



## Iowa Department of Transportation

### SPECIAL PROVISIONS FOR HIGH FRICTION SURFACE TREATMENT

Linn County  
IHSIPX-380-6(278)20--08-57

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THE STANDARD SPECIFICATIONS, SERIES 2009, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

#### 090134.01 DESCRIPTION.

Prepare the surface of the existing reinforced concrete bridge deck, and construct a high friction surface treatment.

#### 090134.02 MATERIALS.

##### A. Epoxy.

- Provide an AASHTO M325 Type III, Grade 1 or 2, 100 percent solids, thermosetting, moisture-insensitive epoxy with the following additional requirements:

Table 090134.02-1: Epoxy Requirements

Property	Requirement	Test Method
Viscosity	7-25 poises	ASTM D2393, Brookfield RVT, Spindle No. 3 at 20 RPM
Gel Time	15-45 min.	ASTM C 881, para. 11.2.1 modified, 50 to 100 ml sample.
Compressive Strength*, 3 hr.	1000 psi min.	ASTM C 109, w/ plastic inserts
Compressive Strength*, 24 hr.	5000 psi min.	ASTM C 109, w/ plastic inserts
Tensile Strength, 7day	2000-5000 psi	ASTM D 638
Elongation, 7 days	30-70 percent	ASTM D 638
Adhesive Strength, 24 hr.	250 psi min.	ACI 503R, Appendix A

\*Mixed with aggregate.

- The epoxy formulation supplied must have a minimum application history of 3 years in a state or states in the northern half of the U.S. Include a list of bridges on which the material has

been applied, the name of the owner agency and a contact at the owner agency for each structure submitted. Provide independent laboratory reports documenting that the epoxy binder meets the requirements of this section.

3. Provide the Engineer with a copy of the epoxy materials manufacturer's recommendations.

#### **B. Aggregate.**

1. Ensure that the aggregate is a calcined bauxite material that is clean, dry and free from foreign matter and meets the following requirements:

**Table 090134.02-2: Bauxite Aggregate Requirements**

<b>Property</b>	<b>Requirement</b>	<b>Test Method</b>
Accelerated Polishing Value	70.0 BPN minimum	ASTM E660
LA Abrasion Test	20.0 maximum	AASHTO T96 "C" Grading (on parent aggregate)
Aggregate Gradation	95.0-100.0% Passing No. 6 0.0 – 5.0% Passing No. 16	AASHTO T27

2. Submit certification from the manufacturer that the aggregate topping meets the above requirements. Submit documentation of the in-place friction characteristics (minimum 60 FN40R in accordance with ASTM E274) of aggregate bonded to a vehicular bearing surface using the modified epoxy binder. Submit a list of projects with owners contact information on which a minimum of 3,000 square yards of high friction aggregate and epoxy binder has been placed within the past three years.

#### **090134.03 CONSTRUCTION REQUIREMENTS.**

This procedure may involve hazardous materials, operations and equipment.

#### **A. Contractor Qualifications.**

The contractor shall have at least 3 years experience applying high friction surface treatments. Submit a list of projects with owner contact information for high friction surface treatments projects placed within the past 3 years.

#### **B. Equipment.**

Equipment is subject to approval of the Engineer and must comply with these requirements:

##### **1. General.**

Provide an overall combination of labor and equipment with the capability of proportioning and mixing the epoxy components, and placing the epoxy and aggregate in accordance with this specification and the manufacturer's recommendations.

##### **2. Surface Preparation Equipment.**

- a. Shot-blasting equipment capable of removing all loose disintegrated concrete, dirt, paint, oil, asphalt, laitance carbonation and curing materials from the deck surface.
- b. Sandblasting equipment capable of removing all oxidation, dirt, paint, oil and asphalt from the metal expansion joints.

##### **3. Mechanical Application Equipment.**

Use the following equipment.

