C.I.P.P. Corporation
Specifications

CIPP PIPE SPECIFICATIONS

I. Scope

A. This practice describes the procedures for the reconstruction of pipelines and conduits (4 to 96-in. diameter) by the installation of a resin-impregnated, flexible tube which is inverted into the existing conduit by use of a hydrostatic head or air pressure or a combination of each. The resin is cured by circulating hot water within the tube or by the calibrated introduction of steam. When cured, the finished pipe will be continuous and tight-fitting. This reconstruction process can be used in a variety of gravity and pressure applications such as sanitary sewers, storm sewers, process piping, electrical conduits, and ventilation systems.

B. The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

C. This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

II. Referenced Documents

A. ASTM Standards:
   1. D 543 Test Method for Resistance of Plastics to Chemical Reagents
   2. D 638 Rest Method for Tensile Properties of Plastics
   3. D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Material
   4. D 903 Test Method for Peel or Stripping Strength of Adhesive Bonds
   5. D 1600 Terminology for Abbreviated Terms Relating to Plastics
   6. D 3839 Practice of Underground Installation of Fiberglass (Glass-Fiber-Reinforced Thermosetting Resin) Pipe
   7. F 1216 Terminology Relating to Plastic Piping Systems

B. AWWA Standard
   1. Manual on Cleaning and Lining Water Mains, M28

C. NASSCO Standard
   1. Recommended Specifications for Sewer Collection Systems
III. Terminology

A. Definitions
1. Definitions are in accordance with Terminology ASTM F1216 and abbreviations are in accordance with Terminology ASTM D1600, unless otherwise specified.

B. Cured-in-place pipe (CIPP)
1. A hollow cylinder containing a non woven or a woven material, or a combination of non woven and woven material surrounded by a cured thermosetting resin.
   (a) Plastic coatings may be included. This pipe is formed within an existing pipe. Therefore, it takes the shape of and fits tightly to the existing pipe.

C. Inversion
1. The process of turning the resin-impregnated tube inside out by the use of water pressure or air pressure.

D. Lift
1. A portion of the CIPP that has cured in a position such that it has pulled away from the existing pipe wall.

IV. Significance and Use

A. This practice is for use by designers and specifiers, regulatory agencies, owners and inspection organizations who are involved in the rehabilitation of conduits through the use of resin-impregnated tube inverted through the existing conduit. As for any practice, modifications may be required for specific job conditions.

V. Materials

A. Tube
1. The tube should consist of one or more layers of flexible needled felt or an equivalent non woven material, or a combination of non woven and woven materials, capable of carrying resin, withstanding installation pressures and curing temperatures.
   (a) The tube should be compatible with the resin system used.
   (b) The material should be able to stretch to fit irregular pipe sections and negotiate bends.
   (c) The outside layer of the tube should be plastic coated with a material that is compatible with the resin system used.
2. The tube should be fabricated to a size that, when installed, will tightly fit the internal circumference and the length of the original conduit.
   (a) Allowance should be made for circumferential stretching during inversion.
3. The tube thickness shall be specified by the owner utilizing pipe conditions and engineering formulas listed in ASTM F 1216-03.
TABLE I
CIPP Initial Structural Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Method</th>
<th>psi</th>
<th>(Mpa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexural Strength</td>
<td>D 790</td>
<td>4,500</td>
<td>(31)</td>
</tr>
<tr>
<td>Flexural Modulus</td>
<td>D 790</td>
<td>500,000</td>
<td>(2,755)</td>
</tr>
<tr>
<td>Tensile Strength (for pressure pipes only)</td>
<td>D 638</td>
<td>3,000</td>
<td>(21)</td>
</tr>
</tbody>
</table>

B. Resin
1. A general purpose, unsaturated, styrene based, thermoset resin and catalyst system that is compatible with the inversion process should be used.
2. The resin must be able to cure in the presence of water and the initiation temperature for cure should be less than 180°F (82.2°C).
3. The CIPP system can be expected to have as a minimum the initial structural properties given in Table 1.

