

**ITEM 01555.8001 M - CRACK SEALING BY EPOXY INJECTION (PREVENTION)**

**ITEM 01555.8002 M - CRACK REPAIR BY EPOXY INJECTION (RESTORATION)**

**DESCRIPTION:** Install injection ports, seal the crack opening, inject the crack with epoxy (full depth for restoration work, or as deep as conditions allow for prevention work), and restore the sealed surface to a flush condition in areas visible to the public. Perform the work at locations indicated on the contract plans or where directed by the Engineer.

PREVENTION - use in contaminated, cracked concrete areas to prevent movement and protect reinforcing.

RESTORATION - use in uncontaminated cracked concrete areas to restore structural integrity. Take verification cores for payment. Have an experienced epoxy manufacturer representative present until the work is acceptable to the Engineer.

**MATERIAL REQUIREMENTS:**

1. Crack Sealant - epoxy paste that completely cures in 4 hours or less and retains the injected epoxy. Any other type of crack sealant is subject to a project demonstration and approval by the Engineer.
2. Low Viscosity Injection Epoxy - Manufacturer certified to meet ASTM C881, Type I or IV, Grade 1, Class B or C (as temperature conditions require.)
3. Vertical & Overhead Patching Material (Approved List) - (for ITEM 01555.8002 M) §701-08

**INJECTION EQUIPMENT:** Use equipment in good working order, as approved by the Engineer, with the following features:

- Separate feed lines to the mixing chamber
- Automatic mixing and metering pump
- Ability to thoroughly mix the epoxy components in the mixing chamber
- Operator control of the epoxy flow from the mixing chamber
- Clean, legible, accurate pressure gauges easily viewable by the operator
- Ability to provide an uninterrupted pressure head to continually force epoxy into the cracks
- Injection pressure from 0 to at least 1.4 MPa
- Capable of metering each epoxy component to within 3.0% of the epoxy manufacturer's mix ratio

Unreacted epoxy components may be stored overnight in separate reservoirs and feed lines.

Before starting the work, demonstrate to the Engineer the ability of the equipment to meter and mix epoxy components to the required mix ratio. Ratio accuracy may be determined by simultaneously metering each component into separate, clean, accurately graduated, volumetric containers, or another procedure approved by the Engineer. Also, activate the automatic mixing and metering pump, mix a small amount of injection epoxy, and waste it into a disposable container. The Engineer will observe this trial operation and be satisfied the equipment is working properly, and the epoxy is mixed with no streaks.

**CONSTRUCTION DETAILS:**

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1. Crack and Surface Preparation. Remove all debris or contaminants accessible within the cracks by using hand tools, water blasting or oil-free high pressure air blasting, vacuuming, or other methods suitable to the Engineer. Epoxy resin will not penetrate: compacted, water or oil soaked debris. Allow free moisture within the crack to be absorbed before injecting epoxy. Remove all materials, including moisture, from the surface adjacent to the crack which might interfere with bonding of the crack sealant.
2. Injection Port Installation. Attach injection ports to the prepared surface by placing them onto (surface adapters) or into the cracks (socket ports) and affixing with crack sealant. Larger cracks may be ported by inserting an anchored tube into the crack.

Use positive connection port designs to connect injection equipment to the ports. Other injection port designs and attachment methods, where worker fatigue would not be a problem, require approval by the Engineer.

Use the following general guidelines for spacing injection ports when cracks are uniform in width through the structure. For cracks that get tighter with depth, double this spacing. Intermediate ports may be placed for observation. To permit maximum flow into the void, position ports on the wider crack sections and at intersections, rather than at an exact spacing.

If these guidelines cannot be followed, use port locations approved by the Engineer. Port spacing may be modified by the Engineer as experience is gained, or when cores are taken to determine penetration.

**FOR CRACKS COMPLETELY THROUGH A MEMBER**

- A. Cracks accessible from one side - space the ports not less than the thickness of the member.
- B. Cracks accessible from both sides - space the ports not less than twice the thickness of the member and stagger them relative to the ports on the opposite side. Make the stagger between ports (on opposite sides of the member) at least the thickness of the member.

