Poly-Triplex® CIPSL By Envirocort

“Cured-In-Place-Structure-Liner”

The permanent renewal solution for sanitary sewer and storm manholes, catch basins, lift stations, wet wells, vaults and other vertical structures.

Poly-Triplex® CIPSL

Solving the 3 goals of structure renewal as set forth by NASSCO in the Inspector Training Certification Program “ITCP” for Manhole rehabilitation

1. Leak Protection
2. Corrosion Protection
3. Structural Build-back

PRODUCT AND TECHNICAL INFORMATION

Poly-Triplex® CIPSL "Cured-In-Place-Structure-Liner"

WHAT IT IS

The **Poly-Triplex® CIPSL** liner system is a highly engineered CIPP, epoxy/fiberglass reinforced composite. It was designed for use as a non-porous, multilayer structural system for the express purpose of renewing structures such as manholes, pump stations, wet wells, vaults, storage tanks and other vertical structures. It may also be used for proactive prevention in new structures. It provides an impervious water and sewer gas resistant membrane, imbedded between layers of structural fiberglass. Therefore, the **Poly-Triplex® CIPSL** liner system is ideal for correcting Hydrogen sulfide (H2S) gas deterioration, infiltration and exfiltration problems in structures of most any shape or size.

HOW IT WORKS

First, due to aggressive bonding, the **Poly-Triplex® CIPSL** liner permanently adheres to wet or dry surfaces and completely seals off infiltration and exfiltration issues within the host structure. Second, the use of the impermeable membrane in the composite design eliminates all pinholes which prevents further corrosion in the renewed structure. Third, the 2-layer fiberglass design provides a structural "build-back" for the manhole or structure being renewed.

Each **Poly-Triplex® CIPSL** liner is custom fabricated to fit the individual structure and does require detailed measurements to facilitate a proper fit. During on-site installation, each liner is lowered into the structure using a specialized steam canister and is pressurized into place using air and then cured with steam. Most structures will be renewed within one hour.

WHY IT SHOULD BE USED

In addition to satisfying all 3 goals of structure renewal as recommended by NASSCO and Civil Engineering firms across the nation, the **Poly-Triplex® CIPSL** liner is easy to install and cures to a finished thickness of less than 250mils (.25"). This results in minimal loss to the original structure diameter. The CIPSL liner is easily designed and fabricated to allow rehabilitation of concentric, eccentric or flat top structures without removing the ring top section or corbel. This minimizes traffic disruption and eliminates the need for road repairs. NO EXCAVATION REQUIRED.

WHERE DOES IT WORK

The **Poly-Triplex® CIPSL** liner is designed and built to be deployed in most manholes and other structures up to 60 ft. in depth. With three (3) liner designs to choose from, the customer can choose the product that best fits the renewal solution required for most situations. All three liner products will permanently adhere to brick, concrete, PVC, ductile iron and many other surface types. In addition, specialized epoxies or vinyl-ester resins may be used in conjunction with the **Poly-Triplex® CIPSL** liner for industrial or commercial applications requiring specific heat and/or chemical resistant properties.

WHY IT SAVES MONEY

Independent laboratory testing confirms that all 3 **Poly-Triplex® CIPSL** liner products offer a 50-year design life and a 100-year expected service life. The end result is a long-term solution built to withstand infiltration and H2S gas deterioration for decades. When compared to low budget, short term solutions that will need re-application multiple times over the same period, the **Poly-Triplex® CIPSL** solution will save utilities thousands of dollars over its lifespan. Additionally, users will benefit and save through the significant reduction in treatment costs associated with ground water entering the collection system.

"Brick MH before Poly-Triplex® CIPSL"

"Brick MH after Poly-Triplex® CIPSL"

Poly-Triplex® "CIPSL" Design

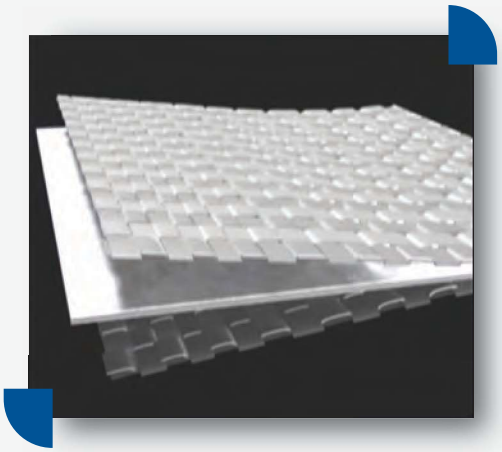
POLY-TRIPLEX® 3-LAYER COMPOSITE DESIGN

LAYER ONE: Structural fiberglass for strength.