- a. An epoxy distribution system capable of accurate and complete mixing of the epoxy resin and hardening agent, verification of the mix ratio and uniform and accurate distribution of the epoxy materials at the specified rate on 100% of the work area;

- b.** A self propelled aggregate spreader capable of uniform and accurate application of the dry aggregate a minimum of a continuous 12 foot width;
  - c.** An air compressor capable of producing a sufficient amount of oil free and moisture free compressed air to remove all dust and loose material; and
  - d.** Adequate additional hand tools to facilitate the placement of the surface treatment according to this specification and the manufacturer's recommendations.
4. Do not use power driven tools heavier than a 15 pound chipping hammer, during deck preparation.

#### C. Proportioning.

1. Proportion all epoxy materials according to the manufacturer's recommendations.
2. Follow all manufacturer suggested safety precautions while mixing and handling epoxy components.

#### D. Preparation of Surface.

1. Before preparation of the surface remove deteriorated concrete and repair the area with suitable patch material, as per the Developmental Specifications for Partial Depth Bridge Patching.
2. As the final preparation for the placement of the surface treatment, make a complete cleanup by shot blasting and/or other approved means, followed by an air blast with dry, oil free air or vacuum. Brooming is not acceptable. Remove all loose disintegrated concrete, dirt, paint, oil, asphalt, laitance carbonation and curing materials from patches and other foreign material from the surface of the deck.
3. Completely remove existing pavement markings in surface treatment area. Grinding may be required to completely remove the pavement markings.
4. The following test will determine if additional surface preparation is necessary.
  - a. Place a polymer concrete test patch a minimum of 0.5 square yards for each bridge deck surface. The test patch shall be full depth, placed by the normal construction sequence.
  - b. Final acceptance will be based on the following results of the test outlined in ACI 503R Appendix A:
    - Minimum Tensile Rupture Strength of 250 psi from an average of 3 tests on a test patch regardless of depth of failure; or
    - Failure in the concrete at a depth greater than or equal to 1/4 inch over more than 50% of the test area for 3 of the 4 tests in the test patch.
  - c. If failure in the concrete is at a depth less than 1/4 inch and the Minimum Tensile Rupture Strength is less than 250 psi, or the failure in the concrete is less than 50% of the test area, additional surface preparation is necessary.
  - d. A failure in the concrete below 250 psi and greater than 1/4 inch deep indicates weak concrete, not poor polymer concrete bond.
  - e. Do not perform tensile adhesion tests when temperatures are above 85°F.
5. Remove any contamination of the prepared deck surface or surface of subsequent courses. Sand blast or bush hammer contaminated areas to produce an acceptable surface for placement of the surface treatment.
6. Protect any areas of the bridge deck that are not to be treated from the shot blast.
7. Close deck drains so the epoxy and aggregate shall not pass through the drains.

8. Rain will not necessarily contaminate the surface. However, care must be taken so no contamination occurs.
9. Visible moisture on the prepared deck at the time of placing the surface treatment is unacceptable. Identify moisture in the deck by taping a plastic sheet to the deck for a minimum of 2 hours (ASTM D 4263).
10. Place the surface treatment within 24 hours of preparing the deck surface. Deck surfaces exposed for more than 24 hours must be sand blasted prior to application of the surface treatment.
11. The use of scarifiers, scrablers or milling machines will not be allowed unless approved by the Engineer.
12. Wet sand blasting shall not be allowed.
13. Sandblast expansion joints prior to placing surface treatment. Mask off all gaps in expansion joints to prevent epoxy and aggregate from collecting in joints.

