

## ITEM 512 TREATING CONCRETE

### 512.01 Description

### 512.02 Materials

### 512.03 Sealing of Concrete Surfaces

### 512.04 Sealing Concrete Bridge Decks with HMWM Resin

### 512.05 Soluble Reactive Silicate (SRS) Concrete Treatment

### 512.06 Treating Concrete Bridge Decks with Gravity-Fed Resin

### 512.07 Sealing Cracks by Epoxy Injection

### 512.08 Waterproofing

### 512.09 Method of Measurement

### 512.10 Basis of Payment

**512.01 Description.** This work consists of sealing and treating concrete surfaces, sealing cracks in concrete, and applying waterproofing to structures.

**512.02 Materials.** Furnish materials conforming to:

|                                      |                           |
|--------------------------------------|---------------------------|
| Asphalt cement.....                  | 702.01 (PG 64 - 22)       |
| Asphalt primer for .....             | 702.02 (RC-70 or RC-250), |
| waterproofing .....                  | 702.05                    |
| HMWM Resin.....                      | 705.15                    |
| Epoxy-Urethane Sealer .....          | 705.23.A                  |
| Non-epoxy Sealer.....                | 705.23.B                  |
| Soluble Reactive Silicate(SRS) ..... | 705.24                    |
| Gravity Fed Resin .....              | 705.25                    |
| Epoxy injection Materials .....      | 705.26                    |

Sand..... 703 with the following exceptions:

Maximum moisture content of 0.5 of the percent of absorption when treated, according to California Test 226.

Grading:

| SIEVE SIZE     | % PASSING MAX. |
|----------------|----------------|
| No. 4 (4.5mm)  | 100            |
| No. 8 (2.36mm) | 90 - 100       |
| No. 20 (850µm) | 5 -15          |
| No. 50 (300µm) | 0 - 5          |

Emulsified asphalt primer, ..... 702.04 (MS-2, SS-1)

Asphalt for waterproofing .....
 702.06 |

Hot applied joint sealer .....
 705.04 |

Type 3 membrane primer .....
 705.04 |

Waterproofing fabric .....
 711.24 |

Sheet Type 2 membrane waterproofing.....
 711.25 |

Sheet Type 3 membrane waterproofing.....
 711.29 |

**512.03 Sealing of Concrete Surfaces.** This work consists of applying an approved sealer on existing and new concrete surface areas after the concrete is cured and repairs completed and cured. Apply the sealer to locations described in the plans. Apply the sealer listed in the pay item description. Choose a type of sealer if no sealer is listed in the pay item description.

### 512.03

A. **Equipment.** Use application equipment recommended by the sealer manufacturer. Use spray equipment, tanks, hoses, brooms, rollers, coaters, squeegees, etc., that are clean, free of foreign matter, oil residue and water.

B. **Mixing.** Mix the sealer according to the manufacturer's recommended procedures. Furnish the Engineer with the manufacturer's application instructions. Do not mix or apply the sealer until the manufacturer's written recommendations are supplied to the Engineer. Mix and maintain materials at a uniform consistency during application.

C. **Storage.** Store all sealer components in tightly sealed containers, in a dry location, and as recommended by the manufacturer. Deliver unopened drums or containers of the sealer or sealer components to the job site with the manufacturer's numbered seal intact.

D. **Application submittals.** At least five (5) days before sealing, provide the Engineer the sealer manufacturer's written requirements for application equipment, mixing equipment, mixing procedures, mixing time, storage requirements, recoat times and temperatures, and MSDS sheets.

E. **Surface Condition.** Apply sealers only to surfaces which are dry, free from dust, dirt, oil, wax, curing compounds, efflorescence, laitance, coatings and other foreign materials. Visually inspect all surfaces before applying sealer. Remove all structurally unsound surfaces and weak sections.

Perform all concrete patching prior to surface profiling. Perform concrete patching on areas identified by the Engineer according to 519, or as otherwise directed in the Contract Documents. Cure repaired areas for at least seven (7) days.

Air dry all concrete surfaces for at least ten (10) days after completion of required curing.

For accelerated cure of precast concrete, obtain the required 28 day strength and air dry the surfaces at least ten (10) days after completing accelerated cure.

F. **Surface Preparation.** Remove dust, dirt, oil, wax, curing compounds, efflorescence, laitance, coatings and other foreign materials from surfaces to be sealed.

Use one or both of the following methods to produce a surface profile that feels and looks like 100 grit sandpaper or coarser. Provide the Engineer sandpaper for comparison.

1. Water blast, or
2. Abrasive blast, followed by air brooming or power sweeping, to remove dust and sand from the surface and opened pores.

