OKLAHOMA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISIONS
FOR
CONCRETE SURFACE REPAIR BY SEALING

These Special Provisions revise, amend, and where in conflict, supersede applicable sections of the 1999 Standard Specifications for Highway Construction, English and Metric, as applicable. Units of measurement are provided in the subsections in both English and Metric equivalents. The units applicable for this project will be those specified in the project plans.

(add the following new section:)

SECTION 523
CONCRETE SURFACE REPAIR BY SEALING

523.01. DESCRIPTION.

(a) General. This work consists of using Sealers to seal bridge decks and approach slabs and to fill and rebond cracks as noted on the plans. Where HMWM is specified on the Plans, the Contractor may substitute epoxy penetrant. *Obtain permission in writing from the Engineer for substitution of materials.*

- *High Molecular Weight Methacrylate* (HMWM): Furnish and apply a polymer material (monomer) which, when polymerized, can structurally rebond cracks and act as a film forming sealer against the ingress of chloride ions on concrete surfaces.

- *EPOXY Penetrant*: Furnish and apply a two part, low viscosity, epoxy resin penetrating sealer to rebond cracks and act as a film forming sealer against the ingress of chloride ions on concrete surfaces. No substitution will be allowed when epoxy penetrant is specified in the Plans.

(b) Definition of Terms.

- *Acrylic Resins.* Acrylic Resins are any of numerous thermoplastics or thermosetting polymers or copolymers of acrylic acid, methacrylic acid, esters of these acids, or acrylonitrile, used to produce synthetic rubbers and lightweight plastics.

- *Density.* Density is the mass per unit volume of a material.

- *Bulk Cure.* Bulk cure is the time required before the methacrylate monomer has hardened to form a polymer.
- *Flash Point.* Flash point is the lowest temperature at which a material will give off explosive or ignitable vapors.

- *High Molecular Weight Methacrylate.* High molecular weight methacrylate(HMWM) is a non-fuming monomer with low viscosity, low volatility, low initial shrinkage, and high flash point. Methacrylates are members of the acrylic family of monomers and polymers.

- *Initiators.* Initiators are chemicals that start the polymerization process.

- *Monomers.* Monomers are liquid molecules which are converted into solid polymers by reaction with a catalyst.

- *Promoters.* Promoters are chemicals used with initiators to accelerate the polymerization process.

- *Resin.* Resin is a natural or synthetic, solid or semi-solid organic material of indefinite and often high molecular weight, having the tendency to flow under stress.

- *Shelf Life.* Shelf life is the maximum interval during which a material may be stored and remain in a usable and/or safe condition.

- *Surface Cure.* Surface cure is the amount of time required after placement before the HMWM treated concrete is free from surface liquid or tackiness.

- *Vapor Pressure.* Vapor pressure is a component of atmospheric pressure which is caused by the pressure of vapor; expressed in inches, centimeters, or millimeters of height of a column of mercury. Vapor pressure measures the volatility and depletion rate of monomers.

- *Viscosity.* Viscosity is the resistance that a gaseous or liquid system offers to flow when it is subjected to shear stress.

- *Working Time.* Working time is the elapsed time after mixing methacrylate monomer with catalyst before solution viscosity begins to increase. Working time usually depends of temperature and the amount of initiators and promoters being used. Working time will also vary with the particular manufacturer's monomer system.

523.02. MATERIALS.

(a) Materials for HMWM.

(1) Monomer Materials. Supply a low viscosity, low odor, high molecular weight methacrylate monomer system that conforms to Table A. Supply a compatible promoter/initiator system capable of providing a Deck Surface Cure Time of no less than 40 minutes nor more than 6 hours (360 minutes) at deck temperature during application. The promoter/initiator system must be formulated to allow for adjustment of the gel time to compensate for the changes in temperature during the treatment application. Provide to the Engineer a table showing correct proportions of initiator and promoter to be added to the monomer to achieve the cure time requirements based on the surface temperature. Ship materials within six (6) months of the date of manufacture. Two component materials are acceptable, provided all the material requirements of Table A are met.

