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Product Information

Polyester Felt Cured-In-Place Pipe (CIPP) Lining Tube

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Company Profile

Liner Products, LLC is a worldwide supplier of quality lining tubes to the cured-in-place pipe (CIPP) industry. The Liner Products manufacturing facility, located in Paoli, Indiana, occupies approximately 120,000 square feet of production and administrative area.

Product Types

CIPP lining tubes are designed and manufactured according to the intended installation technique. CIPP liners may be either inverted or pulled into the host conduit.

Inversion Tubes

The inversion technique utilizes a polyester felt tube with an exterior thermoplastic coating. Inversion tubes may be manufactured with a single layer or multiple layer construction, depending upon the required thickness. The tube is saturated with resin and inverted into place inside the host pipe. The resin is then cured to produce the finished CIPP.

A preliner may be pulled or inverted into the host pipe prior to inversion of the resin saturated tube to control resin migration and contamination. Inversion tubes may be installed with a removable calibration hose so that the remote end of the CIPP is left open and expanded to the pipe wall after the calibration hose is removed.

Pull-In-Place Tubes

The pull-in-place system uses two distinct tubes: (1) a polyester felt tube with an exterior thermoplastic coating which is saturated with resin and pulled into place inside the host pipe, and (2) a calibration hose which is used to inflate the resin saturated tube before and during the curing process. The resin is then cured to produce the finished CIPP. The exterior coating serves as a built-in preliner to control resin migration and contamination.

Pull-in-place installations may use either a felt stay-in-place calibration hose (which becomes an integral component of the finished CIPP) or a removable calibration hose.

Pull-in-place tubes and stay-in-place calibration hoses may be manufactured with a single layer or multiple layer construction, depending upon required thickness.

Pull-In and Inflate Tubes

The pull-in and inflate method utilizes a multiple layer polyester felt tube with both interior and exterior thermoplastic coatings. The tube is saturated with resin and pulled into place inside the host conduit. The resin is then cured to produce the finished CIPP. The exterior coating serves as a built-in preliner to control resin migration and contamination.

Lateral Tubes

Small diameter lateral lining tubes may be manufactured for installation using any of the methods described above. Lateral tubes are often constructed with specialized materials to enhance flexibility and performance for differing installation equipment and techniques.

Resins

Polyester felt tubes are compatible with commonly used thermosetting resins, including neat and filled polyester, vinyl ester, non-styrene, and epoxy resins.

Resins may be cured using a variety of methods, including hot water, steam, ambient, and semi-ambient cures.

Overview of Tube Construction

Polyester felt CIPP lining tubes are generally manufactured from one or more needed polyester felt layers constructed together to form a tube. Each tube is specifically made to diameter, thickness, and length per the customer's specifications. These customer specifications usually originate from measurements of the host pipe and a CIPP thickness design.

The specified diameter of each tube is achieved by slitting felt for individual layers to a calculated width before closure into tubular form. Seams in the tube are formed by either heat bonding or stitching the adjoining edges.

Appropriate sizing for each tube is determined in the tube design phase. Tubes are typically undersized to minimize wrinkling of the liner along the length of the pipe, particularly at bends and points where the diameter of the pipe may be substantially reduced, such as offset joints and areas of significant deflection.

The specified thickness of each tube is achieved through combinations of the number of layers and the respective thicknesses of each of the layers. The outermost layer of each tube is coated with an impermeable thermoplastic film to allow for vacuum-assisted resin saturation of the tube, resin containment, and containment of the fluid(s) used to invert the tube and cure the resin.

Seams in the coated layer are sealed with a thermoplastic sealing strip which is bonded to the exterior of the coated layer. All seams are inspected to ensure an adequate bond between the coated layer and the sealing strip.

Quality Assurance

Liner Products maintains a quality control laboratory which performs quality assurance testing for all component materials, manufacturing processes, and finished tubes to ensure conformance with customer specifications and applicable standards. All lining tubes comply with applicable ASTM standards, including ASTM D5813, ASTM F1216, and ASTM F1743.

All felt used in the manufacture of lining tubes is individually numbered and quality tested to specifications for thickness, weight, and density in accordance with ASTM standards and material specifications. Thermoplastic coated felts are also tested for coating thickness. Thermoplastic sealing strips are tested for thickness, weight, and density.