Install suitable traps, filters, drip pans and other separation devices in the cleaning equipment so oil and other foreign material are not deposited on the surface.

If the concrete surface had curing compound applied, acid test the surface after blasting to see if the curing compound was removed. Perform the acid test for every 500 square ft (47 square meters). Use a solution of 1 part 20° Baume muriatic acid and 2 parts water. Apply 4 to 5 drops to the concrete surface. If foaming/fizzing occurs the curing compound is removed. Rinse the tested location with an ammonia solution to neutralize the concrete area tested (1 cup ammonia to 5 gallons water).

[NOTE: Muriatic acid and ammonia can be bought in a hardware store. Muriatic acid is used to clean masonry. Only dilute by pouring the acid into the water. DO NOT pour the water into the acid.]

When surfaces show intermittent or no foaming, use chemicals or other cleaning compounds to remove the curing compounds. Only use products approved by the sealer manufacturer. Furnish the Engineer documentation of the sealer manufacturer's approval and method to test if materials are removed.

After re-cleaning perform the acid test to confirm removal of the curing compound.

Ensure that all wastes generated by the surface preparation operation are managed to prevent the direct or indirect discharge to the environment.

**G. Application and Coverage.** When using a water blast, apply the sealer between 24 hours and 48 hours after surface preparation. Otherwise, with an abrasive blast, no waiting period is required. Do not apply sealer if rain is anticipated within six (6) hours after application. Clearly mark where the sealer application stops if not continuous.

**1. Epoxy - Urethane sealers.**

a. Apply the epoxy coat of the epoxy-urethane sealer at the coverage rate of 120 square feet per gallon (2.9 square meter per liter). Use a coverage rate of 150 square feet per gallon (3.6 square meter per liter) when the City's Qualified Products List for the epoxy authorizes it. Apply the Urethane coat of the epoxy-urethane sealer at a rate of 200 square feet per gallon (4.8 square meter per liter). When surfaces are not smooth and flat, adjust the given coverage rates by the following-formulas to determine the correct coverage rate.

(1) For surfaces using large stone liners and standard concrete = specified coverage rate (sq ft/gal [sq m/l]) x 0.8

(2) For surfaces using large stone liners and porous concrete = specified coverage rate (sq ft/gal [sq m/l]) x 0.7

(3) For surfaces using fluted liners and standard concrete = specified coverage rate (sq ft/gal [sq m/l]) x 0.5

b. Only apply sealer when the surface temperature is 50 °F (10 °C) or above

c. Apply with a brush, squeegee, roller or spraying equipment and as recommended by the manufacturer.

d. Apply one coat of epoxy and one coat of the urethane top coat. Time between coats shall meet the manufacturer's written recommendation provided to the Engineer during 512.03.D. Use epoxy and urethane from the same manufacturer. Achieve specified coverage regardless of the number of passes per coat.

e. Tint so the final color is Federal Color Standard No. 17778 - Light Neutral, or as otherwise specified in the Contract Documents. Pigment content shall be limited so as not to reduce sealing effectiveness of the second coat. Refer to the plans for colors for specific projects.

f. Sags and runs are not acceptable in the sealer.

## 512.03

g. For sealed sidewalks or other horizontal surfaces with repetitive foot traffic or vehicular traffic, integrate 1-1/2 lbs. per square yard (0.8 kg/m<sup>2</sup>) of silica sand into the surface of the second coat to produce a non-skid surface satisfactory to the Engineer.

h. From the date of Final Acceptance, provide a five (5) year warranty for coating failure such as scaling, flaking, delamination, or other similar defects.

### **2. Non-epoxy sealer.**

a. Apply the sealer according to the manufacturer's recommended mode of application and under the observation of the Engineer.

b. Coverage.

- I. Surfaces subject to abrasive wear (bridge decks, bridge deck shoulders and sidewalks); Minimum, one gallon (3.875 liter) of sealer for each 100 square feet (9.0 square meter);
- II. Curbs, vertical surfaces of beams and deck slabs subject to direct roadway drainage; Minimum, one gallon (3.875 liter) for each 125 square feet (11.5 square meter)
- III. Other surfaces (for example, parapets, abutments, pier caps and median dividers); Minimum, one gallon (3.875 liter) for each 150 square feet (14.0 square meter)

Stone or fluted formed concrete surfaces may require additional sealer materials for coverage.

c. Apply sealer on horizontal surfaces in a one-pass operation at the required coverage. An acceptable application procedure consists of saturating the surface and waiting a few seconds for the sealer to completely penetrate the concrete surface. Broom in the sealer if recommended by the manufacturer.

