

1. CURED-IN-PLACE PIPE (CIPP) DRAINAGE STRUCTURES

A. Description. Reconstruct existing cross drainage structures by forming a new pipe within an existing deteriorated structure, which has generally maintained its original shape. Reconstruct the pipes by installing thermosetting resin-impregnated flexible felt fiber tube, coated on one side with an elastomeric coating which is installed within the existing line pipe utilizing a water column or other approved method. Cure by circulating hot water, applying steam, or by other approved methods, throughout the length of the installed tube to cure the thermosetting resin into a hard, impermeable pipe with the elastomeric coating on the inside surface of the new pipe. Provide a CIPP extending the full length of the original pipe, which is structurally sound, jointless, and close-fitting. This specification references ASTM F1216 (Rehabilitation of Pipelines by the Inversion and Curing of a Resin-Impregnated Tube), ASTM F1743 (Rehabilitation of Pipelines by Pulled-in-place Installation of a Cured-in-Place Thermosetting Resin Pipe), and ASTM D790 (Test Methods for Flexural Properties of Unreinforced Plastics), ASTM D5813 (Standard Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems), ASTM D2990 (Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics) which are made a part of this specification by such references and refer to the latest editions and revisions. In case of conflicting requirements between this specification and these referenced documents, this specification will govern. The Department reserves the right to approve materials or installation practices which differ from these standards.

B. Qualification Requirements. Install the CIPP by using products on the qualified projects list QPL.

1) Product Requirements. Inliner, Insituform, and National Liner are pre-approved products. If not using a preapproved product, provide documentation of long term successful installation in storm sewer rehabilitation projects. A minimum of 500,000 linear feet of the product shall have been in successful service for a minimum of five (5) years.

2) Contractor Requirements. Contractors certified or licensed by Inliner, Insituform, or National Liner are preapproved. If not pre-approved, provide documentation of successful installation of a minimum of 200,000 linear feet of the exact product intended for use in the last five (5) years.

3) Documentation Requirements. The documentation will consist of a minimum of the following: a list of projects, including location, pipe size, product used, dollar value of project, Engineer of record and contact information.

C. Materials.

1) General. Verify the pipe size in the field prior to fabrication. Fabricate the flexible felt fiber tube to a size that, when installed, neatly fits the internal circumference of the conduit. An allowance will be made for some circumferential stretching during inversion. The minimum length is that deemed necessary by the Contractor to effectively span the distance from the inlet to the outlet of the respective access points unless otherwise specified in the plans. Verify the lengths in the field before impregnating the tube with resin. Individual installations can be made over one or more access points as determined in the field by the Contractor and as approved. Before installing, ensure the outside of the tube has an impermeable plastic coating. This coating will form the inner layer of the finished pipe and is required for enhancement of corrosion, flow, and abrasion properties. Ensure the layers, which constitute the pipe wall, are such that when the thermosetting resin cures, the total wall thickness must be homogeneous with no internal layer of plastic which might weaken the pipe wall and allow internal shear. When cured, the CIPP must be mechanically locked within the conduit. Before using the lining material, furnish satisfactory written certification of compliance with the ASTM and manufacturer's standards for all materials including the tube, resin and catalyst system. In addition to the above structural requirements, provide satisfactory evidence that the proposed lining material will incorporate a polyester resin suitable for chemical resistance. Provide a

finished CIPP that is continuous over the entire length of an inversion run and as free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes, and delamination. Monitor installation pressures during cure as referenced in ASTM F1216, Section 7.6.3., or ASTM F1743, Section 6.6. Repair any defects, which will affect the integrity or strength of the CIPP at no expense to the Department up to and including removal and replacement.

2) Resin. The resin system to be a corrosion resistant polyester, vinyl ester, or epoxy and catalyst system that when properly cured within the tube composite meets the requirements of ASTM F1216 and ASTM F1743, the minimum physical properties herein, and the physical properties used and submitted for review in the Design of the CIPP for this project. The resin will produce CIPP that comply with the structural and chemical resistance requirements of this specification.

