



**SPECIAL PROVISIONS  
FOR  
MULTI-LAYER POLYMER CONCRETE OVERLAY**

**Clay County**  
BRFN-018-2(118)--39-21  
BRFN-018-2(119)--39-21

**Sioux County**  
BRFN-018-1(90)--39-84

**Effective Date**  
**July 18, 2017**

**THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.**

**150276.01 DESCRIPTION.**

Prepare the surface of the existing reinforced concrete bridge deck, and construct a multi-layer polymer concrete overlay for bridge preservation.

**150276.02 MATERIALS.**

**A. Epoxy.**

1. Provide an AASHTO M 325 Type III, Grade 1 or 2, 100% solids, thermosetting, moisture-insensitive epoxy with the following additional requirements of Table 150276.02-1:

<b>Table 150276.02-1: Epoxy Requirements</b>		
<b>Property</b>	<b>Requirement</b>	<b>Test Method</b>
Viscosity	7-25 poises	ASTM D 2393, Brookfield RVT, Spindle no. 3 at 20 RPM
Gel Time	14-45 minutes	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, 7 day	2000-5000 psi	ASTMD 638
Elongation, 7 days	30-70 percent	ASTMD 638
Adhesive Strength, 24 hr.	250 psi min.	ACI 503R, Appendix A
*Mixed with aggregate		

2. 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 installation recommendations.

**B. Aggregate.**

Provide singly crushed aggregate that is free of dirt, clay and foreign or organic material and meets the requirements of Table 150276.02-2 and Table 150276.02-3.

Table 150276.02-2: Aggregate Requirements		
Property	Requirement	Test Method
Sodium Sulfate Soundness, Max loss	0.12	AASHTO T104
Wear, Maximum	30%	AASHTO T96
Acid Insoluble Residue, Minimum	55%	ASTM D 3042
Fine Aggregate Angularity, Minimum	45%	AASHTO T304
Moisture Content, Maximum	0.20%	IM381

Table 150276.02-3: Gradation Requirements for Aggregates (Percent Passing)				
3/8"	No. 4	No. 8	No. 16	No. 30
100	100	75-30	5-0	0

**150276.03 CONSTRUCTION.**

This procedure may involve hazardous materials, operations and equipment.

**A. Contractor Qualifications.**

The contractor shall have at least 3 years experience applying multi-layer polymer concrete overlays. Submit a list of projects with owner contact information for multi-layer polymer concrete overlay 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 mechanical aggregate spreader capable of uniform and accurate application of the dry aggregate over 100% of the work area;
- 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. Uniformly scarify or prepare the entire existing concrete deck to a depth of 3/8 inch or as noted on the Plans, except over areas of Class A or Class B repair where the removal may be coincident with operations for repair removal. Removal to a greater depth may be required at drains and elsewhere as noted in the Plans.
2. Place all new concrete above the prepared surface for multi-layer polymer overlay at the thickness specified in the Plans. Check the thickness and clearance in the following manner before concrete is placed: according to Article 2413.03, B, 3, a, of the Standard Specifications or other approved means acceptable to the Engineer.
3. As the final preparation for the placement of the surface treatment, make a complete cleanup by shot blasting 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.
4. Produce a surface relief equal to the International Concrete Repair Institute (ICRI) Surface Preparation Level 6 or 7 or ASTM E 965 Pavement Macrotexture Depth of 0.04 to 0.08 inch. The following Tensile Rupture test will determine if additional surface preparation is necessary. Tensile Rupture tests shall be performed by the Contractor and observed by the Engineer.
  - a. Place a polymer concrete test patch a minimum of 0.5 square yards for each bridge deck surface or every 300 square yards of prepared deck surface, whichever is smaller. The test patch shall be full depth, placed by the normal construction sequence. The Engineer may waive the test patch and permit the Tensile Rupture tests to be performed on the finished surface at a location near the bridge rail. After testing, the Contractor will be required to fill the test locations with epoxy and aggregate.
  - 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 three 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 three of the four 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. Keep areas from which concrete has been removed free of slurry produced by wet sawing of concrete joints. Remove all slurry from prepared areas before placing new concrete.
8. Use hand tools to remove final particles of concrete or to achieve the required depth. Shot blast the entire surface against which new concrete is to be placed, including curbs and exposed reinforcement. Remove all dirt, oil, and other foreign material, as well as any unsound concrete. Clean epoxy coated reinforcing with hand tools that will not damage the epoxy coating.
9. Close deck drains so the epoxy and aggregate shall not pass through the drains.
10. Rain will not necessarily contaminate the surface. However, care must be taken so no contamination occurs. Do not presaturate existing concrete prepared for repair or overlay with water before placing new concrete.
11. 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). Moisture tests shall be performed by the Contractor and Observed by the Engineer.
12. 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.
13. Wet sand blasting shall not be allowed.
14. 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. Deck Repair.**

1. Prepare the surface for Class A or Class B Deck Repair for areas specified in the plans or as directed by the Engineer according to Article 2413.03, C of the Standard Specifications.
2. Place repair concrete for Deck Repairs prior to placing the polymer overlay, and finish level with the prepared surface (lower boundary of polymer overlay). Use the procedures for Class B Repairs in Article 2413.03, E, 1, b of the Standard Specifications.