d. Apply sealer on vertical surfaces to saturate the surface. The surface is saturated when runs of 6 to 12 inches develop. Apply additional passes in 10 to 15 minute intervals until the coverage rate is achieved. Apply sealers with brush or roller if recommended by the manufacturer.

e. After 10 to 15 minutes, squeegee off excess material on smooth finished or dense concretes where the required coverage is not absorbed.

f. For sealed sidewalks or other horizontal surfaces with repetitive foot traffic or vehicular traffic, integrate 1-1/2 lbs. per square yard (0.8 kg/m<sup>2</sup>) of silica sand into the sealer application to produce a non-skid surface satisfactory to the Engineer.

g. Tint clear non-epoxy sealers with a vanishing dye that will not damage the concrete.

h. Do not apply sealer if the ambient temperature is below 40 °F (5 °C) or will fall below 32 °F (0 °C) within 12 hours after application.

**H. Test Site/Application.** Apply epoxy-urethane or non-epoxy sealer to measured coverage areas, both on horizontal and vertical surfaces, and on different concrete types, demonstrating:

1. The project's visual effects for the epoxy-urethane sealer application at the required coverage rate.

2. Visually, the absorption necessary to achieve the specified coverage rate for the non-epoxy sealer. Use at least ½ gallon (2 liter) of sealer, following the manufacturer's recommended method of application, for the total of the test surfaces.

3. Apply to the deck, safety curb or sidewalk for the horizontal test surfaces and use an abutment parapet or pier face for the vertical test surface so different textures are tested.

**I. Appearance.** Epoxy/Urethane sealers. Uniform appearance and the final color shall visually match the test section. Re-coating, removal and re-application or other methods recommended by the manufacturer will be required to correct final appearance. Non Epoxy Sealers. The sealer shall result in a uniform appearance.

**J. Traffic.** Allow traffic on deck shoulder areas after 12 hours of drying time for an epoxy/urethane sealer. Keep traffic off a non-epoxy sealer until the sealer is dry.

**K. Safety Precautions.** Follow precautions defined on the manufacturer's MSDS. Provide the Engineer a copy of the MSDS sheet for information before any work commences.

**L. Protection of Adjoining Surfaces and the Public.** Protect the public during all operations, especially when applying sealer to the fascia or the underside portions of a bridge that spans an area used by the public.

During sealing, mask off, or use other means of protection, for surfaces not being sealed. Protect asphalt and mastic type surfaces from spillage and heavy overspray. Do not apply sealers to joint sealants which have not cured according to the manufacturer's instructions. Joint sealants, traffic paints and asphalt overlays may be applied to the treated surfaces 48 hours after the sealer has been applied. Protect nearby steel, aluminum or glass surfaces when non-epoxy overspray could be deposited on those surfaces.

**M. Environmental Requirements.** Protect plants and vegetation from overspray by covering with drop cloths.

**N. Superintendent.** In addition to the requirements of 105.06, the Superintendent must successfully complete a Sealing of Concrete Surfaces training pre-qualification course offered by ODOT. The Superintendent must have completed the course within the past four years and received an individual course certificate. Present certificate to the Engineer prior to beginning the sealing of concrete surfaces work. Work will not be permitted to begin until after the Superintendent provides a valid course certificate.

**512.04 Sealing Concrete Bridge Decks with HMWM Resin.** This work shall consist of preparing and treating the concrete wearing surfaces of bridge decks with a penetrating sealer in accordance with these specifications, in reasonably close conformity with the plans and the manufacturer's recommendation and as directed by the Engineer.

**A. Limitations.** Do not perform this work during the period beginning November 1st and ending March 31st.

## 512.04

**B. Surface Preparation.** Remove roadway dirt and debris from the area of the deck to be treated. Sweep, sandblast, then with the use of a manual or power broom sweep and blow with compressed air so that the surfaces to which the sealer is to be applied is dry and free of dust and dirt. Use high pressure compressed air to blow all loose material from visible cracks. Fit the cleaning equipment with suitable traps, filters, drip pans, driers and other devices to prevent oil and other foreign material from being deposited on the surface. Do not allow traffic on the clean surface prior to application of the sealer. Remove existing pavement markings according to Section 641.10. Remove all traces of asphalt or petroleum products and concrete curing seals by abrasive blasting prior to air sweeping.

**C. Installation.** Provide a compatible promoter/initiator system capable of providing the same physical qualities of the hardened resin as if promoted/initiated with 2% cobalt naphthanate (6%) and 2% cumene hydroperoxide. Store materials at 65-80 °F (18-27 °C). Provide a system that has a resin gel time of not less than 40 minutes to not more than 1½ hours at the time and temperature of application.

