

SECTION 07680 – EPOXY SURFACE TREATMENT

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. The General Provisions of the contract, including the General Provisions for Construction Projects (2016), Special Provisions, and General Requirements of the Specifications, apply to the work specified in this Section.

1.02 SUMMARY

- A. Section includes work for applying surface treatment by spreading resin binder and aggregate on Portland cement concrete surfaces. The Ewa and Diamond Head Concourse Second Level Roadways will receive Epoxy Surface Treatment after new concrete pavement has been placed. The Ewa Concourse Third Level Roadway will receive Crack Penetrating Sealer and then Epoxy Surface Treatment.
- B. Related Sections
 - 1. Section 03300 – STRUCTURAL CONCRETE for pavement slab cast-in-place concrete at the second levels of the Ewa and Diamondhead concourse roadways
 - 2. Section 03730 – CONCRETE REPAIR for defective concrete repairs at the third level of the Ewa concourse roadway prior to receiving surface treatment

1.03 SUBMITTALS

- A. Epoxy Surface Treatment Submittal Requirements: Prior to the start of this work, provide six copies of the following submittals in one complete set for acceptance. Indicate clearly the name of the product and its manufacturer on pertinent submittals. No work that is related to these submittals shall be performed until written acceptance has been received.
 - 1. The name and contact information of the resin binder and aggregate manufacturer's technical representative and other key personnel.
 - 2. A list of projects with owner' contact information on which a minimum of 10,000 square yards of surfacing treatment has been installed within the past five years.
 - a. List the following for each project submitted:
 - 1) Project Name
 - 2) Locations (state, routes, and Identifiers)

- 3) Scope of work
 - 4) Products used
 - 5) Approximate date of the system was completed, accepted, and opened to traffic
- b. If the minimum installation requirement is not met, manufacturer's representative must be present at all times during installation to ensure proper workmanship. In lieu of list of projects, submit the following information of the manufacturer's representative who will be on site during installation:
- 1) First and last name
 - 2) Company
 - 3) Email address
 - 4) Phone number.
- B. Crack Penetrating Sealer Submittal Requirements. Prior to the start of this work, provide six copies of the name and contact information of the resin binder and aggregate manufacturer's technical representative and other key personnel in one complete set for acceptance. Indicate clearly the name of the product and its manufacturer on pertinent submittals. No work that is related to these submittals shall be performed until written acceptance has been received.
- C. Quality Control (QC) Plan: Submit a QC Plan in accordance with Paragraph 1.04.A.
- D. Work Plan: Submit a Work Plan in accordance with Paragraph 1.04.B.

1.04 QUALITY CONTROL

- A. Submit a QC Plan to DOT-A for acceptance a minimum of 30 days prior to the installation and the Just-In-Time-Training (JITT). Resubmittal of the document will require another 30 days for each resubmittal. Discuss the QC Plan requirements at the JITT, pre-construction, pre-installation, and progress meetings. The JITT shall not be held unless the QC Plan is accepted 30 days before it is held. Work shall not start on the surface treatment including the test strip until the JITT has been completed, QC Plan, and the Work Plan have both been accepted. The QC Plan shall contain at a minimum the following information:
1. Names and contact information for key personnel, project superintendent, and lead technician responsible for field quality control sampling and testing.
 2. Location of resin binder production plants and batch production records.

3. Location of aggregate production plants and batch production records.
4. Proposed method of installation at each location identified to receive surfacing.
5. Resin binder and aggregate manufacturer's material information including:
 - a. Recommended placement instructions
 - b. Mixing Instructions
 - c. Recommended installation temperatures
 - d. Anticipated gel and cure times at various expected ambient temperatures for all sites.
 - e. Methods of safe storage and handling
 - f. Applicable installation and material limitations
 - g. Disposable methods for excess missed resin binder and associated components
 - h. Production plant location contact information for the quality control/quality assurance (OC/OQ) personnel where additional information can be requested concerning record keeping methods, inspection methods, equipment calibration records, and accreditation certificates.
6. The QC Plan shall designate a QC Manager, who shall be present at the jobsite and have a full authority to request any action necessary for the operation of the QC Plan providing it complies with the contract documents and acceptance of DOT-A.
 - a. The QC Manager shall be certified in all test methods used and be responsible for the required field quality control in sampling and testing in conformance with the accepted quality control plan, test methods, and contract documents. All sampling shall be performed in the presence of and with no direction by DOT-A. DOT-A is not responsible or shall be regarded as part of the contractor's QC team. It is the responsibility of the contractor and the QC Manager to ensure that the test procedure being used is compliant with the test method standard. Inspections are performed for the exclusive benefit of the state. The inspection of or the failure to inspect the work shall not relieve the Contractor of obligations to fulfill the contract as prescribed, to correct defective work, and to replace unsuitable or rejected materials regardless of whether payment for such work has been made. DOT-A has the right to reject the test if it

