EXPECTED IMPLEMENTATION JULY 2014

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413 SEALING CRACKS AND CONCRETE STRUCTURE SURFACES. (REV 1-22-14) (FA 1-24-14) (7-14)

SECTION 413 is deleted and the following substituted:

SECTION 413
SEALING CRACKS AND CONCRETE STRUCTURE SURFACES

413-1 Description.

Seal concrete surfaces and cracks in concrete using materials, surface preparation, and application of penetrant sealers and high molecular weight methacrylates (HMWM) as specified in this Section and in accordance with the manufacturer recommendations. Consult with the FDOT State Materials Office (SMO) in the event of conflict between the manufacturer's recommendations and this specification. Perform surface preparation and application to all areas as shown in the Plans or as directed by the Engineer.

413-2 Penetrant Sealers.

413-2.1 Materials: Use alkylalkoxysilane penetrant sealers, with 40 percent solids and active materials dispersed in water that meet the following:

Table 1: Physical Properties of Penetrant Sealers	
Appearance	White, or light gray color or fugitive dye
VOC content (EPA method 24)	Less than 350 g/l
Flash Point (ASTM 3278)	Greater than 200°F SETA
Resistance to Chloride ion penetration AASHTO T259 and T260	Less than 0.52 pounds/yd^3(criteria of 1.5) at 1/2 inch level; 0.00 pounds/yd^3 (criteria of 0.75) at 1 inch level
Water absorption test (ASTM C 642)	0.50% maximum/48 hours; 1.5% maximum/50 days
NCHRP 244	
Series II - cube test	
Water weight gain	85% reduction minimum
Absorbed chloride	87% reduction minimum
Series IV - Southern climate	
Absorbed chloride	95% reduction minimum
Scaling resistance (ASTM C 672)	(non - air - entrained concrete) 0 rating "No Scaling" (100 cycles)

413-2.2 Surface Preparation for Penetrant Sealer:

413-2.2.1 General: Prepare concrete surfaces to receive a penetrant sealer in accordance with these Specifications dependent on whether the surfaces are of recently cast concrete (new construction) or of existing concrete.

413-2.2.2 Surface Preparation for New Construction: Remove substances such as dust, grime, dirt, curing compounds, form oil, debris, etc. by water blasting, light sandblasting, wire brushing, or other methods acceptable to the Engineer, all in accordance with the penetrant

sealer manufacturer's recommendations. When using cleaning methods other than water blasting, wash the cleaned surfaces with water meeting the requirements of Section 923, as a final cleaning operation.

413-2.2.3 Surface Preparation for Existing Concrete: Remove substances such as dust, grime, dirt, stains, mineral deposits, oil, bituminous materials, debris, and all other deleterious material by using water blasting equipment of sufficient operating capacity and pressure, all in accordance with the penetrant sealer manufacturer's recommendations.

413-2.2.4 Cleaning Equipment: Use approved water blasting equipment to clean existing concrete surfaces. Use water blasting equipment which is specifically manufactured to clean concrete surfaces. Use equipment that has a minimum rated nozzle capacity of 6,000 psi using the spray head proposed for use in the work.

413-2.2.5 Water for Blasting: Use water meeting the requirements of Section 923.

413-2.2.6 Concrete Surface Cleaning Operation: Exercise sufficient care during the cleaning operation to minimize the removal of the concrete matrix. Furnish hand tools, power grinders, and other similar equipment to remove materials which cannot be removed by water blasting without abrading the concrete matrix beyond acceptable limits. Wash concrete surfaces cleaned by methods other than water blasting with water blasting equipment as the final cleaning operation.

Limit the duration of water blasting to provide a light abraded surface. Do not allow surface abrasion to exceed 0.016 inch. The Engineer will not require further cleaning of stains still apparent after abrading to a depth of 0.016 inch. Avoid exposure of coarse aggregate by water blasting.

Reclean concrete surfaces which become contaminated before applying the penetrant sealer at no expense to the Department prior to applying the penetrant sealer.

413-2.3 Application of Penetrant Sealer Materials: Apply the penetrant sealer only to surfaces which have been prepared in accordance with these Specifications and approved by the Engineer. For application of the penetrant sealer, meet these Specifications and the penetrant sealer manufacturer's recommendations.

Prior to application of any penetrant sealer, cure concrete for a minimum of 21 days.

Apply penetrant sealer no later than ten days after completion of the surface preparation and prior to any contamination of the prepared surfaces as determined by the Engineer.

413-2.3.1 Application Equipment: Apply the penetrant sealer using any suitable air or airless sprayer with an operating pressure of approximately 20 psi.