3) Structural Requirements. The CIPP shall be designed as per ASTM F1216, Appendix X1. The CIPP design shall assume no bonding to the original pipe wall. The Contractor must have performed long-term testing for flexural creep of the CIPP pipe material installed by their Company. Such testing results are to be used to determine the long-term, time dependent flexural modulus to be utilized in the product design. This is a performance test of the materials (Tube and Resin) and general workmanship of the installation and curing. A percentage of the instantaneous flexural modulus value (as measured by ASTM D790 testing) will be used in design calculations for external buckling. The percentage, or the long-term creep retention value utilized, will be verified by this testing. Values in excess of 50% will not be applied unless substantiated by qualified third party test data. The materials utilized for the contracted project shall be of a quality equal to or better than the materials used in the long-term test with respect to the initial flexural modulus used in Design. The layers of the cured CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers. If separation of the layers occurs during testing of field samples, new samples will be cut from the work. Any reoccurrence may cause rejection of the work. The CIPP shall conform to the structural properties and minimum structural standards in accordance with Table 1.

Table 1: Minimum Physical Properties

Property	Test Method	Minimum
Flexural Stress	ASTM D790	4,500 psi
Flexural Modulus of Elasticity	ASTM D790	250,000 psi

Values shown are for polyester; vinyl ester, and epoxy resins may be substituted when applicable.

a) The required structural CIPP wall thickness shall be based as a minimum, on the physical properties in Table 1 or greater values if substantiated by independent lab testing, and in accordance with the design equations in the appendix of ASTM F1216, and the following design parameters:

Design Safety Factor = 2.0

Retention Factor for Long-Term Flexural Modulus to be used in Design = 50% (max)

Ovality = 2%

Soil Modulus = 500 psi (min) – 2000 psi (max)

Soil Density = 120 pcf

Live Load = Highway HS20 Design Condition (partially or fully deteriorated) = Fully Deteriorated

Additional information, such as pipe depth, size, etc., required for the CIPP wall thickness design, will be shown in the plans.

Any layers of the tube that are not saturated with resin prior to insertion into the existing pipe shall not be included in the structural CIPP wall thickness computation.

D. Testing Requirements.

1) Chemical Resistance - The CIPP shall meet the chemical resistance requirements of ASTM F1216. CIPP samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical testing requirements.

2) Hydraulic Capacity - Overall, the hydraulic profile shall be maintained as large as possible. The CIPP shall have a minimum of the full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material based on new condition.

3) CIPP Field Samples - When requested, submit test results from field installations in the USA of the same resin system and tube materials as proposed for the actual installation. These test results must verify that the CIPP physical properties specified in Table 1 have been achieved in previous field applications.

E. Construction.

1) Reference Specifications. This specification references standard test methods as defined in ASTM specifications previously listed.

2) Pre-Installation Procedures. Adhere to the following installation procedures unless otherwise approved.

a) Safety. Perform operations in strict accordance with all applicable MDT and OSHA standards. Pay particular attention to those safety requirements involving work and entry into a confined space or the use of steam.

b) Cleaning. Remove debris located within the pipe. Debris is defined as dirt and other material not part of the drainage system. Clean, as needed, with high-velocity jet cleaners, mechanically powered equipment, cable attached devices, fluid-propelled devices, or other approved methods.

c) Installation of Internal Energy Dissipation Rings. Install the internal dissipation ring according to the manufacturer instructions for the crossing located at 139+15, 180+54, and 428+71.

d) Inspection. Perform video inspection by experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television inspection. Carefully inspect the interior of the pipe. Note which locations need point repair. Also, notify the Engineer if any conditions exist which may prevent proper installation of the CIPP so these conditions can be corrected as approved. Keep a video record and suitable log for later reference by the Engineer consisting of no less than the following:

- Provide video records in CD or DVD format;
- Label each video indicating the Montana Department of Transportation, the location and lines recorded on the video, and the name of the Contractor;
- Prepare logs from each line inspected during the actual field inspection activities;
- Submit video and logs in a timely manner after the completion of all field activities; and
- If requested, make additional copies of the video on professional duplication equipment at no additional cost to the Department.

e) By-Passing. When required, provide for the flow of water around the structure or structures that are to be lined. Use a pump and by-pass lines of adequate capacity to handle the

flow. Payment for by-passing drainage during the construction operation by approved measures will not be paid for directly but will be subsidiary to bid items of the Contract.

f) Line Obstructions and/or Pipe Damage. If inspection reveals pipe damage, an obstruction that cannot be removed, or a condition that will prevent completion of the installation process, make a point repair as approved. This repair work will be subsidiary to CIPP bid items.

