



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

**Linn County
IMN-380-6(507)20--0E-57**

**Effective Date
June 9, 2026**

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.

230421.01 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.

230421.02 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 promoter and initiator for the HMWM resin 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 be supplied by the PPC System Provider and meet the following requirements:
 - a. Singly crushed aggregate that is free of dirt, clay and foreign or organic material.
 - b. Fine aggregate shall consist of natural sand only.
 - c. Aggregate shall meet the requirements in table 2.

Table 2: Aggregate Requirements

Property	Requirement	Test Method
Crushed particles	45% maximum retained on No. 8 sieve	AASHTO T335
Weighted average aggregate absorption	1% maximum	AASHTO T84 and T85
Moisture content (at time of mixing with resin)	One half of weighted average aggregate absorption maximum	AASHTO T255
Aggregate hardness	7 minimum	Moh's hardness test

2. Sand used for abrasive sand finish shall be supplied by the PPC System Provider and meet the following properties:
 - a. Shall be a commercial-quality blast sand.
 - b. Shall be kiln dried and protected from moisture until time of placement to ensure dryness 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% \pm 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.
5. Accelerators or inhibitor may be required to achieve proper setting time of PPC. They shall be used as recommended by the PPC System Provider.

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. If bulk resin is to be used, the contractor shall notify the Engineer in writing 10 days prior to the delivery of the bulk resin to the job site. Bulk resin is any resin that is stored in containers in excess of 250 gallons. 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.

230421.03 CONSTRUCTION.

A. Placement Plan.

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.

1. Schedule of repair work and testing.
2. Responsible personnel and hierarchy.
3. Staging plan describing repair sequence.
4. Description of equipment used for:
 - a. Removals and surface preparation including grinding and abrasive blasting.
 - b. Applying HMWM primer resin.
 - c. Measuring, mixing, placing, and finishing the PPC repairs.
 - d. Applying surface finish sand.
5. Placement procedure - including but not limited to surface preparation of existing concrete surfaces, application and spreading of HMWM primer, application and spreading of PPC, finishing of PPC, and application of surface finish sand.
6. Quality control of batch proportions, mixing times, and batch placement times.
7. Threshold limits for ambient temperature, ambient relative humidity, batch consistency, batch temperature, batch times, moisture content of deck and related corrective actions.
8. Method of protecting inlets and bridge drains.
9. Cure time for polyester concrete.
10. Storage and handling of HMWM resin and polyester concrete components.
11. Procedure for disposal of excess HMWM resin, polyester concrete, and containers.
12. Procedure for cleanup of mixing and placement equipment.
13. Method for cleaning up spills or discharge of HMWM resin and polyester concrete, including materials and equipment.

A preconstruction meeting will be required to review the Contractor's Placement Plan prior to placement of the PPC repairs. Required attendees include the System Provider's representative, the Contractor's staff, and representatives from the Iowa DOT District Office. Optional attendees include the Bridges and Structures Bureau, and Construction and Materials Bureau. No PPC repair will be permitted until the aforementioned Placement Plan has been submitted by the Contractor and approved by the Engineer.

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 proposed Placement Plan.

B. Equipment.

All equipment for cleaning the existing concrete surfaces and mixing and applying the repair system shall be as specified, in accordance with the System Provider's recommendations, and as approved by the Engineer prior to commencement of any work.

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 sand-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.

3. Mixing Equipment.

Polyester concrete shall be mixed in either mechanically operated mixers of appropriate size for proposed batches and as recommended by the System Provider or continuous automated mixers meeting the following requirements:

- a. Employ an auger screw/chute device capable of sufficiently mixing catalyzed resin with dry aggregate.
- b. Employ a plural component pumping system capable of handling polyester binder resin and catalyst, while maintaining proper ratios to achieve set/cure times within the specified limits. Catalyzed resin shall flow through a static mix tube for sufficient duration to completely mix the liquid system.
- c. Be equipped with an automatic metering device that measures and records aggregate and resin volumes. Record volumes at least every five minutes, including time and date. Submit recorded volumes at the end of the work shift.
- d. Have a visible readout gage that displays running totals of aggregate and resin being recorded.
- e. Produce a satisfactory mix consistently during the entire application process.
- f. The Contractor shall submit documentation of current certification that mixing equipment has been calibrated (Caltrans test CT 109 or similar).