Adjust the gel time to compensate for the change in temperature throughout the day. The temperature of the surfaces to be treated may range from 50 °F (10 °C) to 120 °F (49 °C). Arrange to have a technical representative on site to provide mixing proportions equipment suitability, and safety advice. Resolve any conflict between these provisions and representative's advice at the job site. The technical representative shall remain at the job site until the Engineer and technical representative agree that the Contractor is qualified in all aspects of the application of the sealer.

Do not allow the promoter and initiator, if supplied separate from the resin, to contact each other directly. Do not store containers of promoter or initiators together in a manner that will allow leakage or spillage from one to contact the containers or materials of the other.

Machine application of the resin may be performed by using a two-part resin system utilizing a promoted resin for one part and an initiated resin for the other part. This two-part resin system may be combined at a spray bar through positive displacement atomization of the resin. Do not use compressed air to produce the spray.

Use appropriate cleaning and flushing of equipment, tools, etc., with an appropriate solvent, as approved by the Engineer, in such a manner to minimize personal and environmental hazards. Advise workman that the resin will soften gum rubber soles, and a face-mask should be used to protect from accidental splashes. Clothing and leather saturated with resin will harden and become useless.

Prior to resin application the surface to be treated shall be visibly dry and its temperature between 50° F (10° C) and 120° F (49° C). Do not apply the resin within 24 hours after a rain or when rain is forecast within 12 hours or when the ambient air temperature is below 50° F (10° C). Pre-mark the deck to control mixed material usage and to provide a rate of application of approximately 100 square feet per gallon (2.45m<sup>2</sup>/L). The exact rate shall be determined by the Engineer prior to commencing full-scale deck treatment operations.

Before using the material, submit to the Engineer copies of the manufacturer certified test data showing that the material complies with the requirements of this specification. The test data shall be developed by an independent approved testing laboratory, and

shall include the brand name of the material, name of manufacturer, number of the lot tested and date of manufacture. When the material has been approved by the Engineer, further testing by the manufacturer will not be required unless the formulation of manufacturing process has been changed, in which case new certified test results will be required. The manufacturer shall certify that the formulation is the same as that for which data has been submitted. The state reserves the right to sample and test delivered lots for compliance.

Flood the deck surfaces resin, allowing penetration into the concrete and filling of all cracks. Limit the initiated mix of promoted resin to 5 gallons (19L) at a time for manual application. A significant increase in viscosity shall be cause for rejection. Apply the treatment within 5 minutes after complete mixing. Redistribute excess material by squeegee or brooms within 10 minutes after application.

Take all steps necessary to prevent the resin from flowing into lanes open to traffic. Broadcast sand over the entire treated area of the bridge deck by mechanical means to affect a uniform coverage of 0.80 to 1.2 pounds per square yard (0.43 kg/m<sup>2</sup> to 0.65 kg/m<sup>2</sup>). The sand shall be uniformly graded aggregate conforming to the quality requirements of 703 and shall conform to the following limits for grading:

| Sieve Size     | % Passing Max. |
|----------------|----------------|
| No. 4 (4.75mm) | 100            |
| No. 8 (2.36mm) | 90-100         |
| No. 20 (850µm) | 5-15           |
| No. 50 (300µm) | 0-5            |

It is the intention of the specification to allow the use of commercially available blast sands applied by a common lawn broadcast type seeder/spreader. Place sand between 10 to 15 minutes behind the resin spreading front and before any jelling of the resin occurs. If the surface contains large deep cracks, the low-viscosity liquid could run completely through the concrete slab. Apply a second coat in these areas after the first coat has started to cure.

Before the monomer hardens, fill imperfections or spalls with standing liquid with commercial quality concrete or sandblast sand, and finished to a uniform surface. The sand shall have a maximum moisture content of 0.5 of the percent of absorption when tested in accordance with a California Test 226.

Do not permit traffic and equipment on the tested deck until it is tack free and a minimum of 6 hours have elapsed since treatment and the sand cover adheres sufficiently to resist brushing by hand. Protect the treatment from moisture for not less than 4 hours after placement.

**512.05 Soluble Reactive Silicate (SRS) Concrete Treatment.** This item consist of the necessary labor, materials and equipment to prepare and treat portland cement concrete surfaces with a reactive silicate sealer meeting these specifications.

**A. Equipment.** Use application equipment that is recommended by the manufacturer. Use spray equipment, tanks, hoses, brooms, rollers, coaters, squeegees, etc., that are thoroughly clean, free of foreign matter, oil residue and water prior to applying the treatment.

