

TECHNICAL SPECIFICATIONS

EPOXIES

SPECIFICATION NAME

GENERAL GUIDE for INJECTING EPOXY

MANUFACTURER

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SPECIFICATION DESCRIPTION

1. Grouting and Sealing Cracks

ACI 504 70 describes practices for sealing of cracks including design, material available, and methods of application. Before grouting or sealing structural cracks, it should be determined whether they are working cracks, i.e., opening and closing with changes in temperature or moisture content. Concrete movements can be restrained by bonding with epoxy compounds if the resulting stress does not exceed the strength of the concrete being bonded. Where restraint of large movements is attempted, it may cause the formation of the new cracks in neighboring locations. When this problem is anticipated it is necessary to correct the condition that causes movement before repairing. If this is not possible, it is then necessary to seal the crack with an epoxy that allows the crack to move without restraint. Depending on the size and stresses involved the following epoxies are suitable for injecting cracks.

Denepox I – 40

Denepox I – 60

Denepox I – 150

Denepox I – 300

Denepox Gel 125 – for use in larger, moving cracks.

2. Surface Seals

The first step in filling a crack by injecting liquid epoxy resin adhesive is to provide a surface seal or dam on all faces of the crack so that the liquid resin will not leak and flow out of the crack prior to gelling and curing. If unexposed faces of the concrete cannot be reached, crack repair by pressure injection is extremely difficult unless special steps are taken. Where the crack face cannot be reached but where there is backfill, or where a slab on grade is being repaired, the backfill material or sub-base material is often an adequate seal in itself. There are two methods used to provide this seal.

2.1.1 Routing.

Frequently the cracks are V-grooved or routed to a depth of about 1/2 inch (13mm) and a width of approximately 3/4 inch (19mm) by the use of light chipping hammers or a grinding tool. The V-grooved crack is then filled with a non-sagging epoxy adhesive compound or mortar which is applied like putty and then struck off flush with the concrete surface such as **Denepox Rapid Gel** or **Denepox Gel 50** where movement may be a factor. This type of seal is used most frequently where very high injection pressures are expected.

2.1.2 Surface Dam.

An alternate method of sealing or damming the surface is to use a surface seal which is merely applied to the face of the crack and which completely bridges the crack. Frequently, the material used here is also a non-sagging epoxy adhesive which sets rapidly such as **Denepox Rapid Gel**. In some cases, a thermoplastic seal is used where the sealing material is applied at an elevated temperature.

3. Entry Ports.

To inject the adhesive material through the surface seal, entry ports must be provided. Three methods are in general use:

3.1 Drilled Holes - Fittings inserted.

The method which was historically first used is to drill a hole into the crack into which a fitting is placed. These fittings are bonded with the same epoxy, which is used to fill the V-grooved portion of the crack (mechanical fittings can also be used). If the structure is made up of Concrete Block or Brick, care should be taken to avoid drilling through the Concrete block or Brick. **(It will be necessary to check the cells in the block to see if they have been filled. If the cells have not been filled with mortar, it may be necessary to fill the effected cells surrounding the crack)**. If at all possible, the holes should be drilled through the mortar joint. Brick should be treated the same, especially the face brick.

3.2 Bonded Flush Fitting.

When the cracks are not V-grooved, a method frequently used to provide an entry port is to bond a fitting flush to the concrete face over the crack. This flush fitting has a hat-like cross section with an opening at the top for adhesive to enter. **Denepox Rapid Gel** adhesive is recommended for the V-groove and for bonding the fittings to the substrate.

3.3 Interruption In Seal.

Another system of providing entry is to omit the seal from a portion of the crack. This method can be used when special gasket devices are used that cover the unsealed portion of the crack and allow injection of the adhesive directly into the crack without leaking. **Denepox Rapid Gel** is recommended for the seal.

4.0 Mixing The Adhesive.

This is done either by batch or continuous methods. In batch mixing, the adhesive components are premixed according to the manufacturer's instructions, usually with the use of a mechanical stirrer, like a paint paddle. Care must be taken to mix only the amount of adhesive that can be used prior to the material beginning to gel. When the adhesive material begins to gel, its flow characteristics begin to change and pressure injection becomes more and more difficult. In the continuous mixing system, the two liquid adhesive components pass through an automatic mixing head. This system allows the use of fast-setting adhesives that have a short working life in a larger mass.

5.0 Pumping The Adhesive.

To get the mixed adhesive into the crack, some means of providing pressure and flow is required. The following methods are typical:

5.1 Pressure Pot.

Perhaps the most frequently used method is that of forcing the material with air pressure from a standard paint pressure pot through hoses to the entry port. The adhesive may be placed in a disposable container within the paint pot.

