SP- 230262
(New)

SPECIAL PROVISIONS
FOR
POLYESTER POLYMER CONCRETE DECK REPAIR WITH HIGH MOLECULAR WEIGHT METHACRYLATE RESIN PRIMER

Polk County
MBIN-080-1(512)137--0M-77
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THE STANDARD SPECIFICATIONS, SERIES 2023, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

230262.01 DESCRIPTION.

This specification consists of supplying, mixing, transporting, surface preparation, placing, finishing, and curing of a Polyester Polymer Concrete (PPC) with High Molecular Weight Methacrylate (HMWM) resin primer in accordance with the Contract Documents and as directed by the Engineer.

230262.02 MATERIALS.

PPC shall consist of polyester resin binder and aggregates with a compatible primer meeting the component and composite material properties specified. All components shall be supplied collectively through the same provider, qualified as defined herein, referred to as the System Provider.

A. Primer.

1. The prepared concrete surface shall receive a wax-free, low odor HMWM primer consisting of a resin, initiator and promotor. HMWM shall meet the requirements of Table 1.

Table 1: HMWM Primer Resin Requirements

Property	Requirement	Test Method
Viscosity*	25 cps maximum	ASTM D 2196, Brookfield RVT with UL adapter, 50 RPM at 77°F
Volatile Content*	30% maximum	ASTM D 2369
Specific Gravity* (at 77°F)	0.90 minimum	ASTM D 1475
Flash Point*	180°F minimum	ASTM D 3278
Vapor Pressure* (at 77°F)	1.0 mm Hg maximum	ASTM D 323
PCC Saturated Surface-Dry Bond Strength, with primer** (24 hours and 70 ± 1°F)	700 psi minimum	California Test 551, part 5

* Test shall be performed before initiator is added.
** Initiated polyester concrete tested at 12% resin content by weight of dry aggregate.

2. The prime coat promoter/initiator shall consist of a metal drier and peroxide. If supplied separately from the resin, at no time shall the metal drier be mixed directly with the peroxide, a violent exothermic reaction will occur. The containers and measuring devices shall be stored in a manner that will not allow leakage or spillage from one material to contact the containers or material of the other.

B. Aggregate.

1. Aggregate for PPC shall meet the following requirements:
   - **a.** Singly crushed aggregate that is free of dirt, clay and foreign or organic material.
   - **b.** Aggregate retained on the No. 8 sieve shall have a maximum of 45% crushed particles when tested in accordance with AASHTO Test Method T335.
   - **c.** Fine aggregate shall consist of natural sand only.
   - **d.** Weighted average aggregate absorption shall not exceed 1.0% as determined by AASHTO Test Methods T84 and T85.
   - **e.** At the time of mixing with the resin, the moisture content of the aggregate, as determined by AASHTO Test Method T255, shall not exceed one half of the aggregate absorption.
   - **f.** Aggregate shall have a minimum Mohs hardness of 7.
   - **g.** Aggregate shall meet the gradation requirements in Table 2.

Table 2: PPC Aggregate Gradation Requirements

Sieve Size	Percent Passing
3/8 inch	100
No. 4	62-85
No. 8	45-67
No. 16	29-50
No. 30	16-36
No. 50	5-20
No. 100	0-7
No. 200	0-3

2. Sand used for abrasive sand finish shall meet the following properties:
   - **a.** Shall be a commercial-quality blast sand.
   - **b.** Shall not have less than 95% pass the No. 8 sieve and not less than 95% retained on the No. 20 sieve when tested under AASHTO T27.
   - **c.** Shall be dry at the time of application.

C. Polyester Resin Binder.

Provide a polyester resin binder meeting the following requirements:

1. Shall be an unsaturated isophthalic polyester-styrene co-polymer suitable for a polyester concrete mixture with a resin content of 12% ± 1% of the weight of the dry aggregate.

2. Shall contain at least 1% by weight gamma-methacryloxypropyltrimethoxysilane, an organosilane ester silane coupler.

3. Shall be used with a promoter that is compatible with suitable methyl ethyl ketone peroxide and cumene hydroperoxide initiators.

