SP-150667
(New)

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

Dallas County
MBIN-080-4(511)118--0M-25

Effective Date
July 21, 2020

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.

150667.01 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.

150667.02 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.

150667.03 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 aforementioned Placement Plan has been submitted by the contractor and approved by the Engineer.

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.

Abrasive sandblasting 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.

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 with the proper crown. The contractor may elect to use formwork which is marked or trimmed to the correct elevation and crown to provide the limits for hand finishing. Wood and foam formwork shall be lined with plastic to prevent the PPC from bonding to forms.

C. Surface Preparation.
All surfaces that will be in contact with the repair shall be prepared 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.

The final prepared surface shall meet the following requirements:

1. Areas to receive the PPC repair shall be cleaned by abrasive sandblasting. Cleaning shall not commence until all work involving the repair of the concrete substrate surface has been completed and repair materials have cured. All contaminants shall be picked up and stored in a vacuum unit, and dust shall not be created during the cleaning operation that will obstruct the view of motorists.

2. The Contractor shall 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. Cleaned surfaces shall not be exposed 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 must 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. All steel surfaces that will be in contact with the repair shall be cleaned in accordance with SSPC-SP No. 10, Near-White Blast Cleaning, except that wet blasting methods shall not be allowed.

D. Trial Application.

1. Prior to constructing the repair, a trial application of the PPC material shall be completed offsite to demonstrate proper initial set time, mixing, placing and finishing equipment proposed. The trial application shall be placed in a box constructed of similar materials that will be used for production formwork. Box shall have a minimum length of 36 inches and minimum width of 12 inches. Depth shall be 16 inches. 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, the Contractor shall 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 for the Contractor 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.

E. 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 Representatives to be present on the second bridge.

b. Application of the HMWM primer and placement of PPC shall not begin 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. Application of HMWM primer and placement of PPC shall not commence if rain is forecast.

2. Prime Coat.

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

b. Primer shall be mixed and applied in accordance with the System Provider's recommendations. Primer shall be applied 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. Primer shall be uniformly spread to completely cover all surfaces to receive repair, including any adjacent vertical surfaces. Care should be taken to avoid heavy application that results in excess puddling. Excess material shall be removed or distributed to meet the recommended application rate. Primer shall be reapplied to any areas that appear visibly dry prior to PPC placement.

3. Polyester Polymer Concrete.

a. PPC shall be mixed and applied in accordance with the System Provider's recommendations.

b. The maximum thickness that may be placed in a single pour is 18 inches".

c. PPC shall be applied after 15 minutes and within 2 hours of placing the primer and shall be placed prior to gelling or within 15 minutes following addition of the initiator, whichever occurs first, or as recommended by the System Provider.

d. 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, the material shall be removed and replaced at no additional cost.

e. 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.

f. 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. Curing.

1. The PPC repair shall be allowed 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.

G. Acceptance Testing.

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

2. Testing shall be performed by the Contractor and 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

150667.04 METHOD OF MEASUREMENT.

The quantity of Polyester Polymer Concrete will be measured as the number of cubic yards of PPC placed and accepted. The volume will be computed using the dimensions shown on the plans.

150667.05 BASIS OF PAYMENT.

A. The quantity of Polyester Polymer Concrete will be paid at the Contract unit price per cubic 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.

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.