

SPECIFICATIONS FOR CURED IN PLACE PIPE
(AS PROVIDED BY LANZO LINING SERVICES FOR THE INLINER® PULL IN -PLACE PROCESS)

1. Intent:

It is the intent of this specification to describe the procedures for the reconstruction of pipelines and conduits by the pulled in place (cipp) installation of a resin impregnated, flexible tube into an existing conduit and secondarily inflated by use of a hydrostatic head to invert an impermeable calibration hose. The resin is cured by circulating hot water throughout the length of the installed tube. When cured, the finished cured in place 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.

2. General:

This specification references astm standards and other related standards which are made a part hereof by reference and shall be the latest edition thereof.

3. Reference specifications:

- 3.1) AWWA M28 — CLEANING SPECIFICATION
- 3.2) ASTM D790 - RESIN PROPERTIES SPECIFICATION
- 3.4) ASTM F-1743 & F-1216 — CURED-IN-PLACE PIPE SPECIFICATION

4. Materials:

- 4.1) As specified, the contractor will use an epoxy vinyl ester resin and catalyst system, isophthalic polyester, or epoxy resin system that is compatible with the pulled in place installation process. The minimum physical properties for the cured in place pipe shall be as follows:

FLEXURAL MODULUS OF ELASTICITY	ASTM D790	300,000 PSI
FLEXURAL STRENGTH	ASTM D790	5,000 PSI

If required by the engineer or client, the finished cured in place pipe shall meet the chemical resistance requirements of the California green book "pickle jar" test as specified in section 210-2.3.3 of that document. This chemical resistance property is provided by use of epoxy vinyl ester resin and catalyst system.

- 4.2) The tube shall consist of one or more layers of flexible, needled felt or an equivalent non woven material. The material shall be capable of carrying epoxy vinyl ester resin, be able to withstand installation pressures and curing temperatures, and be compatible with the epoxy vinyl ester resin used. The approved epoxy vinyl ester resin shall be compatible with the application and pipeline environment and be able to cure in the presence of water.
- 4.3) The outer tube coating shall consist of a translucent material that allows for visual inspection and verification of proper resin impregnation. The tube used shall be fabricated to a size that, when installed, will tightly fit the internal circumference and the length of the original conduit. The material of construction shall be able to stretch to fit irregular pipe sections and negotiate bends.

- 4.4) The calibration hose shall consist of an impermeable plastic coating on a flexible needled felt or equivalent woven and/or non woven material that is capable of absorbing resin and is of a thickness to become fully saturated with resin.
- 4.5) The calibration hose shall be fabricated to a size that, when installed, will tightly fit the internal circumference and the length of the resin saturated tube. Once inverted the calibration hose becomes a part of the tube, and once properly cured shall bond to and become a permanent part of the tube.
- 4.6) The wall thickness of the finished product shall be designed in accordance with guidelines of ASTM F-1743 & F-1216.

5. Quality assurance:

5.1) The contractor shall conduct operations in strict accordance with all applicable OSHA standards. Particular attention is drawn to safety requirements involving working with scaffolding and entering confined spaces.

5.2) Testing:

5.21) The water tightness of the cured in place pipe shall be gauged while curing and under a positive head.

5.22) For each installation length designated by the owner in the contract documents purchase order, the preparation of CIPP samples is required from one of the following two methods:

5.22a) The samples shall be cut from a section of cured CIPP at an intermediate manhole or at the termination point that has been installed through a like diameter section of pipe or other tubular restraining means which has been held in place by a suitable heat sink, such as sandbags.

5.22b) The sample shall be fabricated from material taken from the tube and the resin / catalyst system used, and cured in a clamped mold, placed in the downtube with the heated circulating water. This method is also recommended when large diameter cipp is installed that may otherwise not be prepared with a tubular restraint.

6. Submittals & prequalification:

6.0) The cured in place liner thickness shall be calculated based on physical conditions and design criteria desired by the engineer and client. Liner thickness shall be calculated by the contractor, sealed by a Florida registered professional engineer, and submitted to the client's engineer for final approval. Initial nominal tube thickness and added resin allowances shall be sufficient to allow for resin migration onto the host pipe while still producing the specified final design thickness.

6.1) For the liner system to be acceptable, a minimum of 2,000,000 lbs of satisfactory waste water collection system liners installed in the United States must be documented. To be acceptable,

the installer shall have had at least five (5) years of active satisfactory experience in the commercial installation of the product, and shall have satisfactorily installed an aggregate of at least 700,000 lf of this liner system in at least three (3) municipal waste water collection systems within the state of Florida. Satisfactory completion of three projects of at least 30" - diameter must be documented.

7.0) Product Handling:

The following procedures shall be adhered to unless otherwise approved by the engineer or owner.