feels that it is non-compliant, e.g., the technician that performed the test if not certified or the material testing laboratory accredited to the tests performed. DOT-A is under no obligation to correct or direct non-compliant procedures if observed. Maintain and have available upon request, the current test standard methods documentation being used, referenced documents, complete records of sampling, testing, corrective actions, and quality control inspection results.

- b. A technical representative from the resin binder manufacturer shall be present at the JITT, Test Application, e.g., deck repair, surface preparation, installation and acceptance of the surface treatment, and at the construction site for the first two days of the surface treatment.
- B. Work Plan: Submit a Work Plan for both the epoxy surface treatment and crack penetrating sealer to DOT-A for approval 14 days prior to the installation. Discuss the Work Plan requirements at the pre-construction, pre-installation, and progress meetings. The Work Plan shall contain at a minimum the following information:
 - 1. Method of surface preparation and required surface condition for adequate bonding.
 - 2. Method of crack repair/defective concrete repair of existing concrete deck.
 - 3. Construction during inclement weather, Plan for the occurrence of rain, moisture and temperature requirements for the materials being used.
 - 4. Mixing ratio and application rates for resin binder and aggregate.
 - 5. Application Method
 - 6. Curing time and requirements for opening to traffic.
 - 7. Corrective actions that will be taken for unsatisfactory installation practices.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Storage and Handling. All materials shall be delivered in their original containers bearing the manufacturer's label, specifying date of manufacturing, batch number, trade name, and quantity. Each shipment of resin binder shall be accompanied by a Safety Data Sheet (SDS).
- B. 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.
- C. Stored materials shall be inspected prior to their use, and shall meet the requirements of this Specification at the time of use.

- D. Any material which is rejected because of failure to meet the required tests or that has been damaged so as to cause rejection shall be immediately replaced at no additional expense to the State.
- E. Sufficient material to perform the entire penetrating sealer application shall be in storage at the site prior to any field application, so that there shall be no delay in procuring the material for each day's application.
- F. The contractor shall arrange to have the material supplier furnish technical service related to application of material and health and safety training for personnel who are to handle the penetrating sealer.

PART 2 – PRODUCTS

2.01 PENETRATING CRACK SEALER

- A. Epoxy Sealer shall be a solvent-free 0-VOC, two-component, 100% solids, moisture insensitive, low viscosity, low modulus epoxy flood-coat penetrating sealer. Epoxy shall meet the current ASTM C881, Type III, Grade 1, Classes B & C specifications and the requirements listed in Table 1 below.

Table 1. Penetrating Crack Sealer Requirements

Property	Requirement
Viscosity (ASTM D2393)	<50 cps
Gel Time (60 g mass)	45 minutes
Tack Free Time (73° F or 23° C)	3 to 5 hours
Tensile Properties (ASTM D638), 7 day cure	Tensile Strength 1,800 psi Tensile Elongation: 75%
Bond Strength (ASTM C882)	2 day cure: 1,500 psi 14 day cure: 2,000 psi
Compressive Properties (ASTM D695)	7 day cure Compressive Strength: 3,000 psi Compressive Modulus: 90,000 psi
Bond Strength (ASTM C1583/ACI 503R)	300 psi
Shrinkage on Cure (ASTM D2566)	0.002
Thermal Compatibility (ASTM C884)	Pass
Water Absorption (ASTM D570)	0.2% (24 hr)
Chloride Ion Permeability (ASTM C1202)	0.0 coulomb

