



# Installation Guide for Epoxy Structural Grouts TDS 431

## Preparation of Concrete Substrate:

The concrete substrate to receive the structural grout must be free of grease, oils, laitance, debris, carbonation and other contamination. A sound, bone-dry substrate is required. The best bond is achieved when the top surface of the concrete has been removed by chipping to expose large amounts of coarse aggregate. The surface preparation may require removing the surface to a depth of ¼” (6 mm) or more. It should be noted that sandblasting and acid etching may not leave the concrete surface sufficiently rough for good bond. The aggressive chemical action of acid etching causes a weakening of the cement paste. However, sandblasting may be satisfactory preparation for small, non-critical projects.

## Preparation of Baseplates and Sole Plates:

The baseplate/sole plate to be grouted should be sanded or sandblasted to a white or bright metal condition. Sandblasting produces the best profile for epoxy bonding. All oil, grease, paint, and other contamination must be removed. To assure rusting does not occur, it is best that the sanding or sandblasting be performed no earlier than 24 hours before grouting. The surface to be grouted against must remain free of moisture at all times. If moisture is present at the time of grouting, voids will develop at the interface between the epoxy structural grout and the underside of the baseplate/sole plate. Many large baseplates/sole plates employ vertical stiffening beams. At the intersection of these beams a cavity is formed and air can be entrapped here during the placement of the epoxy structural grout. The entrapment of air can be eliminated by placing a 1/8” (3mm) hole through the baseplate/sole plate near the intersection of the beams. This will allow the air to escape and prevent the formation of a void.

## Forming for Epoxy Structural Grout Placement:

Epoxy structural grouts ([L&M™ EPOGROUT™ 758](#)) require more physical effort to place than cementitious grouts. The formwork must be very rigid. All forming must be made watertight by sealing all seams and joints with a caulking or sealing compound. The formwork must be protected from the epoxy structural grout. Two methods that have proved successful are: (1) placing polyethylene sheets between the formwork and the grout and (2) coating the forms with paste wax. If the wax method is used, two coats of paste wax should be applied and polished. A third coat should be applied and not polished. This is to allow a surplus of wax at the surface of the form that is to come into contact with the epoxy structural grout.

When placing a very workable epoxy structural grout the formwork must not butt against the baseplate\sole plate. The formwork should be designed so that a shoulder of grout is formed around the baseplate\sole plate approximately 2” (51 mm) wide. This allows the grout to flow from under the baseplate\sole plate taking with it entrapped air and voids.

In order for the grout to maintain contact with the bearing area of the baseplate/sole plate, the formwork must extend at least 1” (25mm) higher than the highest point to be grouted. If a head box is to be used to place the grout, the head box must extend at least 8” (200 mm) higher than the highest point to be grouted. The head box must be constructed to allow the structural grout to be physically pushed under the baseplate\sole plate. If the



epoxy grout is to be placed in a stiff consistency, dry packed, it will be necessary to restrain the movement of the grout by placing a form against the baseplate/sole plate at the end opposite of the direction of the packing motion.

*Note: Plastic sheets should be used to protect the surrounding area and equipment from epoxy spills and splashes.*

## **Tools and Equipment:**

- A variable speed electric drill fitted with a jiffy type mixer for the pre-mixing of the resin and hardener components (batches of one unit size).
- For large batches, a clean dry mortar mixer free of mortar with tight fitting rubber wipers is preferred.
- Concrete mixers are not recommended as they will not properly mix the grout and will entrap a great amount of air in the grout.
- Always have emergency backup mixing capability available.
- For transporting large amounts of grout, have a clean, dry, wheelbarrow.
- Bucket and shovels for placement.
- Rubber gloves, dust masks, respiratory protection, and goggles for safety.
- Plastic sheeting to protect work environment and forms from contact with epoxy grout.
- A large amount of rags for cleaning tools and equipment.
- Aromatic solvent such as xylene or lacquer thinner for cleaning tools and equipment. Do not add to the grout.
- Other specialized equipment such as grout pumps and portable head boxes.
- Liquid dish washing soap and water
- Pea gravel and concrete sand for cleaning equipment.

## **Premixing the Resin and Hardener:**

Epoxy grout is a three-component product: resin, hardener, and aggregate. It is essential that the resin and hardener be mixed separate from the aggregate. The epoxy liquids must be mixed to a very precise ratio as stated in the product mixing instructions. If the unmixed resin and hardener are mixed in the presence of the aggregate it is very likely that a portion of the resin or hardener can become lost in the aggregate and never react, thereby reducing the total volume of epoxy binder. This will result in loss of workability and strength.

