

CIP Manhole Liner as manufactured by CIP Industries

100 Year Service Life Certification Report

By

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February 12, 2025

INTRODUCTION

A "100-year service life" certification for a sewer indicates that the material and installation are expected to endure for a minimum of 100 years in the environment in which it is installed. This standard can be applied to cured-in-place liner materials, which are renowned for their durability and resistance to corrosion.

Municipalities such as the City of Atlanta mandate this certification for all products prior to installation. The goal of sewer rehabilitation is to improve structural integrity, provide chemical resistance and eliminate inflow and infiltration, thereby preventing sanitary sewer overflows, sink holes and violations of water quality standards.

By implementing the "100-year service life certification," municipalities ensure long-term value and reliability for taxpayer investments in their sewer systems.

To meet these stringent requirements, manufacturers must provide comprehensive evidence of the durability and performance of their products. This typically involves rigorous testing and certification processes that simulate the conditions that products will endure over a century of use. Such testing includes exposure to various environmental factors, such as temperature fluctuations, chemical interactions, and physical stresses.

Moreover, it is imperative for manufacturers to develop and adhere to strict quality control measures during production to ensure the integrity of the materials used. This includes meticulous monitoring of the fiberglass, membrane, felt and polymer resin to guarantee they meet the necessary standards for resistance to corrosion and wear.

Additionally, the installation process plays a critical role in achieving the desired service life. Products must be installed in accordance with the precise specifications provided by the manufacturer, and installers must be adequately trained and certified to handle and install the Liner correctly. Any deviation from the recommended installation procedures

can significantly compromise the effectiveness and longevity of the sewer system components.

CONSIDERATIONS

This report was prepared for the CIP Liner as manufactured by CIP Industries.

To determine the likelihood of a manhole rehabilitated with CIP Liner to last 100 years the following must be taken into consideration.

1. Resistance to the environment and external forces
2. Chemical resistance
3. Liner manufacturing
4. Installation according to manufacturer's specifications
5. Comprehensive QA/QC program

Resistance to the Environment and External Forces

If a product such as a manhole liner is to last 100 years, an element that it must overcome is the environment in which it is to be installed. Proper evaluation of the atmosphere and condition that exist in a manhole must be documented and compared to the Liner's capabilities. The Liner must also resist the stresses that could be exerted onto the liner. Manholes in sewer systems may encounter effective lateral earth pressure, external hydrostatic pressure, traffic loading, and impact forces. Additionally, manholes may be subject to internal pressures caused by surcharges. Therefore, it is necessary that all manholes be designed to exceed the maximum stresses. The key physical properties when considering long term design are flexural strength, flexural modulus, tensile strength, compressive strength and hardness. The physical properties of the individual components and the composite Liner are pivotal in determining a long-term design.

The manhole Liner must also vigorously bond to the manhole substrate when the intention is to mitigate water coming into the manhole in the form inflow and infiltration. This is a product of the Liners' bonding capabilities and the preparation of the substrate.

Chemical Resistance

The channel (invert) portion of the manhole is typically exposed to sewage effluent. The effluent can contain dirt, debris, chemicals and sulfides. The remaining part of the manhole will be exposed to the sewage effluent in cases of surcharging. Furthermore, the sulfides that are airborne are consumed by bacteria known as thiobacillus and converted to sulphuric acid. The microbially induced corrosion (MIC) is more predominant in areas where there is excessive sewage retention such as a lift station/wet well and the downstream manholes from these structures, in addition to areas of the sewer that have bellies or flat grade. The MIC corrosion is the single biggest reason concrete and mortar based constructed manholes corrode. The manhole Liner must be able to withstand the effluent and sulphuric acid for 100 years. A typical pH level in a manhole that is experiencing MIC is between 2 and 6.5. Therefore, the manhole Liner must withstand these low pH levels.