- B. Topping Aggregate. Furnish aggregate meeting the requirements listed in tables below unless otherwise specified by DOT-A. Deliver the aggregate to the construction site in bags or super sacks labeled clearly for identification. Provide aggregate that is virgin, clean, dry, and free from foreign matter. Ensure aggregate

meets the requirements in Table 2 and Table 3. Ensure aggregate is angular, consists of natural silica sand, basalt, or other nonfriable aggregate, and contains less than 0.2 percent moisture when tested in accordance with ASTM C 566. A sample of the aggregate lot/batch shall be supplied upon request.

Table 2. Topping Aggregate Requirements

Property	Test Method	Testing Lab. Results
Gradation	ASTM C136	See Table 3
Moisture	ASTM C566	NCAT 0.0%
MOHS Hardness	MOHS Scale	7+
Aggregate Soundness	AASHTO T104	NCAT 0.2%
LA Abrasion	AASHTO T96	NCAT 14.6%
Micro-Deval	AASHTO T327	ODOT 2.6%
Absorption	ASTM C127	NCAT 1.0%
Fractured Faces	ASTM D5821	NCAT 100%

Table 3. Aggregate Gradation Requirements

Sieve size	Percentage Passing
No. 10	100
No. 12	99
No. 14	98
No. 16	84
No. 20	37
No. 30	9
No. 40	2
No. 50	0.5
No. 60	0.1
No. 100	0.1
Pan	0

2.02 EPOXY SURFACE TREATMENT RESIN BINDER SYSTEM

- A. Provide a resin binder system meeting the requirements of Table 1 below, recommended by the manufacturer as suitable for use on the intended pavement surface. A sample of the resin binder system for each lot/batch shall be supplied upon request.
 1. Note: All materials shall be virgin; free of secondary components, volatile solvents, and external/conventional flexibilizers. Component batches shall be interchangeable.

Table 4. Two Component Resin Requirements

Property	Requirement	Test Method
Viscosity	10-30 Poise	ASTM D2556 ^{*1}
Cure Rate (Set to Touch)	3 hours max	ASTM D1640 ^{*2}
Shore D Durometer Hardness	60-80	ASTM D2240
Compressive Modulus	130,000 psi maximum	ASTM D695
Ultimate Tensile Strength		ASTM D638 ^{*3}
Elongation at Break Point	40%-70%	ASTM D638 ^{*3}
Adhesive Strength (Bond to Concrete at 24 hrs)	250 psi min. or 100% concrete substrate failure	ASTM C1583 ^{*4}
Thermal Compatibility	PASS	ASTM C88
Water Absorption	1% max	ASTM D570
<p>*ASTM Material Properties Test Method Table Notes:</p> <p>1. Mix test sample for 2 minutes. Test at a temperature of 73 ± 1°F.</p> <p>2. Prepare specimens of 50-55 wet mil thickness.</p> <p>3. Prepare Type I specimens.</p> <p>4. Follow manufacturer's recommendation for curing before testing.</p>		

2. A test report, dated within 90 days of contract award, consisting of a certification by an AASHTO recourse/CCRL accredited independent testing laboratory showing compliance with the requirements of this specification and material properties. Include the accredited laboratory's test results with the certification.
3. Product data sheets and specifications from the manufacturer showing instructions, application recommendations and methods, product properties.

Table 5. Epoxy Working Time

WORKING TIME	
Surface Temperature (°F)	Maximum Working Time* (minutes)
50	45
60	35
70	20

80	11
90	9
100	7
110	6
120	4
*Include mix time, resin binder and aggregate placement.	
Note: Consult manufacturer for surface temperatures exceeding 120°F	

2.03 EPOXY SURFACE TREATMENT AGGREGATE

- A. Furnish aggregate meeting the requirements listed in the tables below unless otherwise specified by DOT-A. Deliver the aggregate to the construction site in bags or super sacks labeled clearly for identification. Provide aggregate that is virgin, clean, dry, and free from foreign matter. A sample of the aggregate lot/batch shall be supplied upon request.