4. Shall meet the requirements in Table 3.

Table 3: Polyester Resin Binder Requirements

Property	Requirement	Test Method
Viscosity*	75 to 200 cps	ASTM D 2196 RVT No. 1 spindle, 20 RPM at 77°F
Specific Gravity*	1.05 to 1.10	ASTM D 1475
Styrene Content*	40-50% by weight	ASTM D 2369
Silane Coupler*	1.0% by weight	NMR Spectrum
Gel Time	30 to 60 minutes	ASTM C881 at 73°F
Elongation	35% minimum (Type I specimen, thickness 0.25± 0.03" at Rate = 0.45 inch/minute)	ASTM D 638
	Sample Conditioning: 18/25/50+5/70	ASTM D 618
Tensile Strength	2500 psi minimum (Type I specimen, thickness 0.25± 0.03" at Rate = 0.45 inch/minute)	ASTM D 638
	Sample Conditioning: 18/25/50+5/70	ASTM D 618

* Test shall be performed before initiator is added.

D. PPC Composite System.

The composite PPC system shall meet the requirements in Table 4.

Table 4: PPC Composite System Requirements

Property	Requirement	Test Method
PCC Saturated-Surface Dry Bond Strength, without primer* (24 hours and 70 ± 1°F)	500 psi minimum	Caltrans 551
Abrasion Resistance	2g weight loss maximum	Caltrans 550
Modulus of Elasticity	1000 to 2000 ksi	ASTM C 469

* Initiated polyester concrete tested at 12% resin content by weight of dry aggregate.

E. Packaging and Shipment.

Provide a Safety Data Sheet prior to use for each shipment of polyester resin binder and HMWM resin. All components shall be shipped in strong, substantial containers. Polyester resin binder and primer resin shall bear the system provider's label specifying lot/batch number, brand name and quantity. In addition, the mixing ratio shall be provided to the Contractor by the system provider prior to shipment.

F. Storage of Materials.

All materials shall be stored in a cool, dry location and in their original containers in accordance with the system provider's recommendation to ensure their preservation until used in the work. The shelf life for liquid materials stored out of direct sunlight and at temperatures 80°F and below shall be at least 12 months. All aggregates shall be stored in a clean, dry location away from moisture. Applicable fire codes may require special storage facilities for some components of the repair system.

230262.03 CONSTRUCTION.

A. Placement Plan.

1. Submit a placement plan with a detailed construction work schedule to the Engineer for review and approval at least 30 days prior to the scheduled PPC repair. The following list is intended as a guide and may not address all the means and methods the contractor may elect to use. The Contractor is expected to assemble a comprehensive list of all necessary

items for executing the PPC repair.

a. Responsible personnel and hierarchy.
b. Equipment – including but not limited to mixers, holding tanks, generators, wheelbarrows, scales, meters, thermometers, floats, screeds, burlap, plastic, heaters, blankets, etc.
c. Quality Control of batch proportions - including dry ingredients, polyester resin binder, water and admixtures.
d. Quality Control of mixing time and batch times.
e. Batch procedure sequence.
f. Form work – including materials and removal.
g. Placement procedure – including but not limited to surface preparation of existing concrete surfaces, application and spreading of HMWM primer, and spreading, finishing, and curing of PPC material. Include provisions for acceptable ambient conditions and batch temperatures and corrective measures as appropriate.
h. Threshold limits for ambient temperature, ambient relative humidity, batch consistency, batch temperature, batch times and related corrective actions.

2. A preconstruction meeting will be held between the PPC material manufacturer's representative, the Contractor's staff, and representatives from Iowa DOT District Office, Bridges and Structures Bureau, and Construction and Materials Bureau to review the Contractor's Placement Plan prior to placement of the PPC repair. No PPC repair will be permitted until the placement plan has been submitted and approved by the Engineer.