**B. Cleaning and Surface Preparation.** Insure that surfaces which are to be treated meet the approved product's requirements for surface condition. Do not begin sealing until all concrete repairs have been completed and cured. Furnish the Engineer with written instructions for surface preparation requirements and have a representative of the manufacturer present to assure the surface condition meets their requirements.

At a minimum, thoroughly clean the surface to remove dust, dirt, oil, wax, curing components, efflorescence, laitance, coatings and other foreign materials. Obtain the approval of the manufacturer or its representative before the use of chemicals and other cleaning compounds to facilitate the removal of these foreign materials. Apply the treatment within 48 hours following surface preparation.

Fit cleaning equipment with suitable traps, filters, drip pans and other devices to prevent oil and other foreign material from being deposited on the surface.

**C. Test Application.** Treat a measured test coverage area on horizontal and vertical surfaces of the different components of the structure to be treated for the purpose of demonstrating the desired physical and visual effect of an application or of obtaining a visual illustration of the absorption necessary to achieve the specified coverage rate prior to final application. In the latter case, use at least ½ gallon (2 liter) of treatment following the manufacturer's recommended method of application for the total of the test surfaces. Locate horizontal test surfaces on the deck and on the safety curb or sidewalk and locate vertical test surfaces on an abutment parapet and pier face so that the different textures are displayed.

**D. Application.** Apply the concrete treatment to concrete surfaces as designated on the plans. Apply the SRS by thoroughly saturating the concrete surfaces at an application rate specified by the manufacturer.

Apply the SRS when the concrete surface temperature is above 35° F (2° C). Use a surface thermometer on the concrete to establish the temperature of the concrete if the air temperature at the time of application is 45° F (7° C) or below.

Spread the SRS from puddles to dry areas.

If unable to complete the entire application continuously, note and clearly mark the location where the application was stopped.

**E. Protection of Adjoining Surfaces and the Public.** Protect by masking off or by other means adjoining surfaces of the structure which are not to be sealed when applying a treatment. Make provision to protect the public when treating the fascia of a bridge and/or portions of the underside of the deck of a bridge that spans an area used by the public.

Protect asphalt and mastic type surfaces from spillage and heavy overspray. Do not apply joint sealants, traffic paints and asphalt overlays to the treated surfaces until 48 hours after the treatment has been applied. Cover adjoining and nearby surfaces of aluminum or glass where there is a possibility of the treatment being deposited on the surfaces.

Protect plants and vegetation from overspray by covering with drop cloths. Follow precautions as indicated on the manufacturer's MSDS.

**F. Opening to Traffic.** Only allow traffic on a deck after a treated area does not track.

**512.06 Treating Concrete Bridge Decks with Gravity-Fed Resin.** This work shall consist of preparing and treating the concrete bridge deck with a gravity-fed crack welding system in accordance with these specifications in reasonably close conformity with the plans and the manufacturer's recommendations and as directed by the Engineer.

**A. Limitations.** Do not perform this work during the period beginning November 1st and ending March 31st, unless otherwise authorized by the Engineer.

Prior to resin application insure that the surface to be treated is visibly dry with a temperature between 40 °F (4 °C) and 100 °F (38 °C). Do not apply the resin within 24 hours after a rain, during rain, when rain is forecast within 12 hours or when the ambient air temperature is below 40 °F (4 °C).

**B. Surface Preparation.** First remove roadway dirt and debris from the area to be treated. Sweep abrasive blasted surfaces to which the sealer is to be applied, then manual or power broom swept and blown with compressed air so that they are dry and free of dust and dirt. Use high pressure compressed air to blow all loose material from visible cracks. Use a high pressure water blast followed by an air blast if particles are highly embedded in the cracks, to clean cracks. Fit the cleaning equipment with suitable traps, filters, drip pans, dryers and other devices to prevent oil and other foreign material from being deposited on the surface. Do not allow traffic on the clean surfaces prior to application of the sealer. Remove existing pavement marking according to section 641.10. Remove all traces of asphalt or petroleum products and concrete curing by the abrasive blasting prior to air sweeping.

**C. Application.** Pre-mark the deck to control mixed material usage and to provide a rate of application of approximately 100-150 square feet per gallon (2.45m<sup>2</sup>/L-3.68m<sup>2</sup>/L). The Engineer will determine the exact rate but will not exceed 150 square feet per gallon (3.68m<sup>2</sup>/L). Flood the area to be sealed with resin. Allow the resin to penetrate into the concrete and fill all cracks. Mix the resin to a limit of 5 gallons (191) at a time for manual application. Reject resin with a significant increase in viscosity. Redistribute excess material by a squeegee within 10 minutes after application. Front and back movement with the squeegee is recommended over cracks and patch perimeters to enhance penetration. Take all steps necessary to prevent the resin from flowing into lanes open to traffic. Broadcast sand over the entire sealed area of the bridge deck by mechanical means to effect a uniform coverage of 1 pound (0.45kg) per 2-3 square foot (0.1858-0.2787 square meter).