Table 6. Aggregate Requirements

Test Data Description	Test Procedure	Testing Lab. Requirements
Gradation	ASTM C136	See Table 4
Moisture	ASTM C566	NCAT 0.0%
Micro-Deval	AASHTO T327	ODOT 2.6%
Absorption	ASTM C127	NCAT 1.0%

Table 7. Aggregate Gradation

Sieve size	Percentage passing
No. 4	100
No. 8	30-75
No. 16	0-5

PART 3 – EXECUTION

3.01 CRACK PENETRATING SEALER EQUIPMENT

- A. For the epoxy healer sealer, provide a distribution system or distributor capable of accurately blending the epoxy resin and hardening agent, and uniformly and accurately applying the epoxy materials at the specified rate to the bridge deck in such a manner as to cover 100 percent of the work area, including 1 inch of the vertical face of curb/barrier. Provide a fine aggregate spreader capable of uniformly

and accurately applying dry aggregate to cover 100 percent of the epoxy material. Provide a self-propelled vacuum truck.

1. For hand applications, provide calibrated containers, a Jiffy® type mixer for mixing and stiff bristle brooms suitable for applying the epoxy. Aggregate shall be hand broadcast to refusal onto the wet epoxy.
2. For mechanical applications, provide meter-mixing equipment that will automatically and accurately proportion the components in accordance with the manufacturer's recommendations and will mix and continuously place the penetrating sealer. Ensure the operation proceeds in such a manner that will not allow the mixed materials to segregate, dry, be exposed or otherwise harden in such a way as to impair the retention and bonding of broadcasted aggregate.
3. Coverage is approximate depending on surface profile and volume of cracks.

3.02 CRACK PENETRATING SEALER SURFACE PREPARATION

A. Surface preparation shall conform to the following requirements:

1. Sweep the surface clean.
2. Blow the surface clean to remove dust and laitance.
3. Clean cracks greater than 0.25-inch-wide and pretreat per resin binder manufacturer's recommendations.
4. All laitance, contaminants, paint, markers and foreign material, must be removed from the surface.
5. If the prepared surface is contaminated prior to installing the surface treatment, abrasive blast, sweep and blow the surface clean.
6. Placement.

3.03 CRACK PENETRATING SEALER MIXING

- A. Precondition material to 65°-85°F (18°-29°C) before using. Measure and mix one part by volume of Part A with one part by volume of Part B for three minutes with a low speed (< 450 rpm) drill using a jiffy mixer or paddle. Mix only as much material as can be used within the pot life. Air, material, and surface temperature must be 50°F (10°C) and rising prior to mixing or installation. For mechanical applications consult material manufacturer for proper mixing and dispensing equipment.

3.04 CRACK PENETRATING SEALER APPLICATION

- A. Ensure handling and mixing of the epoxy resin and hardening agent is performed in a safe manner to achieve the desired results in accordance with the manufacturer's recommendations or as directed by the Engineer. Do not place penetrating sealer when the concrete surface is less than 50 degrees Fahrenheit (F) or ambient air temperature is forecast to fall below 50 degrees F within 8 hours of application. Do not place healer sealer materials if weather or surface conditions are such that the material cannot be properly handled, placed, and cured according to the manufacturer's requirements and the specified requirements for traffic control.
- B. At the start of each shift and prior to application of the Penetrating Sealer and following the surface prep, all expansion joints, drains and grates shall be adequately isolated utilizing construction paper to prevent any penetrating sealer from entering drainage and joint systems. The construction paper will then be removed prior to full cure of the epoxy.
- C. The Penetrating Sealer will be applied utilizing an epoxy pump system specially designed for epoxies. The epoxy pump is mounted on the rear of a truck which also houses two 250 Gallon totes of material. The totes to be used will be between 65°-85°F. The pump is equipped with a detailed digital read out displaying the gallons per minute and total volume of both part A and B. It also gives the total volume of material pumped. This allows for easy verification of the correct amount of material applied to the surface and at the correct ratio of 1:1.
- D. The mixed epoxy will be dispensed onto the concourse deck surface, this will be followed by a ground laborer(s) using a saw-toothed/notched squeegee to spread the sealer meeting the 25-30 mill wet thickness. Any variation in the surface (i.e., cracks) surface conditions will result in penetrating sealer being spread until refusal.
- E. Following 5 minutes of the material being worked into the surface, the topping aggregate / sand application will start. Adjacent to the sealer application will be a truck with a bulk sand pot with the topping sand. Special care will be given as to not direct the hose directly to the surface disrupting or causing the epoxy material to disperse. Special care will also be taken to minimize dust during the process. DOT-A will approve the method. The topping sand will be applied to the point of refusal.
- F. Hand broadcasting of the topping sand is allowed provided the sand can be applied over the wet resin within 10 minutes of the resin having been placed. Spike shoes will need to be worn by any person who may come in contact with wet placed sealer without aggregate.
- G. To ensure no wet spots exist, a final walk of the surface will be done immediately behind the sand application to ensure no wet areas of epoxy shining through are present. In the case wet areas are visible, additional sand will be applied to these

