Make the following Section a part of the Standard Specifications:

"SECTION 677 - BRIDGE POLYESTER CONCRETE OVERLAY

677.01 Description. This work shall consist of furnishing and placing a polyester concrete overlay as described herein and as shown on the plans. This work shall include preparation of the receiving surfaces. Polyester concrete is also referred to herein as polyester-styrene polymer concrete or PPC.

677.02 Materials.

(A) Primer. The prepared surface shall receive a wax-free, low odor, high molecular weight methacrylate (HMWM) resin prime coat. HMWM resin shall conform to the following requirements:

METHACRYLATE RESIN PRIME COAT		
Property	**Requirement**	**Test Method**
Volatile Content*	30%, maximum	ASTM D 2369
Viscosity*	0.025 Pa-s, maximum (Brookfield RVT with UL adaptor, 50 RPM at 77°F)	ASTM D 2196
Specific Gravity*	0.90, minimum, at 77°F	ASTM D 1475
Flash Point*	180°F, minimum	ASTM D 3278
Vapor Pressure*	1.0 mm Hg, maximum at 77°F	ASTM D 323
Tack-Free Time	400 minutes maximum at 77°F	ASTM C 679
PCC Saturated Surface-Dry Bond Strength	0.5 ksi, minimum at 24 hours and 70°F +/- 2°F	California Test 551

*Test shall be performed prior to adding initiator.

The prime coat promoter/initiator system for the methacrylate 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. The containers 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.

NOTE: Mixing the metal drier directly with the peroxide will result in a violent exothermic reaction.

(B) Polyester Resin Binder. The polyester concrete shall consist of polyester resin binder and dry aggregate. The resin shall be an unsaturated isophthalic polyester-styrene co-polymer, and shall conform to the following requirements:

POLYESTER RESIN BINDER		
Property	**Requirement**	**Test Method**
Viscosity*	0.075 to 0.200 Pa-s (RVT No. 1 Spindle, 20 RPM at 77°F)	ASTM D 2196
Specific Gravity*	1.05 to 1.10 at 77°F	ASTM D 1475
Elongation	35%, minimum Type I at 0.45"/min. Thickness = 0.25" ± 0.04"	ASTM D 638
	Sample Conditioning: 18 hours/77°F/50% + 5 hours/158°F	ASTM D 618
Tensile Strength	2,500 psi, minimum Type I at 0.45"/min. Thickness = 0.25" ± 0.04"	ASTM D 638
	Sample Conditioning: 18 hours/77°F/50% + 5 hours/158°F	ASTM D 618
Styrene Content*	40% to 50% by weight	ASTM D2369
Silane Coupler	1.0%, minimum (by weight of polyester-styrene resin)	Gas Chromatograph analysis from an independent lab
PCC Saturated Surface-Dry Bond Strength	0.5 ksi, minimum at 24 hours and 70°F	California Test 551
Static Volatile Emission*	60 gram per square meter, loss, maximum	South Coast Air Quality Management District, Standard Method

*Test shall be performed prior to adding initiator.

The silane coupler shall be an organosilane ester, gamma-methacryloxypropyltrimethoxysilane. The promoter shall be compatible with suitable methyl ethyl ketone peroxide (MEKP) and cumene hydroperoxide (CHP) initiators.

(C) Aggregate. The aggregate for polyester concrete shall conform to Section 703, shall be provided by the polyester concrete resin supplier and conform to one of the following combined aggregate grading:

COMBINED AGGREGATE		
Sieve Size	Percent Passing	
	3/8" Maximum	No. 4 Maximum
½"	100	100
3/8 "	83 - 100	100
No. 4	65 - 82	62 - 85
No. 8	45 - 64	45 - 67
No. 16	27 - 48	29 - 50
No. 30	12 - 30	16 - 36
No. 50	6 - 17	5 - 20
No. 100	0 - 7	0 - 7
No. 200	0 - 3	0 - 3

Aggregate retained on the No. 8 sieve shall have a maximum of 45 percent crushed particles when tested in accordance with AASHTO Test Method T335. The minimum Mohs scale hardness shall be 7.0. Fine aggregate shall consist of natural sand only.

Combined aggregate absorption shall not exceed one percent as determined by AASHTO Test Methods T84 and T85.

At the time of mixing with the polyester resin binder, the moisture content of the aggregate, as determined by AASHTO Test Method T 255, shall not exceed one half of the aggregate absorption.

(D) PPC Composite. The following tests are required to verify PPC composite properties. Testing shall be performed by an independent testing laboratory.