413-2.3.2 Application Limitations: Apply the penetrant sealer material only when the ambient air temperature is between 50 and 90ºF. Apply the penetrant sealer only to concrete surfaces which have dried a minimum of 48 hours after water from any source last contacted the concrete surfaces. Do not apply the penetrant sealer when winds are blowing 25 mph or more, during rainfall, or when water spray or mist is present.

413-2.3.3 Application: Apply the penetrant sealer only to concrete surfaces that have been prepared in accordance with the requirements and limitations set forth in these Specifications. Determine the actual coverage rate in square feet per gallon on the basis of field trials. Conduct a field trial to determine coverage rate at the beginning of any penetrant sealer application operation. Conduct additional confirmation field trials at a frequency of once for

every 5,000 ft^2 applied, each production day of application, or when the character of the work changes, whichever is sooner. For each field trial, determine the optimum coverage rate for 500 ft^2 of surface area. Maintain the penetrant sealer application rate between 155 and 225 ft^2 covered per gallon of penetrant sealer used. Apply the penetrant sealer in a uniform manner without puddling and skips. Redistribute any penetrant sealer which is applied and subsequently puddles in low areas over the concrete surfaces by use of a squeegee.

Begin the application of the penetrant at the lowest elevation and proceed upward toward higher elevations unless otherwise approved by the Engineer.

Maintain operating pressures in the sprayers used for application of the penetrant sealer material sufficiently low so that atomization or misting of the material does not occur. Saturate cracks to refusal when used as crack sealer per 400-21.

413-2.4 Control of Materials:

413-2.4.1 Packaging and Identification: Deliver the penetrant sealer to the project in unopened, sealed containers with the manufacturer's label identifying the product and with numbered seals intact. Ensure that each container is clearly marked by the manufacturer with the following information:

a. Manufacturer's name and address.
b. Product name.
c. Date of manufacture.
d. Expiration date.
e. LOT identification number.
f. Container serial number.

413-2.4.2 Manufacturer's Certification: Provide the Engineer a certification conforming to the requirements of Section 6 from the manufacturer, confirming that the penetrant sealer meets the requirements of this Section. Do not incorporate these materials into the project until the Engineer has accepted and approved the certification for the material. Submit such certification for each LOT of material delivered to the project. In each certification, identify the serial or LOT numbers of the containers certified.

413-2.4.3 Materials Sampling for Tests: The Engineer may require samples from each LOT or container of materials delivered to the project or from containers at the point of use. When samples are required, furnish samples in accordance with the Engineer's instructions.

413-2.4.4 Storage of Materials: Store materials delivered to the job site in original unopened containers within an appropriate storage facility. Use a storage facility that provides protection from the elements, and safe and secure storage of the materials.

413-2.4.5 Unused Material in Opened Containers: Do not return unused material in opened containers to storage for later use. Either apply such material to appropriate areas on concrete surfaces or remove and dispose of it at offsite locations provided by the Contractor.

413-2.5 Acceptance: The Engineer will accept penetrant sealer application when it is determined that the Contractor has properly cleaned all surface areas to be sealed and has applied the penetrant sealer within the required rates of application.

413-3 High Molecular Weight Methacrylate (HMWM).

413-3.1 General: Perform the surface preparation and application of a high molecular weight methacrylate to seal cracks on horizontal and slightly sloped concrete surfaces as

approved by the Engineer. Applications on bridge decks and other riding surfaces will require the addition of sand over the treated areas to increase the surface friction number (FN) measured as described by AASHTO T242.

The rate of application (ft^2 of concrete per gallon) and the application method and equipment to achieve a minimum average penetration of 1 inch must be approved by the SMO prior to commencement of work based on the size, depth and the internal condition of cracks. Submit a written sealer application plan based on the above described crack characteristics for approval by the SMO. In addition, provide a minimum of 14 days advanced notice so that personnel from the SMO may be present at the beginning of work to evaluate the cracks and provide final approval of the application rate if such is requested by the Engineer. Make arrangements with the material manufacturer to provide an on-site technical representative with a minimum of ten previous projects with experience in the application and formulation of the methacrylates for the initial application and certify that the mixing ratio, application methods, and sand broadcasting are correct and in accordance with their recommendations. The representative shall then visit the site to provide quality assurance observations every two weeks for applications lasting longer than two weeks.

Maintain a daily log of used resin material to be verified by the Engineer. Include the drum or container identification number in the log as well as the date and location of use. Retain the containers at the jobsite until the Engineer verifies its use and authorizes removal from the site.

413-3.2 Materials: Use a methacrylate system that has a three component formulation consisting of: a) methacrylate monomer, b) cumene hydroperoxide (CHP) initiator, and c) cobalt promoter. Use a HMWM monomer that is approved by the Department and included on the Department's Qualified Products List (QPL). Use initiator and promoter approved by the monomer manufacturer. Manufacturers seeking evaluation of their products must submit an application conforming to the requirements of Section 6 along with the following documentation:

1. Manufacturer's material installation instructions showing the product can be installed in accordance with this Section.