**F. Placing the Polymer Concrete Overlay.**

1. Place the polymer concrete overlay to the grades, thickness and cross sections as shown in the Plans. 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. Follow all manufacturer suggested safety precautions while mixing and handling epoxy components. Place the overlay in two separate courses at the application rates shown in Table 150276.03-1:

<b>Course</b>	<b>Epoxy Rate</b>	<b>Aggregate Rate*</b>
1	Not less than 0.22 gal./sq yd	10 lbs./sq yd
2	Not less than 0.45 gal./sq yd	14.5 lbs./sq yd

\*Apply enough aggregate to completely cover the epoxy

3. Use notched squeegees or mechanical application equipment to place the prepared epoxy on the deck immediately and uniformly at the prescribed rate. If mechanical application equipment is used, take 2 ounce samples for each 100 gallons of material placed to verify mix ratios and curing times. Place samples on the bridge rail or deck and note time to cure.
4. Use a paintbrush or roller to apply the epoxy on the face of curbs to the top of the curb. On bridges with continuous concrete barrier rails apply the epoxy to the first break in the geometry of the barrier to a minimum height of 6 inches above the deck. Apply the epoxy to the curb or barrier as each of the overlay applications are performed.
5. The bridge deck and all epoxy and aggregate components must be a minimum of 60°F at the time of application.
6. Apply the dry aggregate to cover the epoxy completely within 10 minutes of application. Remove and replace any first course areas that do not receive enough aggregate before gelling of the epoxy occurs.
7. Vacuum or broom excess aggregate from the first course after sufficiently cured. If damage or tearing occurs stop brooming or vacuuming.
8. Do not open the first course to traffic.
9. Place the epoxy and aggregate for the second course at the prescribed rate and in the same manner as the first course. Second course areas that do not receive enough aggregate before gelling of the epoxy may be re-coated with epoxy and aggregate.
10. Locate any longitudinal joints along lane lines, or as approved by the Engineer. Keep the joints clear of wheel paths as much as practical.
11. Produce and place the overlay within the specified limits in a continuous and uniform operation.
12. Correct surface variations exceeding 1/4 inch in 10 feet unless directed otherwise by the Engineer.
13. Longitudinal grooving is not required.
14. Tape all construction joints to provide a clean straight edge for adjacent polymer concrete placement. This includes joints between previously placed polymer overlay materials and at centerline.
15. Finish the exposed edges at the ends of the bridge and at expansion joints to minimize bridge deck roughness.
16. Apply a bond breaker to all expansion joints.
17. 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.

#### **G. Curing**

1. Minimum curing times are noted in Table 150276.03-2:

Table 150276.03-2: Polymer Concrete Overlay Cure Times							
Course	Average Temperature of Overlay Components, °F						
	55-59	60-64	65-69	70-74	75-79	80-85	85+
	Minimum Cure Time (hours)						
1	5	4	3	2.5	2	1.5	1
2	6.5	6.5	5	4	3	3	3

2. Cure the second course for 8 hours if the air temperature falls below 55°F during the curing period.
3. Plan and perform the work in such a way as to provide for the minimum curing times as specified in this specification or as specified by the material manufacturer.

**H. Weather Limitations.**

1. Do not place the polymer concrete prior to April 1 or after September 30. The polymer concrete may be placed outside of the allowable dates with approval of the Engineer and the material supplier.
2. Do not place the overlay when conditions are such that the deck temperature will exceed 100°F.
3. Do not place the overlay if conditions are such that gel time is less than 10 minutes.
4. Do not place the overlay if the air temperature is expected to drop below 55°F within 8 hours of placement.

**I. Correction of Unbonded or Damaged Areas.**

Repair areas discovered to be unbonded (by tapping or chaining) and areas of the overlay damaged by the Contractor's operation. Saw cut the unbonded or damaged areas to the top of the deck surface, remove the overlay 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 overlay according to these specifications at no additional compensation.

**150276.04 METHOD OF MEASUREMENT.**

- A. Multi-Layer Polymer Concrete Overlay: the Engineer will measure the area placed in square yards.
- B. Deck Repairs: according to Section 2413 of the Standard Specifications.
- C. Sealing (as required in Article 2413.03, G of the Standard Specifications): not measured separately for payment.

**150276.05 BASIS OF PAYMENT.**

- A. Multi-Layer Polymer Overlay: Payment 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 scarification and removal of concrete), furnishing and applying the epoxy, furnishing and applying the aggregate, and any corrective action required.
- B. Deck Repairs: according to Section 2413 of the Standard Specifications.
- C. Sealing as required in Article 2413.03, G of the Standard Specifications: included in the contract unit price for Multi-Layer Polymer Concrete Overlay.