

EPOXY OVERLAY FOR SEALING AND HIGH FRICTION SURFACE TREATMENT ON CONCRETE BRIDGE DECKS.

(REV 8-11-20)

The following new Section is added:

SECTION 403 EPOXY OVERLAY FOR SEALING AND HIGH FRICTION SURFACE TREATMENT ON CONCRETE BRIDGE DECKS

403-1 Description.

403-1.1 General: Provide and apply an epoxy as an overlay system over concrete bridge decks in accordance with this specification and in conformity with the lines and details shown on the plans. The overlay shall be uniform in texture and color and shall not change the existing deck slopes.

The work also includes pre-treatment of the concrete surface and the sealing of existing concrete cracks using a crack sealing material proven compatible with the overlay.

403-1.2 Manufacturer Representative: Secure the services of a manufacturer representative to visit the construction site to train inspection and contractor personnel in the application and testing of the overlay system prior to application. The representative shall also observe initial application and testing to confirm that application is performed in accordance with the manufacturer's instructions and this Specification. As a minimum, the manufacturer's representative must be available to the Contractor and the Engineer for technical advice and inspection of the application during the duration of the overlay work. Upon completion of the project, the manufacturer must provide a notarized statement indicating that the material has been applied as per the manufacturer's requirements.

403-1.3 Manufacturer Warranty: Provide a performance bond warranty for the overlay system that would cover a minimum period of five years. Include materials, labor, MOT, testing, and all required incidentals in the warranty.

403-1.4 Contractor Qualifications: The overlay contractor or subcontractor must have the following qualifications and must provide the following information for review by the Department:

1. A record showing a minimum of three successful previous bridge epoxy overlay applications with a minimum requirement of five years of service life applied by the Contractor/Subcontractor within the last three years.

2. List of names and telephone numbers of the overlay owner's contact personnel for previous projects.

3. Brand names of epoxy compounds used for these previous applications along with the surface treatment and application process.

In addition to the above qualifications, the Contractor must demonstrate that the proposed methods and procedures will satisfactorily provide the specified final product by installing the overlay on two designated test sections of the bridge prior to commencing production work. Each test section must be no less than 200 square feet and no larger than 400 square feet.

403-2 Materials.

403-2.1 Pre-Treatment Material: Use a pre-treatment material that is of ultra-low viscosity (as described in Table 403-1) capable of penetrating and sealing cracks 4 mils wide and larger, and that is certified by the manufacturer to be compatible with the epoxy overlay.

The mixed pre-treatment material must meet the following requirements and be maintained between 73°F and 75°F for a minimum of 24 hours prior to mixing and testing:

Table 403-1: Properties of Pre-Treatment Material*		
Property	Requirement	Test Method
Viscosity	100 cP max.	ASTM D2556
Tack-Free Time	3 hours max. at 70°F & 50% ± 5% Relative Humidity	ASTM C679
Compressive strength at 24 hours	5000 psi min.	ASTM C579 Method B
Bond Strength	250 psi min.	ASTM C882
Tensile Elongation	30% min.	ASTM D638 (Type I)
*Properties may be slightly adjusted as manufacturer warranties include proper penetration of cracks and is included in bond warranty.		

403-2.2 Overlay Epoxy Binder: Use two-component epoxy or epoxy-urethane overlay binder materials that are compatible with the pre-treatment material. The mixed overlay epoxy must conform to the following characteristics:

Table 403-2: Properties of Overlay Epoxy Binder		
Property	Requirement	Test Method
Gel Time	15 to 45 minutes at 75°F	ASTM C881 (50 ml sample in paper cup)
Tensile Strength	2,000 psi min. at 7 days	ASTM D638
Tensile Elongation	25% to 70%	ASTM D638
Viscosity	50 to 1500 cP*	ASTM D2556
Compressive Strength at 3 hours	1,000 psi min. at 75°F	ASTM C579 Method B
Compressive Strength at 24 hours	5,000 psi min. at 75°F	ASTM C579 Method B
Adhesion Strength at 24 hours	250 psi min. at 75°F	ASTM C1583/ACI 503R
Flash Point	>200°F	ASTM D6450
Thermal Compatibility	No delamination of overlay	ASTM C884

*Or as per manufacturer overlay system design. Provide equivalent Zahn Cup viscosity in centistokes (cSt) for the overlay resins.