3. Construction loads applied to the bridge during PPC repair placement and curing are the responsibility of the Contractor. Submit the weight and location of concrete placing equipment, grinding equipment, or other significant construction loads for review as part of the placement plan.

B. Equipment.
Equipment is subject to approval by the Engineer and must comply with the following requirements.

1. General.
Provide an overall combination of labor and equipment with the capability of proportioning and mixing the PPC components and placing the HMWM primer and PPC 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, grease, slurry, or rust from the deck surface.
b. Automatic shot-blasting units shall be self-propelled and include a vacuum to recover spent abrasives. The abrasive shall be steel shot.
c. In areas inaccessible to shot-blasting equipment, the surface may, with the Engineer's approval, be cleaned with sandblasting equipment.

3. Mixing Equipment.
Polyester concrete shall be mixed in either mechanically operated mixers or continuous automated mixers meeting the following requirements:
a. Employ an auger screw/chute device capable of completely blending catalyzed binder resin and aggregates.
b. Employ a plural component pumping system capable of handling polyester binder resin and catalyst, adjustable to maintain proper ratios to achieve set/cure times within the specified limits.
c. Be equipped with an automatic metering device that measures and records aggregate and resin volumes. Record volumes at least every 5 minutes, including time and date. Submit recorded volumes at the end of shift.

d. Have a visible readout gage that displays volumes of aggregate and resin being recorded.
e. Produce a satisfactory mix consistently during the entire application process.
f. Be calibrated per Caltrans California Test CT 109 or similar. Submit current certificate of calibration to the Engineer.

4. Application and Finishing Equipment.
After the PPC has been placed it shall be hand finished to provide a smooth surface. Match profile of patches to the existing deck grade and cross slope. Wood and foam formwork shall be lined with plastic to prevent the PPC from bonding to forms.

C. Deck Repair Removal Procedures and Limits
Remove concrete from each area (either designated in the contract documents or by the Engineer) to a depth and in a manner consistent with the classification for that area. Areas as shown in the contract documents are based on the best information available. The Engineer will determine actual areas. Deck repairs have no removal area restrictions.

1. General.
a. Use hand tools to remove final particles of concrete or to achieve the required depth.
b. Thoroughly clean all reinforcing bars and newly exposed concrete by sandblasting or shot blasting. Clean epoxy coated reinforcing with hand tools that will not damage the epoxy coating. Where bond between existing concrete and reinforcing steel has been destroyed, remove the concrete adjacent to the bar to a depth that will permit new concrete to bond to the entire periphery of the exposed bar. A minimum of 3/4 inch clearance is required around the bar. Exercise care to prevent cutting, stretching, or damaging any exposed reinforcing steel. The Engineer may require enlarging a designated area should inspection indicate deterioration of concrete or corrosion of reinforcing beyond the limits previously designated.

2. Class A Deck Repair.
a. Class A repair removal is considered to start at the top of existing surface. Removal for Class A repair extends at least to the level of the top reinforcing bars, and deeper, as determined by the Engineer, to remove unsound concrete.
b. Concrete may be removed by using a jack hammer, chipping hammer, shot blasting, hydro blasting, or by a combination of these. Concrete removal beneath reinforcing bars shall be accomplished using a 15 pound chipping hammer. Complete the final cleanup at the periphery and base of Class A repair using a 15 pound chipping hammer or hand tools.

3. Class B Deck Repair.
a. Class B repair removal is considered to start at the top of existing surface. Remove all concrete within all areas designated for Class B repair, and in all areas designated for Class A repair in which the depth of the remaining sound concrete is less than 50% of the original depth of the bridge deck.
b. Designated Class A repair areas will be measured as Class B deck repair when full depth removal is required. At the Engineer's direction, limited areas of removal greater than 50% of the floor thickness (such as beneath reinforcing) may be allowed. These limited areas of excess depth will be measured as Class A deck repair.
c. Remove concrete using a jack hammer or chipping hammer, or by using a combination of a scarifyier and chipping hammer. Accomplish the final removal at the periphery and base (if not full depth) of Class B repair using a 15 pound chipping hammer or hand tools. Provide a method of removal at the bottom of the bridge deck that will prevent feather edging of the concrete.
d. Provide forms to enable placement of new concrete in the full depth opening. Use forms that, preferably, are suspended from existing reinforcing bars by wire ties. In the case of large area openings, forms may be supported by blocking from the beam flanges. Support all forms by elements of the existing superstructure unless specifically noted or

shown otherwise in the contract documents.

