CURED-IN-PLACE STRUCTURAL LINER (CIPSL)  
MANHOLE REHABILITATION

PART 1 – GENERAL

This section covers the lining and rehabilitation of structures within sanitary and storm water collection systems with the use of a cured-in-place structural liner (CIPSL) that forms a laminated composite bonded to the host structure, comprised of a three-layered, five component laminated structural system containing fiberglass, non-porous membrane with felt fibers imbedded on both sides and fiberglass; or pre-approved equal.

Any alternative product being submitted for pre-approval must provide third party test certification that the product will meet or exceed the physical properties named herein in Section 2.1.G, Table 1. Product must also meet or exceed the installation standards, experience and performance qualifications as herein described in this specification. If approved, notice from the Owner/Engineer shall be delivered to all plan holders and potential bidders a minimum of fourteen calendar days prior to date of bid opening, in the form of a written addendum. Spray applied coatings shall not be considered for use on this project.

Any product used must provide warranty that infiltration, further deterioration and root intrusion shall be prevented for the warranty period. Said warranty shall be non-prorated for a minimum 10-year materials and 5-year labor.

1.1 DESCRIPTION OF WORK

A. Liner material and components shall have been custom fabricated to fit the specific configuration of each structure prior to the commencement of the liner installation. Liner shall be of the type that allows rehabilitation of concentric, eccentric or flat top manholes without removing manhole ring, top section, flat-top, or corbel.

B. Cured-in-place structural liner (CIPSL) shall completely seal the manhole, shelf, pipe inlet and outlets, and the lid ring frame in a monolithic method, as required, or as shown on the plans, and that no holes, cracks or seams in the liner are left unsealed, which would allow gases or fluids to flow behind the CIPM manhole liner.

C. Contractor shall furnish all labor, materials, equipment, and incidentals required to supply and install a chemical resistant CIPSL as required or as shown on the plans.

D. The CIPSL shall be designed and installed to protect concrete, brick and other manhole surfaces from corrosion. The CIPSL product shall be designed to stop infiltration, root intrusion, and further deterioration in the
structure. The interior surfaces to be protected shall include the walls, shelves, pipe junctions and the lid ring frame.

E. Omission of a specific item or component obviously necessary for the proper installation and functioning of the system shall not relieve the Contractor from the responsibility of supplying that specific item or component at no additional expense to the Owner.

1.2 REFERENCED SPECIFICATIONS

The CIPSL corrosion resistant system shall be manufactured and installed as to be in compliance with the listed minimum values of the applicable ASTM testing requirements.

- ASTM D-638 Tensile Strength
- ASTM D-790 Flexural Strength and Flexural Modulus
- ASTM D-5813 Standard Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems

1.3 SUBMITTALS

A. The Contractor shall submit for review, complete detailed shop drawings and schedule for all materials furnished under this section.

B. The Contractor shall submit for approval all manufacturer warranties for all materials furnished under this section and Manufacturer’s certification that the materials supplied are in compliance with this specification.

C. The Contractor shall submit for approval, the Manufacturer’s Licensee Certification for the installer under this section.

D. The Contractor shall provide a reference list of not less than 5 manhole rehabilitation projects, where the proposed product has been utilized and project completed in the past 3 years that are similar in the size and scope of this project. Reference shall include: Name and address of Client, project name, contact person, phone, scope including number of manholes lined, and gross dollar amount of the project.

E. The Contractor shall supply engineering certification that the lining system has a 100-year life service in a standard wastewater collection system environment.

F. Contractor shall submit the Manufacturer’s affidavit, with the accompanying third party test data, showing that the product meets or exceeds the physical properties named herein on Table 1, Test Property Values, and that the CIPM liner material has passed a 30-day chemical immersion test in 20% sulfuric acid concentration with less than a 20% loss in flexural modulus.
G. The Contractor shall submit Manufacturer’s experience qualification affidavit that the product proposed has been successfully used in wastewater structures for a minimum period of 10-years in wastewater collection systems, including 5 references where the product has been installed for a minimum of 10-years. Reference shall include name and address of client, date of installation, contact person, and phone.

H. Contractor shall submit Manufacturer’s affidavit attesting to the proposed product having been supplied and installed in a minimum of 10,000 structures.

1.4 WARRANTY AND REPAIRS

A. Manufacturer shall warrant the performance of the CIPSL materials for 10 years and Certified Installer shall provide 5-year labor warranty to repair or replace any failing conditions of the liner in the structure. Certification of the conforming warranty shall be provided prior to approval of the submittals and award of contract.

B. The cured-in-place liner system shall be flexible, and have an elongation sufficient to bridge up to a ¼-inch settling crack, without damage to the lining. The liner shall be able to bridge expansion cracks that may occur.

C. The cured-in-place liner system shall be repairable at any time during the life of the structure, with the same type of liner system materials used in the original installation, including repair or lining of the upper chimney portion where grade adjustments have been made. Repair/lining materials shall be of the type that will bond to the original liner materials.

