



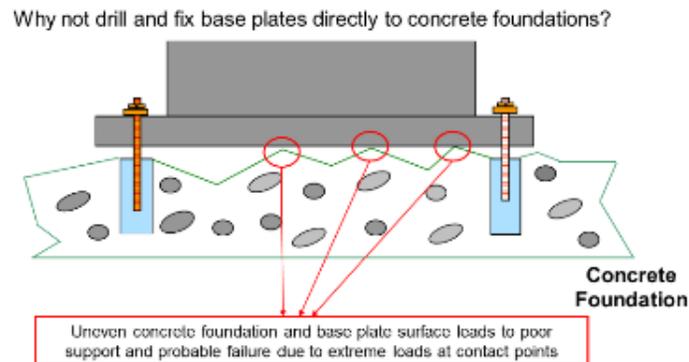
# A Guide to Epoxy Grouting

Proper Preparation,  
Mixing, Installation and  
Testing of Epoxy Grouts



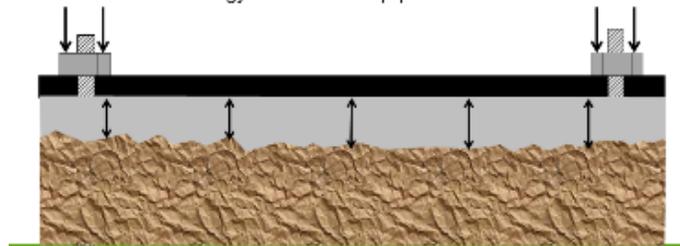
## Introduction

Epoxy Grouts are precision grouts, used to support and align critical equipment, transferring loads from the equipment baseplate to the foundation.



### A precision grout must:

- Fill void between equipment base and foundation
- Maintain contact between surfaces
- Allow load/energy transfer from equipment to foundation



Grouting materials are selected based on the type of load they will support. *Dynamic loads* are associated with reciprocating equipment, motors, generators, turbines etc. *Static loads* are associated with columns or non-moving equipment.

Epoxy grouts offer unique performance advantages in many applications. They achieve strength quickly, allowing fast return to service or commissioning of equipment. Greater bond to the underside of a prepped baseplate, density and lower modulus of elasticity help to absorb impact and vibration. Low shrinkage and high tensile and flexural strengths optimize load transfer ensuring stable, secure alignment and protecting equipment from unnecessary wear and tear. Chemical resistance properties ensure they are durable even in harsh industrial environments.

With more than 100 years of experience in precision equipment grouting, Master Builders Solutions is an early developer and pioneer in both cementitious and epoxy grouts. We understand not only the in-service performance demands that our grouts must meet, but also the inter-relationship between various physical properties and application criteria that must be carefully considered. Master Builders Solutions has applied advanced chemistry to balance the physical properties of compressive strength, bearing area, chemical and high temperature resistance, shrinkage and creep with the sometimes difficult yet also very important application enablers of flow and working time, to provide uncompromised and durable support, protecting the equipment investment by improving reliability, operating efficiency and life cycle of machinery.

The performance of any epoxy grout, in fact for most all construction materials, depends on the proper fit-for-purpose design, and the proper installation. This Guide to Epoxy Grouting is designed to help equipment manufacturers, engineers and specifiers, owners and contractors understand the Proper Preparation, Mixing, Installation & Testing of Epoxy Grouts to enable durable, quality, installations of MasterFlow Grouts.

Further information on the engineering properties, design protocols and testing methods related to epoxy grouting can be found on our website, or from any of our dedicated Master Builders Solutions technical experts across the globe

# Proper Preparation, Mixing, Installation & Testing of Epoxy Grouts

## Foundation Preparation

Before setting structural elements or machinery, all of the areas of the foundation which will be in contact with the grout, including anchor bolt holes, must be properly prepared. The concrete foundation surface must be thoroughly cured, and roughened as specified, to expose sound aggregate.

A fresh concrete surface may be uniformly roughened before it has set using a nail rake in one direction only. Use of a bull float, darby, broom, or wood float finish, or scratching at random with a garden rake or trowel is *NOT recommended*.