Premix or stir each liquid component separately to ensure uniform consistency before mixing.



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In order to obtain maximum performance from the epoxy structural grout, with the mixer in operation, pour the hardener (catalyst) into the container holding the resin and mix. If the resin is poured into the hardener, the chemical reaction will accelerate and working time can be greatly reduced. Carefully inspect all empty resin and hardener containers for residue to ensure that the mix ratio of resin and hardener is in balance. The resin and hardener should be slowly mixed together for at least 2 minutes after all of the hardener has been poured into the resin. A ½" (13 mm) variable speed reversible electric drill fitted with a jiffy type mixer is best for this operation. The speed and direction of rotation of the electric drill must be adjusted to avoid the entrapment of air during the mixing operation. The electric drill's direction of rotation must be set such that the mixing action produces a vortex that pulls the liquid up from the bottom of the container to the top. A downward flowing vortex will entrap air. If air is entrapped in the epoxy after the grout has been placed, the entrapped air will migrate to the underside of the baseplate/sole plate and collect as foam. The presence of foam will greatly reduce the load carrying capability of the epoxy grout pad.

*Note: All equipment being used to mix the epoxy hardener and resin should be cleaned every hour. If this procedure is not followed flash set may occur.*

## **Adding Aggregate to the Liquid Epoxy Binder:**

### **First batch, special instructions:**

Note: During the first batch some of the epoxy binder will be lost in coating the inside of the mortar mixer. It is a good practice to reduce the aggregate content of the first batch. The amount of aggregate reduction will depend on the size of the batch and the size of the mortar mixer. This aggregate reduction will accommodate the coating requirements of the mortar mixer and provide a good volume balance between the epoxy binder and the aggregate, while maintaining good working and placing characteristics.

### **Mixing Large Batches:**

Place the pre-mixed epoxy binder into the tub of the mortar mixer. With the mortar mixer running slowly add the aggregate. Care should be taken not to overload the mixer with too much aggregate at once to the point of stalling. After all the aggregate is in, continue mixing for 3 to 5 minutes until all the aggregate is uniformly coated with the epoxy binder.

### **Mixing Small Batches:**

Place all the pre-mixed epoxy binder into a pail or tub. With the mixing equipment (electric drill fitted with a jiffy type mixer) in operation, add the aggregate slowly into the tub or pail. The mixing operation must be continual until the aggregate is uniformly coated with the epoxy binder. This operation should take 3 to 5 minutes. During the mixing operation it may be necessary from time to time to push the dry aggregate at the top midway down into the pail or tub. This is best done by turning off the electric drill and raising the jiffy mixer out of the grout and pushing down as the electric drill is turned on.

**Caution:** All the ingredients in each unit of epoxy grout are precisely proportioned. Any variation from these set proportions can produce epoxy structural grout of poor quality. ***Broken or partial units of epoxy components should not be used.*** Only materials found in the manufacturer's pre-packaged unit may be mixed into the epoxy grout. ***No other additives are allowed.***

### **Working Time:**

The working time of an epoxy grout is measured from the time the resin and hardener are mixed. The primary factor influencing the working time, other than the chemistry of the product, is the temperature of the grout at the

time it is being worked. Using 70°F (20°C) as a base line, temperature rising 18°F (10°C) will reduce the working time by half and a decrease of 18°F (10°C) will double the working time. The temperature of the aggregate has a great influence on the initial temperature of the grout. The epoxy binder when first mixed with the aggregate will quickly reach the same temperature as the aggregate. As the epoxy binder becomes chemically active, heat will be generated. It is the aggregate component, acting as a heat sink that helps control the temperature rise of the epoxy grout. If the temperature of the epoxy grout were allowed to rise without control it would very quickly stiffen to the point that it could no longer be placed. If the mixed epoxy binder is allowed to stand without aggregate it will undergo a dramatic heat buildup, which will cause the grout to stiffen very rapidly to the point that it can no longer be placed.

## **Cold Weather Grouting:**

At temperatures below 60°F (15°C), the viscosity of the epoxy binder can be very thick, making for a very stiff structural grout. In this temperature range, the working and curing time will be extended. The strength gain will be slower than at 70°F (20°C).