areas manually to the point of refusal. Once all material has cured and inspected, a full sweep/vacuum will commence prior to opening to traffic.

- H. Ensure application of aggregate is of sufficient quantity so the entire surface is covered in excess. Ensure no bleed through or wet spots are visible in the overlay. Remove and replace any areas with wet spots or where epoxy has bled through. Minimize all foot traffic on the uncured epoxy and ensure any foot traffic will only be done with steel spiked shoes approved by the Engineer. Do not allow traffic or equipment on the penetrating sealer surface during the curing period. Remove all loose aggregate after the curing period with a vacuum or broom without tearing or damaging the surface. Ensure all expansion joints are free of loose aggregate, epoxy and other debris.

3.05 CRACK PENETRATING SEALER CURING

- A. Refer to manufacturer's curing schedule for estimated cure times.

3.06 EPOXY SURFACE PROTECTION PREPARATION

- A. Surface Preparation for concrete decks with a crack penetrating sealer and aggregate topping overlay shall conform to the following requirements:
 - 1. Sweep the surface clean with a vacuum sweeper.
 - 2. Below the surface clean using oil-free air to remove dust, laitance, and other deleterious material that may affect the bonding of the surface treatment from the surface.
 - 3. All laitance, contaminants, paint, markers, and foreign material that may inhibit the bond of the surface treatment, shall be removed from the surface before sweeping with vacuum sweeper.
 - 4. If the prepared surface is contaminated prior to installing the surface treatment, abrasive blast, sweep and blow the surface clean.
- B. Surface Preparation for on new concrete shall be abrasive blast, sweep and blow the surface clean. Abrasive blast shall create a surface profile to CSP-3.

3.07 EPOXY SURFACE PROTECTION TEST APPLICATION

- A. The test application shall be a part of the production location before starting production work. Resin binder manufacturer's representative shall be present during the test application. The test application shall meet the following requirements:
 - 1. Install a minimum of 200 square yards.

2. Shall be constructed using the same method and equipment as the production work.
3. Shall construct an additional test application for each method proposed for the production work.
4. Shall replicate field conditions, including ambient and surface temperatures, time period, anticipated for production work.
5. Shall demonstrate surface preparation method as outlined in the QC Plan
6. Shall demonstrate that the data management system is capable of documenting ambient and surface temperatures, quantities of resin binder and aggregate, coverage rates, and reporting application rates in real time.
7. Determine the initial set time for the resin binder.

3.08 EPOXY SURFACE PROTECTION SURFACE APPLICATION

- A. The following information is required in a real time reporting method:
 1. The volume of mixed resin binder per square yard being applied.
 2. The mixed resin binder mil thickness on average throughout the application width per square yard.
 3. The volume of aggregate applied throughout the application width per square yard.
 4. The ambient and pavement surface temperature during the application period.
- B. Apply the blended resin binder on the pavement surface plane in a uniform application with a minimum thickness of 60 mils. Verify thickness using a Wet-Mil fil thickness gauge every 75-100 lineal feet of application. Ensure the surfacing aggregate is applied uniformly at a rate of 14-17 pounds per square yard within the working time per Table 2.