LAYER TWO: Non-porous membrane. Critical layer utilizing embedded felt fibers on both sides to allow bonding to the fiberglass material. Provides a corrosion and moisture barrier.

LAYER THREE: Structural fiberglass for strength.

EPOXY: 100% solids epoxy – solvent free. Saturates all 3 layers to create a monolithic composite structure once cured.



The **Poly-Triplex® CIPSL** Liner System is manufactured in three (3) standard liner weights based on the 3-layer design above, that are configured for varying depths and varying structural conditions. These three (3) liner designs provide the end-user with the right choice for fulfilling lining needs ranging from preventive maintenance to very serious structural problems, extensive infiltration and/or ex-filtration problems and heavy top-loading requirements. The minimum liner thickness is determined by a formula based on hydrostatic and soil pressure related to the depth and diameter of the structure, and traffic loading. Generally, the minimum "Factor of Safety" is 2.0 for all **Poly-Triplex® CIPSL** liners, but can be adjusted for specific on-site conditions. Engineering Design Methodology and calculations are available upon request.

Poly-Triplex® 56-SL Liner : For structures up to 22 ft in depth.

Poly-Triplex® 56-SL Liner: Classic 3-layer design used for the majority of structures up to 22' in depth where moderate to severe Inflow and Infiltration are the main issue, and, the structure is subject to light to moderate deterioration due to sewer gases. The host structure should be structurally sound, with no severe cracking of concrete, no missing bricks and should not be subject to heavy traffic-loading.

Layer #1: 18-oz. structural fiberglass
Layer #2: Non-porous inner membrane
Layer #3: 18-oz. structural fiberglass

Poly-Triplex® 68-SL Liner: For structures up to 38 ft in depth.

Poly-Triplex® 68-SL Liner: Enhanced 3-layer design used for the majority of structures up to 38' in depth that are exhibiting structural issues, deterioration due to sewer gases, Inflow and Infiltration issues, or, are subject to moderate to heavy top-loading conditions.

Layer #1: 24-oz. structural fiberglass
Layer #2: Non-porous inner membrane
Layer #3: 24-oz. structure fiberglass

Poly-Triplex® 116-SL Liner: For structures up to 60 ft in depth.

Poly-Triplex® 116-SL Liner: The strongest 3-layer design used to renew the majority of structures that are larger in diameter and up to 60 ft in depth. This liner design will be used to rectify the most severe structural issues, deterioration issues, Inflow and Infiltration issues, and, handle heavy traffic or other top-loading conditions. In addition, the 116-SL liner may be used for culvert pipe CIPP renewal.

Layer #1: 2 layers of 24-oz. structural fiberglass (48-oz. total)
Layer #2: Non-porous inner membrane
Layer #3: 2 layers of 24-oz. structural fiberglass (48-oz. total)

Poly-Triplex® CIPSL Epoxy:

The **Poly-Triplex® CIPSL** Liner utilizes a 100% solids, thixotropic epoxy laminating resin that may be used with a variety of hardeners to produce fiber-reinforced composites. It wets out and bonds to fiber reinforcements exceptionally well with minimal drainage. The advantages of using epoxy resin as the polymer matrix for fiber-reinforced composites include: chemical resistance, outstanding fatigue resistance and low thermal expansion.

The epoxy is designed to be mixed and field applied at the job site just prior to installation. After the resin is applied, the liner is lowered into the manhole where, in most cases, it is cured-in-place using air pressure and steam heat injection. Most liners are cured within one hour at approximately 180°F and becomes a structural, monolithic wall bonded to the host structure. Adjustments to the epoxy can be made to achieve different cure times.

Other chemical and industrial applications may require an alternate resin system depending on the site conditions and chemicals present in the structures. In these cases, the owner shall supply an analytical report of chemicals present to Envirocort Technologies LLC. The resin system used is determined on a case by case basis.