In periods of cold weather, it may be necessary to pre-warm the epoxy grout components, baseplate/sole plate, and the foundation. The resin and hardener, in their containers, may be warmed by storing in a warm protected room or immersing in warm water (water temperature not greater than 100°F (38°C)). The temperature of the resin and hardener should not be allowed to rise above 85°F (29°C). The aggregate should be stored in a warm area for at least 24 hours, allowing the aggregate to achieve a temperature as close to 70°F (20°C) as possible. The baseplate/sole plate and foundation at the time of grouting should be brought to a temperature between 50°F (10°C) and 70°F (20°C). This may be achieved by warming with electric heating blankets or by tenting the area and heating using infrared heaters or dry forced air free of petroleum pollutants. Strength gain over time is a function of curing temperature. If a certain strength is expected within a given time, it may be necessary to continue warming the grouted area until the required strength is achieved.

## **Hot Weather Grouting:**

As the grout temperature approaches 85°F (30°C) the working time of the grout will be approximately one half of the working time at 70°F (20°C). At 85°F (30°C) and above, placement may become very difficult and steps to control the temperature of the epoxy structural grout and its immediate environment will become necessary. The baseplate/sole plate and foundation should be shaded from sunlight for at least 24 hours. If more aggressive cooling methods are used, they must not allow the area to be grouted (between the baseplate/sole plate and foundation) to become wet. The goal is to bring the grout, baseplate/sole plate and foundation to approximately 70°F (20°C). This may be very difficult to accomplish. Lowering the temperature of the grouting environment will aid placement and improve curing. The aggregate should be placed in a cool, dry environment for at least 24 hours. The unmixed unopened cans of epoxy resin and hardener may have their temperature lowered by being placed in a tub of ice water. In very hot weather it may become necessary to schedule grout placement for the coolest part of the day or night.

## **Grout Placement:**

Check all formwork, concrete substrate, baseplates/sole plates for compliance with the requirements of this guide. Have all scheduled equipment, materials, and personnel present at the location to be grouted to ensure continual production and placement of grout on a timely basis. Take temperature readings to ensure compliance with requirements. Grout all holes, bolt holes, and anchor sleeves first. Then begin grouting from one end of the formwork and continue until the entire void is filled. Do not place from opposite sides. Grouting from two directions should be avoided, as this method will entrap air and create undesirable air voids under the plate.



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The careful use of banding straps may be employed to move the grout into confined areas. Over-vibrating or excessive strapping should be avoided. If grout is being placed by pump, the discharge end of the hose should be placed at the most distant point to be grouted. As the grouting continues the hose should be withdrawn making sure the discharge end of the hose remains in the mass of the grout. If the discharge end of the hose is removed from the mass of the grout, the grout will flow in two directions, causing undesirable air voids under the plate. When a head box is used to place grout, the head box should be kept full of grout at all times during the grouting procedure. It is the weight of the grout in the head box producing a hydraulic head that forces the grout to move under the plate. If the head box is allowed to become empty, and then refilled, the placement of additional grout can entrap air, creating a void under the plate.

The grouting procedure should be continuous until the forms are overflowing with grout. This will ensure that all void areas under the plate have been removed. Throughout the grouting operation the formwork should be checked for leaks. Epoxy grout will not seal the leaks in time to prevent voids under the plate. The aggregate to epoxy binder ratio greatly influences the grout's flowing and working characteristics. Some epoxy grouts allow a reduction in aggregate content. This has three primary affects, one positive, and two negative: 1) The grout has greatly improved flowing and working characteristics, 2) the heat generated during the curing process may be increased and may affect the physical properties of the hardened epoxy grout if temperatures become too excessive, and 3) a resin-rich mix has a lower modulus of elasticity and is therefore more susceptible to creep. For this reason, structural grouts having the reduced aggregate content should not be used for deep pour grouting. While grouts using less than full aggregate loading will have better placement characteristics than those using the full aggregate loading, the working time will be somewhat less. This can become problematic in warm and hot weather. The amount of grout mixed at one time may have to be adjusted to prevent waste. Solvents should never be added to epoxy grout in the attempt to modify the grout's working or setting characteristics. These attempts always have a disastrous effect on the performance and service life of the grout. Consult the epoxy manufacturer for maximum allowable reduction in the aggregate component. Generally, a reduction in excess of 20% is not generally recommended.

## **Deep Pour Grouting:**

If a project requires a placement depth greater than the manufacturer's allowable depth for a single lift the grout will have to be placed in lifts. The minimum time between lifts should be 24 hours or when the exothermic temperature of the in place grout is within the manufacturer's limits. If this procedure is followed thermo-shrinkage will be nil and will result in a volume stable grout pad.