2. Independent laboratory test data and results showing the product has been tested in accordance with the requirements of this Section and meets the requirements.

3. Qualification of their on-site representatives.

413-3.2.1 Properties: Use a methacrylate material that meets the following physical and performance requirements:

Table 2: Physical Properties of Methacrylate Resin	
Viscosity (Brookfield RVT)	14-20 cps at 50 rpm
Density (ASTM D1481)	8.5 - 9.0 lb/gl at 77° F
Flash Point (ASTM D93)	> 200°F (Pensky Martens CC)
Odor	Low
Bulk Cure Speed	3 Hours @ 73°F (max.)
Surface Cure	8 Hours @ 73°F (max.)
Gel Time (ASTM 2471)	60 minutes (max.)
Tack Free Time	4-6 Hours (max.) (at 72°F and 50% Relative Humidity
Compressive Strength (AASHTO T106)	6,500 psi (min)
Tensile Strength (ASTM C307)	1,300 psi (min)

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Shear Bond Adhesion (ASTM C882)	600 psi (min)
Elongation* (ASTM D638)	10% to 30%
Wax Content	0
*Do not use methacrylate with elongation less than 20% for concrete decks supported by steel girders.	

The monomer shall have a shelf life of no less than 12 months and shall be no more than 8 months old at the time of application. Provide each container shipped to the job site with the following information on a manufacturer's label: manufacturer's name, product name, lot or batch number, date of production, and drum serial number. Identify the catalysts by their generic classification and provide the date of manufacture.

413-3.2.2 Sand: Use uniformly graded 6-20 (or similar), clean, bagged, blast sand for spreading over the applied polymer on bridge decks and other riding surfaces. Certify that the sand has a maximum moisture content that does not exceed 0.25% and that the maximum amount of dust or other material that may pass through a No. 200 sieve -200 content) is not greater than 0.75%.

Store the sand at a location that will preserve the above described conditions and characteristics of the sand until applied.

413-3.2.3 Identifier: Use methacrylates with a fluorescent dye when applying methacrylate over previously sealed cracks. The fluorescent dye shall be part of the manufacturer formulation and be clearly fluorescent under a UV light source provided by the Contractor.

413-3.3 Surface Preparation:

413-3.3.1 Cleaning: On the day of application, thoroughly power sweep the area to be treated to remove all dust, dirt or debris present. On bridge decks and other riding surfaces, use a tractor mounted (or similar) power broom with non-metallic bristles suitable for the intended purpose.

Use a power vacuum after sweeping when sealing cracks on grooved bridge decks. Re-clean the deck as necessary immediately prior to the application as debris may be blown back onto the work area by adjacent traffic or other means.

If present, remove oils and oil based substances from the concrete surface using an approved solvent.

413-3.3.2 Containment: Provide adequate containment to prevent the sealer material from flowing beyond the designated area of application. Plug any drain holes or openings within the work area. Prevent airborne material from dispersing onto open traffic lanes or outside the work area.

413-3.3.3 Pavement Markers: Protect by masking or clean after application, all existing pavement markers affected by the application of the methacrylate. Alternatively, remove and replace such markers as indicated in the Contract Documents.

413-3.4 Application:

413-3-4.1 Equipment: Apply the methacrylate material according to the manufacturer's specifications using mobile equipment capable of distributing material on large areas of decks and riding surfaces. Apply the material by hand using adequate containers for isolated or localized applications.

413-3.4.2 Mixing: Mix the methylmethacrylate material following the manufacturer's specified mixing proportions for the catalysts. Perform the initial mixing by equally dividing the resin to be used into two separate containers. In all instances, mix the

initiator (CHP) at the HMWM manufacturer's specified volume with 50% of the monomer resin in one container and the cobalt promoter at the HMWM manufacturer's specified volume with the other 50% in the second container. After properly blending, combine the two resins and mix as per manufacturer's instructions. For spray bar application, mix the activator/resin blend and the promoter/resin blend through a static mixer in the feed line located ahead of the material distribution bars where polymerization would start. Calibrate the valves to the static mixer to ensure a one to one mixing ratio of the two blends.

413-3.4.3 Polymer Application (Mobile Distribution): Distribute the monomer uniformly over the work area using a pressure nozzle or spray head distribution bar system. Provide feed to the distribution bar(s) using positive displacement pumps moving equal amounts of the two monomer blends from two calibrated drums.

Calibrate the equipment to mix the two monomer blends to the recommended ratio (by volume) within plus or minus 5%. The discharge volume shall be calibrated to the moving speed to provide a discharge rate capability ranging from 50 to 200 square feet per gallon at a pressure ranging from 15 to 60 psi.