4. Application and Finishing Equipment.

After the PPC has been placed it shall be hand finished to provide a smooth surface. Match profile of repairs 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 Removal Procedures and Limits.

Remove concrete from each area as designated in the contract documents or as directed by the Engineer.

1. General.

- a. Initiate removal of existing deck with $\frac{3}{4}$ " deep saw cut at removal boundaries.
- b. Remove concrete using a jack hammer or chipping hammer, or by using a combination of a scarifier and chipping hammer. Accomplish the final removal at the periphery 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.
- c. Thoroughly clean all reinforcing bars and newly exposed concrete by sandblasting. Clean epoxy coated reinforcing with hand tools that will not damage the epoxy coating. 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.

- d. Provide forms to enable placement of new PPC in the full depth opening. Support all forms by elements of the existing superstructure unless specifically noted or shown otherwise in the contract documents.

D. 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. 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 contaminants 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 Contracting Authority. 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.

E. 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, minimum width of 12 inches and minimum depth of 16 inches. The location(s) of the trial application shall be approved by the Engineer.
2. A representative of the System Provider knowledgeable in surface preparation, supplying, mixing, transporting, placing, finishing, curing and testing of the PPC system, including the HMWM primer, must be present during placement. Do not start mixing or placing the primer or PPC until the System Provider's representative is on-site.
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 Contracting Authority 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.
5. Notify Engineer at least 15 days before constructing the trial application.

F. Placing and Finishing.

1. General.

- a. A representative 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. Do not start mixing or placing the primer or PPC repair until the manufacturer's representative is on-site.
- b. Methods indicated in these Special Provisions are typical of general installations. If recommended by the System Provider, modified methods may be submitted for review, subject to approval by the Engineer.
- c. 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. A moisture meter may be used to verify dryness at the discretion of the Engineer in cases when surface dryness is difficult to determine. The moisture content shall not exceed 4.5%.
- d. The concrete surface temperature shall be between 40°F to 90°F at the time of primer and PPC placement.
- e. Application of HMWM primer and placement of PPC shall not commence if rain is forecast by the National Weather Service within 24 hours of placement.

2. HMWM Primer Application.

- a. Primer shall be mixed and applied in accordance with the System Provider's recommendations.
- b. Immediately before placing primer, all exposed surfaces shall be dry in accordance with SP-230421.03, E, 1, c, and blown clean with oil-free compressed air from 185 CFM minimum compressor. Exposed surfaces shall be protected from precipitation and heavy dew during and after the application of the primer.
- c. After the exposed surfaces have been prepared and are dry, primer shall be applied in accordance with the System Provider's recommendations. Primer shall be placed within 5 minutes of mixing at approximately 75 to 100 square feet per gallon. Ensure any cracks present in repair areas are filled with primer.
- d. 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, or as recommended by the System Provider.
- 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 polyester resin binder shall be initiated and blended completely. Aggregate shall be added and mixed sufficiently when a portable mechanical mixer is used.
- e. Polyester concrete shall have an initial set time of at least 20 minutes and at most 90

minutes following resin catalyzation. The initial set time can be determined in the field when the in-place PPC cannot be deformed by pressing with a finger, indicating that the resin binder is no longer in a liquid state. If the initial set is not within 90 minutes of catalyzation, the material shall be removed and replaced.

- f. 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 or drains.
- g. Resin content shall be as specified herein and to yield a PPC consistency that requires surface applied consolidation and finishing to consolidate aggregates and yield a slight sheen of bleed resin on top surface yet does not yield excess bleed resin.
- h. A surface friction sand finish of at least 2.2 lbs. per square yard shall be broadcast onto the glossy surface immediately after sufficient finishing and before resin gelling occurs. To ensure adequate pavement friction, the completed PPC repair surface shall be free of any smooth or "glassy" areas such as those resulting from insufficient quantities of surface aggregate. Any such surface defects shall be repaired by the Contractor in the manner recommended by the System Provider and approved by the Engineer at no additional cost to the Contracting Authority.
- i. Wait a minimum of 24 hours for any surface correction grinding.

G. 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.

H. 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

230421.04 METHOD OF MEASUREMENT.

- A. The quantity of Polyester Polymer Concrete, Joint Replacement will be measured as the number of cubic yards of PPC placed and accepted.

- B. The volume will be computed using the dimensions shown on the plans.

230421.05 BASIS OF PAYMENT.

- A. The quantity of Polyester Polymer Concrete, Joint Replacement 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.