



NEVADA DEPARTMENT OF TRANSPORTATION - RESEARCH SECTION

EXTERNAL PRODUCT/MATERIAL ACCEPTANCE CRITERIA
QPL Section 497.02.05 – AGGREGATES FOR MULTILAYER OVERLAYS

Category Description: Aggregate to be used for thin-bonded multilayer overlays.

Primary Evaluating Section: Materials

Evaluation Criteria (adopted 09/20/2021):

Requirement	Criteria	Test
Independent laboratory test results showing conformance to the criteria	Current criteria is attached	Pass/Fail
If product passes screening for above item, applicants may be invited for the next stage:		
NDOT Field Testing	Product demonstrates satisfactory performance after the successful competition of a two-year field test (NDOT will select the date and location)	Pass/Fail

INSTRUCTIONS TO APPLICANTS:

Submit completed application package which demonstrate conformance to section 497.02.05 of the above-stated criteria. Include an SDS and the product brochure or technical data sheet which includes packaging and storage information. Independent laboratory test may not be more than twelve months old at time of application.

Do not submit samples at this time. If your application passes the initial screening, NDOT will contact you to discuss any samples needed or potential field testing.

SECTION 497 - THIN BONDED MULTILAYER OVERLAY

DESCRIPTION

497.01.01 General. This work consists of bridge deck preparation and placement of a thin bonded multilayer overlay.

MATERIALS

497.02.01 Certificates and Submittals. Materials for thin bonded multilayer overlay shall be tested by an independent lab. Submit a certified copy of test results that are less than 1 year old for review and approval. The materials so tested and certified shall be of the same composition as the materials used on the project.

Submit two certificates of compliance, technical data sheets, and Material Safety Data Sheet (MSDS). Provide manufacturer's installation instructions including the application rate for the aggregate course.

Submit material analysis data certifying binder and aggregate conformance to material requirements for each manufactured batch of polymer binder and lot of aggregates, a minimum of 30 working days in advance of constructing the overlay.

Furnish documentation that includes the source and type of aggregate. Do not order materials until written approval of materials is obtained.

497.02.02 Labeling and Storage. Clearly label binder component containers with the manufacturer's trade name and product identification number, type of binder component, shelf life, date of manufacture, and batch or lot number. Label containers with the material quantity, mixing ratio, and mixing directions. Show warnings concerning the storage, handling, and application of the materials on the label.

Store binder materials in airtight, upright containers, away from direct sunlight, and at atmospheric temperatures between 50 °F to 90 °F unless recommended otherwise by the manufacturer's instructions. Do not store the initiators with the promoters and monomers. Store aggregates in an area that prevents the aggregates from getting wet, contaminated, or blended with other materials.

497.02.03 Sampling and Testing. Submit 1 five-gallon bucket aggregate sample for testing a minimum of 20 working days before use. Submit one sample per project, per source, per size, and per supplier.

Additional aggregate and binder component samples may be required after delivery. Take and submit samples during established working hours or other acceptable times.

497.02.04 Polymer Binder. Polymer binder components shall conform to the uncured and cured properties specified herein. Maintain the materials at 73 °F ± 1 °F for a minimum of 24 hours before mixing, curing, or testing.

Mixed, uncured properties of the polymer binder shall conform to the following requirements:

TEST	TEST METHOD	TYPE OF POLYMER BINDER		
		EPOXY	EPOXY - URETHANE	POLYESTER
Viscosity, Method (a) No. 3 spindle @ 20 rpm, Brookfield RVT, Poises	ASTM D2196 or ASTM D2556	7 - 25	35 - 70	—
Viscosity, Method (a) No. 1 spindle @ 20 rpm, Brookfield RVT, Poises	ASTM D2196	—	—	10 - 20
Working Life or Gel Time @ 73 °F, Para.11.2 Modified, 70 ml, minutes	ASTM C881	15 - 45	15 - 45	10 - 60
Flash Point, °F	ASTM D3278	200 Min.	200 Min.	181 Min.

