shall be that deemed necessary by the Contractor to effectively span the distance between respective access points, unless otherwise specified. It is the Contractor's responsibility to verify the CIPP lengths and diameters in the field before fabricating the tube. Individual installation runs can be made over one or more manhole sections as determined in the field by the Contractor. The maximum allowed installation run is 1,200 feet. Intermediate manholes will be reopened as directed by the Project Construction Engineer.

2. Prior to installation the outside layer of the tube shall be translucent plastic coated with flexible material that clearly allows inspection of the resin impregnation, or wet-out procedure. The plastic coating shall not be subject to delamination after curing of the CIPP. The tube shall be homogenous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No materials shall be included in the tubes that are subject to delamination from the cured CIPP.
3. The wall color of the interior pipe surface of the CIPP after installation shall be light green or light brown so that a clear detail examination with closed circuit television inspection equipment may be made.
4. The wet-out textile tube shall meet ASTM F1216, 7.2 as applicable, shall have a uniform thickness and 5% to 10% excess resin distribution that when compressed at installation pressures will meet or exceed the design thickness after the cure.

#### 10.7.4.2 Resin

1. The resin/liner system shall conform to ASTM D2990 and ASTM D5813 Section 8.2.2 – 10,000-hour test.
2. The resin shall be a general purpose, unsaturated, styrene-based, thermoset resin and catalyst system or epoxy resin and hardener that are compatible with the inversion process as per the requirements of ASTM F1216. The resin shall be tinted so that adequate saturation can be readily observed.
3. The tube shall be impregnated with sufficient amount of resin to insure that the resin will be observed on the outer surface of the tube when squeezed. After the tube is cured, it shall show satisfactory evidence of a fully impregnated tube or the existence of excess resin on the outer surface.

#### 10.7.4.3 Calibration Hose

If a calibration hose is required to be used during the process of the installation of the CIPP, the hose shall be wet and impregnated with sufficient amount of resin prior to inversion to prevent delamination after the curing of the CIPP. Delaminating or failure of the calibration hose will be cause for a bid reduction or complete removal of that CIPP section at the discretion of the Project Construction Engineer.

#### 10.7.4.4 Structural Requirements

1. The CIPP shall be designed as per ASTM F1216, Appendix X.1. The CIPP design shall assume no bonding to the original pipe wall. The CIPP thickness must meet the required minimum nominal thickness specified in the Contract Documents, with a -5% tolerance allowed.
2. The layers of the cured CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers; nor shall separation of the layers occur during the required testing.
3. The cured pipe material (CIPP) shall conform to the minimum structural standards, as listed below:

Flexural Stress	(ASTM D-790)	4,500 psi
Modulus of Elasticity	(ASTM D-790)	400,000 psi
Tensile Strength	(Pressure Pipe) ASTM D-638	3,000 psi
Tensile Strength	(Gravity Sewer) ASTM D-638	2,500 psi

#### 10.7.5 Quality Control

The Contractor will be allowed to work on and complete only one installation run at a time unless approved otherwise by the Project Construction Engineer. Prior to the start of each subsequent installation run, the Contractor shall submit at least two samples for field thickness testing. All samples provided for testing shall be restrained with equivalent diameter pipe to match the actual field installed liner. The Contractor must identify the samples using the City Project Number, Line Number, Date and Specified Thickness Requirement. From these samples a representative group will be selected by the Project Construction Engineer for Laboratory Testing of tensile and flexural strength as per ASTM D638 and flexural stress and modulus of elasticity as per ASTM D790. The laboratory reports for these tests shall be as outlined in the measurement and payment and project bids quantities. The laboratory report shall indicate, but not be limited to, the following properties:

1. Tensile strength
2. Flexural stress
3. Modulus of elasticity
4. Wall thickness of cured pipe

In the event that the results of these tests do not meet the requirements of these Detail and Technical Specifications and referenced ASTM standards, the Contractor may proceed with the work at his/her own risk and will be required to submit to the Project Construction Engineer his/her proposed changes in the process to meet the required properties of the CIPP.

For the run which failed to meet the required properties, the Contractor's attention is directed to General Condition 304 - Substituted Performance. At the discretion of the Project Construction Engineer and at the Contractor's own expense, the Contractor will be required to remove and replace any liner, or install another liner on top of the one that failed in order to meet these Detail and Technical Specifications.

The City may elect at any time to decrease the frequency and later reinstate the original schedule of these sample and testing requirements.

