

**Specification for Type MMS
(Methyl Methacrylate Slurry)
Polymer Overlays
for Bridge and Parking Garage Decks**

An ACI Standard

Reported by ACI Committee 548



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Specification for Type MMS (Methyl Methacrylate Slurry) Polymer Overlays for Bridge and Parking Garage Decks

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**American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48331
U.S.A.**

**Phone: 248-848-3700
Fax: 248-848-3701**

www.concrete.org

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Michael S. Stenko
Chair

Herschel H. Allen III
Milton D. Anderson
John J. Bartholomew
Constantin Bodea
James T. Dikeou
Garth J. Fallis

David W. Fowler
Robert W. Gaul
Albert O. Kaeding
John R. Milliron
Brad Nemunaitis
Richard C. Prusinski

Mahmoud M. Reda Taha
John R. Robinson
Donald A. Schmidt
Qizhong Sheng
Joe Solomon
Michael M. Sprinkel

Donald P. Tragianese
Cumaraswamy Vipulanandan
Wafeek S. Wahby
Harold H. Weber, Jr.
David White
David P. Whitney

This Specification covers methyl methacrylate slurry (MMS) overlays for bridge and parking garage decks. Type MMS polymer overlay incorporates methyl methacrylate-based primer, binder, and top coat with selected filler and aggregate to produce a flexible, skid-resistant, and water-resistant slurry overlay. The overlay is used for both new construction and rehabilitation. The overlay is placed by applying the polymer slurry system to the surface and broadcasting aggregate. This Specification includes requirements for chemical components, aggregates, storage and handling, surface preparation, surface profile, mixing, placement, finishing, and quality control.

The materials, processes, quality control measures, and inspections described in this document should be tested, monitored, or performed as applicable only by individuals with appropriate ACI certifications or equivalent.

Keywords: aggregate; bridge decks; methyl methacrylate; mortar; overlays; parking garage decks; polymer; premixed; resin; slurry.

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SECTION 1—GENERAL

1.1—Scope

1.1.1 This Specification covers materials and procedures for polymer overlays for new construction and for repair and rehabilitation of bridge and parking garage decks. Methyl methacrylate slurry (MMS) polymer overlay incorporates a methyl methacrylate-based primer, binder, and top coat with selected filler and aggregate to produce a flexible, skid-resistant, and water-resistant overlay. This Specification includes requirements for chemical components, aggregates, storage and handling, surface preparation, surface profile, mixing, placement, finishing, quality control, and quality assurance.

1.1.2 This Specification supplements the Contract Documents and shall govern the construction of MMS polymer overlays, except where this Specification conflicts with requirements in Contract Documents.

1.1.3 Units—Values in this Specification are stated in inch-pound units. A companion specification in SI units is also available.

1.2—Definitions

accepted—determined to be satisfactory by Architect/Engineer.

Architect/Engineer—the architect, engineer, architectural firm, or engineering firm developing Contract Documents or administering the Work under Contract Documents, or both.

Contract Documents—a set of documents supplied by Owner to Contractor as the basis for construction; these documents contain contract forms, contract conditions, specifications, drawings, addenda, and contract changes.

Contractor—the person, firm, or entity under contract for construction of the Work.

Owner—the corporation, association, partnership, individual, public body, or authority for whom the Work is constructed.

Project Specification—the written document that details requirements for the Work in accordance with service parameters and other specific criteria.

quality assurance—actions taken by Owner or Owner's Representative to ensure Work done and materials provided are in accordance with Contract Documents.

quality control—actions taken by Contractor to ensure that Work meets requirements of Contract Documents.

required—mandatory as prescribed in Project Specification or Contract Documents.

submittal—document or material provided to Architect/Engineer for review and acceptance.

submit—provide to Architect/Engineer for review.

tack free—material is fully cured and the surface is dry to the touch.

Work—the entire construction or separately identifiable parts thereof required to be furnished under Contract Documents.