403-2.2.1 Packaging: Furnish the two components of the epoxy resin systems in separate containers that are non-reactive with the materials. The size of the containers will be such that the recommended proportions of the final mixture will be obtained by combining a container of Component A with a container of Component B. Provide containers that do not exceed 10 gallons unless otherwise approved by the Engineer based on type of manufacturer

delivery system. When less than one complete unit is used, each component will be measured within plus or minus two percent of the volume required. Batches of less than 6 fluid ounces will be measured within plus or minus one percent. Do not use materials from opened containers that have been exposed to air for more than 48 hours and obtain manufacturer approval for mixing materials from previously opened containers.

Identify the containers as “Component A – Contains Epoxy Resin” and “Component B – Contains Hardener” and show the type, class, and mixing directions. Mark each container with the name of the manufacturer; class, batch, or lot number; date of packaging; date of shelf life expiration; pigmentation, if any; and the quantity contained in pounds and gallons.

403-2.3 Pre-Qualification of Materials: Submit all overlay systems and materials along with manufacturer’s materials warranty for approval by the Engineer prior to delivery to the site.

Submit the following documentation for approval:

1. Independent laboratory or National Transportation Product Evaluation Program (NTPEP) test results documenting that the proposed epoxy materials meet all of the properties as required by this Specification. The independent laboratory shall be ISO 9001 certified.

2. Manufacturer approved method(s) for mobile and localized application.

403-2.4 Aggregate: Use basalt, bauxite, or flint aggregate unless otherwise noted in the contract documents for the project. Use aggregates that are thoroughly cleaned and having less than 0.2% moisture. The aggregates must be free of dirt, clay, asphalt and other foreign or organic materials. Only use calcined bauxite aggregate with a 76% minimum alumina content when the overlay is also intended as a high friction surface treatment.

Use aggregates that have a Mohs’ scale hardness of 6.5 minimum or an LA Abrasion (AASHTO T 96) of 30% maximum. The aggregate must be 100% fractured in at least one face. Fractured condition will apply to all material retained in the No. 8 sieve. Unless otherwise approved, aggregate must conform to the following gradation:

Table 403-3: Percent by Weight of Material Passing			
No. 4	No. 8	No. 16	No. 30
US Sieve Size	US Sieve Size	US Sieve Size	US Sieve Size
100	30-75%	Max. 5%	Max. 1%

403-2.5 Resin Binder: Provide a minimum of one random test sample of each component from each batch or lot number for each shipment of material greater than 15 gallons. Provide one quart of Component A and the quantity of Component B necessary to react with the quart of Component A to the State Materials Office (SMO). Provide resin binder components in as few different batches or lots as possible. Submit a certification to the State Materials Office for each batch or lot from the manufacturer stating that Components A and B conform to these specifications. The certification must include:

1. Name of the manufacturer,
2. Identification, type, and name of product,
3. Batch or lot number represented,
4. A statement from the manufacturer indicating that Components A and B have been sampled and tested.

403-2.6 Storage of Materials: Provide all SDS and other information pertaining to the safe practices for the storage, handling and disposal of the materials, and to their hazards. Obtain the SDS from the manufacturers and post a copy at the Engineer designated area(s). Provide an additional copy of such information to the Engineer.

Store the materials in a dry area that would prevent these from getting wet and that will maintain a temperature between 50 and 90 °F. Store the polymer-based primers, binders and top coat away from open flames or other ignition sources.

403-3 Construction Methods.

403-3.1 Mixing Epoxy Binder: Furnish and mix epoxy resin in two components for combining in accordance with the manufacturer's instructions immediately prior to use. Component A will contain the epoxy polymer resin. Component B will contain one or more hardening agents that will cause the system to polymerize and harden when mixed with Component A. Thixotropic agents used to control viscosity will be permitted only when utilized in strict accordance with the manufacturer's recommendations.