Epoxy grouts do have the capability, after a period of curing (hardening), of forming chemical bonds to freshly placed epoxy grout. The amount of chemical bonding decreases with maturity of the in- place epoxy grout. If the in-place epoxy grout is less than 72 hours old at the time fresh epoxy is placed over it, under normal conditions, a good chemical bond between lifts will be achieved. If the in-place epoxy grout is older than 72 hours at the time fresh epoxy grout is placed over it the bond will be primarily mechanical. In this case the surface preparation of the in-place epoxy grout becomes very critical. Optimum mechanical bond can only be achieved after the surface of the epoxy grout has been abraded exposing larger areas of aggregate. The epoxy grout surface to receive the next lift of epoxy grout must be free of grease, oils, laitance, debris, and other contamination. A sound, bone dry surface is required.

When planning multiple lift, deep pour grouting, it is a good practice to plan the lift size so that the last lift is one half the manufacturer's maximum allowable thickness for a single lift. If less than full aggregate loading for deep pour grouting is used, at depths of 2" (50 mm) and greater, the rate of heat loss from the epoxy grout is not sufficient to protect the grout pad from thermo-expansion and other forms of theme-degradation. Using less than the full aggregate load can cause the grout to undergo stress that can result in failure. Epoxy grouts with full aggregate loading require more time for placement. This is a special concern when placing grouts at the upper

end of the allowable temperature range. It is a good practice to reduce the amount of mixed grout on hand in order to prevent waste.

## **Curing:**

The curing rate of epoxy grouts is affected by temperature. The ideal curing temperature is between 70°F (21°C) and 77°F (25°C). If the temperature of the environment is below 50°F (10°C) or above 95°F (35°C), precautions must be taken to ensure that the curing temperature range of the grout is maintained between 50°F (10°C) and 95°F (35°C). At a 50°F (10°C) range the grout must be protected for a minimum of 48 hours, and at a 95°F (35°C) a minimum of 24 hours. If the temperature of the grout at the time of placement is below 40°F (4°C), crystallization of the resin may occur, and the ultimate strength of the grout will be substantially and permanently reduced. The curing rate for epoxy grout is very rapid as compared to cementitious grout. Most epoxy grouts are fully cured at 7 days, with most of the strength being developed during the first 1 to 3 days.

## **Storage and Handling of Epoxy Grout Components:**

All epoxy grout components should be stored in weather tight barns or warehouses. It is mandatory that the resin and hardener be maintained in a temperature range between 50°F (10°C) and 85°F (29°C). If the temperature of the liquid resin component reaches 40°F (4°C) or below, crystallization may occur. If crystallization occurs the resin will be insoluble in the presence of the hardener and will not properly chemically react to form a hardened mass. If this crystallization is apparent, the resin must first be heated to 160°F (71°C) by indirect heat (placing the resin in its container in hot water) and stirred until the crystals dissolve. The resin must be allowed to cool to normal grouting temperature range before mixing with the hardener. The aggregate component must remain completely dry from the point of manufacture to the time of mixing with the liquid premixed epoxy binder. If the aggregate component is allowed to become wet (or damp), the presence of moisture will create foam in the epoxy binder, which will in turn produce many thousands of small undesirable voids at the inter-face between the baseplate and the epoxy grout. Epoxy grout units that have leaking epoxy containers or broken aggregate bags should be discarded. All of the components of an epoxy grout unit have been very accurately proportioned to obtain the desired performance. Any departure from these proportions can produce a grout which will have less than desirable performance characteristics.

## **Cleaning Equipment:**

A very economical and efficient method for cleaning equipment uses both solvent and abrasive aggregate. The solvent will soften and dissolve the epoxy. Aggregate acts to extend the solvent and, with abrasive action, the aggregate mechanically cleans the surfaces coated with epoxy residue. Mortar mixers can be cleaned by placing about 55 lbs. (25 kg) of dry or damp concrete sand mixed with pea gravel or pea stone and 1 gal. (3.8 L) of aromatic solvent, such as xylene or lacquer thinner, into the mixer and mixing for 3 to 5 minutes. After discharging this mixture, a solution of soap, water and grit should be used, followed by a clean water rinse. Jiffy mixers and other equipment may be cleaned using the same technique.

*Note: Cleaning between batches is not recommended unless there is a long delay. Do not add solvent to epoxy grout mixture.*

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