TABLE A: HMWM PROPERTIES

Property	Requirement	Standard
**Viscosity* (Brookfield)	10 - 25 cps	ASTM D 1824
Density (Pensky Martens CC)	> 8.4 lbs/gal at 77^{O}F	ASTM D 2849
Flash Point	> 200^{O}F	ASTM D 93
Vapor Pressure	<1.0 mm Hg at 77^{O}F	ASTM D 323
Shelf Life	1 year minimum	None
Gel Time	>40 minutes (100 gram mass) thin film	ASTM D 2471
Tensile Elongation	30% minimum	ASTM D 638
Bulk Cure Time at deck temperature	40<t<150 minutes (t is time)	None
Surface Cure Time at deck temperature	40<t<360 minutes (t is time)	None
Bond Strength	>750 psi	ASTM D 882
Percent Volatile	30% maximum	ASTM D 2369

*Brookfield viscometer, Model RVT with a UL adaptor or Model LVF, #1 spindle and UL adaptor at 77^{O}F.

(2) Storage of HMWM Materials. Store initiators and promoters separately to prevent accidental combination which can result in a violent reaction or explosion. Obtain a Material Safety Data Sheet (MSDS) for each material prior to shipment of material with information pertaining to the safe practices for storage, handling and disposal of all materials and to their explosive and combustion characteristics, health hazards and the recommended fire fighting techniques by the manufacturer. Post safety and handling information at all storage areas and at the job site. Provide a copy of such information to the Engineer.

2.1 *Monomers.* Store Monomers in shaded areas away from the initiator storage area. Maintain sufficient ventilation in all storage areas to prevent the hazardous buildup of vapor concentration.

2.2 *Initiators.* Store initiators in a cool [<90^{O}F(32^{O}C)] place away from any monomer and promoter storage areas.

2.3 *Promoters.* Store promoters in a cool [<90^{O}F(32^{O}C)] place away from the initiator storage area.

(3) Safety Provisions for HMWMs. Use HMWM with low volatility which does not evaporate. Note that standard methyl methacrylate (MMA) resins are very volatile and are not suitable for filling joints or cracks. Do not use MMA. Thoroughly train all personnel in the safe handling of all materials in accordance with the manufacturer's recommendations. Wear impervious protective gloves and splash-proof goggles during the application of the HMWM to prevent accidental eye or skin contact. Handle solvent for cleaning and flushing of equipment, tools, etc., in such a manner

as to minimize personal and environmental hazards as approved by the Engineer. Provide an eye wash facility and soap and water wash station for the workers at the job site. Advise workmen of the following:

- HMWM monomer will soften gum rubber soled shoes
- Clothing or leather that becomes saturated with the HMWM monomer will harden and become brittle.

(b) Materials for Epoxy Resin. Supply a two part Epoxy Resin meeting the Material requirements of Table B. Add a fluorescent tracer dye to the Epoxy Resin to provide evidence of crack penetration.

TABLE B: EPOXY - MIXED SYSTEM

Property	**Requirement**	**Standard**
Mixing Ratio	1:1	None
Viscosity (Brookfield)	50 cps maximum	ASTM C 881
Bond Strength (14 Day Cure)	1500 psi minimum	ASTM C 882
Water Adsorption (24 Hour)	1.0% maximum	ASTM D 570
Tensile Strength (10 mil thickness)	2,500 psi minimum	ASTM D 638
Elongation	2% minimum	ASTM D 638
Gel Time in Mass @ 72^{O}F	30 Minutes minimum	AASHTO —235
% Volatile	30% Maximum	ASTM D 2369

(c) Fine Aggregate (sand) for HMWM and/or Epoxy Penetrants. Supply clean, dry sand, with a maximum moisture content of ½ of the percent absorption of the aggregate, that is free of dirt or other organic materials, and conforms to the following gradation:

Sieve Size	**% Retained Maximum**
No. 4 (4.75mm)	0-1
No. 8 (2.36mm)	0-10
No. 30 (600µm)	0-95
No. 50 (300µm)	0-100

Note: This gradation is intended to allow the use of commercially available blast sands of No. 8/20 (2.36mm/850µm) or 10/20 (2mm/850µm). The Engineer may approve alternate gradations.

(d) Acceptance of Materials - HMWM and/or Epoxy Penetrant. For source approval, supply a Type A certification in accordance with subsection 106.04 showing satisfactory test results from an approved testing laboratory. The certification shall include the manufacturer's name, test results and dates, brand name, lot number, and date of manufacturer. New certification shall be required if any of the following conditions occur: the manufacturing process or formulation is changed, testing indicates nonconformance to the Specifications, or the certification is older than 5 years. Supply a Type C certification for each project use.