Polyester Concrete Composite Properties		
Property	**Requirement**	**Test Method**
SSD Bond Strength	0.5 ksi, minimum at 24 hours and 70°F	California Test 551
Compressive Strength (4x8 or 6x12 cylinders are acceptable)	5.0 ksi at 7 days	AASHTO T22
Abrasion Resistance	<2g weight loss	California Test 550
Modulus of Elasticity	1,000 ksi - 2,000 ksi	ATM C469 (7 days at 77°F)
Flexural Strength	>1800 psi	ASTM C78 (7 days at 77°F) (3"x3"x12", 3 points)

For SSD bond strength, abrasion resistance and modulus of elasticity, one sample of the composite material to be used during overlay construction shall be tested. A representative sample shall be provided to the testing laboratory and results provided from the laboratory to the Engineer a minimum of 21 days prior to start of the project. This requirement may be waived by the Engineer if historical laboratory data shows consistency of testing results from the same mix design. For compressive strength and flexural strength, one sample for each test shall be tested for each 20 cubic yards of PPC placed during overlay construction. At least one sample shall be tested for each test per workday.

(E) Sand for Abrasive Finish. The sand for abrasive finish shall be commercial quality blast sand and conform to Section 703.01 and the following gradation:

Abrasive Finish Sand	
Sieve Size	**% passing by weight**
No. 8	95 - 100
No. 20	0 - 5

Sand for abrasive finish shall be commercial quality blast sand. Absorption shall not exceed one percent as determined by AASHTO Test Methods T84 and T85.

(F) Certification of Materials. The Contractor shall submit a Certificate of Compliance from an independent nationally recognized testing laboratory stating that the materials meet the requirements listed in paragraphs A, B, C, D and E above. Certificate of Compliance and all test reports from the independent testing lab shall be submitted at the time of the mix design review. The manufacturer of the polyester resin binder shall warrant that the HMWM resin is compatible with the polyester resin binder and shall provide this warrant in writing along with the Manufacturer's Certification of Compliance for both materials.

(G) Storing and Handling. All materials shall be delivered in their original containers bearing the manufacturer's label, specifying date of manufacturing, batch number, trade name brand, quantity, and mixing ratio. Each shipment of polyester resin binder and HMWM resin shall be accompanied by a Materials Safety Data Sheet (MSDS). If bulk resin is to be used the Contractor shall notify the Engineer in writing 10 working days prior to the delivery of bulk resin to the job site. Bulk resin is any resin stored in containers in excess of 55 gallons.

The material shall be stored to prevent damage by the elements and to ensure the preservation of their quality and fitness for the work. The storage space shall be kept clean and dry, and shall contain a high-low thermometer. The temperatures of the storage space shall not fall below nor rise above that recommended by the manufacturer. Every precaution shall be taken to avoid contact with flame.

Stored materials shall be inspected prior to their use, and shall meet the requirements of these Special Provisions at the time of use.

Any material which is rejected because of failure to meet the required tests or that has been damaged so as to cause rejections shall be immediately replaced at no additional expense to the State.

Sufficient material to perform the polyester concrete overlay application shall be in storage at the site prior to any field preparation, so that there shall be no delay in procuring the materials for each day's application.

All personnel working with the polyester concrete shall be issued suitable appropriate protection equipment. Appropriate impermeable protective garments shall be used by all workers who may contact the resin or initiators to prevent skin contact. If skin contact occurs, the resin or initiators shall be immediately washed off. Clothing that becomes saturated with resin shall be removed immediately.

677.03 Construction Requirements.

(A) Submittals. The Contractor shall submit the following items for approval in accordance with these Special Provisions:

(1) A written procedure describing the method by which the Contractor plans to prepare the concrete surface for the overlay including a list and description of the equipment including the type of shot blasting machine selected by the Contractor for use in this project The procedure shall include the method and materials used to contain, collect, and dispose of all concrete debris generated by the scarifying process, including provisions for protecting adjacent traffic from flying debris

(2) A written safety plan which shall include:

(a) Notice to the public stating overlay work locations, dates and times and what to expect. The notice and appropriate documents such as MSDS shall also be sent to the local fire and police officials at least 7 days before starting work. The notice shall be posted at the work site.

(b) An airborne emissions monitoring plan prepare and executed by a Certified Industrial Hygienist (CIH) certified in comprehensive practice by the American Board of Industrial Hygiene. The plan must have at least 4 monitoring points including the mixing point, application point, and point of nearest public contact. Monitor airborne emissions during overlay work and submit emissions monitoring results after completing the work.

(c) An action plan for protection of the public when airborne emissions levels exceed permissible levels.

(d) A copy of the CIH's certification.

(3) The polyester concrete mix design including special mix design at end transitions. The estimated curing time based on anticipated temperatures.

(4) Certificates of compliance and test reports for all materials used in the polyester concrete mix and for the HMWM.

(5) Manufacturer's written instructions for the installation of the overlay system and the storage of all overlay and primer materials.

(6) The name of the manufacturer of the polymer overlay materials including the name and phone number of the Manufacturer's Technical Representative.

