

**Specification for Type EM
(Epoxy Multi-Layer) Polymer
Overlay for Bridge and
Parking Garage Decks**

An ACI Standard

Reported by ACI Committee 548



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Specification for Type EM (Epoxy Multi-Layer) Polymer Overlay 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
Harold (Dan) R. Edwards
Garth J. Fallis

David W. Fowler
Robert W. Gaul
Larry E. Good
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 epoxy multi-layer (EM) polymer overlay for bridge and parking garage decks. Type EM polymer overlay incorporates a low-modulus epoxy binder and selected aggregate to produce a flexible, skid-resistant, and waterproof overlay. The overlay may be used for both new construction and rehabilitation. The overlay is placed by applying the neat epoxy binder to the surface and broadcasting aggregate. This Specification includes requirements for chemical components, aggregates, storage and handling, surface preparation, surface profile, mixing, placement, and finishing.

Keywords: bridge decks; epoxy; multi layer; parking garage decks; polymer overlay; surface preparation.

NOTE TO SPECIFIER

This Specification is incorporated by reference in the Project Specification using the wording in P3 of the Preface and including information from the Mandatory Requirements and Submittals Checklists following the Specification.

PREFACE

P1. ACI Specification 548.8M is intended 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.

P2. If Sections or Parts of ACI Specification 548.8M 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.

P3. A statement such as the following will serve to make ACI Specification 548.8M a part of the Project Specification: “Work on (Project Title) shall conform to all requirements of ACI 548.8M-07, ‘Specification for Type EM (Epoxy Multi-Layer) Polymer Overlay for Bridge and Parking Garage Decks,’ published by the American Concrete Institute, Farmington Hills, Michigan, except as modified by Contract Documents.”

P4. Each technical section of ACI Specification 548.8M is written in the three-part Section format of the Construction Specifications Institute, as adapted for ACI requirements. The language is imperative and terse.

P5. The Specification is written to the Contractor. When a provision of this Specification requires action by 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 the Owner or Architect/Engineer.

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SECTION 1—GENERAL

1.1—Scope

1.1.1 This Specification covers materials and procedures for constructing a polymer overlay for new construction and for repair and rehabilitation of bridge and parking garage decks. Type EM polymer overlay incorporates a low-modulus, multi-component epoxy binder and selected aggregate to produce a flexible, skid-resistant, and waterproof 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 The provisions of this Specification shall govern unless otherwise specified in the Contract Documents.

1.1.3 Units—Values stated in SI units are to be regarded as standard.

1.2—Reference standards

1.2.1 ASTM Standards

| | |
|----------------|---|
| C566-97 (2004) | Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying |
| C579-01 (2006) | Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes |
| C778-06 | Standard Specification for Standard Sand |
| 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 |
| C1583-04 | 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) |
| D638-03 | Standard Test Method for Tensile Properties of Plastics |
| D2393-86 | Standard Test Method for Viscosity of Epoxy Resins and Related Components (withdrawn) |
| D3278-96 (2004)e1 | Standard Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus |
| D4263-83 (2005) | Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method |

1.2.2 SSPC standards

SSPC-SP 10/NACE No. 2, Near White Metal Blast Cleaning

1.3—Reference organizations

Abbreviations for and complete names and addresses of organizations issuing documents referred to in this Specification are listed:

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

The Society for Protective Coatings (SSPC)
40 24th Street
6th Floor
Pittsburgh, PA 15222-4656
www.sspc.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 epoxy and lot of aggregate. A lot or batch is a quantity of material manufactured at one time and placed into containers.

1.4.2 Submit material 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 when the temperature of the deck or applicable surface and polymer materials is below 15 °C unless otherwise recommended by the material manufacturer and accepted by the Architect/Engineer.

1.5.2 Hot weather limits—Do not place overlay if the 70 mL job site production samples have gel times less than 10 minutes or if the broadcast aggregate will not penetrate the epoxy layer.

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

1.6—Labeling, storage, and handling of materials

1.6.1 Labeling—Mark product containers with the following information:

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

1.6.2 Storage—Store epoxy resins and hardeners in an area that prevents them from getting wet. Store them away from open flames and other sources of ignition. Store epoxy resins and hardeners at temperatures between 15 and 45 °C unless otherwise recommended by the material manufacturer. Store aggregates in an area that prevents them from getting wet.