### **10.7.5.1 Testing**

#### *10.7.5.1.1 On-Site Thickness Testing*

A minimum of 2 (two) samples will be collected at each installation. All samples selected for testing shall be restrained with equivalent diameter pipe to match the actual field installed liner. The wall thickness will be measured in accordance with the applicable sections of ASTM Test Method D2122. A minimum of eight sufficient readings will be made to ensure that the minimum thickness has been determined. The inner and outer surface of the lining material should not be included in the measured structural thickness. A cylindrical anvil tubing micrometer accurate to +0.02 mm (+0.001 inch) will be used. The minimum wall thickness tests will be performed by the Project Construction Engineer or assigned field representative from the two samples at each installation. All costs associated with providing the required samples shall be borne by the Contractor.

If the deviation in thickness of any one sample is less than 5% (five percent), no payment adjustment will be required. If the deviation in thickness is measured to be between 5%-10% (five percent and ten percent) an adjustment of 10% (ten percent) reduction of the liner unit bid cost will be applied. If the deviation in thickness is greater than 10% (ten percent), the entire run will be rejected and removed and replaced solely at the Contractor's expense.

#### *10.7.5.1.2 Allowable Pulling Force*

Prior to installation, the Contractor shall submit to the Project Construction Engineer the maximum allowable force, per the material manufacturer, that can be used in pulling the tube into the pipe without rupturing or diminishing the diameter and/or the thickness of the tube. Such pulling force shall be monitored at all times during the installation operation with a gauge that is available for viewing by the City and the tube shall be rejected and removed if the allowable pulling force is exceeded.

#### *10.7.5.1.3 Allowable Elongation of Flexible Tube*

Prior to installation, the flexible tube shall be measured and marked equal to the installation run (distance between manholes less one manhole diameter). After the completion of installation, the length of the flexible tube outside of the installation run (face of the manhole

to the mark) shall be measured. This length or elongation shall not exceed 3% (three percent) of the original length of measured flexible tube. In the event that this length is exceeded, the entire run length may be rejected and permanently discarded, the Project Construction Engineer may order an additional tube to be inserted at no cost to the City, or may accept the elongated tube, but reduce the price paid for the work by 5% (five percent) for every percent elongation above the 3% (three percent) allowable tolerance, as provided by General Condition 304, Substituted Performance. Acceptance will be at the sole discretion of the Project Construction Engineer.

#### *10.7.5.1.4 Laboratory Testing*

CIPP samples shall be prepared and tested in accordance with ASTM F1216, Section 8.1 using both methods 8.1.1 and 8.1.2 for either the Inversion Method or the Pulled-In-Place Method. Testing for cured liner thickness, modulus of elasticity, flexural stress and tensile strength shall be performed by a Certified Independent laboratory approved by the Project Construction Engineer. Test results are to be submitted to the Project Construction Engineer and all costs of tests shall be included in the related bid price unless identified elsewhere. The Contractor shall take samples from the first week's installation and have the short term test completed and results to the Project Construction Engineer prior to application for the first pay estimate. Additional testing will commence at intervals required by the Project Construction Engineer.

Additional laboratory testing, at the City's expense, may be requested as frequently as every CIPP installation, at the discretion of the Project Construction Engineer. The Contractor will be reimbursed for additional testing at the Contract unit bid price. At the option of the Project Construction Engineer any sample taken by the Contractor may be sent to an independent laboratory for similar testing.

#### *10.7.5.1.5 Infiltration Test*

If the ground water level is above the top of the pipe throughout the length being reconstructed, the Project Construction Engineer, at his/her discretion, may order that an infiltration test be performed. The maximum allowable infiltration shall be 50 gal per day/inch dia/mile (.95 gpd/inch/100 ft.). Unless otherwise specified, infiltration will be measured by the Project Construction Engineer using measuring devices furnished by the City. If the infiltration is found to exceed the prescribed amount, the Contractor shall make the appropriate repairs as approved by the Project Construction Engineer. Additional infiltration tests will be performed until acceptable results are obtained.

#### *10.7.5.1.6 Exfiltration Test*

In the absence of ground water, the Project Construction Engineer, at his/her discretion, may order an exfiltration test be performed in accordance with these specifications. The allowable rate of exfiltration shall be equal to the limits of infiltration. Each section of CIPP will be tested between successive manholes by closing the lower end of a sewer and the upper manhole(s) to the proper level with water. The water level in the upper manhole shall be a minimum of 4 feet above the level of the ground water.