Thoroughly stir the contents of the separate packages containing Components A and B prior to use. Do not use the same mixing device to stir both components. Clean or replace mixing devices used for mixing components A and B after mixing each batch. Dispose of solvents used for cleaning in accordance with all applicable Local, State and Federal policies and regulations. Store Components A and B between 65°F and 80°F for at least 2 hours prior to use. Epoxy components may be heated in hot water or by indirect heat prior to mixing to bring them to the required temperature and viscosity. Do not use solvents and thinners except for cleaning equipment.

403-3.2 Spall Repairs: Repair all spalls present on the bridge deck and within the areas to receive the overlay. Use an epoxy mortar or polymer modified concrete material that is free of magnesium phosphate with a minimum compressive strength of 5,000 psi (ASTM C39) after extending, if extension is necessary. Sawcut the perimeter of the spall and excavate behind all exposed bars to provide a good mechanical bond between the deck and the patch material. Allow the patch material to cure for a minimum of 24 hours for epoxy concretes and twenty eight days for cementitious based concretes prior to placement of the overlay unless otherwise approved by the Engineer and the overlay manufacturer.

403-3.3 Surface Preparation: Determine the level of bridge deck cleaning and the preparation methods necessary to provide a minimum of 250 psi bond strength on two pre-selected test sections. Use ASTM C1583 or ACI 503R bond tests to determine the size of shot, flow of shot, forward speed of shot-blast machine, and number of passes necessary to provide a tensile bond strength greater than or equal to 250 psi (using a 2-inch dolly) prior to commencing production work. Alternatively, the surface preparation must provide a failure area, at a depth of 1/4 inch or more into the base concrete that shows on 50% or more of the test dolly. A test result will be the average of three pull tests with no one pull less than 175 psi on a test section of 1.5 feet x 3 feet consisting of two courses. Repair all tested areas.

Install the test sections with the same materials, equipment, personnel, timing, sequence of operations, and curing period prior to opening to traffic that will be used for the installation of the production overlay. The cleaning method, materials, and installation procedure will be approved if passing test results are obtained from each test area. Remove and reinstall test sections if satisfactory results are not obtained.

Clean the deck surface under its specific maintenance of traffic scheme by shot-blasting and other means using the approved cleaning method (examples - diamond grinding,

hand grinding) before placement of the epoxy concrete overlay pre-treatment. Remove all asphaltic material, oils, dirt, rubber, curing compounds, paint, carbonation, laitance, weak surface mortar and other potentially detrimental materials, which may interfere with the bonding or curing of the pre-treatment or the overlay (solvents will not be allowed). Mortar which is sound and soundly bonded to the coarse aggregate must have open pores after cleaning to be considered adequate for bond. Otherwise, these shall be removed and replaced with suitable patch material. Remove areas of asphalt larger than one inch in diameter, or smaller areas spaced less than six inches apart.

Remove all deck striping prior to application. Traffic paint lines will be considered fully removed when the concrete has exposed aggregate showing through the paint stripe. Use a truck with a sweep-vacuum or sweep-compressed air system to remove all dust and other loose material from the area to be treated immediately prior to the pre-treatment application.

Only use cleaning methods and procedures recommended by the manufacturer and that have been approved by the Engineer.

Do not place epoxy overlay on hydraulic cement concrete that is less than 28 days of age. Do not place epoxy concrete overlay on magnesium phosphate cement concretes. Remove and replace with polymer modified concrete any magnesium phosphate patches found on the deck prior to placement of the overlay system. Patching and cleaning operations will be inspected and approved prior to placing each layer of the overlay. Any contamination of the deck or to intermediate courses, after initial cleaning will be mechanically removed to sound concrete extending two feet in all directions from the contaminated area. Do not use any open flame to remove applied epoxy or to dry the surface of the deck under any circumstances. Apply both courses within 24 hours following the final cleaning and prior to opening the area to traffic.

Verify that there is no visible moisture present on the surface of the concrete at the time of application of the epoxy concrete overlay. Conduct moisture test in an area away from traffic as per ASTM D4263 for a minimum of five hours prior to application. Use clean compressed air to dry the deck surface if necessary.