VI. Installation
A. Cleaning and Inspection
1. Confined Space Entry
   (a) Prior to entering access areas such as manholes, and performing inspection or cleaning operations, an evaluation of the atmosphere to determine the presence of toxic or flammable vapors or lack of oxygen must be undertaken in accordance with local, state, or federal safety regulations.
2. Cleaning of Pipeline
   (a) All internal debris should be removed from original pipeline.
   (b) Gravity pipes should be cleaned with hydraulically powered equipment, high-velocity jet cleaners, or mechanically powered equipment (see NASSCO Recommended Specifications for Sewer Collection System Rehabilitation).
   (c) Pressure pipelines should be cleaned with cable-attached devices or fluid-propelled devices as shown in AWWA Manual on Cleaning and Lining Water Mains, M28.
3. Inspection of Pipelines
   (a) Inspection of pipelines should be performed by experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television or man entry.
   (b) The interior of the pipeline should be carefully inspected to determine the location of any conditions that may prevent proper installation of the impregnated tube, such as protruding service taps, collapsed or crushed pipe, and reductions in the cross-sectional area of more than 40%. These conditions should be noted so that they can be corrected.
4. Line Obstructions
   (a) The original pipeline should be clear of obstructions such as solids, dropped joints, protruding connections, crushed or collapsed pipe, and reductions in the cross-sectional area of more than 40% that will prevent the insertion of the resin-impregnated tube.
   (b) If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, then a point repair excavation should be made to uncover and remove or repair the obstruction. The owner should be notified so that appropriate action may take place. Point repairs are not included in this contract.

B. Resin Impregnation
   1. The tube should be vacuum impregnated with resin (wet-out) under controlled conditions.
   2. The volume of resin used should be sufficient to fill all voids in the tube material at nominal thickness and diameter.
      (a) The volume should be adjusted by adding 5 to 10% excess resin for the change in resin volume due to polymerization and to allow for any migration of resin into the cracks and joints in the original pipe.

C. Bypassing
   1. If bypassing of the flow is required around the sections of pipe designated for reconstruction, the bypass should be made by plugging the line at a point upstream or the pipe to be reconstructed and pumping the flow to a downstream point or adjacent system.
   2. The pump and bypass lines should be of adequate capacity and size to handle the flow.
      Bypass systems should be redundant in case of pump failure and monitored at all times.
   3. Services within this reach will be temporarily out of service.
      (a) Public advisory services will be required to notify all parties whose service laterals will be out of commission and to advise against water usage until the mainline is back in service.

D. Inversion
   1. Using Hydrostatic Head
      (a) The wet-out tube should be inserted through an existing manhole or other approved access by means of an inversion process and the application of hydrostatic head sufficient to fully extend it to the next designated manhole of termination point.
      (b) The tube should be inserted into the vertical inversion standpipe with the impermeable plastic membrane side out.
      (c) At the lower end of the inversion standpipe, the tube should be turned inside out and attached to the standpipe so that a leak proof seal is created.
      (d) The inversion head should be adjusted to be of sufficient height to cause the impregnated tube to invert from point of inversion to point of termination and hold the tube tight to the pipe wall, producing dimples at side connections.
      (e) Care should be taken during inversion to not over-stress the felt fiber.
   2. Top Inversion
      (a) An alternative method of installation is a top inversion. In this case, the tube is attached to a top ring and is inverted to form a standpipe from the tube itself or another method accepted by the engineer.

Note - The tube manufacturer should provide information on the maximum allowable tensile stress for the tube.
3. Using Air Pressure
   (a) The wet-out tube should be inserted through an existing manhole or other approved access by means of an inversion process and the application of air pressure sufficient to fully extend it to the next designated manhole or termination point.
   (b) The tube should be connected by an attachment at the upper end of the guide chute so that a leakproof seal is created and with the impermeable plastic membranes side out.
   (c) As the tube enters the guide chute, the tube should be turned inside out.
   (d) The inversion air pressure should be adjusted to be of sufficient pressure to cause the impregnated tube to invert from point of inversion to point of termination and hold the tube tight to the pipe wall, producing dimples at side connections.
   (e) Care should be taken during the inversion so as not to overstress the woven and non-woven materials.

   Note - Suitable precautions should be taken to eliminate hazards to personnel in the proximity of the construction when pressurized air is being used.

4. Required Pressures
   (a) Before the inversion begins, the tube manufacturer shall provide the minimum pressure required to hold the tube tight against the existing conduit, and the maximum allowable pressure so as not to damage the tube.
   (b) Once the inversion has started, the pressure shall be maintained between the minimum and maximum pressures until the inversion has been completed.
   (c) Should the pressure deviate from within the range of the minimum and maximum pressures, the installed tube shall be removed from the existing conduit.