Cured properties of the polymer binder shall conform to the following requirements:

TEST	TEST METHOD	TYPE OF POLYMER BINDER		
		EPOXY	EPOXY - URETHANE	POLYESTER
Tensile Strength, (Type 1) @ 7 days, psi	ASTM D638	2000 - 5000	2000 - 5000	2000 - 5000
Tensile Elongation, (Type 1) @ 7 days, %	ASTM D638	30 - 80	30 - 100	30 - 80
Absorption, 24 hour Percent Gain	ASTM D570	1 Max.	1 Max.	1 Max.

Use a binder listed in the QPL or an approved equal.

497.02.05 Aggregate. The combined aggregate shall consist of calcined bauxite or mineral aggregate. Up to 50% substitution by mass with steel slag is allowed.

The combined aggregate shall have a maximum of 0.2% moisture when tested according to Nevada T112 Method A and shall have a minimum Sand Equivalent of 95 when tested according to California Test 217.

The calcined bauxite or mineral aggregate shall have minimum MOHS scale hardness of 7 or greater unless otherwise approved.

Sieve Size	Percent Passing by Mass
No. 4	100
No. 8	25-65
No. 16	0-5
No. 30	0-1

The combined aggregate shall also conform to the following:

Project Control Tests	Test Method	Requirements
Sieve Analysis	Nev. T206	Above
Sampling Aggregate	Nev. T200	—

Source Requirement Tests	Test Method	Requirements
Percentage of Wear (500 Rev.)	AASHTO T96/ASTM C131	20% Max.

Use an aggregate listed in the QPL or an approved equal.

497.02.06 Thin Bonded Overlay. The overlay mixture shall conform to the following requirements:

TEST	TEST METHOD	TYPE OF POLYMER BINDER		
		EPOXY	EPOXY - URETHANE	POLYESTER
Compressive Strength, Method B, psi	ASTM C579 ¹	1000 Min. @ 3 hour 5000 Min. @ 24 hour	1000 Min. @ 3 hour 5000 Min. @ 24 hour	1000 Min. @ 3 hour 4000 Min. @ 24 hour
Flexural Yield Strength, psi	ASTM D790	5000 Min.	5000 Min.	4000-4600
Thermal Compatibility, Method B	ASTM C884	No delamination of overlay	No delamination of overlay	No delamination of overlay
Resistance to Chloride Ion Penetration @ 28 days, Coulombs	AASHTO T277 or ASTM C1202	100 Max.	100 Max.	100 Max.

¹ Molds may be brass. Suggest plastic inserts in gang molds. Procedure has been simplified by use of oversized cube openings in brass molds to allow use of plastic inserts to provide correct 2 inch by 2 inch cubes. Paragraph 4.3.2 is changed so that measurements for height and distances between opposite faces read 2.060 ± 0.005 inch. The plastic inserts with an exterior opening of the size of 2.060 inch by 2.060 inch shall be used in the molds with an interior measurement of 2.0 ± 0.005 inch between opposite faces and the height of inserts shall be 2 inch with permissible variations of 0.01 inch. Paragraph 6.3 is changed to read manufacturer is to provide mix ratio of binder components by weight and by volume. Ratio of aggregate to binder components shall be 2.75 parts of aggregate passing No. 20 sieve and retained on the No. 30 sieve, as specified in ASTM C778 para.3.2.2, by volume to 1.00 part of binder components. A typical mix for testing to the requirements of this specification to produce 2 inch by 2 inch cubes would be 260 ml of binder components mixed with 715 ml of aggregates passing No. 20 sieve and retained on No. 30 sieve. Review AASHTO-AGC-ARTBA Joint Committee Task Force 34 Report Guide Specifications for Polymer Concrete Bridge Deck Overlays pages 25 thru 26 for additional information.

CONSTRUCTION

497.03.01 General. Submit a work plan for constructing the overlay for approval a minimum of 10 working days prior to commencing the preparation of the existing surface. The work plan shall include the materials, construction procedures and methods, equipment, schedule for traffic control operations, surface preparation, protection methods, placement sequence, application and curing rates, and related justification to support the work plan.