403-3.4 Application Equipment: Provide equipment that meets the following requirements:

403-3.4.1 Mobile Application Equipment: Equipment for mobile application will conform to the FDOT Standard Specifications, Section 100 and will consist of no less than the epoxy distribution system with spreader bar(s) or dispenser nozzle(s), flow meters, aggregate spreader, application brooms and squeegees, and vacuum-broom trucks. The distribution system or distributor will accurately mix the epoxy resin and hardening agent, and will uniformly and accurately distribute the epoxy at the specified rate to the bridge deck in such a manner as to cover 100% of the work area. Mixing and distribution shall not promote the entrapment of air in the resin. Properly spread the aggregate in such a manner as to uniformly and accurately apply the dry aggregate to cover 100% of the epoxy resin. Use self-propelled vacuum trucks.

403-3.4.2 Localized Application Equipment: Equipment for localized applications will consist of calibrated containers, a paddle type mixer, squeegees, rollers and brooms, which are suitable for mixing the epoxy and applying the epoxy and aggregate in accordance with this specification. Rolling mixing stations that are allowed on the bridge must be diapher from leaking fluids including condensate water from air conditioning. Fabricate the work platforms for mixing so as to prevent any spill of the mixed epoxy, the resin, or the hardener. Use localized application equipment only for areas not accessible by the mobile

application equipment or for applications no greater than 100 square feet in one work shift. Clean or replace mixing paddles after mixing each batch. Areas larger than 100 square feet shall be treated using the equipment specified for Mobile Application.

403-3.5 Application: Perform handling and mixing of the epoxy resin and hardening agent in a safe manner to achieve the desired results in accordance with this specification and with the manufacturer's published product data sheet as approved or directed by the Engineer. Do not place epoxy pre-treatment or concrete overlay materials if traffic has been on the already prepared section(s) or when weather or surface conditions are such that the material cannot be properly handled, placed and cured within the specified time period.

Verify that concrete, resin, air and equipment temperatures are within the manufacturer's specified limits.

Apply the epoxy overlay ensuring that the original slopes of the bridge are maintained and the deck surface is uniform as to not to allow any accumulation of water. Perform the crack sealing and pre-treatment operation immediately followed by the application of the overlay. Apply the overlay in two separate courses in accordance with the following rate of application, and the total of the two applications will not be less than 7.5 gallons of resin per 100 square feet.

Table 403-4: Application Rates		
Course	Rate gal./100 ft ²	Aggregate lb./yd ² **
1	No less than 2.5	10+
2	No less than 5.0	14+
* Application rates per course may differ as recommended by the overlay system manufacturer for the particular concrete surface.		
** Application of aggregate will be of sufficient quantity to completely cover the epoxy. Weight of applied aggregate may vary based on material selected.		

Place the epoxy mixture on the surface of the bridge deck after it has been prepared for the epoxy concrete overlay and distribute the epoxy uniformly over the concrete periodically cleaning the epoxy distribution tools. Ensure that the temperature of the bridge deck surface and all epoxy and aggregate components will be 55°F or above at the time of application. Do not apply epoxy if the air temperature is expected to drop below 60°F within 8 hours after application, or the remaining gel time is less than 10 minutes. The dry aggregate shall be applied in such a manner as to cover the epoxy mixture completely within 5 minutes. Provide a two inch wide offset between courses for adjacent lane placement, so as to give an overlap of the joint. The same offset joint will be made at transverse locations where work has ceased.

Remove and replace first course applications which do not receive enough aggregate or exceeded the approved thickness prior to gelling of the epoxy. A second course with insufficient aggregate may be left in place, but will require additional epoxy and aggregate applications before opening to traffic and the total thickness of the overlay shall not exceed 0.6 inch. Cure each course of epoxy concrete overlay until vacuuming or brooming can be performed without tearing or damaging the surface. Traffic or equipment will not be permitted on the overlay surface during the curing period. Remove all loose aggregate after the curing period has expired by vacuuming or brooming.

Inspect all the longitudinal centerline joint or multiple longitudinal joints for correct placement prior to final opening to traffic. Make any corrections at no additional cost to the Department.

