

# MAINSTAY COMPOSITE LINER APPLICATION GUIDE



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## TABLE OF CONTENTS

Section 1: Introduction.....	2
Section 2: Surface Preparation.....	2
Section 3: Leak Correction.....	4
Section 4: Mortar Resurfacing.....	4
Section 5: Epoxy Coating.....	5
Section 6: Flexible Joint Sealant & Frame Seal.....	7
Section 7: Final Inspection and Testing.....	7

## **SECTION 1: INTRODUCTION**

The MAINSTAY COMPOSITE LINER is a concrete rehabilitation system consisting of two compatible products: a high strength restoration mortar, such as MAINSTAY ML-72 Microsilica Restoration Mortar, and an epoxy corrosion barrier coating, such as MAINSTAY DS-5 Epoxy Coating, that cures simultaneously to repair and protect brick and concrete manholes and other sanitary sewer structures. The near simultaneous application of these materials creates a monolithic lining that cures into a strong, highly corrosion resistant, and continuous surface, free of pinholes, holidays, and voids. The mortar and topcoat are tightly bonded not only to the concrete substrate but also to each other.

The products that comprise the MAINSTAY COMPOSITE LINER system are well suited for application in moisture laden environments, such as those present in manholes, wet wells, and other sanitary sewer system structures. While a dry environment is often required when applying corrosion resistant lining systems, the MAINSTAY line of restoration mortars and epoxy lining materials exhibit superior adhesion and performance in wet environments. Of course, these products may also be applied in a dry environment.

The purpose of this guide is to provide the user with the necessary information regarding work, materials, and equipment required for the surface preparation and installation of the MAINSTAY COMPOSITE LINER. However, as this guide and the product technical data sheets cannot cover every situation that may be encountered in the field, it is recommended that the user contact Madewell Products

Corporation Technical Support at (770) 475-8199 for questions.

## **SECTION 2: SURFACE PREPARATION**

### **2.1 Concrete and Masonry Surface Preparation**

A properly prepared surface ensures the MAINSTAY COMPOSITE LINER will achieve maximum adhesion to the substrate. A sound substrate is one that is clean and free of loose, latent, or unsound concrete, poorly adhered or incompatible coatings, dirt, oils, grease, curing compounds, form release agents, or other contaminants that may interfere with adhesion. New concrete may be coated as soon as it has reached sufficient strength that forms may be removed or, in the case of flat work, the concrete is hard enough to walk on. There are several methods of surface preparation available to the user to achieve adequate levels of cleanliness and a minimum Concrete Surface Profile (CSP) as outlined in International Concrete Repair Institute (ICRI) Technical Guideline 310.2R-2013.

Prepare all surfaces to receive the MAINSTAY COMPOSITE LINER in accordance with NACE No. 6/SSPC-SP13. Appropriate methods may include Low Pressure Water Cleaning (LP WC, 4,000 psi minimum), abrasive blasting, hand, or power tool cleaning to remove all unsound concrete, contaminants, dirt, debris, and/or deteriorated reinforcing steel. Refer to the ICRI Technical Guideline No. 310.1R "Guide for Surface Preparation for Repair of Deteriorated Concrete Resulting from Reinforcing Steel Corrosion" and 310.2R "Selecting and Specifying Concrete Surface Preparation for Sealers, Polymer Overlays, and Concrete

Repair” and/or contact a Madewell Technical Representative for information best suited for your application. Surfaces should have a minimum ICRI CSP #5, preferably with aggregate exposed. In brick structures with a glazed finish, it is recommended that abrasive blasting be used to achieve a suitably rough surface similar to that of medium grit sandpaper. Unglazed brick surfaces may be prepared by pressure washing at a minimum to 5,000 psi. Surfaces should be inspected for soundness prior to the application of MAINSTAY ML-72. Saturate all surfaces thoroughly with clean water and allow the surface to dry just prior to the application of MAINSTAY ML-72.

After preparation, concrete surfaces should be inspected for pH. Sound concrete surfaces will have a high pH, typically greater than 9.0. Low surface pH is an indication that the surface of the concrete has been become carbonated or has suffered corrosive acidic attack. A 1% solution of phenolphthalein in ethyl alcohol sprayed onto the surface will turn bright pink if the surface is above a pH of 9.0. Alternatively, paper pH strips and tap water may also be used. If the surface has not reached an alkaline pH of 9.0 or greater, the substrate must be further prepared until a higher pH is achieved.

Saturate all surfaces thoroughly with clean water and allow to surface dry just prior to the application of the restoration mortar.

## 2.2 Abrasive Blasting

Abrasive blasting is the most effective method for achieving sufficient cleanliness and surface profile. A compressor of suitable size should be used to deliver adequate cubic feet per minute (CFM) and psi. When coupled with the

appropriate blast nozzle size and hose length, maintaining a minimum of 90 psi at the nozzle is optimal.