Protect the treatment from moisture for not less than 6 hours after placement.

**D. Traffic.** Do not permit traffic on the treated deck until the resin is tack free, a minimum of 6 hours has elapsed since treatment, and the sand cover adheres sufficiently to resist brushing off by hand.

**512.07 Sealing Cracks by Epoxy Injection.** This specification covers the repair of dry, moist or wet cracks or fractures that are 2 to 100 mils (50 to 2500 micrometers) in thickness in reinforced concrete members. The repair is by means of an epoxy injection system. This system shall consist of a paste epoxy used to seal the surface cracks and an injection epoxy used under low pressure, 200 psi (1400kPa) max., to penetrate and fill the cracks and bond the crack surfaces together. Material for each epoxy shall consist of

## 512.08

a two-component modified resin bonding system. The unmodified resin shall be known as Component A and the hardener as Component B.

Arrange to have a manufacturer's representative at the job site to familiarize him and the Engineer with the epoxy materials, application procedures and recommended pressure practice. This representative shall direct at least one complete crack or area injection and be assured prior to his departure from the project that the personnel are adequately informed to satisfactorily perform the remaining repairs.

Furnish the Engineer a copy of the manufacturer's comprehensive preparation, mixing and application instructions which have been developed especially for use with the proposed epoxy injection system. Ensure that any significant changes to these instructions which are recommended by the representative for an unanticipated situation have been approved by the Engineer prior to the adoption of such changes.

Clean concrete surfaces adjacent to the cracks to be sealed only to the extent necessary to achieve an adequate bond with the paste epoxy, and only by procedures which will not cause abrasive grits or concrete dust to penetrate the cracks. Do not permit the use of solvents or thinners in cracks or on bonding surfaces.

Install injection ports or tees in cracks to be injected. Space injection ports or tees at 6 to 12 inches (150 to 300 mm) vertically and 6 to 18 inches (150 to 450 mm) horizontally but in no case closer together than the thickness of the concrete member if full depth penetration is desired unless otherwise specified or directed. Set ports or tees in dust free holes made either with vacuum drills or chipping hammers. Seal all surface cracks in the area to be repaired, after injection ports or tees have been inserted into the holes, with paste epoxy between ports to ensure retention of the pressure injected epoxy within the confines of the member. The City will allow an alternative procedure of sealing the cracks before the injection holes have been made. Limit the application of paste epoxy to clean and dry surfaces. Limit substrate temperatures to not less than 45 °F(7 °C) during epoxy applications.

Begin the epoxy injection at the bottom of the fractured area and progress upward using a port or tee filling sequence that will ensure the filling of the lowermost injection ports or tees first.

Establish injection procedures and the depths and spacings of holes at injection ports or tees. Use epoxy with flow characteristics and injection pressure that ensure no further damage will be done to the member being repaired. Ensure that the epoxy will first fill the innermost portion of the cracked concrete and that the potential for creating voids within the crack or epoxy will be minimized.

Remove the injection ports or tees flush with the concrete surface after the fractured area has been filled and the epoxy has partially cured (24 hours at ambient temperature not less than 60 °F (16 °C), otherwise not less than 48 hours). Roughen the surfaces of the repaired areas to achieve uniform surface texture. Remove any injection epoxy runs or spills from concrete surfaces.

Obtain two 4-inch (100 mm) diameter core samples in the first 100 linear feet (30 m) of crack repaired and one core for each 100 linear feet (30 m) thereafter. Take the core samples from locations determined by the Engineer and for the full crack depth. The Engineer will visually examine the cores to determine the extent of epoxy penetration. Repair the core holes in the concrete with material specified in 705.21.

### 512.08 Waterproofing.

**General.** Apply an even and uniform coating of asphalt materials using brushes, squeegees, or spray equipment.

If using spray equipment, provide portable power pressure type spraying equipment capable of being moved to the location of the waterproofing operation.

Protect concrete surfaces not covered with waterproofing from overspray, spilling, or otherwise marring of the surface with the asphalt materials.

Ensure that the edge of any exposed application is sharply defined true to line with a uniform exposure.

#### Preparation of Surface.

**Asphalt Materials.** Remove concrete projections. Using wire brushes and clear water, remove dirt and the outside film of cement. Before applying asphalt materials, ensure that the concrete is clean and dry and the concrete temperature is at least 40 °F (4 °C).