E. Lubricant
   1. The use of a lubricant during inversion is recommended to reduce friction during inversion.
   2. This lubricant should be poured into the inversion water in the down tube or applied directly to the tube.
   3. The lubricant used should be a nontoxic, oil-based product that has no detrimental effects on the tube or boiler and pump system, will not support the growth of bacteria, and will not adversely affect the fluid to be transported.

F. Curing
   1. Using Circulated Heated Water
      (a) After inversion is completed, a suitable heat source and water re-circulation equipment are required to circulate heated water throughout the pipe.
         (i) The equipment should be capable of delivering hot water throughout the section to uniformly raise the water temperature above the temperature required to affect a cure of the resin.
         (ii) The heat source should be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another such gauge should be placed between the impregnated tube and the pipe invert at both ends to determine the temperatures during cure.
      (b) Water temperature in the line during the cure period should be as recommended by the resin manufacturer.
(c). Initial cure will occur during temperature heat-up and is completed when exposed portions of the new pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm or cure in the resin.

(d). After initial cure is reached, the temperature should be raised to the post-cure temperature recommended by the resin manufacturer.
   (i) The post-cure temperature should be held for a period as recommended by the resin manufacturer, during which time the re-circulation of the water and cycling of the boiler to maintain temperature continues.
   (ii) The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

(e). Required Pressures
   (i) Before the curing begins, the pressure required to hold the flexible tube tight against the existing conduit shall be provided by the tube manufacturer.
   (ii) Once the cure has started and dimpling for laterals is completed, the required pressure shall be maintained until the cure has been completed. If required by the owner, a continuous log of pressure during cure shall be maintained.

2. Using Steam
   (a) After inversion is completed, suitable steam-generating equipment is required to distribute steam throughout the pipe.
      (i) The equipment should be capable of delivering steam throughout the section to uniformly raise the temperature within the pipe above the temperature required to effect a cure of the resin.
      (ii) The temperature in the line during the cure period should be as recommended by the resin manufacturer.
   (b) The steam-generating equipment should be fitted with a suitable monitor to gauge the temperature of the outgoing steam.
      (i) The temperature of the resin being cured should be monitored by placing a gauge between the impregnated tube and the existing pipe at the termination end to determine the temperature during cure.
   (c) Initial cure will occur during temperature heat-up and is completed when exposed portions of the new pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm or cure in the resin.
      (i) After initial cure is reached, the temperature should be raised to post-cure temperatures recommended by the resin manufacturer.
      (ii) The post-cure temperature should be held for a period as recommended by the resin manufacturer, during which time the distribution and control of steam to maintain the temperature continues.
      (iii) The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

G. Cool-Down
1. Using Cool Water After Heated Water Cure
(a) The new pipe should be cooled to a temperature below 100°F (38°C) before relieving the static head or air pressure in the inversion standpipe.

(b) Cool-down may be accomplished by the introduction of cool water into the inversion standpipe water being drained from a small hole made in the down-stream end.

(d) Care should be taken in the release of head so that a vacuum will not be developed that could damage the newly installed pipe.

2. Using Cool Water After Steam Cure

(a) The new pipe should be cooled to a temperature below 113°F (45°C) before relieving the internal pressure within the section.

(b) Cool-down may be accomplished by the introduction of cool water into the section to replace the mixture of air and steam being drained from a small hole made in the downstream end.

(c) Care should be taken in the release of the air pressure so that a vacuum will not be developed that could damage the newly installed pipe.

H. Workmanship

1. The finished pipe should be continuous over the entire length of an inversion run.

2. If the CIPP does not fit tightly against the original pipe at its termination point(s), the space between the pipes should be sealed by filling with a resin mixture compatible with the CIPP.

VII. Service Connections

A. Reinstatement

1. After the new pipe has been cured in place, the existing active service connections should be reconnected.

(a) This should generally be done without excavation, and in the case of non-man entry pipes, from the interior of the pipeline by means of a television camera and a remote-control cutting device.

(b) Reinstatements will be to 95% of the original size of lateral connection.

VIII. Inspection and Acceptance

A. Final Inspection

1. The installation may be inspected visually if appropriate, or by closed-circuit television if visual inspection cannot be accomplished.

2. Variations from true line and grade may be inherent because of the conditions of the original piping.

3. No infiltration of groundwater should be observed.

4. All service entrances should be accounted for and be unobstructed.