For the purposes of exfiltration leakage, manholes shall be considered to be equivalent length of pipe equal to the diameter of the manhole (i.e. 48, 60 or 72 inch diameter). Air pocket entrapment shall be avoided when filling the line with water. Once filled with water, the system shall be allowed to stabilize for a period of two hours before starting the test. Exfiltration leakage rate is determined by measuring the amount of water required to maintain a constant level in the upper manhole. Test duration is to be no less than two hours.

If the leakage, as shown by the test, exceeds the allowable value, the Contractor shall make the necessary correction at his expense to reduce the exfiltration to within the permissible limits. The Contractor shall furnish all water, material and labor required to perform the test. All tests shall be made in the presence of the Project Construction Engineer.

### **10.7.6 Public Information and Notification**

All written notices shall be issued on current City letterhead, prepared in a professional manner by the contractor and must be accepted by the Project Construction Engineer prior to distribution. All contact with the Public shall be executed in a business professional manner, including adhering to professional standards regarding courtesy, grooming and maintaining visible/legible identification.

The Public Information and Notification program shall at a minimum, require the Contractor to be responsible for contacting each home or business affected by the sewer construction and informing them of the work to be done in all of the following ways:

1. Personally contacting each home and business owner on the day of pre-installation inspection of the sewer and coordinating with that owner the verification of their existing service connection. If the owner is unavailable, other arrangements shall be made for existing service connection verification.
2. Written notice shall be delivered a minimum of 48 hours in advance of the installation, to each home or business describing the work, schedule, how the construction affects them, and a local telephone number of the Contractor they can call to discuss the project or any problems that may arise.
3. Personally contacting each home or business owner and providing written notice the day prior to beginning work on the section of sewer to which they are connected.
4. Personally contacting any home or business owner which cannot be reconnected within the time stated in the Written Notice. Anticipated service tap reconnection time shall be noted within another notice.
5. Personally contacting any home or business owner after the service connection has been reactivated. Provide written notice with the time of reactivation posted on the front door of a residence or business if and only if personal contact is not possible.

6. Upon request by residents and businesses affected by the work, portable toilets shall be furnished and serviced by the Contractor. The costs of these items are considered to be included in the cost of CIPP. No additional payment will be made by the City.

### **10.7.7 Installation**

#### **10.7.7.1 Access Points**

The City has shown all existing manhole access points on the Contract Documents, to the best of its knowledge. It is the Contractor's responsibility to fully examine the project site to verify the location of existing manholes and to determine if all manholes are accessible, as necessary for completion of the work. It will be the Contractor's responsibility to notify the Project Construction Engineer far enough in advance of the CIPP lining process to allow time for the City to make necessary repairs and provide access to the manholes that are not accessible. The Contractor will reschedule the work as needed so that repair work, either by the City or by the Contractor, can be completed.

#### **10.7.7.2 Cleaning of the Sewer Line**

The Contractor shall be required to remove all existing internal debris from the sewer line with the use of water jet, and/or grinding equipment that is accepted by the Project Construction Engineer. Chain knockers will not be allowed for debris and obstruction removal. The cleaning operation shall remove any and all existing debris so that each pipe joint can be thoroughly inspected and successfully reconstructed or rehabilitated.

All sludge, dirt, sand, rocks, grease, and all other solid or semi-solid material resulting from the cleaning operation shall be removed at the downstream manhole of the section being cleaned. Passing material from one manhole section to another shall not be permitted.

All such debris resulting from cleaning operations shall be removed from the site and disposed of in a proper manner. The Contractor shall bear all costs associated with testing of debris and proper dumping. Dumping of the debris shall be in accordance with all local, state, and federal regulations. The City will negotiate for costs associated with material disposal if Hazardous Wastes are encountered during testing.

At the end of each work day, all debris shall be removed from the downstream manhole and from the construction site. No debris shall be left at the construction site unattended by the Contractor. Under no circumstances will the Contractor be allowed to accumulate debris beyond the stated time limit. In the event the Contractor leaves debris unattended at the construction site beyond the stated time, the Contractor will not be allowed to proceed with the work until the debris is properly removed.

During all sewer cleaning operations, satisfactory precautions shall be taken to protect the sewer lines from damage that might be inflicted by improper use of cleaning equipment. Precautions shall be taken to ensure that the cleaning operation will not cause any damage or flooding to public and/or private property being served by the sewer line section involved. The Contractor shall bear all costs associated with flooding, damage to basements or structures, and the City's sewer.