(7) The name of the company doing the PPC overlay work. The location where the HMWM resin and polyester concrete components are to be stored and safeguards being used to keep the materials stored in accordance with manufacturer's recommendations.

(8) The qualifications of on-site supervisors, mobile mixer operators, and finishing machine operators.

(9) A written plan which explains the method and materials used to contain HMWM resin and polyester concrete within the deck area specified to receive the overlay, including isolation of expansion joints and the method by which excess materials, waste products, and containers are to be handled and disposed of by the Contractor.

(10) Description of equipment for:

(a) Applying HMWM resin.

(b) Measuring and mixing polyester concrete.

(c) Placing and finishing the polyester concrete.

(d) Applying the finishing sand.

The Contractor shall not begin scarifying operations until receiving approval of Items 1 and 2. The Contractor shall not begin placing polyester concrete overlay until receiving approval of Items 3 through 10.

(B) General. The polyester overlay manufacturer shall have a representative on the job site at all times who, upon consultation with the Engineer, may suspend any item of work that is suspect and does not meet the requirements of this specification. Resumption of work will occur only after the manufacturer's representative and the Engineer are satisfied that appropriate remedial action has been taken by the Contractor. No work shall proceed and materials will not be accepted if manufacturer's technical representative is not on site.

The Contractor shall arrange to have the suppliers of the polyester resin binder and HMWM resin furnish technical service relating to application of material and health and safety training for personnel who are to handle the polyester-styrene polymer concrete (PPC) and the HMWM resin prime coat and any State personnel the Engineer determines is needed for inspection of the work.

The company doing the PPC overlay work shall provide a project reference list of at least 2 separate PPC overlay projects of 50 CY minimum PPC quantity that have been successfully completed within the last 5 years and that use the same PPC overlay system and materials that will be used on this project. Provide the name and location of the project, quantity of overlay placed, and the Contracting Agency of the project, and the name and current phone number of the Contracting Agency's contact person for the referenced project.

On-site supervisors, and all personnel operating the mobile mixer and finishing machines, shall have successful previous experience in mixing and placing PPC overlay on at least two separate PPC overlay projects within the last three years. Documentation of project experience with PPC overlay shall include the name and location of the project, the Contracting Agency of the project, the area quantity of overlay placed, and the name and current phone number of the Contracting Agency's contact person for the referenced project.

The Engineer may suspend the overlay work if the Contractor substitutes unapproved personnel during construction. Additional costs resulting from suspension of work due to the changing of personnel is the Contractor's responsibility, and no adjustment in contract time will be allowed.

During surface preparation and overlay application, precaution shall be taken to assure that traffic is protected from rebound, dust and construction activities. Appropriate shielding shall be provided as required and as directed by the Engineer at no additional cost. The Contactor shall provide suitable protection as needed to protect all exposed areas not to be overlaid such as parapets, drains etc. All damage and defacement resulting form the application shall be cleaned and, or repaired to the Engineer's satisfaction at no additional cost.

(C) Equipment. All equipment to be used for surface preparation shall be approved by the polyester overlay manufacturer's representative and by the Engineer.

(1) Shot Blasting Machine. The Contractor shall use a shot blasting machine for scarifying concrete surfaces that will receive PPC overlay. The use of a rotary milling or hydro-demolition machines will not be allowed.

Shot blasting machine for scarifying concrete surfaces receiving the PPC overlay shall consist of a self-contained mobile unit using steel abrasive to remove sound concrete to achieve the specified surface profile and capable of scarifying a minimum width of two feet per pass. The shot blasting machine shall vacuum and store all material removed from the scarified concrete surface into a self-contained unit. Spent shot shall be removed from the deck after vacuuming by magnetic rollers.

(2) Mobile Mixer for Polyester-Styrene Polymer Concrete. Polyester concrete shall be mixed in mechanically operated mixers. The mixer size shall be limited to 10 cubic yard capacity, unless approved by the Engineer. The mixer shall be equipped to be calibrated to automatically proportion and blend all components of the specified mix on a continuous or intermittent basis as required by the finishing operation, and shall discharge mixed material directly into the finishing machine.

A continuous mixer employing an auger screw/chute device may be approved for use by the Engineer contingent on a demonstration that the continuous mixer can consistently produce a satisfactory product.

The continuous mixer shall be equipped with a metering device that automatically measures and records the aggregate volumes and the corresponding resin volumes. The metering device shall have a readout display gage visible at all times, and shall be capable of printing out the volumes being recorded for each material. All equipment shall be calibrated no more than 6 months prior to use on the project and at intervals not to exceed 6 months.

The aggregate and resin volumes shall be recorded at no greater than five minute intervals along with the date of each recording. A printout of the recordings shall be furnished at the end of each work shift.