Figure 1: Abrasive Blasting CFM/PSI Chart

Nozzle Size	Orifice Diameter		Nozzle Pressure							Minimum CFM Required
	inches	mm	50	60	70	80	90	100	125	
#6	3/8"	9.5	110	124	145	160	175	200	275	
#7	7/16"	11	150	170	200	215	240	255	315	
#8	1/2"	12.7	200	225	250	275	300	340	430	
#9	5/8"	16	300	350	400	450	500	550	700	
#10	3/4"	19	430	500	575	650	700	800	1100	

## 2.4 Metal Surface Preparation

Surface preparation methods for metals should include those that remove all existing coatings, corrosion products (rust), mil scale, oxides, and other foreign matter. Abrasive blasting is the most effective method for achieving sufficient cleanliness and surface profile.

### 2.4.1 Ferrous Metal (Immersion Service or Severely Corrosive Environment)

Prepare surfaces in accordance with NACE No. 1/SSPC-SP5, White Metal Blast Cleaning. Achieve a 2.5 to 4.5 mil surface profile.

### 2.4.2 Ferrous Metal (Intermittent Immersion Service or Mildly Corrosive Environment)

Prepare in accordance with NACE No. 2/SSPC-SP10, Near White Blast Cleaning. Achieve a 2.0 to 4.0 mil surface profile.

### 2.4.3 Non-Ferrous Metal Surfaces

Prepare in accordance with SSPC-SP16, Brush Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steel, and Non-Ferrous Metals.

#### **2.4.4 Ductile Iron Pipe and Cast-Iron Fittings**

Prepare surfaces in accordance with NAPF 500-03-04 & 500-03-05, Abrasive Blast Cleaning for Ductile Iron Pipe and Abrasive Blast Cleaning for Cast Iron Fittings.

### **SECTION 3: LEAK CORRECTION**

Active leaks should be stopped prior to installing the MAINSTAY COMPOSITE LINER. A variety of methods may be used to stop active leaks.

#### **3.1 Polyurethane Grout Injection**

Remove dirt and loose substances around the leak. Beginning at the lowest point of the vertical crack, or the narrowest side of a horizontal crack, drill a hole at a 45° angle through a minimum of half the thickness of the wall structure (e.g., a 3" deep hole in a 6" thick substrate). After flushing out the hole and inserting the injection port nipple, flush out the port with water. Observe where the water exits for placement of additional ports. Begin pumping grout resin until the crack or joint will accept no more or until resin no longer moves along the crack. Insert the next port on the opposite side of the crack and continue injecting resin in this manner until the crack or joint has been sealed. After the resin cures, remove the ports and excess resin from substrate.

#### **3.2 Hydraulic Cement**

For small, weeping leaks, MAINSTAY ML-10 Hydraulic Cement Mortar may be used in its dry powder form by simply pressing a small handful against the leak while applying firm pressure. For larger leaks, MAINSTAY ML-10

may be mixed with water to form a viscous mass with the consistency of modeling clay and applied to the leaking surface. Mix one or two pounds of MAINSTAY ML-10 with enough water to form a ball, apply at the top of the leak by hand or with a trowel, and work downwards until the leak has stopped. The working time of MAINSTAY ML-10 is approximately 60-90 seconds.

#### **3.3 Alternative Method**

An alternative method to injection grout or hydraulic cement includes the application of an initial layer of MAINSTAY ML-72 Restoration Mortar to the structure and repairing the visible leaks after the mortar has hardened (typically overnight). This may be advisable on brick manholes or those that have hard to trace leak sources. This process may also require the placement of a relief pipe inserted into the manhole wall. This will provide a pathway for the leaking water while allowing the initial layer of mortar to set. After the mortar hardens, the relief pipe can be removed, and the remaining hole can be plugged prior to full application of the MAINSTAY COMPOSITE LINER. Contact a Madewell Technical Representative for more information on this method.

### **SECTION 4: MORTAR RESURFACING**

The application of MAINSTAY ML-72 Microsilica Restoration Mortar provides a consistent, high-strength, and durable surface that can accept the MAINSTAY DS-5 topcoat. For new structures, MAINSTAY ML-72F may be used up to a 1/2" to seal rough surfaces and fill bug holes. For rehab structures or those that require greater thickness, MAINSTAY ML-72

may be applied up to 5” in a single or multiple applications.

#### **4.1 Mortar Packaging**

MAINSTAY ML-72 is normally packaged in 65-pound bags. 2,000-pound and 3,000-pound bulk sacks are also available.