1.7—Safety

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

SECTION 2—PRODUCTS**2.1—Epoxy binder**

Multi-component epoxy shall meet the requirements listed in Tables 2.1 and 2.2. All components used for physical testing shall be maintained at 23.0 °C (±1.0 °C) for a minimum of 24 hours before mixing, curing, or testing. Do not use epoxy systems containing solvents and unreactive diluents.

2.2—Aggregate

Aggregate shall meet the gradation requirements in Table 2.3 and have hardness of six or higher on the Mohs hardness scale. Aggregate shall be angular, shall 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.

2.3—Polymer overlay

Type EM polymer overlay shall meet the requirements of Table 2.4.

SECTION 3—EXECUTION**3.1—Procedure qualification**

3.1.1 Equipment—Remove deteriorated concrete, grease, dirt, oil, and other contaminants that inhibit bond of the overlay with blasters using steel shot or grit abrasives.

3.1.2 Quality control procedure qualification—Specify a surface preparation technique (size and flow of abrasive, forward speed, and number of passes of the blasting machine) that shall expose coarse aggregate and ensure adhesion of the overlay to the substrate. Remove all loose material to result in a dust-free surface before application. Use this 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 overlay to the substrate.

3.1.2.1 Test locations will be designated for quality control to evaluate the range of surface conditions on the area to be overlaid, including areas with deck repairs, if any. The engineer shall designate one test location to be evaluated

Table 2.1—Properties of mixed, uncured epoxy binder

| Property | Value | Test method |
|-------------------|-------------------|--|
| Viscosity | 700 to 2500 mPa·s | ASTM D2393 (No. 3 at 20 rpm, Brookfield RVT) |
| Gel time at 23 °C | 15 to 45 minutes | ASTM C881/C881M (modified 70 mL) |
| Flash point | >93 °C | ASTM D3278 |

Table 2.2—Physical properties of cured epoxy binder at 7 days

| Property | Value | Test method |
|--------------------------------|--------------|--------------------|
| Tensile strength | 12 to 34 MPa | ASTM D638 (Type I) |
| Tensile elongation | 30 to 70% | ASTM D638 (Type I) |
| Modulus of elasticity, maximum | 90 MPa | ASTM D638 (Type I) |

Table 2.3—Deck aggregate gradation

| Broadcast bridge deck aggregate gradation | |
|--|-----------------|
| Mesh size | Percent passing |
| 4.75 mm | 100 |
| 2.36 mm | 30 to 75 |
| 1.18 mm | 0 to 5 |
| 600 µm | 0 to 1 |
| Broadcast parking deck aggregate gradation | |
| Mesh size | Percent passing |
| 2.36 mm | 100 |
| 1.18 mm | 51 to 75 |
| 850 µm | 14 to 50 |
| 600 µm | 0 to 25 |
| 425 µm | 0 to 2 |

Table 2.4—Properties of Type EM polymer overlay

| Property | Value | Test method |
|------------------------|--|---------------------------|
| Compressive strength* | >7 MPa (3 hours) >34 MPa (24 hours) | ASTM C579, Method B |
| Thermal compatibility* | Pass | ASTM C884/C884M, Method B |
| Bond strength, minimum | 1.7 MPa | ASTM C1583 |

*Samples should be made using 2.75 volume parts 20-30 sand per ASTM C778, 850 to 600 µm sieve to one volume part of mixed epoxy.

for each span or 400 m², whichever is smaller for bridges, and 400 m² for parking decks.

3.1.2.2 At each test location selected by the Engineer, prepare a minimum surface area of 0.4 m² using the equipment and procedures proposed for project surface preparation.

3.1.2.3 Prepare the surface and apply the overlay at designated quality control test locations.

3.1.2.4 Apply overlays at quality control 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, except that the tensile adhesion evaluation shall not be performed at surface temperatures above 27 °C. Core through the test overlay to a depth of 10 mm

(± 3 mm) into the underlying concrete slab. An evaluation shall be an average of three tests at each location within the quality control test location and have an average minimum pulloff strength of 1.7 MPa.

3.1.2.6 If the test results do not meet the required 1.7 MPa average pulloff strength, check the surface preparation procedures and repeat the tests. If the test results still do not meet the required 1.7 MPa average pulloff strength, check the manufacturer's batching, mixing, placing, and curing requirements and repeat the test until the required pulloff strength is achieved.

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](#).

3.2—Surface preparation

3.2.1 *Concrete decks*—Prepare the overlay area using the approved surface preparation practice until the specified substrate surface conditions have been achieved.

3.2.2 *Steel decks*—Prepare steel surfaces according to SSPC-SP 10/NACE No. 2 and result in minimum surface profiles of 0.1 mm amplitude. If flash rust appears, reblast the surface to SSPC-SP 10/NACE No. 2 specifications.