1.3—Reference standards

1.3.1 ASTM International

C307-03(2008) Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing

C566-97(2004) Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying

C881/C881M-02 Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

C884/C884M-98(2005) Standard Test Method for Thermal Compatibility Between Concrete and an Epoxy-Resin Overlay

C1583/C1583M-04^{e1} Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)

D570-98(2010) Standard Test Method for Water Absorption of Plastics

D638-03 Standard Test Method for Tensile Properties of Plastics

D695-08 Standard Test Method for Compressive Properties of Rigid Plastics

D790-07 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

D1310-01(2007) Standard Test Method for Flash Point and Fire Point of Liquids by Tag Open-Cup Apparatus

D2393-86 Test Method for Viscosity of Epoxy Resins and Related Components (withdrawn)

D4230-02(2007) Standard Test Method of Measuring Humidity with Cooled-Surface Condensation (Dew-Point) Hygrometer

D4263-83(2005) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

1.3.2 Field reference

ICRI No. 03732P Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

1.3.3 Reference organizations—An abbreviation for and complete name and address of the organization issuing documents referred to in this specification is listed:

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428
www.astm.org

International Concrete Repair Institute (ICRI)
10600 W. Higgins Road, Suite 607
Rosemont, IL 60018
www.icri.org

1.4—Submittals

1.4.1 Submit a certificate of compliance and quality control test results verifying conformance to material specifications for each manufactured batch of MMS system primer, binder, filler, top coat, and aggregate lot. A lot or batch is a quantity of material manufactured at one time and placed into containers.

1.4.2 Submit materials and product data sufficient for the Architect/Engineer to evaluate the system, including all installation instructions and quality control procedures required to assure an acceptable finished overlay.

1.4.3 Submit safety data sheets.

1.5—Project conditions

1.5.1 Cold weather limits—Do not place overlay unless the deck temperature or applicable surface and polymer materials are greater than or equal to 32°F and rising, unless otherwise recommended by the material manufacturer.

1.5.2 Hot weather limits—Do not place overlay if the 1 in.³ job-site production samples have gel times less than 10 minutes when tested in accordance with ASTM C881/C881M or if the broadcast aggregate will not penetrate the methyl methacrylate-based slurry layer, unless otherwise recommended by the manufacturer.

1.5.3 Moisture limits—Do not place the overlay on surfaces unless they are moisture-free when tested in accordance with ASTM D4263.

1.5.4 Dew point limit—Do not place overlay on surface unless the ambient temperature is 5°F above the dew point when tested in accordance with ASTM D4230.

1.6—Labeling, storage, and handling of materials

1.6.1 Labeling

Mark product containers with the following information:

- Manufacturer's name;
- Manufacturer's product identification;
- Material quantity;
- Manufacturer's mixing instructions;
- Warning for storage and handling; and
- Hazard information.

1.6.2 Storage—Store MMS system materials in an area that prevents them from getting wet. Store methyl methacrylate-based primer, binder, and top coat away from open flames and other sources of ignition. Store methyl methacrylate-based primer, binder, and top coat at temperatures between 50 and 90°F unless otherwise recommended by the material manufacturer. Store resin, filler, and aggregates in an area that prevents them from getting wet.

1.7—Safety

Heed all warnings on Material Safety Data Sheets and manufacturer's labels.

SECTION 2—PRODUCTS

2.1—Methyl methacrylate-based primer

Methyl methacrylate-based primer shall meet the requirements listed in Tables 2.1 and 2.2. All components used for physical testing shall be maintained at 73°F (± 1°F) for a minimum of 24 hours before mixing and testing.

2.2—Methyl methacrylate-based binder

Methyl methacrylate-based binder shall meet the requirements listed in Tables 2.3 and 2.4. All components used for physical testing shall be maintained at 73°F (± 1°F) for a minimum of 24 hours before testing.

Table 2.1—Physical properties of mixed, uncured methyl methacrylate-based primer

Property	Value	Test method
Viscosity	0.4 to 1.5 P	ASTM D2393 (No. 3 at 20 rpm, Brookfield RVT)
Gel time at 73°F	10 to 30 min	ASTM C881/C881M (modified 70 mL)
Flash point	>43°F	ASTM D1310

Table 2.2—Physical properties of mixed, cured methyl methacrylate-based primer

Property	Value	Test method
Tensile strength	2500 to 6000 psi	ASTM D638 (Type I)
Tensile elongation	<50%	ASTM D638 (Type I)
Water absorption	<0.4%	ASTM D570

Table 2.3—Physical properties of mixed, uncured methyl methacrylate-based binder

Property	Value	Test method
Viscosity	7.0 to 13.0 P	ASTM D2393 (No. 3 at 20 rpm, Brookfield RVT)
Gel time at 73°F	10 to 30 min	ASTM C881/C881M (modified 70 mL)
Flash point	>43°F	ASTM D1310

Table 2.4—Physical properties of mixed, cured methyl methacrylate-based binder

Property	Value	Test method
Tensile strength	1000 to 2000 psi	ASTM D638 (Type I)
Tensile elongation	30 to 70%	ASTM D638 (Type I)
Water absorption	<0.5%	ASTM D570

2.3—Filler

Fillers for the MMS overlay shall be supplied by the overlay manufacturer and, when mixed with the recommended quantity of methyl methacrylate-based binder resin, will result in a self-leveling slurry.