D. Surface Preparation.

Prepare all surfaces that will be in contact with the repair by abrasive sandblasting in order to remove all existing loose, disintegrated concrete, dirt, paint, oil, asphalt, laitance carbonation and curing materials, grease, slurry, rust or any other contaminants that could interfere with the proper adhesion of the repair system.

1. Clean areas to receive the PPC repair by abrasive sandblasting. Do not begin cleaning until all work involving the repair of the concrete substrate surface has been completed and repair materials have cured. Pick up all contaminants and store in a vacuum unit. Do not create dust during the cleaning operation that will obstruct the view of motorists.

2. Determine the size and flow of abrasive and number of passes necessary to provide a surface free of weak or loose surface mortar, exposing the aggregates within the substrate concrete and visibly changing the color of the substrate concrete. Mortar which is sound and firmly bonded to the coarse aggregate must have open pores due to cleaning to be considered adequate for bond.

3. Do not expose cleaned surfaces to vehicular traffic unless required by the repair operation and approved by the Engineer. Cleaned concrete substrates that have been contaminated such that contaminates might interfere with the bonding or curing of the repair shall be cleaned to the satisfaction of the Engineer prior to placing the repair material at no additional cost to the Department. The cleaned concrete substrate shall be dry at the time of application of the primer and repair.

4. Clean all steel surfaces that will be in contact with the repair in accordance with SSPC-SP No. 10, Near-White Blast Cleaning, except that wet blasting methods shall not be allowed.

E. Trial Application.

1. Prior to constructing the repair, place a trial application of the PPC material on the prepared bridge deck to demonstrate proper initial set time, mixing, placing and finishing equipment proposed. The trial application shall be at least 5 feet long and 5 feet wide. The location(s) of the trial application shall be approved by the Engineer.

2. Representatives of the system provider knowledgeable in supplying, mixing, transporting, placing, finishing, and curing of the PPC system, including the HMWM primer, must be present during the trial application.

3. If the cleaning practice, materials, installation, finishing and/or texturing are not acceptable, repeat the trial application at no additional cost to the Department until satisfactory results are obtained.

4. The number of trial applications required shall be as many as necessary to demonstrate the ability to construct an acceptable trial repair section and competency to perform the work. The installer, system provider, and/or proposed equipment/techniques may be rejected by the Engineer if not shown to be acceptable after three failed trial applications.

F. Placing and Finishing.

1. General.

a. Representatives of the system provider knowledgeable in supplying, mixing, transporting, placing, finishing and curing of the PPC system, including the HMWM primer, must be present during placement on both bridges. Do not start mixing or placing the primer or

PPC repair until the manufacturer's representatives are on-site. Provided work is completed without issue on the first bridge, the Engineer may waive the requirement for the representative to be present on the second bridge.

b. Do not begin application of the HMWM primer and placement of PPC until the substrate is visibly surface dry, and free of water and moisture. ASTM D 4263 modified for 2 hours may be used to verify dryness at the discretion of the Engineer in cases when surface dryness is difficult to determine.

c. The ambient and substrate surface temperature shall be between 40°F to 90°F at the time of primer and PPC placement.

d. Do not begin application of HMWM primer and placement of PPC if rain is forecast.

