

SPECIFICATION FOR THE INSTALLATION OF CURED IN PLACE RESIN SLEEVE FROM MANHOLE TO MANHOLE. (TOWN LINER)

Intent

It is the intent of this specification to provide for installation of up to 300 feet long tubular resin impregnated sleeve, affixed to the walls in the middle of a main sewer pipe run, starting from one manhole to another manhole or to a blind outfall, upstream or downstream

General

The method involves the impregnation of an absorbent carrier material; the inversion of the material into the pipe, the curing of the sleeve leaving behind a hard plastic sleeve mechanically bonded to the host pipe.

Reference specification

Tensile strength ASTM-D638

Flexural Strength ASTM D-790

Flexural Modulus ASTM D-790

Chemical Resistance ASTM D 543

Industry Specifications

ASTMF- 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 less than 90% of its 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 an abrasion resistant, chemically resistant, fully bonded 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.

5. The carrier material must be resistant to the resin used and must withstand any installation forces without losing its integrity.

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 electrical 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 8 hours from time of insertion inside 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

Starting Point:	From D/S or U/S manhole
Length in Main Pipe:	Up to 300 feet
Time for cure	3 hours at 110 deg F
Thickness:	6mm or 7.5mm

Resin Carrier Combination

The resin and the carrier fabric 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. There should be no evidence of water ingress within the liner.
2. The sleeve should be watertight internally. Where bends or other pipe deformities are present the maximum wrinkling allowed is 3% of the pipe diameter.

Pressure Testing

If required by the owners bid documents, testing may take place by placing two push rod plugs to the beginning and the end of the sleeve. Air is fed into the isolated area and pressure losses are monitored.

Test criteria and acceptable losses to be determined in advance 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:

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

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 = $[1 - 0.01q / (1 + 0.01q)^2]^3$

$$q = \text{percentage ovality of original pipe} = \frac{100 \times (\text{Mean Inside diameter} - \text{Minimum Inside Diameter})}{\text{Mean Inside Diameter}}$$

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	7.5	14

The table is based on *K* = 7, *E* = 125,000 psi (50 year strength figure), *ν* = 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

Brief description

Method statement

The pipe must be clean and free from debris, encrustation and standing water. Using a camera measure the length of felt tubing required.

Insert the fibre liner tube into a bladder tube.

Mix the resin and hardener required and pour the required amount of resin into the tube.

Attach a Vacuum pump to the other end of the tubes and feed the material through the nip roller, spacers and conveyor system. Adjust the speed of impregnation to ensure thorough wet out on both top and bottom.

Carefully wind the fibre liner.bladder combination into the tank ensuring tension at all times. Turn the trailing end of the bladder back on to the nose cone. Strap the tubes to the cone using a ratchet strap.