The typical application rate of the material is approximately 100 square feet per gallon. Prior to application of the monomer, the SMO will approve the final production application rate based on the internal characteristics of the cracks as determined from Contractor supplied cores that the Engineer approves as being representative of the overall cracking conditions.

413-3.4.4 Polymer Application (Localized Distribution): Distribute the material by hand over the work area using pails or other suitable containers adequate for the size of the area. This only applies to localized small areas or areas where the use of mobile distribution equipment would be considered impractical as approved by the Engineer.

Do not re-use containers or mixing paddles fully or partially contaminated with polymerized methacrylate.

413-3.4.5 Sealing of Cracks: Regardless of the method used to apply the material over the concrete surface, work the material back and forth over the cracks to maximize the amount of material to be absorbed by the cracks. Move the material over the cracks using brooms, squeegees or paint brushes as appropriate, based on the size of the area. Commence this operation immediately after distributing the material on the concrete surface. Continue this operation until no additional material is flowing inside the cracks or the material begins to exhibit signs of polymerization.

Do not distribute material over areas larger than what the available personnel can effectively work over the cracks within the limits of the pot life.

413-3.4.6 Sand Distribution: Apply sand over the monomer treated area within a timely period following the application of the polymer based on the manufacturer's recommendations for the existing conditions. Use equipment that will produce a uniform distribution of the sand over the treated area. If wheel mounted, use a sand spreader that has pneumatic tires compatible with the treatment material such that no tire footprints are left on the deck surface.

Use an initial application rate of 0.6 (plus or minus 0.05) pounds of sand per square yard of treated area, and adjust the rate as necessary to produce a friction number (FN) of no less than FN40R greater than or equal to 35 at 7 days. Coordinate with the Engineer to conduct a preliminary on-site friction test to determine the actual sand application rate prior to the beginning of production application. If friction numbers below those specified are obtained,

completely remove all loose sand from the surface and re-apply the polymer at a rate of 150 square feet per gallon and spread additional sand as necessary to achieve the specified friction numbers. Remove the surface material by grinding, shot blasting, or other approved method if satisfactory friction values are not achieved. Friction tests will be conducted by the State Materials Office.

413-3.5 Opening Riding Surfaces to Traffic: Protect the sand covered area from vehicular traffic until the polymer has fully cured. After curing, power vacuum to remove excess sand from the riding surface, before opening to traffic.

413-3.6 Acceptance Tests: Verify penetration of the methacrylate into the cracks by extracting a 2 inch diameter core (1-1/2 inch deep) for every 1000 square feet or less (if application is less than 1000 square feet) of sealed concrete. Use caution to prevent cutting the reinforcing steel. Frequency of verification may be reduced by the SMO with the concurrence of the Engineer.

Test curing on the treated area using a cotton strand or cotton ball. Consider the material fully cured and ready for traffic when polymer does not adhere to the cotton ball when pressed against the treated surface and then pulled away. Obtain approval from the Engineer prior to reopening area to traffic.

413-3.7 Limitations: Apply the material only under weather conditions recommended by the manufacturer and when no rainfall has occurred during the previous 48 hours and no rain is expected for the next 6 hours following completion of the application.

413-4 Method of Measurement.

Prestressed, precast items designated in the Plans to be sealed with penetrant sealer, will not be measured for separate payment. The Contractor shall include the cost of cleaning, sealing, and applying penetrant sealer with the cost of the prestressed, precast items. For cast-in-place surfaces to be sealed with penetrant sealer, the quantities to be paid for will be (1) the volume, in gallons, of penetrant sealer as determined by use of the field measured area satisfactorily sealed divided by the approved application rate based on field trials, and (2) the area, in square feet, of cleaning and sealing concrete surfaces as determined by field measurement, completed and accepted.

Quantities of high molecular weight methacrylate to be paid will be based on the volume in gallons of monomer resin material (not including the promoter, initiator, and fluorescent dye) actually used to seal the cracked surfaces at the approved application rate, and the dimensions of the treated areas in square feet.

The area of application will be computed based on the plan dimensions of concrete surface sealed with methacrylate. For localized application, the Engineer will determine the method of measurement that most accurately reflects the area of application in square feet.

413-5 Basis of Payment.

Prices and payments will be full compensation for all work specified in this Section, including cleaning, furnishing and applying the material required to satisfactorily clean and seal cracks and designated surface areas, testing, and miscellaneous related costs including storage, handling, etc.

No additional compensation will be made for material, reapplication or removal due to Contractor error, or to correct deficient friction values.

Payment will be made under:

Item No. 413-149- Penetrant Sealer - per gallon

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Item No. 413-151- Methacrylate Monomer - per gallon
Item No. 413-154- Cleaning and Sealing Concrete Surfaces - square foot