5.2 Caulking Gun, Air Or hand Actuated.

A common method is to fill a caulking cartridge with mixed adhesive and apply pressure.

5.3.1 Hydraulic Pumps.

Another method is to drive the adhesive through hydraulic pumps, which receive the adhesive from reservoirs. The adhesive material can be either gravity-fed or force-fed to the driving pumps.

5.4 Injecting the Adhesive.

The mixed adhesive travels to the port and enters the injection port through a connection fitting appropriate to the type of port fitting which has been attached to the concrete. The adhesive is injected into the crack through successive adjacent port. Care must be taken to inject the adhesive at such a rate that the pressure required to inject does not exceed that pressure which the surface seal can tolerate or which might damage the structure.

6.1 Horizontal Concrete.

In a horizontal member, such as a floor, injection proceeds from one end of the crack to the other through adjacent ports. When possible, the crack is injected from the bottom of the horizontal concrete member filling upward.

6.2 Vertical Concrete.

In vertical concrete members the injection takes place from the bottom up through adjacent ports. Care must be taken not to trap air pockets.

6.3 Concrete Block and Brick Walls.

Application will be the same as stated for Horizontal and Vertical Concrete.

7. Making Sure The Crack Is Full.

During injection operations, it is very difficult to be sure that the crack is completely full. Personal experience of the applicator is very important. Ultrasonic testing methods to determine whether the crack has been filled have been perfected, but the limited dissemination of this technology restricts the availability of this control method. The only practical method widely available is by drilling concrete cores. One or the other of these methods is absolutely necessary where assurance of a sound structural bond is required.

7.1 Order of Injection.

The crack must always be filled through successive ports, beginning at the lowest one. Injection must continue through one port until adhesive material starts to come out of the next port. At this point, the first port must be capped off and injection started on the port that has just begun to show adhesive.

7.2 Location of Ports.

Entry ports should be spaced far enough apart to assure that when the adhesive materials show at the adjacent port, it has completely filled the crack to its full depth. Normally, they would be spaced only as far apart as the depth of penetration desired.

7.3 Calculations of Theoretical Amount Required.

A usual technique in helping indicate whether the crack is filled is to estimate theoretical void by measuring the width of the crack and the dimensions of the concrete member. Injection proceeds until the theoretical amount has entered the crack plus a safety factor (1.5:1 has proved suitable). If the theoretical amount cannot be injected, the cause should be determined. The possibility of undetected voids of undetermined size connecting with a crack must be recognized and the gross amount of material to be injected determined and limited.

7.4 Maintaining Pressure.

If pumping pressure cannot be maintained in a crack that is otherwise apparently full, the reason should be determined. Inability to maintain pressure indicated that the adhesive material could be leaking out through a broken seal or vent hole, or could be draining into concrete cracks, or passing through the member into voids on the other side.

8.0 Removing the Surface Seal.

After the injected adhesive has cured, the surface seal should be removed by grinding or whatever means are necessary. Fittings and holes at entry ports should be filled with an epoxy-patching compound.

9.0 **Adhesive Properties.**

Ideally, the adhesive used should be compounded for pressure injection into cracked concrete. It should be pumpable, readily assimilated into small cracks by capillary action and should have the capability of bonding through a layer of dust or concrete fines that might exist inside the crack.

10.0 **Contaminated Cracks.**

Cracks that have been contaminated with oils, grease, food particles, or chemicals present special problems unless the crack can be cleaned sufficiently to allow adequate adhesive penetration and bond pressure grouting will not be an effective repair procedure. Dirt or fine particles of concrete also prevent penetration. They must be removed by flushing with water, followed by drying or blown out using compressed air. Reference ACI 50.3R.

11.0 **Gravity Feed Method.**

Pouring a thin viscosity resin directly into the crack and allowing gravity to pull the liquid downward will ultimately seal the crack. The following considerations should be noted. Provide a removable dam to the surface area adjacent to either side of the crack. (plumbers putty, caulking compound or any type of removable putty) This will form a reservoir for the epoxy and create a small amount of head pressure. Epoxy should be poured until the crack will take no more. Allow sufficient time for the epoxy to cure. It may be necessary to pour a small amount and allow the material to cure in order to seal the bottom of the crack. Once the bottom has been cured the balance of the crack can be filled. Remove the putty from the floor by scraping with a putty knife. Cured epoxy may be scraped or ground off using a grinder.

End of Section
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