PART 2 – PRODUCTS

2.1 MATERIALS AND DESIGN GUIDE

A. The design guide below for Type 1, II, III and IV is intended as a general guide for the Cured-in-Place Structural Liner (CIPSL) products, and is not intended to limit the manufacturer’s and authorized installer’s judgment to vary liner thickness and type of liners for individual structures based upon the specific conditions encountered in each structure. Any variation of the liner thickness requirements detailed below in section 2.1-B, C, D, and E, shall be approved by the manufacturer in writing, and mutually agreed upon between the Owner and Contractor, prior to commencement of the work. Variation in liner thickness by the manufacturer or authorized installer will not affect the warranty requirement.
B. Type 1: In structures up to 8 feet in depth (depending on specific local conditions), the liner shall be not less than a three-layered composite system (see table 1 below). Layer #1 is 12-oz. structural fiberglass impregnated with a modified epoxy resin and bonded to the existing substructure. Layer #2 is to be a gas and liquid impermeable membrane of special non-porous materials with felt embedded on both sides, bonded to layer #1 and layer #3. Layer #3 will consist of 12-oz. structural fiberglass saturated with epoxy and bonded to the non-porous membrane, forming a smooth interior wall to the host structure. The non-porous water and gas shield shall be imbedded between the structural layers of epoxy-fiberglass to guard against nicks, tears and damage to the gas protection membrane.

C. Type II: In structures up to 13 feet deep (depending on specific local conditions), the liner shall be a three-layered composite system (see table 1 below). Layer #1 is 18-oz. structural fiberglass impregnated with a modified epoxy resin and bonded to the existing substructure. Layer #2 is to be a gas and liquid impermeable membrane of special non-porous materials with felt embedded on both sides, bonded to layer #1 and layer #3. Layer #3 will consist of 18-oz. structural fiberglass saturated with epoxy and bonded to the non-porous membrane, forming a smooth interior wall to the host structure. The non-porous water and gas shield shall be imbedded between the structural layers of epoxy-fiberglass to guard against nicks, tears, and damage to the gas protection membrane.

D. Type III: In structures up to 24 feet, (or with site conditions requiring structural enhancement), the liner shall be a three-layered composite system (see table 1 below). Layer #1 will be a 24-oz. structural fiberglass impregnated with modified epoxy resins and bonded to the existing substructure. Layer #2 is to be a gas and liquid impermeable membrane of special non-porous materials with felt embedded on both sides, bonded to layer #1 and layer #3. Layer #3 will consist of a 24-oz. structural fiberglass saturated with epoxy and bonded to the non-porous membrane, forming a smooth interior wall to the host structure. The non-porous water and gas shield shall be imbedded between the structural layers of epoxy-fiberglass to guard against nicks, tears, and damage to the gas protection membrane.

E. Type IV: In structures deeper than 24 feet, (or with site conditions requiring additional structural enhancement), the liner shall be a five-layered composite system (see table 1 below). Layer #1 will be (2) 24-oz. structural fiberglass layers impregnated with modified epoxy resins and bonded to the existing substructure. Layer #2 is to be a gas and liquid impermeable membrane of special non-porous materials with felt embedded on both sides, bonded to layer #1 and layer #3. Layer #3 will consist of (2) 24-oz. structural fiberglass layers saturated with epoxy and bonded to the non-porous membrane, forming a smooth interior wall to the host structure. The non-porous water and gas shield shall be imbedded between the structural layers of epoxy-fiberglass to guard
against nicks, tears, and damage to the gas protection membrane. There is no minimum or maximum manhole depth limit on this liner.

F. The CIPSL shall be constructed such that the non-porous PVC inner membrane is protected from damage by the use of a structural fiberglass and epoxy layer on both sides. This inside surface protective layer is to protect the CIPSL from impact damage e.g. nicks from rodders and root cutters, hydro-vacuum nozzles, inspection cameras, survey equipment, and construction techniques used in pipeline rehabilitation. The non-porous PVC membrane shall not be exposed on the inside of the manhole. The importance of this protective layer cannot be overemphasized to protect the manhole from sulfides and other gases penetrating through nicks and cuts in an unprotected membrane. This CIPM liner must be impervious and without pinholes that will allow hidden corrosion on the concrete behind the liner, which can cause the eventual failure of the liner and the manhole.

G. The CIPSL System shall be applied by a manufacturer certified Licensed Installer and shall be installed in strict accordance with Manufacturer’s specifications. Liner Installer shall be trained in handling and application of the materials, and will custom fit the liner to the manhole in order to protect the concrete and brick surfaces from sewer gases.

TABLE 1, Test Property Values

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<th>Type I</th>
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<th>Type III</th>
<th>Type IV</th>
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</table>

PART 3 – INSTALLATION

3.1 STRUCTURE PREPARATION- CIPSL REHABILITATION

A. Contractor will perform preliminary cleaning the structure with a high-pressure water jet blast at a minimum of 4000 psi to prepare the structure for any necessary grouting or other preparation.
B. The Contractor shall remove the existing manhole steps. The metal portion of all steps will be removed flush to within ½" of the manhole interior wall surface, and any remaining holes or minor protrusions are to be filled or grouted over prior to applying the CIPS L manhole rehabilitation system. The final coated surface shall have a smooth uniform appearance.