### **10.7.7.3 Bypassing Sewage**

The Contractor shall provide for the flow of sewage around the section or sections of pipe designated for reconstruction. The bypass shall be made by plugging the line at an existing upstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow with backup pumps onsite. Bypass pumps must be monitored at all times. Leaking equipment will not be permitted. Bypass pumping must be provided for all mainline and service line flows affected by construction. Wastewater shall not be allowed to spill into storm drains, street gutters, or open excavations. Any spills that occur must be addressed immediately and in full conformance with local regulations and requirements. The Project Construction Engineer shall be notified immediately and the Contractor shall bear all costs associated with any spills.

### **10.7.7.4 Pre-Installation Inspection**

Inspections of pipelines shall be performed by experienced personnel trained in locating and identifying defects, breaks, obstacles, and service connections by closed circuit television. The inspection of pipelines shall also determine active service connections, which addresses they serve and service connections that are opened, capped or misaligned. Only active service connection and laterals shall be re-established unless directed otherwise by the Project Construction Engineer.

The interior of the pipeline shall be carefully inspected to determine the location of any conditions which may prevent proper installation of the CIPP. It is the Contractor's responsibility to notify the Project Construction Engineer of any conditions which may prevent proper installation of the CIPP far enough in advance to allow for remedial action and/or reschedule installation of that section of CIPP. These conditions shall be recorded and submitted to the Project Construction Engineer prior to the commencement of construction so that these conditions can be corrected. Two (2) copies of digital video disks and suitable written log for the pre-installation inspection shall be submitted as outlined in this specification.

### **10.7.7.5 Line Obstructions**

It shall be the responsibility of the Contractor to clear the line of obstructions such as solids and roots that will prevent the installation of the CIPP. If the pre-installation inspection reveals an obstruction such as a protruding service connection, dropped joint, collapse or obstruction that will prevent the rehabilitation process and cannot be removed by conventional sewer cleaning equipment, grinding or extended tap cutting, then the Contractor shall notify the Project Construction Engineer immediately. These conditions shall be recorded and a digital video disk and suitable written log must be submitted to the Project Construction Engineer so that the existing conditions are documented and may be reviewed to determine the extent of repair required prior to CIPP installation. The Project Construction Engineer will notify the Contractor upon completion of required repair(s), at which time the Contractor shall perform sewer line cleaning and a pre-installation inspection prior to CIPP installation.

#### 10.7.7.6 Installation Methods

All bidders proposing to use the CIPP process for a project must use a method that has been approved by the City prior to bid opening. All approved CIPP methods must meet these Detail and Technical Specifications. Any proposed deviation from these Detail and Technical Specifications must be submitted in writing for acceptance at least eight calendar days prior to the bid opening. CIPP installation shall be in accordance with ASTM F1216, Section 7 for the Inversion Method, or Section 6 of ASTM F1743 for the Pulled-In-Place Installation Method, with the following requirements:

1. The Contractor shall designate a location where the tube will be impregnated prior to installation. The Contractor shall notify the Project Construction Engineer of proposed “wet-outs” in order to inspect the materials and procedure. A resin and catalyst system compatible with the requirements of this method shall be used.
2. The Contractor shall pull the flexible tube through the existing sewer line by mechanical means. The Contractor will not be allowed to use water to float the inserted flexible tube into the existing sewer line.
3. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing heat supply. Another such gauge shall be placed at the remote manhole to determine the temperature at that location during cure. The Contractor must maintain an on-site written log during the CIPP curing process for each installation, tracking temperature, pressure (for steam cure) and curing time. This log must be available for review at any time by the Project Construction Engineer. If air pressure and steam are used, a Safety Gas Detector shall be used to ensure that it does not reach the explosive limit.
4. Before the installation process begins, the Contractor shall submit to the Project Construction Engineer, the minimum pressure required to hold the tube tight against the existing conduit and the maximum allowable pressure to avoid damaging the tube. This data shall be obtained by the Contractor from the tube manufacturer. Once the installation has started, the pressure shall be maintained between the minimum and maximum pressures until the operation has been completed. If air pressure is used for the operation, the equipment shall be fitted with a pressure gage accurate to 0.01 psi. Should the pressure deviate from within the range of minimum and maximum pressures, the installed tube shall be rejected and the Contractor will remove and dispose of the tube at no cost to the City.