Liner Manufacturing

A properly constructed manhole Liner is a critical component in ensuring the long-term performance. The dry Liner is constructed of woven roving fiberglass, polyester felt, and an inner impervious membrane. The impermeable membrane is a critical component that provides a barrier between the internal manhole environment and the existing manhole substrate. Because polymers tend to pinhole, the impermeable membrane eliminates the chance of a pinhole going all the way through the Liner, therefore preventing further deterioration. The impermeable membrane also acts as a water stop preventing inflow and infiltration from entering the manhole.

The manufacturer must follow strict standard operating procedures to fabricate and assemble the custom Liner. This will ensure proper fitment into the manhole. Proper size and fitment are critical for both structural support and I&I abatement. In addition, proper selection of the polymer resin is needed to ensure that its physical characteristics provide resistance to the effluent and atmosphere and that the physical properties will provide for a long-term design. The typical resin used for a manhole Liner is a bisphenol A/epichlorohydrin resin suitable for the manhole Liner application. During the fabrication of the Liner, the manufacturer's QA/QC procedures must be followed.

Installation according to manufacturer's recommendations

The final necessary component for a long-term performance of a manhole Liner is proper field installation. Therefore, the installation must be in strict accordance with the manufacturer's specifications. This is a vital portion of the longevity of the Liner. The installation includes measurement, preparation, Liner saturation, placement, pressurization and curing. During the installation and after the completed installation, the manufacturer's QA/QC procedures must be followed. Although experience can vary among installation crews, it is the manufacturer's responsibility to make sure the installer has the necessary expertise required for a proper installation. This requires a manufacturer's certification for the installation company and crew.

Comprehensive QA/QC program

QA/QC programs for the manufacturing process must be comprehensive. The program must demonstrate that the Liner is manufactured correctly. Proper material and assembly must be demonstrated by checks and balances and inspection by an experienced person. Correct amounts of resin for each Liner model must be verified prior to shipment. The QA/QC program must also verify proper installation and its strict adherence to the manufacturer's specifications. Field verification of correct Liner size, resin mixing, resin quantities, Liner saturation, proper placement, adequate pressure and curing must be documented. All field data from the QA/QC log, including photos, should be converted to an electronic database to document installation conditions and for submittal to the owner.

VERIFICATION

The cured in place manhole Liner manufacturer, CIP Industries, provided me with supplementary information to substantiate the service life of the primary components and

fabrication of the Liner. In particular, the primary components are the dry Liner (consisting of fiberglass, felt and membrane) and the resin. I have reviewed the following documents and other items related to the CIP Industries manufacturing of the CIP Liner.

1. Fiberglass technical data sheet (TDS) and safety data sheet (SDS)
2. Resin TDS, SDS and chemical resistance
3. Curing agent TDS and (SDS)
4. Impermeable membrane layer composition and information
5. Liner fabrication standard operating procedure (SOP)
6. Manufacturing quality control SOP
7. Dry material samples
8. Cured Liner samples
9. Third party physical property test data

The installation of the CIP Liner is only performed by an Infrastructure Rehabilitation USA certified, trained installer. I reviewed the following submitted information.

1. Installation specifications
2. Installation training manual
3. Equipment list
4. Written quality control plan
5. Repair procedures
6. Third party bond test data
7. Installation experience requirements

It is recommended that a third-party reviewer be utilized to provide independent analysis of the Quality Control Plan and perform periodic audits.

DESIGN

The design of the Liner must demonstrate sound engineering principles and take into consideration field conditions. The industry standard design for Polymeric Bonded Liners is found in the ASCE Manual of Practice No. 92 Chapter 7. This design methodology can be used to verify that a certain Liner model will withstand a certain unbonded area without failing. Different Liner models have a particular thickness, and strengths associated with them.

Understanding the creep resistance of the epoxy material used in conjunction with the dry Liner material and cured as a composite, one can conclude that the Liner will remain bonded to the host structure and keep its shape for a very long time under the normal stresses that act on the manhole.

CONCLUSION

There are critical components that determine the useful life of the CIP Liner. The components and the assembly of the Liner itself, the resin selection and the installation. Based on the submitted information for the CIP liner from the manufacturer and installer it is determined that the CIP Liner can be certified for a “100-year service life”.