Follow recommendations of the binder manufacturer for placement and curing of the overlay. Adhere to the binder temperature limitations as specified by the binder manufacturer.

497.03.02 Equipment. Use self-propelled mechanical abrasion shot blasting equipment with vacuum recovery to clean and prepare surfaces.

Use self-propelled, high-power vacuum trucks to remove dust, debris, and excess aggregate.

Use compressed air equipment that produces a sufficient amount of clean, dry, oil-free compressed air to remove dust and debris.

Use an automated vehicle that applies the binder and distributes the aggregates in one continuous operation. The vehicle shall include a pressurized spray bar binder distribution system with binder component volume metering devices that are built into the equipment. The distributor shall accurately blend the binder components at the specified rate with verification of the mix ratio and in such a manner that does not overly shear the material or entrap air in the mixture. The distributor shall have positive displacement volumetric metering pumps controlled by a hydraulic or pneumatic power unit. The application rate shall be easily quantified. Use calibrated, pneumatic or mechanical aggregate spreader equipment that controls the quantity of aggregate applied per area of surface. Calibrate the spreader as directed. The calibration procedure will be observed and requires approval. The spreader shall be capable of a uniform application of dry aggregate over the full width of binder material. Use machinery that is approved by the binder manufacturer.

Furnish hand brooms, notched squeegees, additional hand tools, and lightweight hand-driven rollers to facilitate minor areas of hand placement of the overlay as approved and according to the manufacturer's recommendations.

497.03.03 Bridge Deck Preparation. Do not begin surface preparation until bridge deck repair work has been completed as provided for in Section 502.

Thoroughly clean the surface of laitance, dirt, oil, grease, paint, pavement marking materials, curing compounds, sealers, waxes, solvents, other contaminants, and weak surface mortar.

Accomplish final surface preparation by shot blasting. Exposure of the course aggregate may be required. Shot blast until the changing of the color of the concrete is apparent. Multiple passes of blaster equipment may be required. Shot blasting shall not leave the concrete surface polished. Use equipment techniques that produce a uniform, rough texture and do not cause damage to the existing surface such as ravels, aggregate fractures, spalls, or disturbance of joints. Repair damaged areas that were compromised due to abrasion equipment and methods as directed. Remove residue from blasting by vacuum attachment operating concurrently with the blasting equipment. Protect deck drains, adjacent areas, and appurtenances from shot blast.

Use a vacuum truck and oil free and moisture free, compressed air as necessary to remove dust and debris immediately prior to application of the overlay courses.

The surface to receive the overlay shall be dry and moisture free when tested according to ASTM D4263. Test in a low area or an area that drains slowly to be certain that the surface is sufficiently dry. Use a transparent, 4 mil thick polyethylene sheet left taped in place a minimum of 6 hours. Use tape that will stick to the substrate and ensure that all edges are completely sealed after 6 hours. Moisture shall not be visible on the polyethylene sheet after 6 hours. The contractor may use a digital or analog moisture meter that is calibrated within the last 6 months and meets the requirements of ASTM F2659. Testing should be conducted at multiple locations within the application area, and all results shall be less than 4.50%.

Do not apply the overlay until newly cast concrete surfaces have cured a minimum of 28 days.

Protect deck drains, bridge components, curbs, adjacent surfaces, and the traveling public by covering, shielding, or tenting with suitable material prior to construction. Remove the protective material within 12 hours after the overlay has cured and before opening to traffic.

Obtain final approval of the properly prepared surface prior to constructing the overlay. Re-clean unacceptable areas as directed.

497.03.04 Weather Limitations. Construct the overlay when the ambient and surface temperatures are at least 60 °F but less than 100 °F. Do not place the overlay if the air temperature is expected to drop below 55 °F within 8 hours after application. Do not construct in stormy weather. Consider weather as stormy when the rate of precipitation exceeds the rate of evaporation. Allow the existing surface to dry after stormy weather or rain for at least 36 hours and until the surface is moisture free in accordance with ASTM D4263.