3.09 EPOXY SURFACE PROTECTION APPLICATION METHOD

- A. Expansion Joints, drains and grates shall be adequately isolated to prevent any surface treatment from entering drainage and joint systems. The surface treatment discharged from the mixer shall be uniform in composition and consistency. Mixing capability shall be such that initial and final finishing operations can proceed at a steady pace.
- B. Continuous application must be applied utilizing an epoxy pump system specially designed for epoxies. The epoxy pump is mounted on the rear of a truck which also

houses two 250 Gallon totes of material. The totes to be used will be between 65°-85°F. The pump is equipped with a detailed digital read out displaying the gallons per minute and total volume of both part A and B. It also gives the total volume of material pumped. This allows for easy verification of the correct amount of material applied to the surface and at the correct ratio of 1:1. The mixed epoxy will be dispensed onto the concourse deck surface, this will be followed by a ground laborer(s) using a saw-toothed/notched squeegee to spread the sealer meeting the manufacturer specified wet mil thickness.

- C. Adjacent to the sealer application will be a truck with a bulk sand pot with the topping sand. Special care will be given as to not direct the hose directly to the surface disrupting or causing the epoxy material to disperse. The application equipment shall install the surfacing at a minimum application rate of 20 linear feet per minute. Perform a final sweep of loose aggregates and debris from the areas adjacent to the applied surface treatment within end of work shift. Ensure all expansion joints are free of loose aggregate, epoxy, and other debris.
- D. For small, odd shaped areas inaccessible to the continuous applicator truck, mixed epoxy is dispensed from the truck by hand through a mixing wand onto the area to be treated, Contractor shall use a notched squeegee to evenly spread the epoxy according to the manufacturer's recommendations. Broadcast aggregate by hand onto the wet epoxy until rejection and epoxy surface is completely covered with aggregate. Spike shoes will need to be worn by any person who may come in contact with wet placed sealer without aggregate.

3.10 EPOXY SURFACE PROTECTION CURING

- A. Traffic and construction equipment shall not be permitted on the completed surface treatment overlay for 2 hours or until the surface treatment is tack free, whichever is later.

3.11 ACCEPTANCE AND CORRECTIVE ACTION

- A. The completed crack penetration and epoxy surface treatment shall be free of any smooth or wet areas such as those resulting from insufficient quantities of topping aggregate. Completed overlay surface must be uniform in thickness, texture and appearance.
- B. At the discretion of DOT-A, Tensile Bond testing shall be performed for each placement per day. Testing may be conducted on a separate concrete substrate representing the field conditions upon approval of DOT-A. Testing will be performed in accordance with ASTM C 1583 and the manufacturer's recommendations. A passing test is the failure of the concrete substrate or bond strength above 250 psi at 24 hours. Fill cored holes with approved material specified in Section 03730 –Concrete Repairs.

- C. Correct all defects in material and work, as directed, at no additional cost to the State, according to the following:
1. Remove and replace surfacing treatment that DOT-A determines has any raveling, delamination, streaking, or bond test failure.
 2. Replace with acceptable surface treatment at the installer's expense. Replaced areas will be retested and evaluated for acceptance or further corrective action.
 3. Any roadway features disturbed by the work or the installer's operations shall be restored with the same materials and design as directed by DOT-A at no additional cost to the State.

PART 4 – MEASUREMENT AND PAYMENT

4.01 METHOD OF MEASUREMENT

Surface Treatment will be measured per square foot as shown on the plans or as specified in the proposal.

4.02 BASIS OF PAYMENT

Surface treatment shall be measured and paid for, at the contract unit price bid. The contract unit priced paid shall be full compensation for all labor, tools, equipment, and all other incidentals necessary to complete the work.

<u>Item No.</u>	<u>Description</u>	<u>Unit</u>
07680.1	Ewa Concourse Second Level Roadway Overlay	Square Feet
07680.2	DH Concourse Second Level Roadway Overlay	Square Feet
07680.3	Ewa Concourse Third Level Roadway Overlay	Square Feet

All other work specified in this section shall be considered incidental to and included in the bid prices for the various items of work in this project.

END OF SECTION