

# CONSTRUCTION SPECIFICATIONS

## Magnesium Phosphate Cement (MPC) Concrete Specifications for Concrete Repairs, Installations and Overlays

### 1. DESCRIPTION

This work consists of placement of Magnesium Phosphate Cement (MPC) concrete for both full and partial depth application of horizontal, vertical, and overhead concrete as indicated in the contract documents.

MPC concrete has been available since 1990 in the United States. Products are packaged as a magnesium-oxide + aggregate dry mix component that activates either with water or a liquid phosphate component. When mixed, the two components develop MPC concrete, a long lasting, rapid return to service concrete material that can be applied in a safe, fast, and easy manner.

MPC concrete may be packaged as extended mortar with aggregates, or mortar with aggregates mixed on the jobsite.

MPC concrete must not outgas when working in confined spaces, or if coatings may be applied in the future. MPC concretes that do not outgas include Magnesium Aluminum Liquid Phosphate (MALP) and Magnesium Potassium Phosphate (MKP). Magnesium Ammonia Phosphate Cement (MAPC) concretes do outgas and may be excluded from this specification.

MPC concrete is well suited for concrete repairs with high-early compressive and bond strengths.

Install MPC concrete as indicated on the contract documents. Applications for MPC concrete may include but are not limited to full and partial depth installation and repair of concrete expansion joint nosings/headers, pavements, bridge decks, parking decks, columns, beam ends, pier caps, seawalls, culverts, precast members, and dowel bar installations.

MPC concrete bonds both chemically and mechanically to Portland-cement concrete, and to itself.

Petroleum-based coatings (epoxies, elastomers, silicones) and silane sealants can be applied to MPC concrete within one hour following initial set.

MPC concrete may be reinforced with rigid fibers for improved bond, and flexural strengths.

MPC concrete stops rust on contact by converting iron oxide to metal phosphate. MPC inhibits/limits future corrosion by bonding to and encapsulating reinforcing steel. MPC is an acidic concrete, and it acts as an anode to stop the "halo effect."

Some MPC concretes can be installed in ambient temperatures as cold as -5°F (-20°C), and as hot as +105°F (40°C). In regions where temperatures can vary from extreme heat to cold in a 24-hour period, MPC concrete can withstand this temperature variation without loss of bond.

## 2. MATERIALS

### 2.A. Product Data

Provide MPC concrete for rapid setting and accelerated rapid setting performance properties.

**Table 2A. Performance Properties of MPC concrete**

Requirement	Test Method	Rapid Setting	Accelerated Rapid Setting
Time of Setting* (Maximum)	ASTM C191 AASHTO T131	Initial 50 minutes Final: 60 minutes	Initial: 20 minutes Final: 30 minutes
Compressive Strength (Minimum)	ASTM C109	3,500 psi [25 MPa] @ 2 hours 5,000 psi [35 MPa] @ 1 day 7,250 psi [50 MPa] @ 28 days	3,500 psi [25 MPa] @ 1 hour 5,000 psi [35 MPa] @ 1 day 7,250 psi [50 MPa] @ 28 days
Flexural Strength Modulus of Rupture (Minimum)	ASTM C78	500 psi [3.5 MPa] @ 1 day 650 psi [4.5 MPa] @ 28 days	same
Bond Strength by Slant Shear <i>MPC over Concrete and MPC over MPC</i> (Minimum)	ASTM C882	1000 psi [7 MPa] @ 2 hours 2,000 psi [14 MPa] @ 1 day 2,900 psi [20 MPa] @ 28 days	1000 psi [7 MPa] @ 1 hour 2,000 psi [14 MPa] @ 1 day 2,900 psi [20 MPa] @ 28 days
Length Change @ 28 days (Maximum)	ASTM C157	-0.10% Dry Cure +0.10% Wet Cure	same
Freeze / Thaw Resistance @ 300 cycles (Minimum)	ASTM C666 Procedure "A"	Durability: 96%	same
Scaling Resistance to Deicing Salts <i>both NaCl and CaCl2</i> @ 50 cycles (Maximum)	ASTM C672	1 Visual Rating 0.4 lbs./ft <sup>2</sup> [2 kg/m <sup>2</sup> ] Material Loss	same
Resistance to Chloride Ion Penetration @ 28 days with 5 minutes current (mA) (Maximum)	ASTM C1202 AASHTO T277	1000 Coulombs	same

\*Setting time may be controlled in varying ambient temperatures to achieve the required performance properties by heating or cooling the activator and dry mix components, and by using admixtures to speed or slow the reaction.

## **2.B. Product Data**

Provide the Engineer with a copy of the Safety Data Sheets (SDS) for MPC Concrete 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 MPC concrete: report yield, mechanical and environmental performance properties. Confirm compliance with Performance Properties in Table 2A.

Provide Installation Guide of MPC concrete: include storage, handling, surface preparation, mixing, placing, and finishing guidelines.

Provide application-specific installation details for Expansion Joints, Shotcrete, or Overlays,

## **3. EQUIPMENT AND TOOLS**

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

Clean tools with water. Be sure to wipe off excess water between batches to prevent introduction of excess water with uncured MPC concrete.

Wear proper Personal Protective Equipment (PPE), as recommended by the Manufacturer during site preparation and when mixing and placing MPC 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 MPC 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 MPC 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 MPC 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 packaging.

Verify 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 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 MPC concrete to dry surfaces only. Do not apply to over Saturated Surface Dry (SSD) concrete surfaces unless permitted by the manufacturer. Clean all slurry and dust from saw-cutting and demolition prior to application. Do not apply to surfaces contaminated with oil, or on unsound concrete.

Follow Manufacturer's Installation Guide for preparing the surface prior to placing MPC concrete. Follow Manufacturer's application-specific installation and repair guidelines for additional surface preparation requirements.

### **4.B.2. Primer Treatment**

Use MPC Concrete Primer as required in the Manufacturer's Installation Guide.

### **4.B.3. Mixing Instructions**

Follow Manufacturer's Installation Guide for mixing MPC concrete.

### **4.B.4. Admixtures**

Refer to Manufacturer's Installation Guide for usage of Admixtures, and for best practices to speed or slow set time.

### **4.B.5. 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.6. Sealing**

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

**5. METHOD OF MEASUREMENT**

Measure the area covered by the MPC Concrete in cubic feet, accounting for a minimum depth of 2” or as shown in the contract documents or as required by the Engineer.

**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>MPC Concrete Repairs</i>	<i>Cubic Foot</i>
<i>MPC Concrete Joint Headers</i>	<i>Linear Foot</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 MPC Concrete to be included in the unit price bid.