2.4—Methyl methacrylate-based top coat

Methyl methacrylate-based top coat shall meet the requirements listed in Tables 2.5 and 2.6. All components used for physical testing shall be maintained at 73°F (± 1°F) for a minimum of 24 hours before testing.

2.5—Aggregate

Broadcast aggregate shall meet the gradation requirements in Table 2.7 and have a hardness of 6 or higher on the Mohs hardness scale. Aggregate shall be angular; consist of natural silica sand, basalt, or other nonfriable aggregate; and shall contain less than 0.2% moisture when tested in accordance with ASTM C566.

Table 2.5—Physical properties of mixed, uncured methyl methacrylate-based top coat

Property	Value	Test method
Viscosity	0.4 to 1.5 P	ASTM D2393
Gel time at 73°F	10 to 30 min	ASTM C881/C881M (modified 70 mL)
Flash point	>43°F	ASTM D1310

Table 2.6—Physical properties of mixed, cured methyl methacrylate-based top coat

Property	Value	Test method
Tensile strength	2500 to 6000 psi	ASTM D638 (Type I)
Tensile elongation	20 to 50%	ASTM D638 (Type I)
Water absorption	<0.4%	ASTM D570

Table 2.7—Broadcast aggregate gradation

Mesh size	Percent passing
Broadcast bridge deck aggregate gradation	
No. 4	100
No. 8	30 to 75
No. 16	0 to 5
No. 30	0 to 1
Broadcast parking deck aggregate gradation	
No. 8	100
No. 16	51 to 75
No. 20	14 to 50
No. 30	0 to 25
No. 40	0 to 2

Table 2.8—Properties of type MMS mixed cured slurry

Property	Value	Test method
Compressive strength* (24 hours)	1000 to 3000 psi	ASTM D695
Thermal compatibility*	Pass	ASTM C884/C884M, Method B
Bond strength*	>250 psi	ASTM C1583/C1583M
Tensile strength*	400 to 800 psi	ASTM C307
Flexural strength*	800 to 1800 psi	ASTM D790

*Samples shall be made using the recommended ratios of methyl methacrylate-based binder and filler as supplied by the manufacturer. Compressive strength, tensile strength, and flexural strength to be tested on binder and filler slurry only. Thermal compatibility and bond strength to be tested on samples of complete slurry overlay system (primer, slurry, and top coat).

2.6—Polymer overlay slurry

Type MMS polymer overlay slurry shall meet the requirements of Table 2.8. Slurry shall be tested without methyl methacrylate-based primer or top coat.

SECTION 3—EXECUTION

3.1—Procedure qualification

3.1.1 Equipment—Blasters using steel shot or grit abrasives shall be used to remove deteriorated concrete, grease, dirt, oil, and other contaminants that inhibit bond of the overlay.

3.1.2 Quality control procedure qualification—A surface preparation technique (size, flow of abrasive, forward speed, number of passes of the blasting machine) shall be used that

exposes coarse aggregate and ensures adhesion of the test overlay to the substrate. Remove all loose material for a dust-free surface before application. Use quality control procedure (Sections 3.1.2.1 through 3.1.2.6) to determine that the materials, batching, mixing, placing, and curing procedures provide the required adhesion of the test overlay to the substrate.

3.1.2.1 Quality control test locations will be designated to evaluate the range of surface conditions on the area to be overlaid, including areas with any deck repairs, if any. The Architect/Engineer shall designate one test location to be evaluated for each span or 4500 ft², whichever is smaller, for bridges, and for each deck level or 4500 ft², whichever is smaller, for parking decks.

3.1.2.2 At each designated test location, prepare a minimum surface area of 4 ft² using the equipment and procedures proposed for project surface preparation.