**Membranes.** Remove protrusions from the concrete. Sweep off dirt and dust, and blow the concrete clean. Fill joints or cracks greater than 3/8 inch (10 mm) wide with portland cement mortar. In addition to the above, remove oil and grease from surfaces for Type 3 membranes using water and a detergent designed to remove oil and grease from concrete. Flush residual detergent from the surface. Do not allow traffic on the cleaned surface.

**Primer Coat.** Apply the primer coat at the rate of 0.10 to 0.15 gallon (0.50 to 0.70 L) of asphalt material per square yard (square meter).

For primer coats applied between June 1 and September 1, use asphalt primer for waterproofing or emulsified asphalt primer conforming to 512.02.

For primer coats applied between September 1 and June 1, use asphalt primer for waterproofing conforming to 512.02.

If practical, apply asphalt emulsion using spray equipment.

If subjected to traffic, spread sand on the primer coat for protection. Broom off excess sand before applying asphalt waterproofing.

**Type A Waterproofing.** This type of waterproofing consists of one primer coat and at least two coats of asphalt material conforming to 702.06 to provide a total of at least 1 gallon (5 L) of asphalt per square yard ( $m^2$ ) on flat areas and at least 1/2 gallon per square yard ( $3 L/m^2$ ) on vertical or sloping surfaces. Start applying the waterproofing at the lowest point, and progress to a higher elevation. Uniformly cover the surface except apply more asphalt in corners and over construction joints. Apply the asphalt material at a temperature from 250 to 350 °F (121 to 177 °C).

**Type B Waterproofing.** This type of waterproofing consists of one primer coat, three coats of asphalt material conforming to 702.06, and two layers of waterproofing fabric conforming to 711.24 applied as follows:

1. On a clean, dry, and well-primed surface, apply a thorough coating of asphalt at a temperature from 250 to 350 °F (121 to 177 °C).

## 512.08

2. Apply the coating at a rate of at least 1/3 gallon per square yard (1.5 L/m<sup>2</sup>) of surface.

3. While the asphalt is hot enough to penetrate the fabric, lay the fabric according to the following:

a. Surfaces Wider than Normal Fabric Strip. For the first strip, lay a half-width [normally 18 inches (0.5 m) wide] strip of fabric. For the second strip use a full-width strip of fabric, and lap the entire width of the first strip. Lap each succeeding strip 2 inches (50 mm) more than half its full width. Lap the fabric strips in the direction of water flow.

b. Surfaces with Same Width as Fabric Strip. For the first strip, lay a full-width strip. For the second strip, lay another full-width strip, covering the first.

Lay each strip without wrinkles, folds, or pockets. Thoroughly coat the strip with asphalt for the full width of the lap before laying the succeeding strip. Each application shall entirely conceal the texture of the fabric.

4. Apply a final coat of asphalt to provide a thorough covering for the fabric.

5. For all three coats, use a total of at least 1 gallon (5 L) of asphalt waterproofing material per square yard (m<sup>2</sup>).

Lap ends of fabric strips at least 12 inches (0.3 m), and stagger the end joints.

**Type D Waterproofing.** This type of waterproofing consists of one primer coat, one layer of waterproofing fabric conforming to 711.24 over joints, three coats of asphalt material conforming to 702.06, and two shingled plies of asphalt saturated waterproofing fabric conforming to 711.24.

Prime the surface to be waterproofed and allow the primer to dry. Fill joints and irregularities in the surface with asphalt cement. Lay a layer of fabric extending at least 9 inches (230 mm) on both sides of all joints. Leave the underside of this layer unbonded to the concrete surface.

Apply the asphalt at a temperature from 250 to 350 °F (121 to 177 °C) and conceal the texture of each layer of fabric with the asphalt. Use at least 1/3 gallon (1.5 L) of asphalt per square yard (m<sup>2</sup>) of surface for each application. Begin applying the asphalt and fabric at the low side or sides of the surface, and proceed toward the apex or high side so that water runs over and not against or along the laps of the fabric. Lay the fabric without wrinkles, folds, or pockets. Lap ends of fabric strips at least 12 inches (0.3 m), and stagger the end joints.

Start applying waterproofing by mopping asphalt on a surface slightly wider than half the width of the fabric strip. Immediately lay a half-width strip of the fabric onto the asphalt. Mop asphalt on this strip and an adjacent surface slightly wider than half the width of the fabric, and lay a full width of fabric that entirely covers the first strip. Mop asphalt on the second half of this second strip and an adjacent concrete surface and lay a third strip of fabric that laps the first strip at least 2 inches (50 mm). Continue this process of applying asphalt and laying fabric until the entire surface is covered and each strip of fabric laps the next to last strip already placed by at least 2 inches (50 mm). Finish laying fabric with a partial-width strip and mop the entire surface with asphalt.