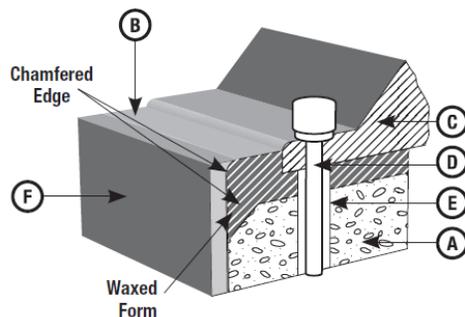
For hardened concrete foundations, hand held, pistol grip pneumatic hammers with chisel point heads are recommended for roughening to remove laitance and loose material. Use of large paving breakers equipped with bush hammers, spade or chisel bits, are *NOT recommended*. Where grout will extend horizontally out beyond the edge of the plate or object to be grouted, the foundation must also be prepared below these areas to help assure bond.

All laitance and unsound material must be removed, and the foundation must be free of oil, grease, wax, curing membranes and other contaminants. Surfaces should be clean and dry before application of the grout.

If an anchor bolt sleeve is to be filled, be sure all water is removed. Use a siphon, vacuum pump, or rubber hose and bulb. Remove the residual moisture by either forced air or evaporation. If the anchor bolt sleeve will not be grouted, seal the bolt hole with felt, foam rubber or other means. Cover all shims, anchor bolts and leveling screws to keep the grout from adhering. Use model clay, glazing putty or anything of a putty consistency which will stick but not harden.

Because the coefficient of thermal expansion of epoxy grout is higher than that of concrete or steel, grout that extends to the edge of a foundation that has a 90 ° edge can lift or tear the concrete just below that edge. Never place grout near the edge of a concrete foundation that has a 90 ° corner or edge. Chamfer the edge of the concrete 45 degrees to about a 2" (51 mm) width. Chamfering the foundation edge will spread the uplift load and reduce the potential for edge lifting.

Figure 1 - Regular Equipment



**Key:**

- |                        |                            |
|------------------------|----------------------------|
| A. Concrete Foundation | D. Anchor Bolt             |
| B. Grout               | E. Anchor Bolt Sleeve Seal |
| C. Equipment Base      | F. Form                    |

Protect the foundation and equipment from rain or moisture. Areas not to be grouted must be sealed off. Shade the foundation from summer sunlight for at least 24 hours before and 48 hours after grouting. Keeping the surface covered will make the later job of cleaning the surface prior to grouting much easier and less costly.

### **Plate and Equipment Preparation**

The bonding surfaces of the base or plate to be grouted should be sandblasted to “white metal” and be free of coatings, wax, grease or scale. Other mechanical methods such as grinding or sanding are also effective but do not produce as high a bond strength as sandblasting. However, where new plant and equipment have been surface finished with high quality coating systems (eg polyurethane), these need not be removed.

Primer should be used ONLY when a long delay between cleaning and grouting could allow excessive rusting or contamination. If the base must be primed, consult your local Master Builders Solutions Construction Systems Sales representative for a primer recommendation. If the primer has been on the surface for more than one month, abrade and solvent wipe it so that no residue remains

Since the grout will come up at least 1/2–3/4 inch (13–19 mm) onto the equipment, it may be advisable to mask above this area with masking tape. To permit easy clean up, wax or cover all surfaces where the grout may splash.

## Forming

Construction of forms and grouting should follow as soon as practical after erection and alignment of baseplates are completed. The forms should be compatible with (1) the placement method to be used, (2) consistency at which the grout will be placed, and (3) the distance the grout must travel. Forms should be built to facilitate continuous, quick and complete filling of the space with these factors in mind.

Forms must be liquid tight and strong enough to withstand the hydraulic pressure of the grout, without leaking. Materials used in building forms include wood (the most common), polystyrene, steel and on rare occasions such exotic material as plexiglass. Forming materials which absorb water, such as wood, should be coated with a good curing compound (such as MasterKure), form oil or plastic coating. These coatings prevent loss of water from the grout and act as bond breakers so that smooth grout surfaces result after form removal, and the forms are protected for reuse.

Seal wood forms to vertical concrete surfaces by applying putty or caulking below top of concrete, then press form into place. The points to caulk are the interfaces between the form and rough foundation surface where grout might leak out during its placement or before setting. Material used for caulking between the form and concrete surface may be joint sealants or epoxy mortars. Vertical joints in the forms should be caulked, especially if large cracks are evident. Caulking should be done on the outside edge of the form rather than the inside. The use of duct tape or “silver” tape applied on the inside of the form, at corners, is useful for this.

Grout is preferably placed from only one direction, so forms should include a placing side, exit side, and side forms, all of which direct and contain the grout under the object being grouted.

Forms should extend vertically a minimum of 1 inch (25 mm) or higher than the underside of the bedplate of the equipment to help ensure complete filling of the space to be grouted and prevent overflowing. The side forms should not be tight against the plate, but should be erected a minimum of 1 inch (25 mm) and a maximum of 6 inches (152 mm) from the edge base, rail or sole plate being grouted so that air being displaced is not trapped below the plate. Excessive edges create thermal stress and can result in cracking.

