

**TECHNICAL SPECIFICATION
FOR THE ENVIROCORT POLY-TRIPLEX®
CURED-IN-PLACE-STRUCTURAL “PANEL LINER” REHABILITATION SYSTEM**

PART 1 GENERAL

1.01 SCOPE OF WORK

It is the intent of this specification to set forth the required parameters and performance standards for a Cured-in-place-structural-liner (“CIPSL”), or equivalent technology, that is designed to properly achieve the following requirements for renewing a vertical sanitary, storm, or other process system manhole, or similar structure, utilizing a resin impregnated fiberglass / membrane composite material. The desired result is to achieve the following three (3) goals for successful renewal as forth by NASSCO in the Inspector Training Certification Program “ITCP™” for Manhole rehabilitation.

- 1) Structural Renewal / Build-back
- 2) Corrosion Protection
- 3) Leak Protection

Successful bidder must furnish all materials, labor, equipment, tools and required incidentals for providing and installing a resin impregnated custom fabricated liner by means of air inflation into an existing manhole, wet well, pump station, or catch basin. The liner shall be installed from the top of the casting to the top of the channel which includes; shim rings, frame and chimney interface, chimney, cone, wall and bench. When cured, the liner will provide a durable monolithic water and chemical resistant barrier that will protect the existing substrate from further deterioration.

Channel lining may be included as directed by the owner, if such components exist within the structure.

1.02 QUALIFICATIONS

All bidders are required to provide all information as requested. Failure to provide the required submittals and other information, and, corroborate each answer with detailed documentation, may result in disqualification:

A qualified bidder shall be a “Certified Installer” of the Liner System Manufacturer, and shall have a minimum of 5 years of experience installing the proposed Liner System, or, a representative of the Liner System Manufacturer shall be onsite during liner installations.

The Owner reserves the right not to consider any other structure rehabilitation method as an “or Equal” which relies on any type of cementitious product, modified cementitious product, modified spray-on, spun, troweled or rolled polymer product, or any other type of exposed coating liner surface, other than a system that contains a PVC/non permeable membrane as their line of defense against sewer chemical attack.

REFERENCE STANDARDS

Structural Standards relating to CIPP composites

D790 – Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

D695 – Test Method for Compressive Strength and Compressive Modulus

D638 – Tensile Strength and Elongation at Break (%)

D7234 – Adhesion / concrete: Expected Field results and Lab results

Bonded Polymeric Liners

ASCE Manual of Practice 92, Chapter 7 – design standard methodology for a fully bonded liner.

Surface Preparation Standards (if required)

American Society for the Testing of Materials (ASTM):

F2414 – Standard Practice for Sealing Sewer Manholes Using Chemical Grouting.

1.03 SUBMITTALS

Furnish the following to the owner:

- A. Detailed installation procedures, including substrate preparation, liner wet out, resin mixing, liner insertion, curing, pipe connection removal and reconnection, and channel cut-out/reinstatement, and edge sealing.
- B. Design/Build drawing showing structure configuration, structure measurements, and all details pertaining to the final liner construction.
- C. Resin information including, Technical Data Sheets (TDS), Safety Data Sheets (SDS), and published physical properties.
- D. Liner information including, TDS, SDS, and composition of the respective layers.
- E. Certified independent laboratory tests on the proposed resin impregnated Liner system showing values for Flexural Modulus of Elasticity, Flexural Strength, Tensile Strength, and Adhesion Testing.
- F. Third Party Chemical Resistance test data shall be submitted showing the resistance of the exposed surface resin used in the lining system to H₂S.
- G. A wall thickness design chart, designed and approved by a Professional Engineer, shall be submitted for the proposed composite liner. The design standard in the chart shall be based on depth, diameter and field conditions. All structure liners must adhere to this guide to ensure the proper design for each liner to withstand the site conditions.

H. A warranty certificate provided by the installer for material and labor.

1.04 PERFORMANCE REQUIREMENTS

A. The lining system applied to the structure shall result in a monolithic, fiberglass/membrane/epoxy composite covering the entirety of the structure and, with the liner system bonded to the shape and contour of all walls and sections within the structure. The liner shall be installed from the top of the casting to the top of the channel which includes; shim rings, frame and chimney interface, chimney, cone, wall and bench. When cured, the liner will provide a durable, monolithic water and chemical resistant barrier that will protect the existing substrate from further deterioration.

B. The Cured-In-Place Liner system shall be designed to allow for maximum bonding to the original substrate in a way that prohibits the majority of ground water infiltration from finding a pathway behind the Liner and entering into the waste, or process stream.