#### **4.2 Mortar Mixing**

Begin by adding one gallon of clean water per 65-pound bag of MAINSTAY ML-72 Microsilica Restoration Mortar depending on application and project requirements. Mix thoroughly using a gasoline, electric, or pneumatic powered paddle style mixer. Additional water, up to one quart per bag maximum, may be added to increase workability. Always try to use the least amount of water possible for job conditions. Less water will produce a mortar that is high in strength but may be difficult to pump. Additional water will make the mortar easier to pump but will reduce the physical strengths of MAINSTAY ML-72.

#### **4.3 Mortar Application**

Saturate all surfaces thoroughly with clean water and allow to surface dry just prior to the application of the restoration mortar. MAINSTAY ML-72 can be applied pneumatically to the substrate using low to medium velocity wet mix shotcrete nozzles, centrifugally using a mortar spinner, or by hand using a trowel. Thicknesses up to 5” are possible; however, the application thickness will depend on the condition of structure being treated, the amount of water added, and the final structural properties desired. A variety of piston, systolic, and rotor/stator pumps may be used depending on project requirements and desired production rates. Consult with a

Madewell Technical Representative for information regarding pumping and spraying equipment.

#### **4.4 Mortar Finishing**

Use a rounded pool trowel to knock down the mortar profile and to even out the mortar thickness if needed. After troweling, apply a light sponge finish to produce a smooth, lightly textured surface. If additional mortar lifts are to be applied, use a broom, brush, or sponge to provide sufficient surface roughness for following applications. If the resurfacing mortar is to be topcoated with MAINSTAY DS-5 Epoxy Coating, a sponge should be used to produce a smooth and grainy finish. Do not allow the finished restoration mortar to become contaminated prior to the installation of the MAINSTAY DS-5 epoxy topcoat.

### **SECTION 5: EPOXY COATING**

MAINSTAY DS-5 Epoxy Coating provides a corrosion resistant barrier and is typically applied at 100 to 125 mils for manhole lining applications. When applying the MAINSTAY COMPOSITE LINER system, MAINSTAY DS-5 should be applied directly to the MAINSTAY ML-72 Restoration Mortar while the mortar is still soft. Although it may seem counter intuitive, it is almost impossible to apply the epoxy too early, the only exception being that the mortar must be sufficiently stiff so as not to be distorted by the force of the epoxy as it is being sprayed. The mortar should be topcoated before it has stiffened to the point that it is no longer possible to push a screwdriver through the mortar to the substrate.

#### **5.1 Epoxy Packaging**

MAINSTAY DS-5 comes packaged in 4.5-gallon kits, 15-gallon kits, and 150-gallon drum sets.

## **5.2 Epoxy Mixing**

MAINSTAY DS-5 is a two-component coating. Mix components at a volume ratio of two parts A to one part B. Whenever possible, avoid mixing partial kits. All components (liquids A and B) should be between 70 degrees Fahrenheit (F) and 90 degrees F prior to mixing. The entire contents of each component should be thoroughly mixed individually before combining separate components together. If it is not possible to mix an entire kit, pour carefully measured quantities of both components into a clean container and blend thoroughly using a power agitator, such as a Jiffy® mixer, and a high strength industrial drill for three minutes. Working time is approximately 45 minutes at 80 degrees F. Working time will be extended at lower ambient, surface, or material temperatures and shortened when higher. Do not mix more material than can be used within stated working times.

## **5.3 Epoxy Application**

In cases where a structure has experienced corrosion, the combination of MAINSTAY ML-72 Microsilica Restoration Mortar and MAINSTAY DS-5 Epoxy Coating is required to both restore and protect the brick or concrete structure from future deterioration. MAINSTAY DS-5 is most commonly applied by airless spray. A minimum 56:1 airless spray pump with an available air inlet input pressure of 90 to 100 pounds per square inch (psi) may be used to feed material through 50' to 100' of 3/8" diameter paint line to a standard airless spray gun with a minimum 0.031" reversible

RAC tip. It is recommended that 30 mesh in-line strainers/stack filters be used. Other equipment, such as whip hoses, heaters, or plural component spray pumps may be employed. It should be noted that paint spray lines and paint spray guns must be properly rated for the pressures used. For instance, a 56:1 airless spray pump with 100 psi of incoming air produces 5,600 psi at the gun tip and would require a hose and gun rated for those pressures. MAINSTAY DS-5 may also be applied by centrifugal spray, brush, or roller in smaller structures. Multiple applications may be needed if applied by hand.

MAINSTAY DS-5 is typically applied between 80 to 100 mils but may be applied up to 250 mils in a single application. Theoretical coverage is 16 square feet per gallon at 100 mils or 72 square feet per 4.5-gallon kit. Allowance should be made for waste. Working time is approximately 45 minutes at 80 degrees F. Working time may be lengthened or shortened depending on ambient, surface, or material temperatures (see Section 5.2).

