

CONSTRUCTION SPECIFICATIONS

Magnesium-Alumino-Liquid-Phosphate (MALP) Concrete Specifications for the Repair of Damaged Concrete Members

Horizontal and Castable Repairs

1. DESCRIPTION

This work consists of placement of Magnesium-Alumino-Liquid-Phosphate (MALP) concrete by Phoscrete Corporation for the horizontal repair of damaged concrete members by pour, form-and-pour, or pre-cast as indicated in the contract documents. Phoscrete HC is the commercial name of MALP concrete by Phoscrete Corporation.

MALP concrete has been available since 1990 in the United States. This technology incorporates a pre-packaged magnesium-alumino-aggregate dry bag component with a liquid component based on an aluminum phosphate activator. When mixed, the two components develop MALP concrete, a long lasting, rapid return to service concrete material that can be applied in a safe, fast, and easy manner.

MALP concrete is well suited for concrete repairs characterized by fast-setting and high-early strength.

Install MALP concrete to repair damaged concrete as indicated on the contract documents. Examples of MALP concrete repairs may include but are not limited to repair of concrete pavements, expansion joint headers, spalls, concrete beam ends, concrete precast members, full and partial depth bridge deck repairs, pier cap, dowel bar, and other repairs.

MALP concrete bonds to Portland-cement based concrete and to itself.

MALP concrete does not out-gas after cure. It accepts polymer coatings (epoxies, elastomers, silicones) and silane coatings as soon as one hour following initial set. Do not confuse with MAPC (Magnesium Ammonia Phosphate Cement) concrete that activates with ammonium di-hydrogen phosphate and water.

In case of MALP concrete applications as joint header of bridge expansion joints, the material accepts sealants without need of saw-cutting or shot-blasting the concrete face.

MALP concrete is reinforced with rigid fibers for improved compressive, bond, and flexural strengths, and enhanced freeze-thaw resistance.

MALP concrete stops rust on contact by converting iron oxide to metal phosphate. MALP inhibits/limits future corrosion by bonding to and encapsulating the reinforcing steel.

MALP concrete can be installed in ambient temperatures as cold as -5°F. In regions where temperatures can vary from extreme heat to cold in a 24-hour period, MALP Concrete can withstand this variation without loss of bond.

2. MATERIALS

2.A. Performance Properties of MALP concrete for Horizontal and Castable Repairs

Provide MALP concrete for horizontal and castable repairs having performance properties in accordance with table 2.A.

Table 2.A- Performance Properties of MALP Concrete		
Requirement	Test Method	Test Value
Initial Time of Setting (Maximum ¹)	AASHTO T131 / ASTM C191	15 minutes
Final Time of Setting (Maximum ¹)	AASHTO T131 / ASTM C191	25 minutes
Compressive Strength (Minimum)	ASTM C109	5,000 psi [35 MPa] @ 1 hour 7,500 psi [50 MPa] @1 day 10,000 psi [70 MPa] @28 days
Flexural Strength Modulus of Rupture (Minimum)	ASTM C78	500 psi [3.4 MPa] @ 1 hour 600 psi [4.1 MPa] @ 1 day 700 psi [4.8 MPa] @ 28 days
Splitting Tensile Strength (Minimum)	ASTM C496	800 psi [5.5 MPa] @28 days
Modulus of Elasticity in Compression (Minimum)	ASTM C469	Modulus Elasticity: 3.0 x 10 ⁶ psi [20,700 MPa] @28 days Poisson's Ratio: 0.274 @28 days
Bond Strength Slant Shear (Minimum)	ASTM C882	MALP over Concrete 1500 psi @ 1 hour 2,000 psi [13.8 MPa] @ 1 day 2,500 psi [17.2 MPa] @ 28 days MALP over MALP 2000 psi @ 1 hour 2,500 psi [13.8 MPa] @ 1 day 3,500 psi [17.2 MPa] @ 28 days

Direct Tension - Pull-off Adhesion (Minimum)	ASTM C1543	250 psi [1.7 MPa] @ 28 days
Length Change (Maximum)	ASTM C157 per C928	-0.05% Dry Cure @28 days +0.05% Wet Cure @28 days
Restrained Shrinkage (Ring Test (Minimum)	ASTM C1581	No cracks @ 90 days
Freeze / Thaw Resistance (Minimum)	ASTM C666 Procedure A	Durability: 100% @ 300 cycles
Scaling Resistance to Deicing Salts (@ 25 cycles) (Maximum)	ASTM C672	NaCl: 0 Visual Rating 0.0 lbs./ft2 Material Loss CaCl2: 0 Visual Rating 0.0 lbs./ft2 Material Loss MgCl2: 0 Visual Rating 0.0 lbs./ft2 Material Loss
Chloride Content (Maximum)	AASHTO T260	Water Soluble: 0.002% by mass of sample 0.20% by mass cementitious Acid Soluble: 0.002% by mass of sample 0.15% by mass cementitious
Resistance to Chloride Ion Penetration (Maximum)	AASHTO T277 / ASTM C1202	500 Coulombs @ 28 days with 5 minutes current (mA)
Abrasion (Maximum)	California Test 550	Mass Loss: 20 g @28 days

†Supercool liquid component as specified by Manufacturer to achieve desired set time.