POLY-TRIPLEX® CIPSL PHYSICAL PROPERTIES

Physical Property	ASTM	56-SL Liner	68-SL Liner	116-SL Liner
Compressive Strength	D 695	9,040	11,630	14,150
Compressive Modulus	D 695	636,600	811,200	1,570,000
Tensile Strength	D 638	13,860	16,200	40,970
Elongation at Break %	D 638	7.40%	7.08%	11.92%
Flexural Strength	D 790	33,946.20	39,865.70	49,912.19
Flexural Modulus	D 790	1,167,990	1,332,000	1,783,142
Adhesion / concrete - lab results	D 7234	Substrate failure	Substrate failure	Substrate failure
Adhesion / concrete - expected field results	D 7234	>200 psi	>200 psi	>200 psi
Durometer Hardness	D 2240	82	82	82

PREPARATION PROCESS

Cleaning: All surfaces of the host structure are to be cleaned with a high-pressure hydro-jet sprayer with an operating pressure of at least 4,000 psi. After pressure cleaning, additional preparation using chemical or mechanical means may be necessary to properly prepare the surface to achieve the necessary concrete surface profile (CSP) of between 3 and 8. This will allow for the proper bonding of the liner to the host structure.

Chemical Grouting: For structures with significant water ingress through the walls, joints or other areas, proper grouting techniques must be employed to eliminate and stop this infiltration. Active infiltration can wash out the epoxy and compromise the integrity of the liner.

PH Testing: The surface of the host structure should be tested for the proper PH level. If the PH levels are not within the range of 6 to 10, adjustments must be made to the surface area prior to liner installation. This could include further surface cleaning, or the application of a compound designed to adjust PH levels.

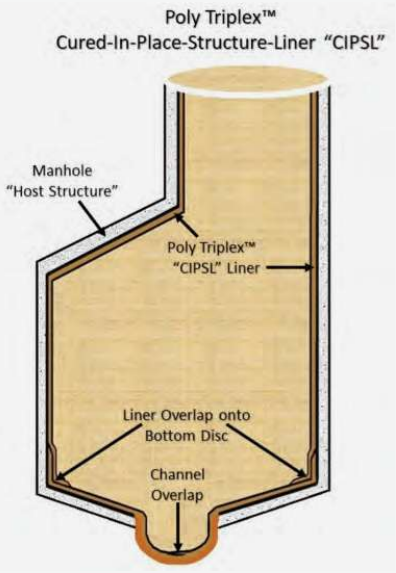
Pipe Connections and Steps: Surface preparation of any structure that is to be lined must include the removal of all protrusions and sharp penetrations existing within the manhole. All incoming and outgoing pipe connections must be properly trimmed down to a 2" protrusion or less. Any sharp edges to the remaining pipe connections, or other sharp areas within the structure, should be ground down as smooth as possible. In addition, all manhole steps must be removed flush to the structure wall. Hydraulic cement, or Portland type II cement should be used to cover all jagged or intruding areas, including any pipe connection protrusions. This process will provide the optimal surface condition that will facilitate proper liner adhesion during installation.

Holes and Voids: All internal surface areas of the structure shall be prepared, repaired or refinished as is necessary, to rebuild the structure when required. All holes, voids and missing sections must be filled with hydraulic cement, or Portland type II cement to bring the structure back to its original dimensions, or as close as possible.

Bench/Channel Preparation: When lining of the channel is specified, an approved pipe plug or by-pass pumping will be required to stop all sanitary flow through the structure. If the channel is not being lined, a flow-through plug or channel cover must be installed into the invert to allow for continued flow of the effluent through the manhole during installation.

"CIPSL" Liner Installation:

All **Poly-Triplex® CIPSL** liners are custom fabricated by Envirocort Technologies, LLC to fit the size and shape of each individual structure. All structure measurements must be taken on-site by the use of remote measuring devices or remote scanning camera systems. The liners are then manufactured to the exact dimensions required and will be shipped to each job site along with the proper amount of epoxy (Part A and B).



Each CIPSL liner consists of two sections, both made of the **Poly-Triplex® CIPSL** 3-layer fabric design: A "bottom disc" liner that will cover the entire bench and channel area, and, the "main shaft" liner which will extend down from the structure rim. The "main shaft" liner section will extend down and over the "bottom disc" liner by a minimum of 6". Based on this design, the **Poly-Triplex® CIPSL** liner, once cured, will form a monolithic structure permanently connecting the ring and cover seat to the chimney, corbel, wall and bench areas of the structure.

See "**Poly-Triplex® CIPSL** manhole diagram"

Bench areas, floors and in some cases, the channel invert, shall be lined with the "bottom disc". The "bottom disc" is wet-out and placed in the bottom/bench area prior to installation of the "main shaft" liner. The "bottom disc" will be oversized and extend up the wall by 6". The "main shaft" liner will also be oversized and will overlap 6" onto the "bottom disc", creating a final overlap of the two-piece liner by a total of 12 inches at the bench/wall junction. In cases where lining of the channel invert is required, the sewage flow must be stopped for a minimum period of 3 hours as the channel must be completely dry prior to lining. When lining the channel invert, the bottom disc will be sized accordingly, allowing for the liner to be cut and placed into the channel opening, creating an overlap that will allow for a one-piece, homogeneous cure in the channel.