3.1.2.3 Prepare the surface and apply the test overlay to designated test locations under environmental conditions that simulate the conditions anticipated at the time of the overlay placement. Test overlays shall be applied no more than the shelf life of the material prior to the overlay placement.

3.1.2.4 Apply test overlays at test locations at the same thickness and with the same materials, equipment, personnel, timing, sequence of operations, and curing period that will be used on the project.

3.1.2.5 Evaluate the test overlays using the procedure described in ASTM C1583/C1583M, except that the tensile adhesion evaluation shall not be performed at surface temperatures above 80°F. Core through the test overlay to a depth of at least 0.5 in. into the underlying concrete deck. An evaluation shall be an average of three tests at each location within the quality control test location.

3.1.2.6 When the average test result is less than 250 psi pull-off strength, check the surface preparation procedures and repeat the tests. If the test results still do not meet the required 250 psi average pull-off strength, check the manufacturer's batching, mixing, placing, and curing requirements, and repeat the test until a minimum average required pull-off strength of 250 psi is achieved. When the average test result is less than 250 psi pull-off strength and the failure is in the concrete at a depth greater than or equal to 0.25 in., replace the concrete before placing the overlay or obtain Owner's approval to place the overlay on concrete with a tensile strength that is lower than recommended.

3.1.3 Quality control of surface preparation—Surfaces prepared for overlay application shall have the same surface profile as accepted test areas in Section 3.1.2 when compared using the concrete surface profiles (CSP) provided with ICRI Guideline No. 03732P.

3.2—Surface preparation

3.2.1 Prepare the overlay area using the approved surface preparation procedure until the specified substrate conditions have been achieved.

3.2.2 Blasted surface shall be free of dust and other loose materials that interfere with the bonding of the overlay.

3.2.3 If the Architect/Engineer rejects the Work because there has been a deviation from the accepted surface preparation procedure, verify the revised procedure is acceptable using the quality control qualification procedure described in **Section 3.1.2** or an alternative method acceptable to the Architect/Engineer. If the revised procedure is not acceptable, blast the area prepared by the revised procedure using an approved procedure.

3.2.4 Obtain inspection and acceptance by the Architect/Engineer of patching and surface preparation before placement of the overlay.

3.3—Mixing methyl methacrylate-based primer, binder-filler slurry, and top coat

3.3.1 Primer—Mix the methyl methacrylate-based primer resin with the catalyst according to manufacturer's instructions.

3.3.2 Binder-filler slurry—Mix the methyl methacrylate-based binder and filler according to the manufacturer's instructions. When continuous mixing is specified, use equipment that continually measures and dispenses the methyl methacrylate-based binder and filler. Thoroughly blend the methyl methacrylate-based binder and filler with a mechanical mixer to a uniform, homogeneous mixture. Use equipment with mixing capacity that allows placement and finishing operations to proceed continuously and be completed before the overlay becomes tack-free at the area of next placement.

3.3.3 Top coat—Mix the methyl methacrylate-based top coat with the catalyst according to the manufacturer's instructions.

3.4—Overlay application

3.4.1 The overlay application consists of four distinct steps:

1. Methyl methacrylate-based primer application;
2. Methyl methacrylate-based slurry placement;
3. Aggregate broadcast; and
4. Methyl methacrylate-based top coat application.

3.4.2 Polymer overlay shall not be placed on hydraulic-cement concrete less than 28 days of age unless specified otherwise by the polymer manufacturer. Polymer overlay shall not be placed on magnesium-phosphate-cement concrete.

3.4.3 Polymer overlay shall not be placed over crack repair materials that will affect the bonding or curing of the overlay.

3.4.4 Visible moisture shall not be present on the surface of the concrete at the time of polymer overlay application. Use a plastic sheet left taped in place to the concrete surface being overlaid, according to ASTM D4263 (modified to a minimum of 2 hours), to identify moisture in the overlay area.

3.4.5 Priming—Mix the methyl methacrylate-based primer components according to the manufacturer's instructions. Use squeegees or paint rollers to apply the primer at a uniform coverage rate $\leq 100 \text{ ft}^2/\text{gal}$. Primer shall cure tack-free prior to slurry placement. Prevent contamination of the primer surface prior to slurry application. Contaminated primer shall be removed and reapplied.

