SUGGESTED TYPICAL SPECIFICATION FOR THE INSTALLATION OF CURED IN PLACE LATERAL CONNECTION INSERT (SADDLE LINER)

Intent

It is the intent of this specification to provide for installation of a tubular resin impregnated sleeve affixed to the walls of a lateral pipe ("Lateral section") at the junction between the pipe and main sewer. In addition the sleeve should seamlessly extend into the main pipe ("the flange section") thus creating a watertight T shaped profile.

General

The method involves the impregnation of an absorbent carrier material; the attachment of the material to a inflatable former; the insertion of the former into the pipe; the remote identification and location the lateral; the inflation of the former; and the curing of the resinated carrier leaving behind a T shaped internal sleeve, consisting of a flange section in the main and a section up the lateral.

Reference specification

Tensile strength ASTM-D638

Flexural Strength ASTM D-790

Flexural Modulus ASTM D-790

Chemical Resistance ASTM D 543

Industry Specifications

ASTM F- 1216- ***Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin Impregnated Tube***

The carrier material

The carrier material shall be of fibrous absorbent composition tailored to achieve the following

1. Allow the migration of resin from its internal structure by compressing to a thickness of at least 50% of it uncompressed thickness under a pressure 1psi

2. The material must consist of non degradable fiber's such as polyester or polypropelene or Corrosion resistant fiberglass.

3. The material must have a coated surface in the lateral portion to ensure that on curing a smooth surface free from blemishes, pinholes or loose non wetted fibers.

4. Where fiberglass is used a surface veil or a layer of felt must be used to act as barrier to prevent osmosis or wicking of the strands.

The resin

The resin must be a thermosetting resin cured by either heat or chemically via the use of accelerators, or any other safe energy source which does not involve the use of electric current within the main sewer, unless where evidence can supplied of the intrinsic safety.

The resin must give give sufficient working time above ground to enable impregnation of the fabric, but must cure to sufficient hardness to carry overburden loads within a maximum of 2 hours from time of insertion into the pipe.

The resin used must have resistance to most chemicals to be found within a sewer system . As a minimum it must have resistance to the following chemicals at the following temperatures

Chemical Resistance

The resin must be resistant to the chemicals likely to be within the pipe and as a minimum must be resistant to the chemicals below.

The test is done in accordance with ASTM D 543. Exposure should be for a minimum of one months at 73.4F. During this period the CIPP test specimen should lose no more than 20% of its initial flexural strength and flexural modulus when tested in accordance with Section 8 of this practice.

Chemical Solution	**Concentration**
Tap Water (ph 6-9)	100%
Nitric Acid	5%
Phosphoric Acid	10%
Sulfuric Acid	10%
Gasoline	100%

Characteristics of the Repair Sleeve

Length in Main Sewer:	12"
Length in Lateral Pipe:	5" on average
Acceptable angle of lateral:	45 or 90 degree
Time for cure at 60 degrees F	2 hours
Access requirement:	From Manhole on the main line
Wrinkling allowance:	10% diameter
Thickness:	Designed to suit. From 2mm- 6mm

Resin Carrier Combination

The resin and the carrier when cured must meet the following minimum criteria

Testing Method

ASTM- D 790

Flexural Strength	4500 psi
Flexural Modulus	250 000 psi

Testing

Visual Inspection

On completion of the work a CCTV survey should be carried out and the repairs must be verified as per below

1. The flange section in the main should be watertight internally.

2. There reduction in the main pipe diameter should be no more than 15% of the original pipe diameter.

3. The junction between the flange and the lateral sleeve must be watertight. A certain amount of wrinkling at this interface is acceptable provided it is no more than 15% of the diameter of the lateral pipe.

Pressure Testing

If required by the owners bid documents, testing may take place by placing a plug in the main sewer and inserting a proprietary push rod plug down the lateral. The "T" section is isolated an air is fed into the isolated section.