The Contractor shall prevent any cleaning chemicals from reaching the polyester concrete mix during mixing operations.

(3) Finishing Machine. Furnish slip-form finishing equipment with an automatic grade control device to strike off the PPC mixture to the established grade and cross section. Fit the finishing equipment with vibrators or other means of consolidating the PPC. Texturing shall be performed using spring steel tines.

(D) Surface Preparation. The repair of potholes, delaminations and areas of poor concrete shall be in accordance with Section 676 - Concrete Deck Repair.

Before placing the overlay, the entire concrete deck shall be thoroughly cleaned by steel shot blasting to ensure proper bonding between the overlay and the concrete substrate. A final surface texture meeting the International Concrete Repair Institute's (ICRI) concrete surface profile numbers 5 through 7 shall be achieved as defined in ICRI Guideline No. 03732 and as shown by Surface Profile Samples available from ICRI, or ASTM E 965 Pavement Macrotextrue Depth of 0.04 to 0.08 inch. Shot blasting is meant to expose the coarse aggregate. The prepared surface shall be free of asphalt material, oil, dirt, rubber, curing compounds, paint carbonation, laitance, weak surface mortar, and other potentially detrimental material which may interfere with the bonding or curing of the overlay. Loosely bonded patches shall be removed and repaired. Moisture and oil free compressed air or high volume leaf blowers shall be used to remove all dust that adheres to the prepared surface. The surface shall then be blown again with moisture and oil free compressed air or high volume leaf blowers. Cleaned pavement surfaces shall not be exposed to vehicular, equipment, or pedestrian traffic other than that required by the overlay operation. If the pavement is contaminated before being overlaid it shall be cleaned again to the satisfaction of the Engineer at no additional cost.

Surface preparation for all bridge joint steel armor surfaces shall be in accordance with the overlay manufacturer's recommendations.

(E) Trial Overlay. The Contractor shall place a trial overlay of PPC using the equipment selected by the Contractor and the production mix and procedure as approved. The Contractor shall notify the Engineer of the time and location of the trial overlay at least seven calendar days prior to the scheduled trial overlay.

The trial overlay shall be placed on a previously cast and cured concrete pad at a location selected by the Contractor and as approved by the Engineer. The plan area of the concrete pad shall be 12 feet minimum in width and 15 feet minimum in length.

The Contractor shall clean the concrete pad surface, mix, place, finish, and cure the PPC overlay, and check the trial overlay for bond in accordance with these Special Provisions. The trial overlay shall be 12 feet wide, 15 feet long and the same thickness as the overlay to be constructed.

The overlay is to be placed using the same equipment as the production work and replicate the field conditions for the production work. The Contractor is to demonstrate to the Engineer the suitability of the proposed means and methods.

During the trial overlay the manufacturer's representative shall determine the initial polyester concrete set time.

The Contractor shall perform three pull-off tests on the trial overlay in accordance with American Concrete Institute 503R - Appendix A. The pull-off tests shall have a minimum tensile bond strength of 250 psi or a failure area, at a depth of 1/8" or more into the base concrete, of no greater than 50% of the test area. The Contractor shall record the pull-off test results and the amount of any failure into the base concrete, and shall provide written documentation of the test results. The Engineer will designate the location of the pull-off tests.

The Contractor shall not begin construction operations at the bridge site receiving the PPC overlay until receiving approval of the completed trial overlay.

After receiving approval of the completed trial overlay, the concrete pad and trail overlay shall become the Contractor's property and shall be removed and disposed of in accordance with all applicable local, state and federal; laws, rules and ordinances.

Monitor airborne emissions in accordance with the written safety plan in accordance with 677.03(A)(2). Results from airborne emissions monitoring of the trial overlay must be submitted to the Engineer and demonstrate to the Engineer's satisfaction the suitability of the airborne emissions monitoring plan before starting production work.

(F) Mixing Polyester-Styrene Polymer Concrete (PPC). Polyester-styrene polymer concrete shall be mixed in mobile mixers conforming to these Special Provisions, and in accordance with the approved mix design. The Contractor shall verify through calibration checks on the aggregate, resin, and initiator that the mix will produce ratios and be placed within the ranges established in the project mix design.

The polyester resin binder in the PPC shall be 12 percent ± 1 percent by weight of the dry aggregate.

One-half percent more resin may be required at working temperatures below 55°F. The Contractor shall determine the exact percentage as approved.

The amount of initiator used in polyester concrete shall be sufficient to produce an initial set time between 30 and 120 minutes during placement. The initial set time will be determined by using an initial-setting time Gillmore needle in accordance with the requirements of ASTM C 266. Accelerators or inhibitors may be required to achieve proper set times and shall be used as recommended by the polyester resin binder supplier and as approved.