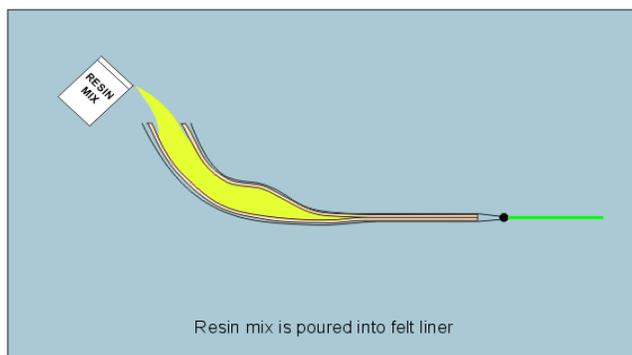
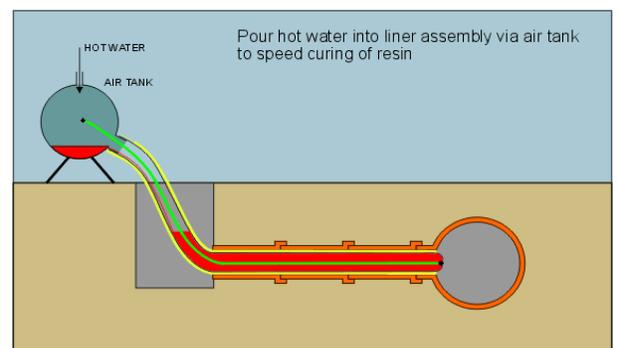
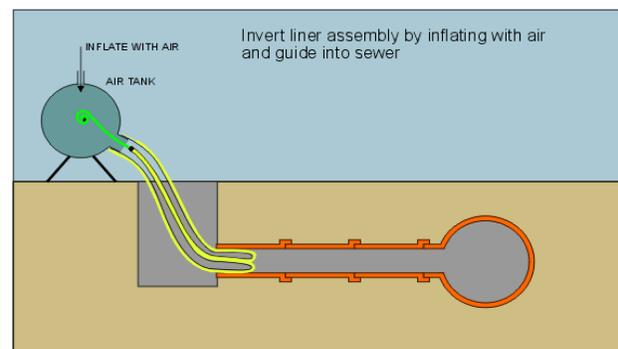
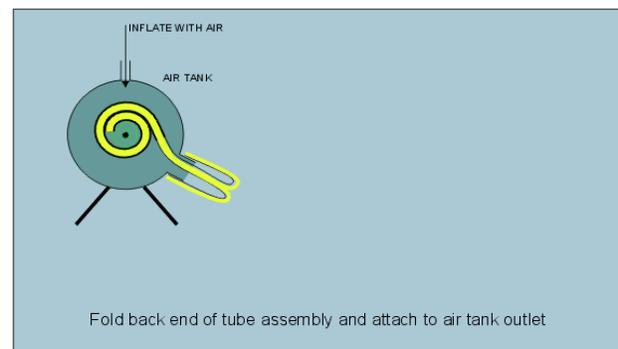
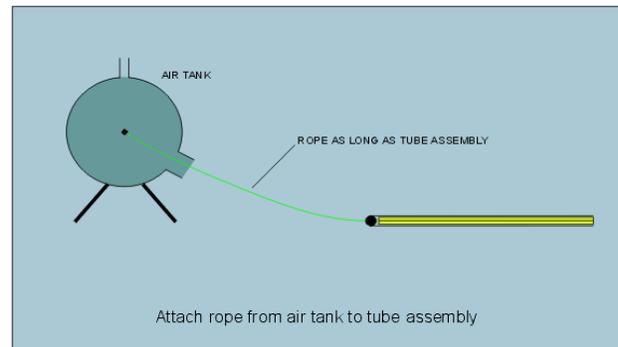
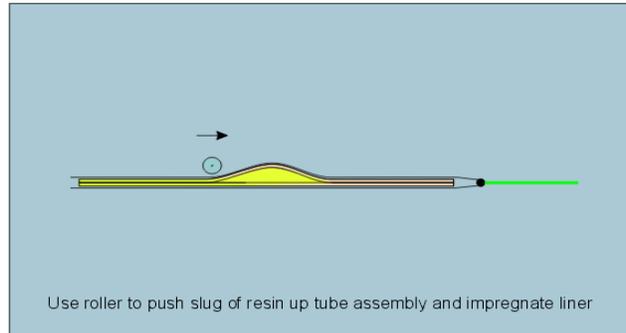
Introduce regulated compressed air (Max 6psi) to the tank and allow sufficient bladder tubing to extrude out. Deflate the tubing by venting out the air. Tuck in the tubing into the pipe run. Switch on the compressor and allow the pressure to build up to 6psi by holding the winding arm.

Gradually unwind the arm at a speed that maintains 6psi pressure till the bladder tubing is fully everted into the pipe and comes out at the required termination point or the downstream manhole.

Connect the boiler to the shaft of the tank and introduce warm water at the prescribed temperature whilst allowing the air to escape through the relief valve.

Continue introducing warm water till the water level backs up to a level just above the crown of the pipe. Leave the combination of tubes till the felt tube cures

Once cured puncture the bladder tube at the upstream end next to where it is clamped on the pipe. Slowly rewind the arm of the tank to un-invert the bladder tube thus forcing water out into the manhole.



Brief description

Method statement

The pipe must be clean and free from debris, encrustation and standing water. Using a camera measure the length of felt tubing required.

Mix the resin and hardener required and pour the required amount of resin into the tube.

Attach a Vacuum pump to the other end of the tube and feed the material through the nip roller, spacers and conveyor system. Adjust the speed of impregnation to ensure thorough wet out on both top and bottom.

Carefully wind the felt liner into the tank ensuring tension at all times. Turn the trailing end back on to the nose cone. Strap the tube to the cone using a ratchet strap.

Introduce regulated compressed air (Max 6psi) to the tank and allow sufficient felt tubing to extrude out. Deflate the tubing by venting out the air. Tuck in the tubing into the pipe run. Switch on the compressor and allow the pressure to build up to 6psi by holding the winding arm.

Gradually unwind the arm at a speed that maintains 6psi pressure till the felt tubing is fully everted into the pipe comes out at the downstream manhole. Deflate the felt tubing and disconnect it from the tank.