3.4.6 Methyl methacrylate-based slurry placement—Use a self- or hand-advanced vibrating screed or gauge rake to apply the overlay. Adjust the screed or gauge rake to the

desired depth of the overlay. Apply methyl methacrylate-based slurry at a thickness not to exceed 0.50 in. or to the thickness as shown on the plans unless approved by the manufacturer.

3.4.7 Aggregate broadcasting—Immediately after placement of the methyl methacrylate-based slurry and while it is still fluid, broadcast aggregate onto the surface until a dry layer of aggregate is present over the entire surface. If wet spots develop, immediately broadcast additional aggregate until a dry surface is reestablished.

3.4.8 Top coating—After overlay has cured and excess broadcast aggregate has been removed, mix the methyl methacrylate-based top coat components according to the manufacturer's instructions. Use squeegees or paint rollers to apply the top coat at a uniform coverage rate between 50 to 80 ft^2/gal , unless otherwise recommended by the manufacturer.

3.5—Curing

If a non-adhering plastic cover is placed over the wet polymer overlay during curing to protect it from adverse weather conditions, remove the plastic cover after the surface is tack-free.

3.6—Excess aggregate removal

Use a broom to remove all excess aggregate from the surface after the overlay has cured.

3.7—Joints

Maintain expansion joints in the concrete surface being overlaid during the overlay application. When a joint must be saw cut into the overlay, perform the cut as soon as the overlay supports the sawing equipment without damaging the overlay. Saw cut joints within 12 hours of overlay placement.

3.8—Open to traffic

Do not open to traffic until the finished overlay is hard enough to not permanently deform under traffic.

NOTES TO SPECIFIER

General notes

G1. ACI Specification 548.10 is to be used by reference or incorporation in its entirety in the Project Specification. Do not copy individual Parts, Sections, Articles, or Paragraphs into the Project Specification, because taking them out of context may change their meaning.

G2. If Sections or Parts of ACI Specification 548.10 are copied into the Project Specification or any other document, do not refer to them as an ACI Specification, because the specification has been altered.

G3. A statement such as the following will serve to make ACI Specification 548.10 a part of the Project Specification: "Work on (Project Title) shall conform to all requirements of ACI 548.10 published by the American Concrete Institute, Farmington Hills, Michigan, except as modified by these Contract Documents."

G4. Each technical Section of ACI Specification 548.10 is written in the three-part Section format of the Construction Specifications Institute, as adapted for ACI requirements. The language is imperative and terse.

G5. ACI Specification 548.10 is written to the Contractor. When a provision of this Specification requires action by the Contractor, the verb “shall” is used. If Contractor is allowed to exercise an option when limited alternatives are available, the phrasing “either...or...” is used. Statements provided in the Specification as information to Contractor use the verbs “may” or “will.” Informational statements typically identify activities or options that “will be taken” or “may be taken” by Owner or Architect/Engineer.

FOREWORD TO CHECKLISTS

F1. This foreword is included for explanatory purposes only; it is not a part of ACI Specification 548.10.

F2. ACI Specification 548.10 may be referenced by the Specifier in the Project Specification for any building project, together with supplementary requirements for the

specific project. Responsibilities for project participants must be defined in the Project Specification. ACI Specification 548.10 cannot and does not address responsibilities for any project participant other than the Contractor.

F3. Checklists do not form a part of ACI Specification 548.10. Checklists assist the Specifier in selecting and specifying project requirements in the Project Specification.

F4. The Mandatory Requirements Checklist indicates work requirements regarding specific qualities, procedures, materials, and performance criteria that are not defined in ACI Specification 548.10. The specifier must include these requirements in the Project Specifications.

F5. The Submittals Checklist identifies information or data to be provided by the Contractor before, during, or after construction.

MANDATORY REQUIREMENTS CHECKLIST

Section/Part/Article	Notes to Architect/Engineer
3.1.2.1	Designate quality control test locations.

SUBMITTALS CHECKLIST

Section/Part/Article	Submittal item and notes to Architect/Engineer
1.4.1	Certificate of compliance and quality control test results.
1.4.2	Materials and product data.
1.7	Material Safety Data Sheets.



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38800 Country Club Drive
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U.S.A.

Phone: 248-848-3700

Fax: 248-848-3701

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The AMERICAN CONCRETE INSTITUTE

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The committees, as well as ACI as a whole, operate under a consensus format, which assures all participants the right to have their views considered. Committee activities include the development of building codes and specifications; analysis of research and development results; presentation of construction and repair techniques; and education.

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