The polyester resin binder shall be initiated and thoroughly blended just prior to mixing the aggregate and binder. The polyester concrete shall be thoroughly mixed prior to placing.

(G) Placement of Polyester-Styrene Polymer Concrete (PPC). Time for placement of the overlay over newly repaired deck concrete shall be in accordance with the recommendation of the overlay manufacturer. Application of the HMWM prime coat and the PPC overlay shall not begin if rain is expected. The area receiving the prime coat shall be dry and had no rain for at least 24 hours. Immediately prior to applying the prime coat, the surface receiving the prime coat shall be swept clean by compressed air to remove accumulated dust and any other loose material.

The concrete bridge deck surface temperature shall be between 50°F and 100°F, and the relative humidity less than 85 percent when the prime coat is applied.

The prepared concrete surface shall receive one coat of HMWM primer resin. The promoted/initiated HMWM resin primer shall be worked into the concrete in a manner to completely cover the area to receive the polyester concrete at a rate and method as approved by the manufacturer's representative, and as given in the manufacturer's written instructions.

If the primed surface becomes contaminated, the contaminated area shall be removed by abrasive blasting and reprimed at no additional expense to the State.

The prime coat shall cure for a minimum of 15 minutes before placing the polyester-styrene polymer overlay.

The HMWM prime coat shall be covered with the PPC overlay within two hours of placing the prime coat. PPC shall be placed prior to gelling and within 15 minutes following initiation, whichever occurs first. PPC that is not placed within this time shall be discarded.

If the polyester concrete is not placed over the prime coat within two hours, work shall be suspended and the Contractor shall propose remedial action.

Under no circumstances shall any primer resin or polyester mixture be allowed to run into drains and expansion joints, or otherwise escape the Contractor's collection and containment system.

Expansion joints, drains and grates shall be adequately isolated prior to placing the overlay as approved. Sawing cutting joints will not be allowed.

The surface temperature of the area receiving the polyester concrete and the relative humidity shall be the same as specified above for the HMWM prime coat.

The polyester concrete shall be consolidated to a relative compaction of not less than 97 percent in conformance with California Test 552. The Contractor shall contract with an certified independent testing lab to do the testing in accordance with California Test 552 and the results made available to the State. The cost of testing shall be considered incidental to the pay items of this section and not be paid for separately.

(H) Finishing Polyester-Styrene Polymer Concrete (PPC). Using the approved finishing machine, the polyester concrete shall be struck off to the established grade and cross section and consolidated to the required compaction. Forms shall be coated with suitable bond release agent to permit ready release of forms.

As the finishing machine progresses along the pour, the surface shall be given a final finish by texturing with a comb parallel to the centerline of the bridge. The texture shall be applied immediately behind the finishing machine. The comb shall consist of a single row of metal tines capable of producing 1/8 inch wide striations approximately 3/16 inch in depth at approximately 1 inch spacing. The combs may be operated manually or mechanically, either singly or in gangs (several combs placed end to end). This operation shall be done in a manner that will minimize the displacement of the aggregate particles. The texture shall not extend into areas within 2 feet of the curb line.

The PPC overlay shall receive an abrasive sand finish. The sand finish shall be applied immediately after overlay strike-off and before gelling occurs. Sand shall be broadcast onto the surface to affect a uniform coverage of a minimum of 0.8 pounds per square yard.

The surface texture of polyester concrete surface shall be uniform. The polyester concrete shall be impervious to moisture. To ensure adequate pavement friction the completed overlay 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 in the manner as recommended by the manufacturer's technical representative and as approved by the Engineer.

Termination edges of the overlay may require application and finishing by hand trowel due to obstructions such as a curb. All hand troweling shall be followed by surface texturing and broadcasting the sand finish while the overlay is still wet.

The Engineer shall check the overlay surface smoothness by Idaho T-87 immediately after the overlay has hardened. The surface shall not vary more than ¼" in 10 ft from the lower edge of the straightedge and 90 percent of the readings shall not exceed 1/8" in10 ft. Overlay surface that does not meet surface smoothness requirements shall be ground until smoothness requirements are met.

The bridge deck areas specified to receive grinding shall be ground in the longitudinal direction. The grinding equipment shall use diamond tipped saw blades mounted on a power driven, self-propelled machine that is specifically designed to texture concrete surfaces. The grinding equipment shall have a blade spacing to provide grooves that are between 0.10 and 0.15 inches wide. The land area between the grooves shall as close as possible match the spacing provided by the texturing comb.

The grinding shall be done in a manner that will not damage the existing bridge deck. Rotary milling machines are not allowed. The Contractor shall demonstrate to the satisfaction of the Engineer that the method and equipment for grinding the PPC overlay are adequate for the intended purpose and will provide satisfactory results. The removal shall not commence until the Contractor receives approval of the grinding equipment.