3.2.3 Blasted surfaces shall be free of dust and other loose material that can interfere with the bonding of the overlay.

3.2.4 If the Engineer determines that there has been a deviation from the accepted surface preparation procedure, prepare the suspect areas using the accepted method or verify using ASTM C1583.

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

3.3—Mixing epoxy binder

3.3.1 Mix the epoxy components according to the manufacturer's instructions.

3.3.2 When continuous mixing is specified, use equipment that continually meters, mixes, and dispenses the epoxy binder.

3.4—Overlay application

The overlay application consists of two distinct steps: epoxy binder application and aggregate broadcasting.

3.4.1 Do not place polymer overlay on hydraulic cement concrete less than 28 days of age unless specified otherwise. Do not place polymer overlay on magnesium phosphate cement concrete.

3.4.2 Do not place polymer overlay over crack repair materials that will affect the bonding or the curing of the overlay.

3.4.3 No visible moisture shall be present on the surface of the concrete at the time of polymer overlay application. Use a plastic sheet left taped in place according to ASTM D4263 (modified to a minimum of 2 hours) to identify moisture in the overlay area.

3.4.4 Apply the first layer of the overlay within 24 hours of surface preparation. No traffic shall be allowed on the accepted prepared surface until all layers of polymer overlay have been applied.

3.4.5 *Epoxy binder application*—Use a squeegee or paint roller to apply the first layer of the epoxy binder to achieve a uniform coverage rate of at least 1.0 L/m^2 .

3.4.6 *Aggregate broadcast*—While the epoxy binder 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 re-established. Accomplish aggregate broadcast while the epoxy is still fluid.

3.4.7 After the first layer of the overlay has cured, remove all excess unbonded aggregate.

3.4.8 Achieve the specified overlay thickness by applying multiple thin layers. Repeat the application for subsequent layers with coverage rates of at least 2.0 L/m^2 of epoxy binder using squeegees or a paint roller and broadcast aggregate until a dry layer of aggregate is present over the entire surface. The Architect/Engineer shall specify the required number of applications and total overlay thickness.

3.5—Curing

3.5.1 If a nonadhering 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

Remove all excess aggregate from the surface after the overlay has cured.

3.7—Joints

Maintain expansion joints in the concrete surface to be overlaid during overlay application. When a joint must be saw-cut into the overlay, perform the cut as soon as the overlay can support 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.

FOREWORD TO CHECKLISTS

F1. This Foreword is included for explanatory purposes only; it does not form a part of Specification ACI 548.8M.

F2. ACI Specification 548.8M 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. The ACI Specification cannot and does not address responsibilities for any project participant other than the Contractor.

F3. Checklists do not form a part of ACI Specification 548.8M. Checklists assist the Specifier in selecting and specifying project requirements in the Project Specification.

F4. The Specifier shall make adjustments to the needs of a particular project by reviewing each of the items in the checklists and including the items the Specifier selects as mandatory requirements in the Project Specification.

F5. The Mandatory Requirements Checklist indicates work requirements regarding specific qualities, procedures,

materials, and performance criteria that are not defined in ACI Specification 548.8M.

F6. The Submittal Checklist identifies Specifier choices for information or data to be provided by the Contractor before, during, or after construction.

F7. Recommended references—Documents and publications that are referenced in the Checklists of ACI Specification 548.8M are listed. These references provide guidance to the Specifier and are not considered to be part of ACI Specification 548.8M.

ICRI standards

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

International Concrete Repair Institute (ICRI)
3166 South River Road, Suite 132
Des Plaines, IL 60018
www.icri.org

MANDATORY REQUIREMENTS CHECKLIST

| Section/Part/Article | Notes to Architect/Engineer |
|----------------------|--|
| 1.1 | Specify scope of the planned overlay. |
| 1.2 | Review applicability of cited references. |
| 1.4 | Submit certificate of compliance, quality control test results, and material samples |
| 3.1.3 | Form comparison of concrete surface textures, use ICRI Guideline No. 03732; for steel surfaces, use SSPC-SP 10/NACE No. 2. |

SUBMITTAL CHECKLIST

| Section/Part/Article | Notes to Architect/Engineer |
|----------------------|-----------------------------|
| 1.4.1 | Certificate of compliance |
| 1.4.2 | Materials and product data |
| 1.4.3 | Material Safety Data Sheets |



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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

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The AMERICAN CONCRETE INSTITUTE

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