3) Installation Procedures.

a) Wet Out. Designate a location where the tube will be impregnated ("wet out") with resin using distribution rollers and vacuum to thoroughly saturate the tube felt fiber prior to installing. Ensure that there are no resin voids or weak areas. The Engineer will inspect the materials and wet out procedure. Use a catalyst system compatible with the resin and tube.

b) Insertion. Dewater the pipe so it is free of water of incoming water. If infiltrating water is present, take measures to control contact of the water with the inverting tube, as required. Insert the wet out tube through an existing manhole or other approved access by means of an inversion, pull in, or other approved procedure to install the impregnated tube from end to end. Hold the tube tight against the existing pipe wall and flared ends of the cured-in-place-pipe.

c) Curing. After the installation of the tube is completed, supply a suitable heat source capable of delivering steam, hot water, or ambient temperature water or air uniformly throughout the section to affect a consistent cure of the resin. Use a curing temperature recommended by the resin/catalyst system manufacturer. Fit the heat source with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Place another such gauge between the impregnated tube and the invert of the original pipe at the termination end to determine the temperatures during the resin curing process. When the exposed portions of the CIPP appear to be hard and the remote temperature sensing device indicates the cure temperature in the pipe/tube interface complies with the recommendation by the resin/catalyst system manufacturer the initial cure is complete.

d) Cool-Down. Cool the hardened CIPP to a temperature below 100 degrees Fahrenheit if using a water cure and below 130 degrees Fahrenheit if using a steam cure system before relieving the internal curing pressure.

4) Post installation Procedures.

a) Inspection. After the CIPP installation, perform inspection and provide video records as outlined in Section 4.B.3., showing completed work

b) Clean-up. Upon acceptance of the installation work and testing, reinstate the project area affected.

F. Measurement. This item will be measured by lump sum per location or culvert being rehabilitated. Measurement will be made from end to end of the reconstructed pipe. Cleaning and television inspection work will be included in the lump sum measurement.

G. Payment. The work performed and materials furnished in accordance with this item and measured as provided under "measurement" will be paid for at the unit price bid as outlined in the following table. This price is full compensation for testing, for the installation procedures (including wet out of tube, insertion of tube, curing of tube, and reopening existing structure), for furnishing, hauling, placing, and reinstating the project area affected by the contractor's operations, and for all materials, equipment, labor, tools, and incidentals.

TABLE 2: BID ITEM SUMMARY

Bid Item	Unit	Quantity	Description/Location
Miscellaneous Items A – LS	Lump Sum	1	Sta. 139+15 Existing 48"x166' CSP
Miscellaneous Items B - LS	Lump Sum	1	Sta. 180+54 Existing 48"x340' CSP
Miscellaneous Items D - LS	Lump Sum	1	Sta. 428+71 Existing 48"x194' CSP

H. Cleaning. The work performed and materials furnished in accordance with this item and measured as provided under "measurement" will be included in the lump sum cost for that specific location as defined. For the various sizes as stipulated by the inside diameters of the existing pipe to be cleaned. This price is full compensation for cleaning, removing and disposing of debris and wash water, equipment, labor, materials, tools, and incidentals.

I. Television Inspection. The work performed and materials furnished in accordance with this item and measured as provided under "measurement" will be incidental to the lump sum bid item as defined. If picture quality is unsatisfactory, as determined by the engineer, no payment will be made for the inspection. This price is full compensation for inspection, equipment, labor, materials, tools, and incidentals.