Construct the thin bonded overlay when weather conditions are such that the materials can be handled, placed, and cured as specified.

497.03.05 Test Section. Construct a test section of at least 50 yd² in an approved area prior to the start of work. Construct the test section using the same materials, methods, equipment, timing, curing period, and personnel

as scheduled for use. Remove and replace unacceptable work as directed. The test section will be evaluated for a minimum of two days after placement.

Perform 3 pull off tests according to ASTM C1583. The results of each test shall be 250 psi minimum. The failure mode of each test shall be in the concrete substrate with more than 50% of the failure area in the concrete at a depth 1/4 inch or greater. The pull off tests shall not fail within the overlay materials, shall not fail at the interface of the existing concrete surface and overlay, and shall not fail at the interface where the epoxy adhesive on the steel disk is bonded to the overlay.

If the test section is determined to be unacceptable, remove and dispose of the unacceptable test section according to Subsection 107.14. Make necessary adjustments and construct an additional test section as directed for evaluation. Remove and construct test sections until an acceptable test section is constructed. Working days will not be charged during the evaluation periods.

Do not begin overlay placement without written approval of an accepted test section. The accepted test section will be allowed to remain in place and will become part of the work.

497.03.06 Joints. Provide suitable width spreading equipment to produce a minimum number of longitudinal joints. Place the overlay materials so that longitudinal joints are constructed within one foot of the final traffic lane lines. Through lanes shall be spread in full width lane passes only.

Maintain joints in the surface to be overlaid. Within 24 hours of application, remove the overlay from over each joint by removing the bond breaker, by scoring the overlay prior to gelling, or by saw-cutting after curing. When a joint is saw-cut, perform the cut as soon as the overlay can support sawing equipment without damaging the overlay.

Provide bond breaker over bridge deck expansion joints. Remove the overlay from over each expansion joint within 12 hours of constructing the overlay and prior to opening to traffic. Do not allow overlay materials to enter into the expansion joints. Clean and repair expansion joints that are contaminated or damaged due to operations as directed.

Use a strip of building paper at the beginning of each spread at least 3 feet in width and 1 foot longer than the length of the distributor spray bar. The use of paper is required at the end of each spread. Remove and dispose of the paper in a satisfactory manner.

497.03.07 Placement. Submit a signed written report each working day indicating the quantities of aggregate and binder components delivered. Include in the written report the quantities of aggregate and binder components used. Submit the amount of area in square yards completed, the application rate of binder components in gallons of binder applied per square yard, and the application rate of aggregate in pounds of aggregate applied per square yard. Additionally, provide surface and ambient temperatures.

Submit an original bill of lading for each delivery of material used on the project from the aggregate and binder component suppliers.

Construct the first course of the overlay within 24 hours of completing the preparation of existing surface. Surfaces exposed for more than 24 hours shall be re-cleaned. Remove dust and debris with a vacuum truck and moisture-free, oil free compressed air immediately before applying the binder components.

Perform an aggregate moisture content test each day of placement a maximum of 6 hours prior to the start of placement. The ambient humidity must be below 80% and the aggregate shall have a maximum of 0.2% moisture when tested according to Nevada T112 Method B.

Measure surface and ambient temperatures at the beginning of each work shift and every two hours thereafter.

Heating or cooling of the existing surface will not be allowed.

Precondition or heat binder components according to manufacturer's installation instruction before mixing and distributing.

Adhere to manufacturer's recommendations for product limitations and warnings.

Do not construct the overlay if warm weather temperatures are such that the job site production samples have gel times less than 10 minutes or if the aggregates will not penetrate the binder layer.

Construct the overlay with an application of two courses of binder and aggregate at the rates specified herein.

Take into account varying cure times due to ambient, surface, and material temperatures at time of construction. Plan and prosecute work so as to provide a minimum of 3 hours cure prior to opening the section to traffic, unless permitted otherwise. Use the following cure times as a guide to plan and prosecute the work so both courses are applied within one work shift:

Average Temperature of Surface, Mixed Polymer, and Aggregate Components, °F	Cure Time Minutes
75-79	120
80-84	90
85	60

The completed overlay shall have a minimum thickness of 0.25 inch. Verification of the depth of the completed overlay may be required by coring or other means as directed. Obtain cores with a depth of 0.75 inch at locations as determined.