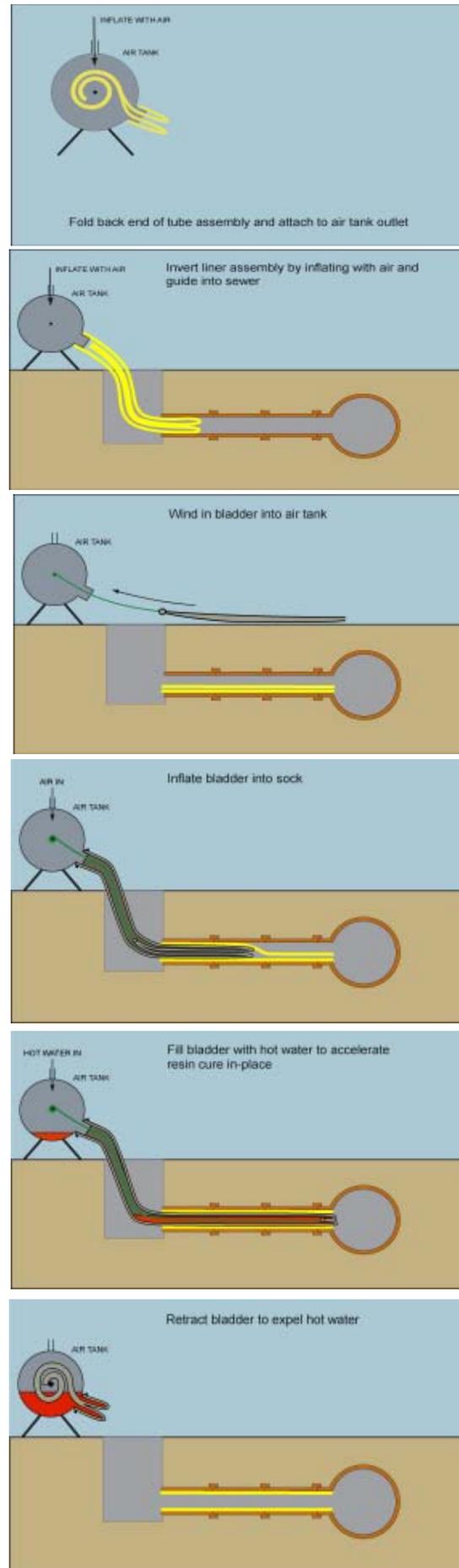
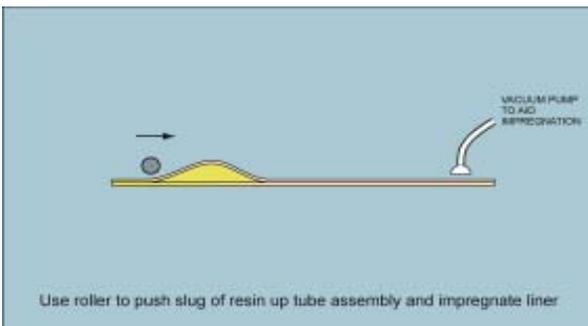
Load the bladder gun with sufficient bladder tubing. Switch on the compressor and allow the pressure to build up to 4psi by holding the winding arm. Feed the bladder into the deflated felt tube.

Gradually unwind the arm at a speed that maintains 4 psi pressure till the adequate amount of bladder tubing corresponding to the length of felt tube is everted into the pipe.

Connect the boiler to the shaft of the tank and introduce warm water at the prescribed temperature whilst allowing the air to escape through the relief valve.

Continue introducing warm water till the water level backs up to a level just above the crown of the pipe. Leave the combination of tubes till the felt tube cures

Once cured puncture the bladder tube at the upstream end next to where it is clamped on the pipe. Slowly rewind the arm of the tank to un-invert the bladder tube thus forcing water out into the soil. Once the bladder is retrieved, trim the ends of the



Preparatory Procedures

Cleaning of the Main Pipe

The manhole to manhole section of main pipe must be free debris, obstructions, scale or any other material that reduces the effective bore of the pipe or loose material which may be pushed forward by the inversion process.

If inverting upstream, provision needs to be made for reducing the flow to no more than 15% of the bore of the pipe

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 presence of bends, groundwater infiltration, flow rates from laterals and through the main pipe, gradient of pipe run.

Repair Process

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

Typical Bill Items

Description	Measurement	Unit Rate
Main Pipe Cleaning	Per Run	General Contractor
Pre repair CCTV of Main pipe and mapping of laterals.	Per run	
Mobilization of Repair Equipment	Lump sum	
Set up for Installation of Liner	Each	
Installation of 8" liner designed to withstand an external hydrostatic pressure of 10 feet.	ft	
Post repair survey of pipe Black and White survey of main pipe.	Per run	
Set up of equipment for reconnecting lateral	Per run	
Cost of reconnecting each lateral	Each	

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 and pinhole leaks.

Testing

Subject to the result of the Inspection test, the Engineer reserves the right to select approximately 10% of the repairs for further testing using a water. The test shall comprise of pushing a plug to the downstream end of the sleeve, inserting a bypass plug at the upstream end and filling the isolated section with water. Losses shall be measured and must be within levels set by the local code.

If the failure rate exceeds 10% and additional retest area of an equivalent size shall be selected for further testing.

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.