The Contractor shall contain, collect, and dispose of all debris generated by the grinding operation.

The edges of the polyester concrete overlay shall be tapered when the overlay work is not completed within the allowable lane closure and the overlay. Tapered polyester concrete overlay areas shall be cleaned and prepared in accordance with the manufacturers written instructions.

The beginning and end limits of the overlay shall be provided with a minimum tapered transition of 5 feet between the overlay and the existing roadway grade. Modification of the overlay mix design shall be made within this transition area to allow the overlay to taper to a feathered edge.

Prior to opening the overlay area to vehicular traffic the finished overlay shall be power swept to remove excess loose aggregate and abrasive sand. The Contractor shall demonstrate to the satisfaction of the Engineer that the power broom equipment will not damage the finished overlay. Any damage to the finished overlay caused by the power broom shall be repaired at no additional expense to the State.

(l) Curing Polyester-Styrene Polymer Concrete (PPC). Traffic and equipment shall not be permitted on the PPC overlay after finishing and until the overlay has reached a minimum compressive strength of 3,000 psi as verified by the rebound number determined in accordance with ASTM C 805. Overlays shall be protected from moisture after finishing during the curing period. The maximum curing time for the overlay to attain a compressive strength of 3,000 psi shall be four hours.

Areas in the polyester concrete that do not totally cure, or that fail to attain the minimum compressive strength in six hours, shall be removed and replaced with new polyester concrete material by the Contractor, at no additional expense to the State.

(J) Checking Polyester-Styrene Polymer Concrete (PPC) for Bond. After the requirements for curing have been met, a chain drag or other appropriate tool or device shall be used by the Contractor in the presence of the Engineer to determine if any un-bonded areas exist between the new overlay and the mating concrete surface. PPC in unbonded areas shall be removed and replaced with PPC by the Contractor, at no additional expense to the State.

(K) Checking Polyester-Styrene Polymer Concrete (PPC) for Thickness. The State may perform random checks of PPC thickness. Areas found deficient shall be removed and replaced at no cost to the State.

(L) Temporary and Permanent Pavement Markings. Temporary pavement markings that are damaged or missing within the daily area of work shall be installed or replaced prior to the close of day. This work shall conform to Section 629 - Pavement Markings.

Permanent pavement markings shall be installed within 30 days after completion of the work.

550 **(M)**

STATE OF CALIFORNIA—BUSINESS, TRANSPORTATION AND HOUSING AGENCY

DEPARTMENT OF TRANSPORTATION
ENGINEERING SERVICE CENTER
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METHOD OF TEST FOR RELATIVE COMPACTION OF POLYMER CONCRETE UTILIZING NUCLEAR GAGES

CAUTION: Prior to handling test materials, performing equipment setups, and/or conducting this method, testers are required to read "**SAFETY AND HEALTH**" in Part H of this method. It is the responsibility of the user of this method to consult and use departmental safety and health practices and determine the applicability of regulatory limitations before any testing is performed.

A. SCOPE

This method describes a simple procedure to determine the relative compaction of a polymer concrete overlay. It describes a procedure to obtain "standard density" and "in-place density" of compacted polymer concrete.

B. APPARATUS AND MATERIALS

1. A nuclear gage and standardizing blocks are required as described in California Test 231.

2. A rigid test frame shall provide a square test area, approximately 450 by 450 mm. It shall be constructed from angle iron or similar metal. The height of the test frame shall be the nominal thickness of the overlay.

3. A wooden strike-off block shall conform to the following dimensions: approximately 40 by 85 by 600 mm.

4. A trowel is required.

5. A metal shovel or large scoop is required to place the material in the rigid test frame.

6. Plastic containers (4 to 20 L) are used to transport materials and clean equipment.

7. A rubber-headed mallet shall weigh 0.60 ± 0.25 kg.

8. Square polyethylene sheets, approximately 450 by 450 mm with a thickness between 0.075 and 0.25 mm are required.

C. STANDARDIZATION OF THE NUCLEAR GAGE

Standardize the nuclear gage as described in California Test 231.

D. STANDARD DENSITY TEST

1. Secure the rigid test frame to the prepared surface to be overlaid (one method is to place a heavy mass on top of each side extension). See Figure 1. Immediately after final mixing of the polymer concrete, obtain a representative sample from the mixer and place it at the center of the rigid test frame. The sample must completely fill the 450 by 450-mm test area from the base to the top of the frame. Use dry, clean equipment (plastic containers and metal shovel or

551
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large scoop) to transport the polymer concrete from the mixer to the rigid test frame.

2. Use the wooden block to strike off the fresh polymer concrete. Place the block on top of the test area, with its 85-mm width touching the polymer concrete surface and its ends extending beyond the rigid frame. Strike the top of the block with the mallet at various locations. Move the block, and restrike as needed, to achieve uniform consolidation throughout the test area. The rigid frame must remain in full contact with the surface to be overlaid during the consolidation process. After consolidation, flushed resin should be evenly distributed throughout the surface of the polymer concrete.