Alternatively, channels may also be renewed by utilizing the hand lay-up method and using a fast setting mastic, or equivalent, and fiberglass material. If choosing this method, it is recommended to do this after the CIPSL liner is installed, cured and all channel and pipe openings have been reinstated. If channel lining is required, it must be specifically noted in the liner proposal or the client's quotation request.

When lining of the channel invert is not required a flow through plug, or channel subfloor, must be installed to prevent the liner from being pushed into the channel area.

After installation of the "bottom disc" liner, the "main shaft" liner will be wet-out and then attached to the Envirocort Steam Canister and lowered into the structure to the pre-marked position at the cover seat of the structure opening. Inflation of the liner is accomplished through the use of a geo-membrane bladder material, installed inside of the 3-ply liner. The bladder assembly is designed to inflate and "push" the liner tightly up against the host structure using air pressure.

Curing Process

After the liner is properly positioned and inflated, steam will be introduced into the structure chamber, through the Steam canister assembly, to initiate the exothermic reaction of the epoxy. When utilizing steam, a minimum temperature of 150 F to 180 F degrees should be reached and held for approximately 1 hour for proper curing. Structure size, site conditions and weather conditions may affect the final curing time.

Most typical **Poly-Triplex® CIPSL** liner installations will be pressurized between 1psi and 8psi (max) depending on the condition of the structure and other factors. For deeper structures, a series of steam hoses are available to release steam into the lower portions of the structure. The "Steam Drop Hose Assembly" attaches to the underside of the Steam canister and can be installed through a special fitting in the canister at any time before pressurization has occurred. This will aid in the uniform heating of the liner at all portions of the structure. Custom curing applications can be used with proper changes to the resin and hardening agents. This may include using heated, or ambient, water or air pressurization instead of steam.

Upon completion of the liner curing process, all excess water condensate must be pumped out of the structure before the inflation bladder can be removed. Next, it is necessary to cut off and remove all of the excess liner material remaining above the structure rim. At this point, a crew member may enter the structure and reinstate the channel and all pipe openings. As a final procedure, it is then recommended to use mastic to seal all cut edges of the channel and pipe openings to smooth over any rough areas.

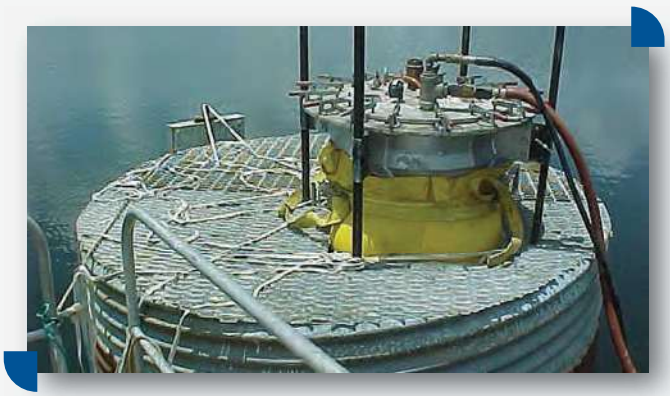
Before returning the structure to service, the final procedure is to remove any and all flow diversion or stoppage equipment, and materials, used in the pipe connections or channel.

Pump Station, Wet Well and Vault Installation:

Any and all pumps, internal pipes, switches, etc. must be removed from the structure, creating a bare surface for the **Poly-triplex® CIPSL** liner to completely bond to all areas. Unless otherwise specified by the owner, the liner will include walls, the floor, and the underside of top slab. The underside of the top slab may be lined in conjunction with the walls and floor, or it may be coated with an approved Mastic or equivalent approved material. The underside of the top slab may also be lined by removing the top slab for installation of the liner and applying **Poly-Triplex® CIPSL** materials or Mastic, then allowing it to cure at ambient temperature. A separate renewal of the top slab will allow the top slab to be removed in the future.

Once the liner is fully saturated with resin, it shall be lowered into the structure to the appropriate pre-marked position at structure entrance. In the case of large or non-cylindrical structures, the liner may be installed in sections with multiple cure times. The liner shall form a monolithic structure permanently connecting the walls and floor of the structure (and top slab where applicable).