Before the curing process begins, the pressure required to hold the flexible tube tight against the existing conduit shall be provided by the tube manufacturer and be submitted to the Project Construction Engineer prior to any installation process. Once the cure has started and dimpling for laterals is completed, the required pressure shall be maintained until the cure has been completed. Should the pressure deviate more than 1 psi (2.3 feet of water) from the required pressure during the critical curing period, the tube will be rejected and the Contractor will be responsible for the removal of the CIPP and

replacement with new CIPP at no additional cost to the City. A complete log of the pressure shall be maintained on the site and shall be furnished to the Project Construction Engineer after each installation.

5. The plastic coating of the tube shall be translucent to allow visual proof that the resin has wet out the entire tube and that there are no dry areas.
6. The Contractor shall maintain a log on site for each installation section documenting elongation, thickness and pulling force.
7. The finished CIPP shall be continuous over the entire length of an installation run between two manholes and be free, as commercially practicable, from visual defects such as foreign inclusions, dry spots, pinholes, and delamination.
8. If the CIPP fails to make a tight seal at each manhole, the Contractor shall apply a joint sealant at that point with a material compatible with the CIPP. The Contractor shall provide a submittal to the Project Construction Engineer for approval on the proposed sealant material.

#### **10.7.7.7 Sewer Service Connection and Reactivation**

The Contractor shall determine if a service connection is active prior to rehabilitation of the sewer. Only active service connections and laterals shall be re-established. All costs incurred to verify active service connections are included within the "Cured-In-Place-Pipe" bid item within the contract. No additional payment for verification shall be considered.

After the curing of the CIPP has been completed, the Contractor shall reopen and restore the existing active service connections and branch connections. It is the intent of these Detail and Technical Specifications that the active service connections and branch connections be reopened without excavation. When the pipe size is too small to facilitate direct manned reactivation, a remotely controlled cutting device, monitored by a close circuit television camera shall be used. The cutting device is required to re-establish service connections to not greater than 100% (one hundred percent) capacity, and not less than 95% (ninety five percent) capacity, while conforming to the shape of the existing opening. The Contractor shall be responsible for completing point repairs of any active service connections that are damaged or misaligned during reactivation procedures. These point repairs shall be completed as directed and approved by the Project Construction Engineer and all costs shall be born by the Contractor.

The Contractor shall certify he/she has a minimum of 2 (two) complete working cutting devices, plus spare key components on the site before each installation.

Service connections shall not remain out of service for more than 24 hours at a time, without the Contractor providing some means of temporary facilities or hotel accommodations for the affected residents or property owners.

### **10.7.8 Post Installation Inspection**

Post installation visual inspection of the CIPP shall be in accordance with ASTM F1216, Section 8.4. The Contractor will provide the Project Construction Engineer with two (2) copies of a color digital video disk and written inspection log of the completed installation, as outlined in this specification. The digital video disk will include both the before and after conditions of the pipe and all restored connections with the address of each connection served. The digital video disk must be labeled using the City of Denver Project Number, line number, manhole numbers, lineal footage and City street address of each service connection both visible in the video and verbally recorded on the digital video disk. The digital video disk shall be submitted to the Project Construction Engineer with a written log that contains all information included on the corresponding DVD. It shall be the Contractor's responsibility to submit the record DVDs and Log Sheets as outlined in these specifications.

### **10.7.9 Record Documentation**

The Contractor is required to record the location and size of all pipe lines rehabilitated as well as the location and size of all service connections. Once completed with each post-installation inspection, the Contractor is required to mark up the Contract Drawings with accurate locations of all pipe lines and service connections. Prior to each pay estimate the Contractor must review the current record drawings with the Project Construction Engineer. Providing inaccurate or incomplete record information is reason for withholding of progress payment as outlined in the General Contract Conditions. A final set of record documents shall be submitted by the Contractor, for As-Built purposes, prior to processing final payment.

### **10.7.10 Clean-Up**

The Contractor shall reinstate all project areas affected by their operations to an equal or better than existing condition upon completion of the CIPP installation. All restoration must be completed prior to submitting that section of CIPP for consideration for payment.

### **10.7.11 Patents**

The Contractor and the Contractor's suppliers shall warrant and save harmless the City against any and all claims, potential litigation involving patent infringement, copyright violations and any loss thereof.