C. Liner System Physical Properties

Minimum Requirements for Liners ranging from 2.5 – 3.0 mm thickness

ASTM D695	Compressive Strength	11,630
ASTM D695	Compressive Modulus	811,200
ASTM D638	Tensile Strength	16,200
ASTM D638	Elongation at Break	7.08%
ASTM D790	Flexural Strength	39,865.70
ASTM D790	Flexural Modulus	1,332,000
ASTM D7234	Adhesion / Concrete – Lab	Substrate Failure
ASTM D7234	Adhesion / Concrete – Field	>200 psi

Minimum Requirements for Liners ranging from 3.1 – 5.0 mm thickness

ASTM D695	Compressive Strength	14,150
ASTM D695	Compressive Modulus	1,570,000
ASTM D638	Tensile Strength	40,970
ASTM D638	Elongation at Break	11.92%
ASTM D790	Flexural Strength	49,912.19
ASTM D790	Flexural Modulus	1,783,142
ASTM D7234	Adhesion / Concrete – Lab	Substrate Failure
ASTM D7234	Adhesion / Concrete – Field	>200 psi

Above results are from independent laboratory testing. Expected field values can be up to 25% less.

D. Additional layers of fiberglass may be added to facilitate and increase strength when factors such as hydrostatic pressure, soil conditions, diameter, top-loading or depths require a stronger liner.

E. The proposed liner must carry a twenty (20) year, Limited Warranty on the materials used. Please submit an official copy of the Manufacturer's Product Warranty with the bid response.

- F. The proposed liner must have an engineered design life of Fifty (50) years.
- G. The proposed liner must withstand high-pressure jetting, for the purpose of cleaning the surface area, that can withstand up to 3500 psi without damage to the liner.
- H. It is the intent of this specification to determine a rehabilitation product / method that will provide the maximum strength and effectiveness in stopping I&I and eliminating further corrosive deterioration to the host structure, while preserving the internal dimensions of the structure, as much as possible. Therefore, final liner thickness will be a key determining factor in product approval.

PART 2 MATERIALS

2.01 MATERIAL MATRIX COMPOSITION

Approved materials for the Liner system proposed must be a composite matrix of fiberglass material, an inner membrane that creates an impervious moisture/gas barrier and, a 100%-solids, solvent-free epoxy (No VOC's). Each Liner must meet or exceed the physical testing criteria set forth in the Performance Section - 1.04.

2.02 RESIN SYSTEM

- A. The Resin shall be 100% solids epoxy formulated to withstand a typical domestic wastewater sewer system including high sulfide areas near force mains and wet wells.
- B. The resin must be compatible with both the non-porous membrane and the fiberglass.
- C. The resin must be a 100% solids epoxy to ensure minimal shrinkage after curing. Any resin system that allows shrinkage greater than 1% will not be accepted.
- D. Polyester resins, or any resin system containing styrene, will not be accepted.

PART 3 EXECUTION

3.01 PREPARATORY PROCEDURES

- A. Contractor will perform preliminary cleaning of the structure with high-pressure water-blasting at a minimum of 4000psi and 4gpm to obtain the desired concrete surface profile (CSP) of 3 or greater.
- B. If the desired CSP is not achieved by high-pressure water-blasting, other methods of obtaining the desired surface profile must be used such as abrasive blasting and/or acid etching.

- C. The Contractor shall remove all the existing manhole steps. The metal-post portion of all steps will be removed to within ½” of the manhole interior wall surface, or flush to the wall if possible. Any remaining protrusion of the steps posts shall be covered with a cementitious material to provide a smooth surface on and around the protrusion to allow for proper bonding of the liner to the host structure. To ensure the complete, water-tight integrity of the CIP liner, step replacement is not recommended.
- D. All open joints, voids, holes, cracks, and missing bricks larger than 3” inches in diameter, or equivalent, shall be patched with a cementitious material to provide a smooth surface for the liner to bond. All loose, cracked or disintegrated material shall be removed from the area to be patched exposing a sound substrate. The cementitious patch material shall be allowed to cure according to the manufacturer’s specifications before continuing with the Liner installation process.
- E. Bench, when present, shall be sloped, or built to slope, so that water will flow back into channel.
- F. All active water leakage shall be stopped for a minimum of 30 minutes prior to installation to allow time to insert and pressurize the Liner. This prevents resin washout and allows proper curing and bonding. Leaks may be stopped with fast setting cement or chemical grout injection.
- G. Contractor shall remove any penetrating pipes to within 2 inches of the wall, or flush with the wall, when possible. The pipe/wall joint area shall be cemented with an approximate 60° taper, forming a fillet between the structure wall and the pipe, creating a tapered transition, to allow for the liner to achieve proper bonding.
- H. After the above-mentioned procedures the surface shall be cleaned with degreaser or other solvents, as needed, in order to remove any film, grease, loose patching material, chemical grout or residue on the surface. Structure shall then be pressure rinsed with water.
- I. PH of the original substrate, on each structure, shall be determined and logged for each structure, before CIPSL renewal takes place. Acceptable pH range shall be between 7 and 13. If pH levels are below 7 for any structure, further cleaning or neutralizing may be required.

3.02 GENERAL INSTALLATION PROCESS

- A. Ensure that bypass pumping, or other measures are properly in place to avoid any active flow or pump activity during the lining process.
- B. Contractor shall verify that the liner intended for the structure matches the structure ID and matches the dimensions of the structure prior to the installation of each liner.
- C. All resin intended for the liner shall be mixed according to manufacturer’s recommendations, ensuring that resin is thoroughly blended.