2.B. Product Data

Provide the Engineer with a copy of the Safety Data Sheets (SDS) for MALP Concrete's components to be used on site.

Provide certifications stating the conformity of the material with local, state, federal, environmental and worker safety laws and regulations, as requested.

Provide Technical Data Guide of MALP concrete, which must report yield, mechanical and environmental performance properties.

Provide Installation Guide of MALP concrete, which must include storage, handling, surface preparation, mixing, placing, and finishing guidelines.

When installing Expansion Joints, provide Expansion Joint Installation and Repair Guide of MALP concrete, which must include installation details specific to the expansion joint design covered under this Construction Specification.

3. EQUIPMENT AND TOOLS

Use mixing equipment and application tools as indicated by the manufacturer's installation guide for the proper application of MALP concrete.

Clean tools with water. Be sure to wipe off excess water between batches to prevent the contact of water with MALP concrete.

Wear proper Personal Protective Equipment (PPE), as recommended by the Manufacturer, when mixing and placing MALP concrete. Refer to the Manufacturer's Installation Guide for detailed application and safety precautions.

4. INSTALLATION METHOD

Provide a technical representative from the Manufacturer of MALP Concrete at the start of work for a minimum of one full working day. Alternatively, provide a written statement by the Manufacturer assuring that the Contractor is qualified to install MALP concrete.

The written statement must be dated within the last twelve (12) months. It must include the names of key personnel who will perform and supervise the actual installation of MALP concrete. The Engineer may suspend work if unauthorized personnel are substituted for authorized personnel during construction.

4.A. Delivery, Storage and Disposal

Deliver the material in original, unopened, undamaged, factory-sealed package.

Verify that the Manufacturer's labels are intact and legible. Labels must include brand, product name, weight, system identification number, and batch number, with verification of date of manufacture and shelf life.

Store the material's components in a clean, dry location, out of direct sunlight. Maintain storage temperature required by the Manufacturer. Avoid contact with moisture.

Do not use components that have exceeded their shelf life.

Dispose of expired material in accordance with Manufacturer's recommendations and local environmental regulations.

4.B. Installation

4.B.1. Surface Preparation

Apply MALP concrete to dry surfaces only. Do not apply over Saturated Surface Dry (SSD) concrete surfaces. Clean all slurry and dust from saw-cutting and demolition. Do not apply to surfaces contaminated with oil, or on unsound concrete.

Follow Manufacturer's Installation Guide for preparing the surface prior to placing MALP concrete. Follow Manufacturer's Expansion Joint Installation and Repair Guide for additional surface preparation instructions for that application.

4.B.2. Primer Treatment

Use MALP Concrete Primer as indicated per Manufacturer's Installation guide and Expansion Joint Installation and Repair Guide for that application.

4.B.3. Mixing Instructions

Follow Manufacturer's Installation Guide for mixing MALP concrete using a drill mixer and paddle in buckets, or in larger quantities using a paddle-style mortar mixer.

Refer to Manufacturer's Installation Guide and All Temperature Guidelines usage of Admixtures to speed or slow initial set of MALP concrete, and for best practices on cooling/supercooling MALP Liquid Activator to extend working time.

4.B.4. Placement and Finishing

Follow Manufacturer's Installation Guide for instructions and usage of concrete finishing tools, vibration, grinding, and when sealing can begin.

4.B.5. Sealing

Follow Sealant Manufacturer's Installation Guide for application of joint seal and for MALP concrete sealants.

5. METHOD OF MEASUREMENT

Measure by cubic foot [cubic meter] of the area covered by the MALP Concrete, accounting for a minimum depth of 2" or the Engineer's required depth.

6. BASIS OF PAYMENT

The Department will pay for each pay item at the contract unit price per the specified pay unit as follows:

<i>MALP Concrete Repairs</i>	<i>Cubic Foot [Cubic Meter]</i>
<i>MALP Concrete Joint Headers</i>	<i>Linear Foot [Meter]</i>

The Owner will consider the cost of all materials, equipment, labor, and incidentals necessary for proportioning, mixing, delivery, storage, handling, surface preparation, installation, sampling, and testing of MALP Concrete to be included in the unit price bid.