Construct the first course with a binder application rate of 2.5 gal/100 ft² and an aggregate application rate of 10 lb/yd², or the manufacturers recommended application rate, whichever is greater, to achieve the required thickness. Increase the binder application as necessary for grooved surfaces. Provide more aggregate if coverage is not of sufficient quantity to cover binder completely.

Proportion and mechanically mix binder components in the order recommended by the manufacturer. Do not add solvents or water to the binder components. Do not change the recommended proportions when blending the binder components. Blend the binder components in such a manner that does not overly shear the material or entrap air in the mixture. Mix only what can be placed in the time available for working the material.

Distribute binder to the surface in a continuous operation such that cold joints are not introduced.

Do not allow binder to run into drains or expansion joints.

Remove unembedded aggregate from the first course with vacuum trucks and compressed air after the layer has thoroughly cured and when the equipment can be used without tearing or damaging the surface. The method used to remove the unembedded aggregate shall not introduce any contaminants which may act to reduce the bond of subsequent binder applications.

Do not allow traffic on the first course of the overlay.

Areas of the first course that did not receive enough aggregate prior to gelling are unacceptable and shall be removed and replaced.

Prior to application of the second course, clean the surface if deemed necessary as directed.

Construct the second course with a binder application rate of 5.0 gal/100 ft² and an aggregate application rate of 14 lb/yd², or the manufacturers recommended application rate, whichever is greater, to achieve the required thickness. Provide more aggregate if coverage is not of sufficient quantity to cover binder completely.

Apply binder and aggregate as specified above. Apply materials in a manner that will not mark or rut the course below.

Finish the exposed edges at the ends of the work limits and at expansion joints to minimize roughness.

Remove unembedded aggregate from the second course with vacuum trucks and compressed air after the layer has thoroughly cured and when the equipment can be used without tearing or damaging the surface.

If approved, areas of the second course that did not receive enough aggregate prior to gelling may be left in place and require an additional application of binder and aggregate. Remove and replace areas deemed unacceptable as directed.

Do not allow traffic on the surface until the completed overlay has sufficiently cured to prevent damage from wheel loads.

The bonded multilayer overlay shall be uniform, shall have a Skid Number (SN) of not less than 55, and shall conform to Subsection 502.03.16. Test the finished surface of the bonded multilayer overlay for the specified SN according to ASTM E274. Perform one test per lane, per structure.

Provide the necessary equipment and supplies for conducting pull off tests on the completed overlay. Perform pull off tests according to ACI 503R – Appendix A of the ACI Manual of Concrete Practice or ASTM C1583. Perform tests at a frequency of one test per every 60 yd² of deck surface up to a maximum of 5 tests per day of placement. Confirm pull off test locations with the Engineer prior to testing. Acceptable pull off test shall exhibit cohesive failure (Type A failure) within existing material below the interface. Pull off tests that fail in the prime coat (Type B failure) are acceptable if a minimum of 250 psi is obtained. Newly placed overlay that fails (Type C failure) with a strength of less than 500 psi is deemed unacceptable and shall be removed and replaced. Patch test holes with approved material immediately after testing.

Repair or replace areas that have been defaced or damaged from construction operations and areas that are determined unacceptable.

METHOD OF MEASUREMENT

497.04.01 Measurement. Bridge deck preparation and thin bonded multilayer overlay will be measured by the square yard.

BASIS OF PAYMENT

497.05.01 Payment. The accepted quantities, measured as provided above, will be paid for at the contract price per unit of measurement for the pay items listed below that are shown in the proposal. Payment will be full compensation for the work prescribed in this Section.

Payment will be made under:

Pay Item	Pay Unit
Bridge Deck Preparation	Square Yard
Thin Bonded Multilayer Overlay	Square Yard