Place the endmost ports at the ends of the crack so as to insure complete filling of the crack.

**FOR MULTIPLE CRACKS ALL OVER A MEMBER.**

Space the ports as far apart as practical, but not less than 200 mm from one another. A 200 mm spacing presumes a 100 mm penetration in each direction, if the adjacent ports are not plugged when epoxy reaches them. For fine cracks that taper to an end, place the endmost ports about 100 mm from the end.

3. Crack Seal. After port installation, seal the crack opening with crack sealant, being careful not to plug the injection ports. Allow the crack sealant to cure completely before injecting epoxy.

Apply crack sealant only when surface and ambient temperatures are above 10°C.

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4. Port Flushing. Prior to any epoxy injection, flush critical ports with oil-free compressed air to verify that air exits from all the installed ports, dry the cracks, and check for leaks.
5. Epoxy Injection. Perform epoxy injection only when the surface and ambient temperatures are above 7°C and are not expected to fall below 7°C during the next 24 hours.

UNIFORM WIDTH CRACKS - start toward the middle of a horizontal crack and work outward, or the lowest point of a sloping or vertical crack and work upward.

VARIABLE WIDTH CRACKS - start at the widest points of all types of cracks and work outward. Secure the feed line to the first port. Initiate and continue flow until epoxy exits from the adjacent port. (Plug observation ports and continue through the same port to achieve maximum penetration.) Temporarily stop the injection process, remove the feed line, and seal the port. Attach the feed line to the adjacent port and repeat this procedure along the crack until the last port is sealed.

Generally, use higher pressures when injecting narrow deep cracks, medium to low for wider cracks, and lowest pressures when injecting a delaminated area or an area susceptible to lifting. Low pressure applied for a longer duration is often more effective than high pressure applied for a shorter duration.

Replenish the epoxy supply in the mixing equipment before it is exhausted. Thoroughly stir each epoxy component both before and after adding it to its respective component in the mixing equipment. Exercise care to assure a continuous injection operation.

Allow the epoxy to fully cure prior to performing subsequent work in the repaired area.

In the event of leakage from a crack, stop the injection process until the leak is sealed. When any work stoppage exceeds 15 minutes, clean the mixing chamber and flush the line that carries mixed epoxy. Flush with a suitable solvent, followed by air.

6. For ITEM 01555.8002 M CRACK REPAIR BY EPOXY INJECTION (RESTORATION), take cores ranging in diameter from 25 to 100 mm, as approved by the Engineer, to verify full penetration by epoxy and its cure. Take a representative core from each structural element, or one from every 30 meters of crack repaired, whichever is greater, at locations approved by the Engineer. The Engineer will retain the cores and determine if they are acceptable for payment. Patch the holes with Vertical & Overhead Patching Material.

More than one core may be necessary to obtain an acceptable sample from cracks that diverge below the surface. (To avoid cutting reinforcing, the core drill may be angled to intercept a crack behind the reinforcing.)

7. Clean Up. In all areas visible to the public, as determined by the Engineer, remove spillage, the ports and crack sealant until flush with the adjacent surface. Remove stains and repair any damage to the satisfaction of the Engineer at no additional cost.

**METHOD OF MEASUREMENT:** The Engineer will measure the work as the number of linear meters of crack sealed or repaired, as specified.

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**BASIS OF PAYMENT:** Include the cost of all labor, materials, and equipment necessary to complete the work in the unit price bid per linear meter. For ITEM 01555.8002 M CRACK REPAIR BY EPOXY INJECTION (RESTORATION), also include the cost of coring and repairing the core holes.

For ITEM 01555.8001 M CRACK SEALING BY EPOXY INJECTION (PREVENTION), the Engineer will authorize payment after the measured length of crack has been sealed and the surface cleaned.

For ITEM 01555.8002 M CRACK REPAIR BY EPOXY INJECTION (RESTORATION), the Engineer will authorize payment after the measured length of crack has been repaired as verified by cores, the core holes patched and the surface cleaned.