3. Remove the wooden block from the test area and place a sheet of polyethylene on top of the polymer concrete. Gently place the nuclear gage on top of the plastic sheet at the center of the test area. Take a 1-min reading with the nuclear gage in the AC Backscatter Mode. Turn the nuclear gage 180 degrees and obtain an additional 1-min reading. Average the two readings. Calculate the count ratio by dividing the count value by the average of the two readings. Use the calibration chart for the nuclear gage to determine the in-place density. See California Test 231. This obtained value represents the standard compacted density for one day's use. If there is a significant change in the resin content, the depth of the overlay, the aggregate source or gradation, a new standard density must be determined.

4. For a valid test, the following items must be completed within a 7-min period: sampling the polymer concrete, filling the rigid frame with material, compacting the polymer concrete, and obtaining the nuclear gage readings.

NOTE 1:

Immediately after all nuclear gage readings are recorded, quickly clean the rigid test frame and all equipment with cleaning solvent before the polymer concrete gels. Properly dispose of all polymer concrete materials used in the compaction test.

E. IN-PLACE DENSITY TEST

1. The relatative compaction test must be taken immediately after the polymer concrete has been placed and finished, and before any surface sanding or texturing. Place a sheet of polyethylene on the polymer concrete surface and gently place the nuclear gage on the polyethylene sheet. Take a 1-min reading with the nuclear gage in the AC Backscatter Mode. Calculate the in-place density and the relative compaction of the material at the site. The formula to calculate percent relative compaction is:

$$\frac{\text{(In-Place Density)}}{\text{(Standard Density)}} \times 100 = \%\ \text{Relative Compaction}$$

2. The % relative compaction is rounded to the nearest whole number.

NOTE 2:

If a relative compaction value is less than specified by the contract, the Resident Engineer should be notified immediately. To date, some polymer concrete overlays have failed due to insufficient compaction of the material at the time of placement. Factors that cause inadequate compaction include:

- Insufficient resin in the polymer concrete mixture, insufficient quantities of catalysts and/or out-dated polymer materials.
- Insufficient or incomplete mixing (dry spots in the mix)
- Polymerization of the material prior to the compaction efforts
- The finishing machine moved too quickly to achieve adequate compaction
- Malfunctioning vibrators on the finishing machine

- Inadequate compaction effort attempted

F. REPORTING OF RESULTS

1. Record relative compaction values for each test area. (Do not average relative compaction values from two or more test areas).

2. Record the operator's name, the CHC number of the nuclear gage, date of test and time of test.

3. Sketch the location of each test area (record the km post or station and distance left or right of centerline).

G. PRECAUTIONS

When handling polymer concrete materials, use suitable protective clothing and eye protection. Respiratory equipment is required in poorly ventilated areas.

Polymer materials can be susceptible to burning prior to polymerization. Do not place these materials near an open flame or extreme heat.

Polymer resins and catalysts should always be mixed using guidelines and proportions recommended by the manufacturer.

H. SAFETY AND HEALTH

This method involves hazardous materials and extreme care must be used performing tests.

Prior to sampling, handling or testing, Caltrans personnel are required to read Sections 5.1, 5.2, 10.4, 12.1, 12.2 and 12.3 of the Laboratory Safety Manual. Requirements for general safety principles, standard operating procedures, protective apparel and how to handle spills, accidents and emergencies are discussed in the above-noted references.

Several types of polymer materials may be considered for overlay use. Testers are required to read the Materials Safety Data Sheets for the applicable polymer type specified. Prior to handling polymer materials in poorly ventilated areas, testers are required use appropriate respiratory equipment. Prior to the anticipated work, testers should be fitted for respiratory equipment according to the procedures outlined in Chapter 15 of Caltrans Safety Manual.

This method does not purport to address all the safety problems associated with its use. It is the responsibility of the user of this test method to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Users of this method do so at their own risk.