523.04.CONSTRUCTION METHODS.

(a) General. Submit a work plan including, but not limited to, surface preparation techniques, materials to be used, and installation procedures. For flood coats, a technical representative from the manufacturer must be on the site during application of the sealers. Cure new concrete for a minimum of 28 days before applying any sealers. Complete and allow any quick set concrete patches to cure a minimum of 48 hours before abrasive blasting the repair area. **If the bridge deck has cracks or joints which extend to the bottom of the deck, seal the bottom of the deck.** Do not use sealers for patching decks (including surface patches).

Sealers should not be placed under the following conditions:

- If detrimental weather conditions such as rain or falling temperatures are forecast.
- If traffic can not be diverted long enough to provide a proper cure.

(b) Surface Preparation - HMWM and/or Epoxy Penetrant. Remove traces of asphaltic or petroleum products, excess grout, and any concrete curing agents by abrasive blasting. Make certain that surfaces to receive sealer are dry before application of sealers. If rain occurs, a minimum of 48 hours of drying time will be required from the time the rain stops. Clean all surfaces and cracks using compressed air with a minimum air pressure of 90 psi and which is free of oil and moisture.

(c) Application of HMWM and/or Epoxy Penetrant. Apply sealers to clean, dry, and frost- free surfaces when the surface temperature is between 45 ^{O}F and 90 ^{O}F (7 ^{O}C and 32 ^{O}C). Place the sealers in accordance with the manufacturer's recommendations as approved or directed by the Engineer. Mix all components in accordance with the manufacturer's recommendations. For HMWM sealers, use a metallic drier and peroxide to catalyze the HMWM monomers to initiate polymerization.
To improve skid resistance, broadcast fine aggregate (specified above) into the sealer before it hardens. Broadcast fine aggregate (sand) either by hand or mechanical means on the entire treated area of the concrete surfaces to achieve a uniform coverage of 0.60 +/- 0.05 pounds per square yard (325.5 grams ±27 grams per square meter). For HMWM, place the sand as the monomer begins to gel. When the sand cover adheres sufficiently to resist brushing by foot and the surface is tack free, as determined by the Engineer, traffic may be resumed. A slight oil may remain on the surface for several hours.

(d) Sealing Cracks. This applies when the plans require that the sealer will be placed in the surface cracks and not on the entire deck. Use a crack comparator aid to visually determine crack size. Unless otherwise recommended by the Engineer or technical representative, use a fine aggregate (sand) to fill the cracks wider than 0.010 inch (0.25 mm) prior to placing the HMWM. Mask across the crack in one or two foot (0.3 or 0.6 meter) intervals. It may be necessary to apply sealer several times in order to completely fill the crack. Place tape approximately 1" either side on the edges of the crack.

(e) Flood coats to be applied to the entire deck. Sweep, squeegee, pour, or spray the area to receive

the sealers allowing the sealers to flow into the cracks. After cracks are full, sweep excess sealer from tining before the material begins to gel. Do not allow excess sealer to plug the tined surface of the bridge deck.

523.05. METHOD OF MEASUREMENT.

Accepted sealer crack repair shall be measured on the surface by the linear foot (meter) of crack and by the gallon (liter) of sealant resin. Linear measurements shall be along three-foot-long (0.9 meter) chords and shall include repairs of all cracks within 6 inches (152 mm)of either side of the chord length. Accepted flood coats of sealer deck repair shall be measured by the square yard (square meter) to the nearest 0.1 square yards (0.08 square meter) complete in place. **NO** gallons of sealant resin will be measured for floodcoats.

523.06. BASIS OF PAYMENT.

Accepted quantities, measured as provided above, will be paid for at the contract unit price for:

523(A) (SP) SEALER CRACK PREPARATION.....LINEAR FOOT (METER)
523(B) (SP) SEALER RESIN.....GALLON (LITER)
523(C) (SP) DECK AREA SEALED
(floodcoats).....SQUARE YARD (SQUARE METER)

which shall be full compensation for performing the work as specified above and the furnishing of all materials, labor, tools, equipment and incidentals necessary to complete the work.