All finished tubes are quality tested for length, circumference, thickness, and quality of construction in accordance with ASTM standards and manufacturing specifications.

Materials

Specifications for each raw material component are formalized in a Material Specification. Each lot of incoming materials is inspected and quality tested for conformance with the governing Material Specification.

Polyester Felt

Polyester felt is generally received in the form of rolls, each of which is uniquely numbered for identification. The properties of polyester felt which are measured and recorded are given in Table 1.

Table 1. Tested Polyester Felt Properties

Property	Description of Test
Roll width	Measured with approved steel rule
Thickness	Measured with ASTM specified gage
Weight	Measured with approved electronic balance
Density	Calculated from thickness and weight measurements
Tensile strength	Supplier certified

Thermoplastic Coated Polyester Felt

Polyester felt CIPP tubes have a polyurethane or polypropylene coating to allow for resin saturation of the tube and containment of the fluid(s) used for installation and curing.

Thermoplastic coated polyester felt is received in roll form. Each roll is uniquely numbered for identification. The properties of thermoplastic coated polyester felt which are measured and recorded are listed in Table 2.

Table 2. Tested Thermoplastic Coated Polyester Felt Properties

Property	Description of Test
Roll width	Measured with approved steel rule
Felt thickness	Measured with ASTM specified gage
Felt weight	Measured with approved electronic balance
Felt density	Calculated from thickness and weight measurements
Coating thickness	Measured with approved gage
Coating weight	Calculated from thickness and felt weight measurements
Tensile strength	Supplier certified

Thermoplastic Sealing Strips

Seams in the coated layer are sealed with an impermeable thermoplastic sealing strip which is bonded to the exterior of the coated layer.

The properties of thermoplastic sealing strips which are received in roll form are measured and recorded as shown in Table 3.

Table 3. Tested Thermoplastic Sealing Strip Properties

Property	Description of Test
Sealing strip thickness	Measured with approved gage
Sealing strip weight	Measured with approved electronic balance
Sealing strip density	Calculated from thickness and weight measurements

Product Design, Documentation, and Scheduling

Product Design

Before production, a tube design is generated to determine the planned construction of the tube. The design of each tube requires the determination of the sequence and specific attributes of individual layers to be combined in the construction of the tube in order to meet the customer's specifications. The specific attributes of each layer include:

1. Felt thickness
2. Coating type (if applicable)
3. Coating thickness (if applicable)
4. Total layer width (or circumference)
5. Individual felt width(s)
6. Overlap width(s)
7. Number of seam(s)
8. Location of seam(s)

Tube Construction Worksheet

A Tube Construction Worksheet is generated for each tube to be manufactured. The Tube Construction Worksheet identifies the tube and planned product design and serves as the primary quality control document. Information regarding specific attributes of each tube (i.e., diametrical transitions, thickness changes, etc.), the felt rolls used in fabrication, process information, and identification of the manufacturing technicians participating in each phase of production are recorded on the Tube Construction Worksheet.

Tube Identification

Each lining tube is assigned a unique tube number for identification and traceability. These numbers are generated sequentially. Each tube is permanently marked with its tube number.

Production Scheduling

Production of lining tubes is scheduled to best meet customer delivery requirements. After each tube has been designed it is entered into the production schedule. The production schedule is kept current by updating schedule information as the manufacture of individual tubes is commenced and completed.

Finished Products

Each finished lining tube is quality tested to ensure it meets customer specifications. A quality control technician takes a sample from the full circumference of each end of each tube to be destructively tested. The properties of finished tubes which are measured and recorded are listed in Table 4.

Table 4. Tested Finished Product Properties

Property	Description of Test
Tube length	Measured with footage counter or other approved means
Tube circumference	Measured with approved flexible rule
Tube thickness	Measured with ASTM specified gage
Coating thickness and quality	Measured with approved gage and visual inspection
Sealing strip bond	Visual inspection
Quality of construction	Visual inspection

The seams of all finished tubes are subjected to a separate visual inspection to ensure a secure bond between the outer coating and sealing strips. Any finished lining tube not meeting customer specifications is rejected.