- 7.1) 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.
- 7.2) Cleaning of pipeline: All internal debris should be removed from the original pipeline. Gravity pipes should be cleaned with hydraulically powered equipment, high velocity jet cleaners, or mechanically powered equipment as per NASSCO recommended specifications for sewer collection system rehabilitation. Pressure pipelines should be cleaned with cable attached devices or fluid propelled devices as per AWWA manual on cleaning and lining water mains, m28.
- 7.3) Inspection of pipelines: inspection of pipelines should be performed by experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television or man entry. 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 forty percent. These conditions should be noted so that they can be corrected.
- 7.4) Line obstructions: The original pipeline should be clear of obstructions such as solids, dropped joints, protruding service connections, crushed or collapsed pipe, and reductions in the cross sectional area of more that forty percent that may hinder or prevent the installation of the resin impregnated fabric tube. 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.
- 7.5) Bypassing: 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 of the pipe to be reconstructed and pumping the flow to a downstream point or adjacent system. The pump and bypass lines should be of adequate capacity and size to handle the flow. Services within this reach will be temporarily out of service.
- 7.6) 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.

8.0 Installation of Product:

- 8.1) The contractor shall designate a location where the tube will be impregnated with resin using a vacuum and distribution roller system to thoroughly saturate the tube prior to installation. The contractor shall allow the owner to inspect the materials and the "wet out" procedure.

- 8.2) Perforation of resin impregnated tube: Prior to pulling the resin saturated tube in place, the outer impermeable plastic coating may be perforated to permit resin to be forced through the perforations and out against the existing conduit by the force of the hydrostatic head or air pressure against the inner wall of the calibration hose. The perforation may be done after fabric tube impregnation with a perforating roller device at the point of manufacture or at the job site.

Pulling resin impregnated tube into position: The wet out tube shall be pulled into place using a power winch. The saturated tube shall be pulled through an existing manhole or other approved access to fully extend it to the next designated manhole or termination point.

- 8.3) Hydrostatic head calibration hose inversion: The calibration hose shall be inserted into the vertical inversion standpipe and attached at the lower end of the inversion standpipe so that a leak proof seal is created. The resin impregnated tube should also be attached to the standpipe so that the calibration hose can invert into the center of the resin impregnated tube. The inversion head should be adjusted to be of sufficient height to cause the calibration hose to invert through the entire length of tube and hold the resin impregnated tube tight to the pipe wall, producing dimples at side connections.
- 8.4) After installation is completed, suitable heat source and water circulation equipment are required to circulate heated water throughout the section to uniformly raise the water temperature above the temperature required to effect a cure of the resin.
- 8.5) The heat source should be fitted with suitable monitors to measure the temperature of the incoming and outgoing water supply. Temperature sensors should also be placed between the resin impregnated tube and the host pipe invert at both termination points to monitor the temperatures during cure.
- 8.6) Initial cure will occur during temperature heat up and is completed when exposed portions of the CIPP 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. After initial cure is reached, the temperature should be raised to the post-cure temperature and held there for a period recommended by the resin manufacturer or CIPP manufacturer. 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).
- 8.7) The new pipe shall be cooled to a temperature below 100-deg. F. (38-deg. C.) Before relieving the static head in the inversion standpipe. Cool-down may be accomplished by the introduction of cool water into the inversion standpipe to replace water being drained from a small hole made in the downstream end. Care should be taken so as to cool down the CIPP in a controlled manner as recommended by the resin manufacturer or CIPP manufacturer.
- 8.8) The finished pipe shall be continuous over the entire length of an installation and be free of dry spots, lifts, and delaminations. If these conditions are present, the CIPP will be evaluated for its ability to meet applicable physical requirements. Where the CIPP does not meet specifically stated requirements of the client or engineer the affected portions of CIPP will be removed and replaced with an equivalent repair mutually agreed upon by the client and contractor.
- 8.9) After the new pipe has been cured in place, the existing active (or inactive) service connections should be reinstated. 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 television camera and a remote control cutting device.

9. Payment:

The unit price bid for rehabilitating the sewer in the manner described shall be full compensation for all materials, labor, equipment, and incidentals required to install the liner pipe within the sewer. Payment shall be for actual linear footage of liner pipe installed in the liner pipe within the sewer. Payment shall be for actual linear footage of liner pipe installed in the field and shall be measured between the center lines of the manholes. Payment for the liner will also include the cost of sealing the liner in the manholes, reworking the manhole inverts and benches, etc.

Television inspection (pre-installation and post rehabilitation), cleaning, and all relevant submittals shall be incidental to the project. The contractor shall submit all tv tapes in VHS format to the city for approval prior to payment. Post tv tapes will become property of the city.