#### **E. Placing the High Friction Surface Treatment.**

1. Place the high friction surface treatment to the grades, thickness and cross sections as shown in the contract documents. Provide a technical representative of the epoxy manufacturer on the job site during the placement of the surface treatment. The representative is to provide technical expertise to the Contractor and the Engineer regarding safe handling, placement and curing of the surface treatment.
2. Apply the two part modified epoxy base binder by a truck or trailer mounted application machine onto the deck surface in a uniform thickness. Binder application shall ensure that no seams are visible in the middle of the traffic lanes of the finished work after application of the surface aggregate. Operations shall proceed in such a manner that will not allow the epoxy base binder material to separate in the mixing lines, cure, dry, or otherwise impair retention bonding of the high friction surfacing aggregate. The application machine shall be equipped with flushing systems such that blockages of lines will not occur, and installation operations are not delayed, stopped or otherwise compromised. Apply the epoxy binder onto the prepared deck surface with a minimum coverage rate of 3.0 square yards per gallon with a uniform thickness of 60 mils. Ensure that application equipment is capable of applying binder uniformly at a minimum rate of 2.5 gal/per minute. Uniformly distribute the binder within the ambient temperature range specified. Ensure that operations proceed in a manner that does not allow the epoxy to separate, chill, or set up in a way that would impair the retention of the aggregate.
3. Apply aggregate using an aggregate drop spreader that evenly distributes the aggregate over the epoxy resin at a uniform rate. Ensure that the mechanical aggregate spreader is capable of applying a minimum of a continuous 12 foot width application, with an adjustable height from spreader to deck surface to ensure proper spread of aggregate. Uniformly spread aggregate within 10 minutes of epoxy application without causing excessive overlap of aggregate outside of coverage area.
4. Remove the excess aggregate by suction, sweeping or other means before opening to traffic. Excess aggregate can be reused on the following day's installation provided the reclaimed aggregate is clean, uncontaminated and dry. Additional sweeping may be necessary after the system fully cures. Ensure that the coverage rate of the retained aggregate is 11-15 lbs per square yard. If damage or tearing occurs, stop brooming or vacuuming. Areas that do not receive enough aggregate before gelling of the epoxy may be re-coated with epoxy and aggregate.

5. Locate any longitudinal joints along lane lines, or as approved by the Engineer. Keep the joints clear of wheel paths as much as practical. Tape all construction joints to provide a clean straight edge for adjacent polymer concrete placement. This includes joints between previously placed surface treatment materials and at centerline. Finish the exposed edges at the ends of the bridge and at expansion joints to minimize bridge deck roughness.
6. Hand equipment may be used to apply treatment to expansion joints.
7. Remove masking material from expansion joints as soon as practical after aggregate application to ensure binder does not harden and bond the masking material to the joints.

#### **F. Weather Limitations.**

1. Do not place the surface treatment prior to April 1 or after September 30. The surface treatment may be placed outside of the allowable dates with approval of the Engineer and the material supplier.
2. Do not place the surface treatment when conditions are such that the deck temperature will exceed 100°F.
3. Do not place the surface treatment if conditions are such that gel time is less than 10 minutes.
4. Do not place the surface treatment if the air temperature is expected to drop below 55°F within 8 hours of placement.
5. The bridge deck and all epoxy and aggregate components must be a minimum of 60°F at the time of application.

#### **G. Correction of Unbonded or Damaged Areas.**

Repair areas discovered to be unbonded (by tapping or chaining) and areas of the surface treatment damaged by the Contractor's operation. Saw cut the unbonded or damaged areas to the top of the deck surface, remove the surface treatment with small air tools (15 pounds maximum) or shotblasting. Shotblast the concrete bridge deck surface at the unbonded area to remove contaminants, and replace the surface treatment according to these specifications at no additional compensation.

#### **H. Friction Acceptance Testing.**

Between 30 and 90 days after construction of the high friction surface treatment, the Engineer will measure the friction characteristics in accordance with ASTM E274. The minimum acceptable friction number (FN40R) is 60. If the minimum acceptable friction number is not met, the contractor will be required to reapply a second layer of high friction surface treatment according to these specifications at no additional compensation.

#### **090134.04 METHOD OF MEASUREMENT.**

The Engineer will measure the area of High Friction Surface Treatment placed in square yards.

#### **090134.05 BASIS OF PAYMENT.**

Payment for High Friction Surface Treatment will be at the contract unit price per square yard. Payment is full compensation for the specified work, including preparation of the bridge surface (including expansion joints), furnishing and applying the epoxy, furnishing and applying the bauxite aggregate, and any corrective action required.