- D. Contractor shall apply mixed resin evenly onto both the inside and outside of the entire liner with rollers. There shall be no white spots (dry Liner) on either side of the Liner including seams and bottom disk(s). Areas of heavily saturated resin shall be spread out to cover areas that are deficient of resin.
- E. Liner can be installed to include or omit the structure flow channel depending upon the intention of the owner and bid requirements.
- F. For Liner installation that does not include the channel, a temporary subfloor shall be constructed to keep liner from inflating into the channel and to allow the sewer to flow unobstructed without bypass pumping.
- G. First, a resin saturated bottom disk comprised of the same material design utilized for the entire structure is installed onto the subfloor/bench area. This disk may be a one-piece or multiple pieces depending on the bench area layout, and must be oversized to extend up the wall a minimum of 4 inches.
- H. Second, a resin saturated “tube” Liner is lowered into the structure and positioned properly to line up any offsets. The “tube” liner must extend down and over the bottom disk liner by a minimum of 4 inches or greater.
- I. Each structure Liner shall be pressurized with air or water, as required by site conditions, structure type, and other variable factors, to allow for the liner to be properly pressed against all areas of the host structure. Contractor shall visually verify proper position of the liner from the inspection portal located on the installation canister, or by means of a remote camera system, allowing the Liner to be raised, lowered or rotated to desired position, before curing commences.
- J. The Liner is cured with steam, water, or ambiently. Cure times will vary, and will range between one (1) to three (3) hours, according to, the curing method, Liner thickness, structure size and configuration, ambient temperatures, and resin formulation. Contractor may use the exposed portion of the Liner above the frame as an indicator for curing completeness.
- K. Liner shall be cut and trimmed to allow for all incoming and outgoing pipe connections to flow without obstruction. If the channel is unlined, the subfloor shall be removed.
- L. As required, any and all cut edges shall be sealed with a fiber-reinforced epoxy mastic material that is compatible with the Liner System.

3.03 FINISHED LINER

- A. The finished CIPSL shall be continuous over the entirety of the structure. The Liner shall be smooth with minimal wrinkling.

- B. Inasmuch as possible, the cured Liner shall be bonded to the host structure, **as required by design**, and in such a way as to minimize any water flow behind the liner, and prohibit water entry back into the waste or process stream.
- C. Any and all internal pipe connections and fittings that must remain in service after liner curing, must be reconnected to be fully operational.

3.04 QUALITY ASSURANCE TESTING

- A. The Licensed Installer shall perform a visual inspection, via manned entry or via a remote camera inspection system to view the cured liner from inside the structure at the completion of the renewal. Photographs and/or final inspection videos must be made available as part of the Final Deliverable program.
- B. Any and all defects or anomalies that are identified within the structure must be reported to the Owner and all known defects that may affect performance of the liner must be repaired or remedied to the Owners satisfaction.
- D. If required by the contract, the Licensed Installer may spark test a specified percentage of any Liner(s), in accordance with the spark testing equipment specifications and manufacturers recommendations. All defects/pinholes must be repaired/sealed, using an epoxy mastic that is compatible to the Liner system. **Strict adherence to the ASTM-4787 standard is required for any holiday / spark testing on the proposed liner system.**

3.06 FINAL DELIVERABLE (Please modify this section as required per job)

The successful bidder shall deliver a final package with full digital information on each structure renewed.

The digital profile information may include any or all of the following if specified:

- A. Required photographs to include;
 - a. General site images showing surrounding area above structure, and top-down images into structure,
 - b. Other general photographs of critical importance to the rehabilitation potential,
 - c. Images of any internal pipes and fittings,
 - d. Any and all defects, voids and other special observations necessary to properly inform the manufacturer and Licensed Installer of important features that may affect the design of the final structure liner.

- B. 360 degree hi-resolution (1080p) video that shows the entire interior of each renewed structure. There shall be up to 3 separate videos to include:
 - a. Initial inspection video completed prior to any preparation work or lining
 - b. Post preparation video
 - c. Post lining video
- C. Full structure diagram with detailed measurements, and/or a full structure point cloud that maps the internal dimensions and features for any and all structure components.
- D. Approved Report Format for all Structures
 - a. Owner approved, or required, reporting in the format specified, or:
 - b. NASSCO MACP Level 1 report on each structure, or:
 - c. NASSCO MACP Level 1 Custom report on each structure, or:
 - d. NASSCO MACP Level 2 report on each structure when required.

3.07 CLEANUP

Clean up the entire project area after the work is completed and all testing accepted. Remove and dispose of all excess material and debris not incorporated into the permanent installation.

3.08 MAINTENANCE

Any defects shall be repaired in accordance with the manufacturers' recommendations on an as needed basis.

3.09 WARRANTY

Manufacturer and Installer of the Liner system shall provide a 10-year warranty on materials and labor. Please see the official Limited Warranty statement provided as a submittal.

END OF SECTION

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