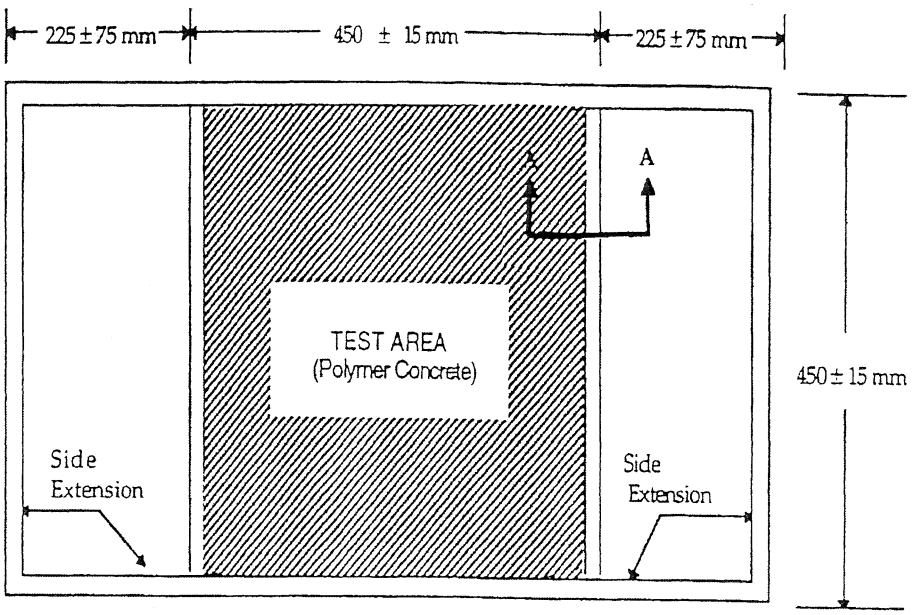
REFERENCE:

California Test 231

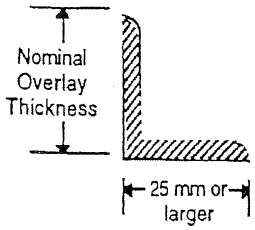
End of Text (California Test 552 contains 4 pages)

559 **(P)**

California Test 552
December 1995



PLAN VIEW
(Polymer Concrete Compaction Testing)



CROSS SECTION AT A-A

Note: More than one rigid test frame may be required for a project. A rigid test frame with a 50-mm height would be unacceptable for use on a project with a specified overlay thickness of 25 mm.

FIGURE 1 - RIGID TEST FRAME

560
561

562 **(Q)**

Idaho Standard Practice for

Pavement Straightedge Procedures

Idaho IR-87-99

ITD Standard Specification Designation: Idaho T-87

1 Scope

1.1 This method establishes procedures for making straightedge measurements on the riding surfaces of pavements and is intended for use with the hand-held 10 ft. (3 m) straightedge.

2 Apparatus

2.1 The apparatus shall consist of a 10 ft. (3 m) straightedge. The straightedge shall be visually straight when checked periodically against a taut fine (about 1/64 in. or 0.5 mm diameter) wire.

3 Procedure

3.1 Surface irregularities shall be measured from the straightedge to various points on the pavement surface below the straightedge. The straightedge shall be firmly supported by the pavement.

3.2 Tests for surface irregularities shall be made parallel to centerline and normal (transverse) to centerline as required to verify conformance with specified limits.

3.3 All transverse construction joints shall be measured. Make these measurements with the straightedge centered on each joint.

3.4 Individual judgement shall be exercised when taking measurements on short, steep, super-elevated sections and crowned sections of short radii such as at intersections of city streets, etc.

3.5 On bridge decks where the specifications require 90 percent of the readings to be less than 1/8 in. (3 mm), measurements shall be taken in each wheel path in continuous lines as provided in paragraph 3.2 above for the full length of the structure. In addition, at locations determined by the Engineer, straightedge measurements are to be taken perpendicular to centerline. These transverse measurements may be made either in continuous lines or as individual 10 ft. (3 m) samples at selected locations. Measure the lengths of irregularities, which are less than 1\8 in. (3 mm) below the straightedge, to the nearest 1 in. (25 mm). Add up the lengths having less than 1/8 in. (3 mm) deviation within each 10 ft. (3 m) increment, divide by the straightedge length and multiply by 100 to obtain the percentage less than 1/8 in. (3 mm). Also measure any deviations greater than 1/4 in. (5 mm) when the specification requires. Measure joints separately as provided in Paragraph 3.3 above.

677.04 Measurement.

Polyester concrete overlay will be paid for on a lump sum basis. The Engineer will not measure polyester concrete overlay for payment.

The Engineer will not measure Temporary and Permanent Pavement Markings for payment.

677.05 Payment.

The Engineer will pay for accepted pay items listed below at the contract price per unit, as shown in the proposal schedule. Payment will be full compensation for the work prescribed in this section and the contract documents.

Pay Item	Pay Unit
Polyester Concrete Overlay, Eastbound Viaduct	Lump Sum

The Engineer will pay for 100 percent of the contract bid price upon completion of the polyester concrete overlay within the limits specified. No payment will be paid for unbonded areas as determined in Subsection 677.03(J) or areas which do not have required thickness as determined in Subsection 677.03(K)."

The Engineer will pay for the accepted Permanent Pavement Markings under Section 629 - Pavement Markings.

The Engineer will not pay for Temporary Pavement Markings separately. The Engineer will consider the cost as included in the contract pay items in this Section.

END OF SECTION 677