Test criteria and acceptable losses to be determined by the engineer in consultation with the contractor

Design Considerations

The design is based on the assumption of a partially deteriorated pipe. The CIPP is designed to support the hydraulic loads due to groundwater, since the soil and surcharge loads can be supported by the original pipe. The groundwater level should be determined by the purchaser and the thickness of the CIPP should be sufficient to withstand this hydrostatic pressure without collapsing. The following equation may be used to determine the thickness required:

$$P = \frac{2KE_L}{1 - v^2} \cdot \frac{1}{(SDR - 1)^3} \cdot \frac{C}{N}$$

where:

P = groundwater load, psi (MPa),
K = enhancement factor of the soil and existing pipe adjacent to the new pipe (a minimum value of 7.0 is recommended where there is full support of the existing pipe),
E_L = long-term (time corrected) modulus of elasticity for CIPP, psi (MPa)
ν = Poisson's ratio (0.3 average),
SDR = standard dimension ratio of CIPP,
C = ovality reduction factor = $[1- 0.01q/ (1+ 0.01q)^2]^3$

q = percentage ovality of original pipe =
100 x (Mean Inside diameter - Minimum Inside Diameter)
Mean Inside Diameter

Using this formula we derive the following tables

Diameter (inches)	Thickness (mm)	Max Pressure Head ft
8	6	40
10	6	20
12	6	11
15	9	20
18	9	11
18	12	27
24	12	11

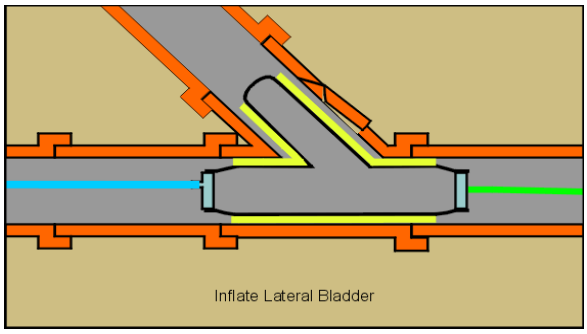
The table is based on K = 7, E = 125,000 psi (50 year strength figure), v = 0.3, C=0.64 (ie 5% ovality) and N=2

Hydraulic Design Considerations

A CIPP liner can reduce the inside pipe diameter and may affect flow in small diameter pipes, but the reduction is usually more than offset by the improved flow characteristics. These compare favorably with an existing concrete pipe's high Manning flow coefficient of about 0.015 or corrugated pipe Manning flow coefficient of 0.024. Reduced flow is insignificant in oval sewer pipes. Area reduction is only 0.6% at 5% ovalization and 2.4% at 10% ovalization

The analysis may be done using the Manning Equation

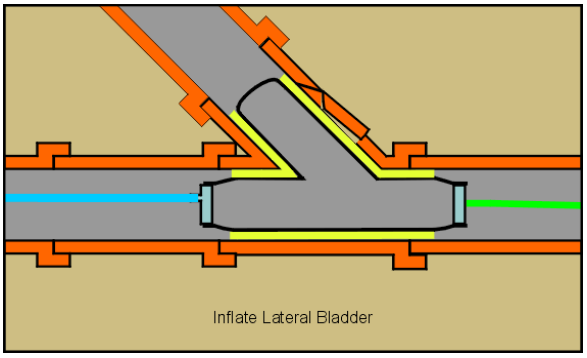
Method Statement



A patent applied stitched polyester fabric is impregnated with an ambient cure resin.

The fabric is made into a T shape , the top of the T representing the portion of the main line and the leg of the T representing the lateral portion.

The main portion starts off as a flat sheet whilst the lateral portion may either be a tube, conical tube or a flat sheet depending on application.