2. Prime Coat.

a. Prior to applying the HMWM prime coat, completely dry and blow clean the area with oil-free compressed air.

b. Mix and apply primer in accordance with the system provider's recommendations. Apply primer within 5 minutes of mixing initiator and resin at a rate of approximately 90 to 100 square feet per gallon, or as otherwise recommended by the system provider.

c. Uniformly spread primer to completely cover all surfaces to receive repair, including any adjacent vertical surfaces. Take care to avoid heavy application that results in excess puddling. Remove or distribute excess material to meet the recommended application rate. Reapply primer to any areas that appear visibly dry prior to PPC placement.

3. Polyester Polymer Concrete.

a. Mix and apply PPC in accordance with the system provider's recommendations.

b. Apply PPC after 15 minutes and within 2 hours of placing the primer and prior to gelling or within 15 minutes following addition of the initiator, whichever occurs first, or as recommended by the system provider.

c. The PPC mixture shall have an initial set time of ≥ 30 minutes and ≤ 90 minutes, when the in-place PPC cannot be deformed by pressing with a finger. If the initial set is not within 30 to 90 minutes, remove and replace the material at no additional cost to the Department.

d. PPC shall be consolidated and finished using placement equipment as defined herein to strike it off to the required grade and cross-section as shown in the contract documents, to within a tolerance specified in Article 2413.03, E of the Standard Specifications. Termination edges of the repair may require application and finishing by hand trowel due to obstructions, such as curbs.

e. Apply abrasive finish sand evenly on the finished repair surface at a rate of at least 2.2 pounds per square yard by broadcasting, immediately after the repair placement before gelling.

f. Wait a minimum of 24 hours for any surface correction grinding or longitudinal grooving. Perform longitudinal grooving according to Article 2412.03, D, 4, a of the Standard Specifications. Transverse grooving or tining in plastic concrete will not be allowed.

G. Curing.

1. Allow the PPC repair to cure sufficiently before being subjected to loads or traffic of any nature that may damage the repair. Cure time is dependent on ambient and substrate temperatures and also initiator/accelerator levels used at the time of mixing. No wet curing or curing compound is necessary or allowed.

2. The repair shall be considered cured to a traffic ready state after 4 hours following finishing or when a minimum reading of 25 on a properly calibrated Schmidt/Rebound hammer is achieved per ASTM C 805, whichever occurs first.

H. Acceptance Testing.

1. Notify the District at least 48 hours prior to anticipated placement to allow them the opportunity to view the operation.

2. Perform testing as approved by the Engineer. Testing is summarized in Table 5. Performance frequencies of each test listed are a minimum value and may be performed at a more frequent interval at the discretion of the Engineer.

Table 5: PPC Acceptance Testing

Description	Test Method	Acceptance Criteria	Frequency
Compressive Strength	ASTM C 805	Minimum reading of 25 using Schmidt/Rebound Hammer (3000 psi)	Per ASTM C 805 for each repair application

230262.04 METHOD OF MEASUREMENT.

The quantity of Polyester Polymer Concrete Deck Repair will be measured as the number of square yards of PPC placed and accepted. The Engineer will calculate the area of Polyester Polymer Concrete Deck Repair in square yards from surface measurements.

230262.05 BASIS OF PAYMENT.

A. The quantity of Polyester Polymer Concrete Deck Repair will be paid at the Contract unit price per square yards. Price and payment will constitute full compensation for trial application, surface preparation, supplying, mixing, transporting, forming, placing, finishing, curing, grinding and for furnishing all equipment, tools, labor, and incidentals required to complete the work. Price and payment will also constitute full compensation for sealing the traffic barrier surfaces and replacing the top portion of the joints at both ends of the bridge as shown on the plans and in accordance with Article 2403.03, P, 3 of the Standard Specifications.

B. Additional quantity of PPC material used in the determination of material properties as described herein will be furnished at no additional cost to the Contracting Authority. No additional payment will be made for trial application, surface preparation, or grinding procedures.

C. If the PPC repair does not meet the minimal material properties as described herein, it will be removed and replaced or remediated to the satisfaction of the Engineer at the Contractor's expense. No additional payment will be made for remedial solutions to insufficient bonding between the PPC repair and underlying bridge elements.