**Type 2 Membrane Waterproofing.** This type of waterproofing consists of a rubberized asphalt and peel-and-stick waterproofing membrane 711.25. If the ambient temperature is below 50 °F (10 °C), use a manufacturer recommended primer coat for vertical surface application. After installing the primer coat, if required, remove the membrane's release liner and place the adhesive side on the prepared concrete surface. Lay the membrane smooth and free of wrinkles. Lap joints in membranes by at least 1 inch (25 mm). Store membrane materials indoors at temperatures not to exceed 120 °F (49 °C).

For precast concrete three- and four-sided structures, install Type 2 membrane on the exterior vertical and exterior top horizontal surfaces.

**Type 3 Membrane Waterproofing.** This type of waterproofing consists of a primer coat conforming to 705.04 and a waterproofing membrane consisting of a high density asphalt mastic between two layers of polymeric fabric conforming to 711.29.

Keep membrane and primer materials dry before installation.

Heat the membrane primer in an oil primer heated, double-jacket kettle. Use a kettle that is clean and free of other materials with any obvious buildup scraped out. The Contractor may use a single-jacket kettle if the primer is capable of being heated in direct fire to the application temperature. Heat primers within the manufacturer's recommended temperatures.

On bridges with curbs, apply the primer and membrane 3 inches (75 mm) up the curb face. On prestressed box beam bridges with no approach slab, apply the primer and membrane 6 inches (150 mm) over the ends of the beams. On prestressed and slab bridges with approach slabs, apply the primer 2 feet (600 mm) out onto the approach slab.

If the plans require a Type 3 membrane on the top exterior surface of precast concrete three- or four-sided structures, apply the primer and membrane to overlay the vertical exterior sides of the structure by 12 inches (300 mm).

Apply primer no further than 5 feet (1.5 m) in front of the membrane using a squeegee to fill all voids and imperfections. Apply membrane from the low to the high side of the surface. Apply an extra bead of primer at the edge of the membrane. Lap joints in membranes by at least 3 inches (75 mm). After installing the membrane over the entire surface, seal joints in the membrane by applying primer and smoothing with a V-squeegee.

**512.09 Method of Measurement.** The City will measure Waterproofing, of the type specified, by the number of square yards (square meters) or on a lump sum basis.

The City will measure sealing of concrete surfaces by the number of square yards (square meters) of coated area projected to a two-dimensional surface.

The City will measure the sealing of concrete bridge decks with HMWM resin and treating concrete bridge decks with SRS as the actual area in square yards (square meters) of surfaces treated.

The City will measure the actual length in linear feet (meters) of crack repaired by epoxy injection.

**512.10**

**512.10 Basis of Payment.** The City will pay for accepted quantities at the contract prices as follows:

The City will consider the cost for the obtaining and repairing the two cores used by the Engineer to determine the extent of the epoxy penetration as incidental to the work of repairing the concrete by epoxy injection.

| <b>Item</b> | <b>Unit</b>                                   | <b>Description</b>                                       |
|-------------|---|--|
| 512         | Square yards<br>(square meter)                | Sealing of concrete surfaces                             |
| 512         | Square yards<br>(square meter)                | Sealing of concrete surfaces<br>(non-epoxy)              |
| 512         | Square yards<br>(square meter)                | Sealing of concrete surfaces<br>(epoxy urethane)         |
| 512         | Square yards<br>(square meter)                | Sealing of concrete bridge<br>decks with HMWM resin      |
| 512         | Square yards<br>(square meter)                | Treating concrete bridge<br>decks with SRS               |
| 512         | Square yards<br>(square meter)                | Treating concrete bridge<br>decks with Gravity-Fed Resin |
| 512         | Linear feet<br>(meters)                       | Concrete repair by epoxy injection                       |
| 512         | Square Yard<br>(Square Meter)<br>Lump Sum     | Type A Waterproofing                                     |
| 512         | Square Yard<br>(Square Meter),<br>or Lump Sum | Type B Waterproofing                                     |
| 512         | Square Yard<br>(Square Meter),<br>or Lump Sum | Type D Waterproofing                                     |
| 512         | Square Yard<br>(Square Meter),<br>or Lump Sum | Type 2 Waterproofing                                     |
| 512         | Square Yard<br>(Square Meter),<br>or Lump Sum | Type 3 Waterproofing                                     |