# Mainstay Calcium Aluminate Restoration Mortar Application Guide

Madewell®
RESTORE. PROTECT. SUSTAIN.

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## SECTION 1: INTRODUCTION

The MAINSTAY line of calcium aluminate restoration mortars are designed for the rehabilitation of deteriorated concrete and brick structures in wastewater environments subject to biologically induced hydrogen sulfide (H2S) corrosion. MAINSTAY ML-CA Pure Calcium Aluminate Restoration Mortar is suitable for corrosive environments with a pH of 2 or higher. MAINSTAY ML-PF Pure Fused Calcium Aluminate Restoration Mortar is suitable for corrosive environments with a pH of 1 or higher.

MAINSTAY calcium aluminate restoration mortars 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 calcium aluminate restoration mortars exhibits 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 MAINSTAY calcium aluminate restoration mortars. 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 MAINSTAY calcium aluminate restoration mortars 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 is 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 Guidelines 310.2R-2013.

Prepare all surfaces to receive MAINSTAY calcium aluminate restoration mortars 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 up to 5,000 psi. Surfaces should be inspected for soundness prior to the application of MAINSTAY calcium aluminate restoration mortars. Saturate all surfaces thoroughly with clean water and allow the surface to dry just prior to the application of MAINSTAY calcium aluminate restoration mortars.

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*

| Orifice Diameter | | | Nozzle Pressure | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Nozzle Size | inches | mm | 50 | 60 | 70 | 80 | 90 | 100 | 125 | Minimum CFM Required |
| #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 MAINSTAY calcium aluminate restoration mortars. 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, and 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 the 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 or hydraulic cement includes the application of an initial layer of MAINSTAY calcium aluminate 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 calcium aluminate restoration mortar. Contact a Madewell Technical Representative for more information on this method.

## Section 4: Mortar Resurfacing

The application of MAINSTAY calcium aluminate restoration mortar provides a consistent, high-strength, and durable surface. MAINSTAY calcium aluminate restoration mortars may be applied up to 5" in a single or multiple applications.

### 4.1 Mortar Packaging

MAINSTAY calcium aluminate restoration mortars are normally packaged in 65-pound bags. 2,000-pound and 3,000-pound bulk sacks are also available.

### 4.2 Mortar Mixing

When applying MAINSTAY ML-CA, begin by adding 1.1 gallon of clean water per 65-pound bag depending on application and project requirements. When applying MAINSTAY ML-PF, add one gallon of clean water per 65-pound bag. 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 the restoration mortar.

### 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 calcium aluminate restoration mortars 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.

### 4.5 Return to Service

MAINSTAY calcium aluminate restoration mortars must not be allowed to freeze before they are fully cured. They 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, MAINSTAY calcium aluminate restoration mortars are typically installed while the structure is still in service.

## Section 5: 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 6: FINAL INSPECTION AND TESTING

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

### 7.1 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.

### 7.2 Adhesion Testing

Adhesion testing may be used to verify the bond strength of MAINSTAY calcium aluminate restoration mortars 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.