Plan and execute the work to provide the minimum curing periods as specified in the Plans, or other longer minimum curing periods as prescribed by the manufacturer prior to opening to public or construction traffic, unless otherwise approved by the Engineer. Do not open lanes to traffic over the first course.

Reapply pavement marking materials as directed in the contract documents after the overlay system has been completed and approved by the Engineer. Temporary striping may be necessary as described in the contract documents or as directed by the Engineer

Provide to the Engineer records for each batch of epoxy overlay applied. Records shall include, but not be limited to the following:

1. batch numbers and sizes
2. location of batches as placed on deck, referenced by stations
3. batch mix time
4. batch gel and cure times (measured on 50 ml samples for each batch of localized application or application section using mobile equipment)
5. temperature of the air, deck surface, epoxy components, including aggregates
6. loose aggregate removal time
7. time of curing before opening to traffic

403-3.6 Limitations: Mask or otherwise provide the expansions joints and scuppers with a bond breaker prior to the application of the overlay.

Overlap top and bottom lifts at joint areas when application is performed in phases.

Remove the overlay over each deck joint by removal of the bond breakers, by scoring the overlay prior to gelling, or by saw cutting after cure within 12 hours of application and prior to opening to traffic. Featheredge the overlay at expansion joints as to provide a smooth overlay to expansion joint transition.

Remove and replace damaged or deficient areas found on the epoxy concrete overlay by saw-cutting in rectangular sections to the top of the concrete deck surface and removing and replacing the various courses in accordance with this specification at no additional cost to the Department. Do not repair deficient areas by placing a third layer unless specifically approved by the Engineer.

403-4 Acceptance Testing.

403-4.1 Friction Testing: Measure the friction values of the installed overlay within 30 days after completion of the overlay application. Measure the friction characteristics of the overlay in accordance with AASHTO T 242 using the ribbed tire (M 261) option and a trailer type measuring vehicle. The Contractor shall secure the services of an independent enterprise experienced on roadway friction testing with the equipment described to perform the tests. The minimum acceptable friction number (FN40R) for non-high friction applications is 55 and for high friction treatment systems is 65.

403-4.2 Bond Testing: Test the tensile bond of the applied overlay after curing. Conduct a minimum of one bond test at every 600 square yards or less if the application is smaller than 600 square yards, or as directed by the Engineer. Inspect the remaining overlay by tapping or chain drag and repair any section discovered debonded or otherwise deficient. Repair test area using the localized application procedure.

Minimum acceptable bond is 200 psi tested as described in 403-3.3. Areas not meeting the bond or friction requirements shall be removed and replaced at no additional cost to the Department.

Provide copy of the friction and bond test results to SMO for final acceptance.

403-5 Method of Measurement.

403-5.1 Overlay Measurements: Epoxy concrete overlay system will be measured and paid for in square yards of completed epoxy system (both courses included) installed, tested, and accepted by the Engineer.

403-5.2 Spall Restoration Measurements: Restored spall areas will be measured based on the volume in cubic feet of actual spalls restored by the Contractor and accepted by the Engineer as necessary to place the overlay.

403-6 Basis of Payment.

All costs to furnish and install the epoxy concrete overlay including but not limited to the following will be included in the cost of Epoxy Concrete Overlay bid item: storage of materials, deck preparation and testing, furnishing and applying the pre-treatment material, furnishing and applying overlay courses, maintaining bridge slopes, protection of deck joints, furnishing and operating testing devices, written test reports.

Cost for restored spall areas will be paid for based on the volume of actual spalls restored by the Contractor. Cost will include all materials and labor associated with identification of spalls, removal of concrete, surface preparation, application of repair material, and curing. Quantities given in the Plans are estimates and may be increased, decreased or deleted beyond the limits allowed by Section 4 of the Specifications as necessary based on actual conditions found on the deck.

Payment will be made under Pay Item:

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|---------|--|
| 403- 1- | Epoxy Concrete Overlay for Concrete Bridge Decks – per square yard |
| 403- 2- | Restore Spalled Areas for Concrete Bridge Decks- per cubic foot |