Pump stations and larger structures are typically pressurized to a minimum of 2psi, with all infiltration being stopped before installation. This is due to the limited weight of the deck slab restricting the amount of internal pressure that can be applied during the installation process. The liner may also be pressurized and cured-in-place at ambient temperatures. Depending upon specific site conditions and safety requirements, the water method is preferred for square or rectangular structures, vaults or large pump stations.



Envirocort Longevity Assurance Commitment

For over two decades and 15,000 successful installations, the **Poly-Triplex® CIPSL** Cured-in-place-structure- liner has been the industry leader in the CIP manhole renewal market. These liners continue to perform to their specifications, offering the only true, long-term solution for corrosion resistance, I&I elimination and structural build-back of failing manholes.

The **Envirocort Longevity Assurance Commitment** begins with the **Poly-Triplex® CIPSL** 3-layer composite liner: a professionally engineered design that achieves a 50-year design life and a 100-year service life based on independent laboratory test results. We employ automated manufacturing, and process standards, utilizing strict quality assurance and control guidelines throughout the entire process. The process includes initial structure inspection, ordering, liner fabrication, packaging, shipping and final installation. The result is a high-quality, consistent product that meets or exceeds multiple ASTM standards for **Extended Longevity** manhole renewal.

Envirocort's "Certified Installers" are a key component of this assurance program. All installers of the **Poly-Triplex® CIPSL** product are extensively trained in all aspects of the program. This includes hands-on training in safety protocols, proper inspection techniques, proper structure preparation, detailed lining installation guidelines, specialized equipment training, material handling and other required measures to guarantee successful and timely installation of all CIPSL liners. Our **Longevity Assurance Commitment** and **Certified Installer Program** was designed and is managed by a team of NASSCO® ITCP Manhole rehabilitation staff.

Envirocorts Extended Longevity Commitment will always be to provide our customers with a sustainable product that also provides cost savings solutions for the industry's manhole renewal needs.

Limited Warranty

Envirocort Technologies, LLC and the **Poly-Triplex® CIPSL** Authorized Licensed Installer, jointly provide our Standard 20-Year Non-prorated Limited Warranty on all materials and a 5-year Labor Non-prorated Limited Warranty. **Poly-Triplex® CIPSL** fabrics and resins are warranted to be free of defects in materials and workmanship, to prevent infiltration through the liner, prohibit root penetration through the liner and, provide a surface coating resistant to sewer gases and chemicals typically found in domestic sewer collection systems. This Limited warranty is expressly given for the repair or replacement of the liner as determined by Envirocort Technologies, LLC. A summary of Envirocort' s Limited Warranty coverage for **Poly-Triplex® CIPSL** Materials are as follows:

- Manholes – Non-prorated 20-Year Materials and 5-Year Limited Labor Warranty
- Sewage Pump Stations, Wet Wells - Non-prorated 20-Year Materials and Five-Year Labor
- Industrial/chemical plant Manholes and Structures: Limited Warranty coverage will be given on a case-by-case basis, and will be based upon the CIPSL liner design, as well as the chemical and heat resistant properties of the curing resin.
- Envirocort Technologies, LLC does not provide warranty coverage on the structural integrity of the existing host structure or substructure. However, in most cases, **the Poly-Triplex® CIPSL** liner system will eliminate further deterioration of the host structure or substructure due to sewer gases and will significantly increase the life of the existing structure
- Envirocort Technologies, LLC does not provide warranty coverage in the event of damage due to external forces that result in physical alteration to any portion of the cured liner.

Please contact Envirocort Technologies for the official Limited Warranty Terms and Conditions.

Long Term Maintenance and Repairs

No maintenance is required for structures renewed using the **Poly-Triplex® CIPSL** Liner systems product. In most cases, external forces that result in physical damage to the **Poly-Triplex® CIPSL** composite, may be repaired using mastic and additional fiberglass material. Mastic is also recommended for use as a seal between any new pipe-connection opening that is introduced after the liner is put into service.

POLY-TRIPLEX® "CIPSL" CURED-IN-PLACE-STRUCTURE-LINER

Installed June 1995 – Zephyrhills, FL
Photos taken August 2019 - "In Service for 24 years"

Poly-Triplex® "CIPSL" CURED-IN-PLACE-STRUCTURE-LINER

BEFORE

PREPARATION

CURED CIPSL

envirocort technologies

TECHNICAL SUPPORT, SERVICE AND SALES INFORMATION

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