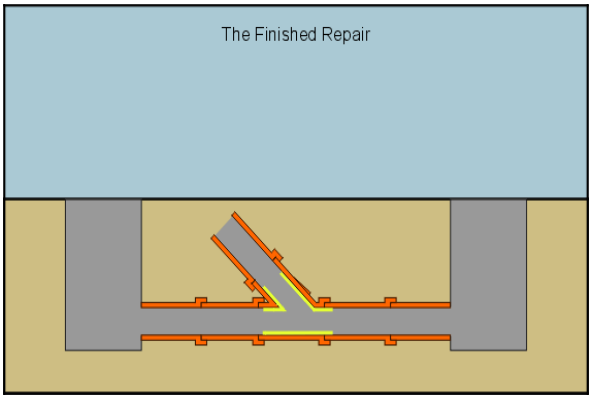
The flat portion is wrapped around the main portion of a T shaped rubber packer.

The lateral portion is wrapped and secured around the lateral portion of the packer.

A robot is attached to the packer and the resulting assembly is dragged into position

The lateral cutter / robot is used to rotate the assembly to ensure alignment with the lateral.

The main and lateral portion of the packers are inflated separately to position the lateral and main portion appropriately.



Both sections of the packer is inflated thus placing the impregnated sleeve in contact with the pipe walls.

The assembly is left to cure for typically 1 - 3hours depending on temperature and resin mix selection.

On curing, the packer is deflated leaving behind a watertight sleeve at the junction.

Preparatory Procedures

Cleaning of Pipe

Cleaning of the mainline shall be performed by the contractor to ensure that the repair sleeve does not entrap any debris when carried to the position of the repair. The lateral pipe should also be clean and free from encrustation for the full distance of the repair.

Preparing surface

Additional precautions need to be taken when applying the sleeve to a main pipe lined with a CIPP liner with a polyolefin coating. The coating is to be lightly scarified, scraping off the coating in the main pipe cipp in the vicinity of the Saddle Liner repair.

Preparing lateral

Where the main pipe has been lined previously with a cipp liner, a check should be made to ensure the prior lateral reopening work created a lateral opening that is flush with the lateral pipe. If this is not the case, the mainline cipp must be trimmed back using a lateral cutter.

Where active infiltration is present, this must be stopped in advance by grouting.

Prerepair survey
A videotaped survey must be done on the main run with a pan and tilt camera to confirm the proposed repair falls within the limitation parameters set by the manufacturer on the following aspects:
The location and clock reference of the lateral junctions to be repaired, any offsets, any intrusion from the lateral into the main; the angle at which the connection comes in; any changes in angle of approach of the lateral for the length of the repair; the potential flows coming throughout the lateral pipe; the potential flows going through the main pipe; the diametric size of the connection for the length of the repair; the size of the main pipe at the point of the repair; the presence of active infiltration within the vicinity of the repair area (as the material should not be applied under active infiltration); the weather; the identification of access to the head of each lateral connection .

The Repair Process

On completion of the the survey, a report should be submitted to the Engineer confirming the feasibility and the required program of works.

Post Repair Survey

On completion of a given run, video taped evidence must be provided by the contractor.

The repair sleeve should be monitored for excessive wrinkling, exposed unwetted fibers, pinhole leaks, and infiltration around the terminations.

Quality Assurance

The workmanship of the works shall be warranted for a period of 12 month following substantial completion. The material shall be warranted as per terms and condition of the manufacturer for a similar period PROVIDED the contractor applies the product in accordance with the current guidelines (Standard Operating Procedure) set out by the manufacturer.

Typical Bill Items

Description	**Measurement**	**Unit Rate**
Pipe Cleaning	Per Manhole Run	General Contractor
Pre Repair CCTV survey	Per manhole run	General Contractor
Mobilization of Repair Equipment	Lump sum	
Setting up Repair Equipment at a given manhole	Per manhole run	
Installation of repair sleeve for given main pipe size of 8”-12” and lateral of 4-6” based on Design head of 10 feet	Each	TBA
Post repair survey (B&W)	Per manhole run	General Contractor
Testing of 10% of contract	Lump sum	General Contractor