C. Prior to patching severe defects in the manhole, all loose and deteriorated material shall be removed and disposed of by the contractor. The bench areas shall be repaired as and contoured to promote hydraulic flow. The prepared surface of the shelves shall be smooth and shall be sloped to allow for all bench areas to drain to the pipe invert.

D. Manhole chimney, wall and shelf repair shall include plugging, and/or patching as necessary, with specified grout, plugging or patching compounds, hydraulic and/or Type II Portland cement or equal.

E. All active hydrostatic water leakage shall be stopped within four (4) inches of where the liner will end around pipes or the shelf area in accordance with manufacturer’s instruction.

F. Contractor shall plug the inlet pipe, inspect for infiltration leaks around the inlet and outlet pipes as well as in the invert channel. All leaks present shall be stopped by the use of chemical foam grout injection with Avanti 202 or equal and/or by the use of hydraulic cement. After stopping leaks with chemical grout, hydraulic cement shall be used to refinish the surface where the leak was occurring.

G. All cracked or disintegrated material shall be removed from the area to be patched exposing a sound substrate. Patches of filling of voids shall be allowed to cure according to the manufacturer’s specifications before continuing with the CIPM rehabilitation process.

H. Contractor shall remove any drop pipes to within 2 inches of the wall. All other incoming laterals shall be trimmed within 2 inches of the interior wall and sewer main line inlet and outlet openings shall be properly trimmed within 4 inches of the wall in areas where such pipes protrude above the benches that form the invert channel. All incoming and outgoing lines shall be grouted with an approximate 60° taper with hydraulic cement, Portland type II cement, or 50/50 combination of hydraulic and Portland, forming a filet (not less than a 6 inch radius) between the structure wall and each pipe. Such application of grout shall extend at least four inches from the outlet onto the wall area making a smooth transition for the liner connection to the pipe openings.

I. Prior to liner installation, Manufacturer’s Authorized Installer shall clean all surfaces of the host structure with a high-pressure sprayer having an operating pressure of at least 3,500-psi. After pressure cleaning, installer may clean structure with degreaser or other solvents as needed to remove
any film or residue on the surface. Structure shall then be pressure rinsed with clean water.

3.3 CIPSL INSTALLATION

Manufacturer’s authorized licensed installer shall install CIPSL with simultaneously combined air pressure and steam heat injection, except where jobsite conditions restrict use. Hand applied fiberglass and epoxy application shall not be accepted, except in areas or conditions as recommended by the CIPSL manufacturer. Installer shall line manhole shelf/bench areas and pump station floors with CIPSL System materials that have been saturated with the epoxy resin and placed in the bottom to extend approximately three inches up the wall section, so as to overlap with the liner wall section. The CIPSL shall be made longer than the structure to overlap and reinforce the bench/floor transition area, providing overlap and double liner thickness in the critical corner section where the wall meets the bench.

3.4 FINAL INSPECTION AND ACCEPTANCE

A. The installation of the approved liner system shall be in strict accordance with the manufacturer’s written instructions. Contractor may submit alternate thicknesses as per the manufacturer’s recommendations. The work shall include re-grouting all inlet and outlet lines and benches, as needed, including all preparation, installation, curing and finish operations for the complete rehabilitation process. The liner shall be installed and cured-in-place via a simultaneous pressurization blower system with steam heat injection, or other manufacturer approved process. The curing process will be typically completed in manholes in approximately four hours. Inlet and outlet lines must be reopened within one hour from the time the curing process is completed.

B. The CIPSL system installed shall result in a monolithic structure, bonded to the contours of the existing host structure. The liner shall be adequately bonded to the interior structure surface, and be completely water tight from the ring and cover area to the transition area where the shelf and invert channel connects, including completely sealing the manhole wall and shelf areas to the inlet and outlet pipes.

C. Qualification testing of the CIPSL materials shall have been completed prior to installation. The initial structural properties shall meet or exceed the properties shown in Table 1. Any pertinent qualification testing shall be completed according to ASTM D 5813 as agreed upon between the owner and manufacturer.

D. Qualification testing of the CIPSL materials shall have been completed prior to installation. The initial structural properties shall meet or exceed the properties shown in Table 1. Any pertinent qualification testing shall be
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completed according to ASTM D 5813 as agreed upon between the owner and manufacturer.

E. Cleaned Structure- - All surfaces of the host structure shall be clean to the concrete substrate, acceptable to the owner/inspector and ready to receive the liner.

F. Resin Quantity- - The liner manufacturer shall provide a tag on each CIPSL indicating the amount of catalyzed resin necessary for impregnation purposes. In order to meet structural requirements, this will be acceptable with a tolerance variation of plus or minus 5%

G. The completed installation should be visually inspected to assure that dry spots are not present in the finished liner. This can also be accomplished by closed circuit television if usual inspection cannot be accomplished. No infiltration of groundwater should be observed coming through the CIPSL or coming out at any place where the liner ends.

END OF SECTION