## **5.4 Return to Service**

The MAINSTAY COMPOSITE LINER must not be allowed to freeze before it is fully cured. It may be returned to service once final inspection has taken place and all touch-ups and repairs have been made. When applied in a manhole, the MAINSTAY COMPOSITE LINER is typically installed while the structure is still in service. For immersion service, MAINSTAY DS-5 epoxy should be cured hard enough that it is not possible to dent the coating surface with a fingernail before it is placed into service. The time required to reach this degree of cure is dependent on temperature. In hot weather, this degree of cure might be achieved in four to six

hours. In cool weather it might take 24 hours or longer. Force curing by the use of indirect fired heaters can be employed to reduce cure time. If the invert channel is to be lined or if service drops are present, additional steps may be required. Contact a Madewell Technical Representative for specific guidance regarding the use of fast setting versions of MAINSTAY ML-72 and DS-5.

## **SECTION 6: FLEXIBLE JOINT SEALANT & FRAME SEAL**

MADEWELL 806 Flexible Joint & Manhole Chimney Seal is applied at the joint between the manhole cast iron frame and the concrete grade ring(s) or bricks to allow for expansion and prevent cracks and leaks that may occur from freeze/thaw or traffic conditions. MADEWELL 806 is a two-component material. All components (liquids A and B) should be between 70 and 90 degrees F prior to mixing. The entire contents of each component should be thoroughly mixed individually before combining separate components together. Mix the components at a volume ratio of one part A to one part B. If it is not possible to mix an entire kit, pour carefully measured quantities of both components into a clean container and blend thoroughly using a power agitator, such as a Jiffy® mixer, and a high strength industrial drill for three minutes. Working time is approximately 20 minutes at 80 degrees F. The working time will be extended at lower temperatures and shortened when higher. Do not mix more material than can be used within stated working times. After proper surface preparation has been completed, apply MADEWELL 806 to the joint between the grade rings and the frame of the manhole 6" wide at a

minimum thickness of 125 mils (1/8") by trowel, brush, or by hand using a clean (disposable) glove. When applied in this way, one 2-gallon kit will normally treat three manhole frames.

## **SECTION 7: FINAL INSPECTION AND TESTING**

A well adhered, monolithic, and pinhole free surface is vital to the performance success of the MAINSTAY COMPOSITE LINER. At a minimum, thorough visual inspection is necessary to ensure proper installation. Several other methods may be used to confirm the same.

### **7.1 Thickness Testing**

To perform in aggressive atmospheric or immersion service, coatings must be applied at the correct thickness. Measuring the thickness of coatings applied to smooth metallic substrates like steel is very simple and straightforward. In contrast, measuring the thickness of coatings applied to non-metallic substrates is substantially more complicated. Please refer to Madewell Products Corporation's Technical Bulletin titled "Controlling and Verifying Coating Film Thickness Over Non-Metallic Substrates" or contact a Madewell Technical Representative for more information on this topic.

### **7.2 Holiday Testing**

After the MAINSTAY COMPOSITE LINER has cured and before it is placed into service, discontinuity (holiday) testing may be performed to verify the surface is pinhole free. Electrical holiday testing of coatings applied over concrete is usually performed in accordance with one of the following two

standards: NACE SP-0188 or ASTM D4787. A proper ground at or near the structure along with a known holiday within the manhole are necessary to properly perform holiday testing. All detected holidays must be repaired prior to placing the structure into service. Refer to Madewell Products Corporation's Technical Bulletin titled "Holiday Testing Coatings In Manholes, Lift Stations, and Other Concrete Sewer Structures" or contact a Madewell Technical Representative for additional information.

### **7.3 Vacuum Testing**

Manholes that are lined completely (including the invert) may be vacuum tested. ASTM C1244 discusses vacuum testing in manholes and should be referenced. To perform vacuum testing, plugs should be placed in all pipes within the manhole along with the test head that will seal the manhole frame. A vacuum pump capable of drawing ten inches of mercury is used to create a vacuum within the manhole. Depending upon the diameter and depth of the manhole, a maximum amount of vacuum loss is allowed over a given time frame. If the vacuum test fails, repairs should be identified and made, plugs checked, and the test rerun until it passes. Refer to Madewell Products Corporation's Technical Bulletin titled "Vacuum Testing Rehabilitated Structures" or contact a Madewell Technical Representative for further guidance.

### **7.4 Adhesion Testing**

Adhesion testing may be used to verify the bond strength of the MAINSTAY COMPOSITE LINER to the substrate. Several standards address adhesion testing including ASTM D4541, ASTM D7234, and ASTM C1583. The

testing procedure and minimum required values may be outlined by the project specifications. The project engineer may determine what areas should be tested for adhesion. Adhesion testing is destructive and should only be done by qualified individuals with knowledge of the testing procedures and protocol. Refer to Madewell Products Corporation's Technical Bulletin titled "Uniaxial Pull Off (Adhesion) Testing" or contact a Madewell Technical Representative for further guidance.