A 5 – 6 inch (127 – 152 mm) clearance is recommended at the area where the grout is to be placed. The vertical form on the exit side (opposite the placing side) should be extended 2 – 4 inches (50 – 100 mm) away from the plate so that straps or other placing aids can be inserted to assist movement of the grout should that become necessary. Large non-supporting grout areas should be eliminated wherever possible.

### *Head Box*



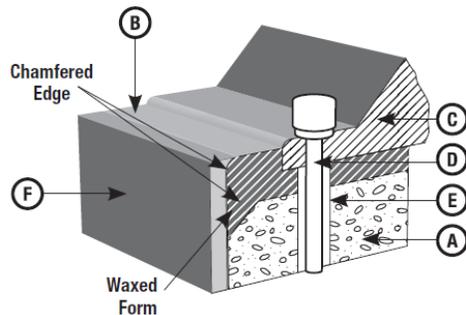
The form on the placing side can be constructed to extend 2 – 4 inches (50 –100 mm) horizontally from the plate at the foundation, slanted upward at an approximate 45 degree angle to facilitate placement. A back board, or splash board form should be built on top of the plate and at the plate edge, opposite the slanted headboard, to prevent spillage of grout and provide containment of the “head” of grout as it is being placed. This will allow grout to be placed with a minimum of turbulence (and entrapment of air bubbles) while directing it smoothly under the plate. The further the grout must travel horizontally, the higher the slanted head box should be for a given consistency. This is to provide “head” pressure to direct the grout around shims, leveling screws, bolts, keys and other obstructions, to the exit side.

Alternatively, moderately sized equipment such as turbines and generators, or other base plates of lengthy dimensions, may utilize a portable “head box” which can be moved along the length of the plate as the grouting proceeds. This portable head box is a way to facilitate continuous flow of the grout and minimize forming costs. The box should utilize a head form sloped at 45 degrees that rests in part of the form, floor and/ or baseplate. This method serves just as well, and often better than a long sloped form, as the thrust of the grout flow is better controlled.

### Edge Chamfers

Eliminating sharp corners in the grout reduces stress concentration. With a cementitious grout, the chamfering is done just prior to final set, cut back at a 45 degree angle from the baseplate to the foundation. For Epoxy grouts, the chamfers can't be trimmed. Therefore, the chamfered edges need to be built into the forms, by 1 – 2 inches (25 – 50 mm) using chamfer strips on the forms. (See Section, *Causes and Prevention of Edgelifting in Epoxy Grouts* later in this grout manual for further explanation).

**Figure 1 - Regular Equipment**



**Key:**

- |                        |                            |
|------------------------|----------------------------|
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| C. Equipment Base      | F. Form                    |



## Deep Pour Recommendations – Reinforcing Bar Installation in Epoxy Grouts

The use of reinforcement bars is recommended where the total thickness of the grout is greater than 6 inches (152 mm) to minimize cracking and help draw excessive heat down into the base slab and transfer stress if cracks do occur.

The top tier should be located about 2 inches (50 mm) below the equipment base. A bottom tier should be located about 2 inches (50 mm) above the foundation surface. Additional tiers, if required, should be spaced equal distances in the grout pour with vertical supports as required.

A typical rebar layout is shown in Figure 1. Most rebar should run lengthwise in the grout with cross bars and vertical dowels placed at approximately 12 – 24 inches (305 – 610 mm) intervals as shown in Figure 1. Rows of rebar should be between 6 – 12 inches (152 – 305 mm) apart. Grout pours of 6 inches (152 mm) require only one layer of horizontal rebar. Pours of 10 inches (254 mm) or more can benefit from an extra layer as shown in Figure 2.

FIGURE 1

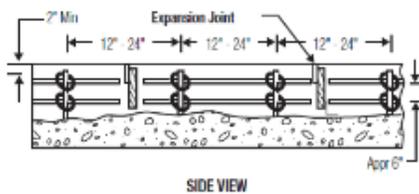


FIGURE 2

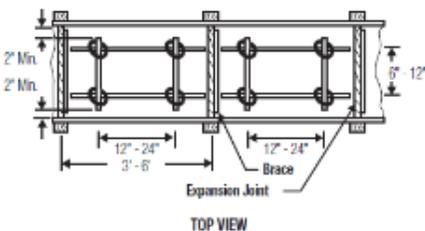
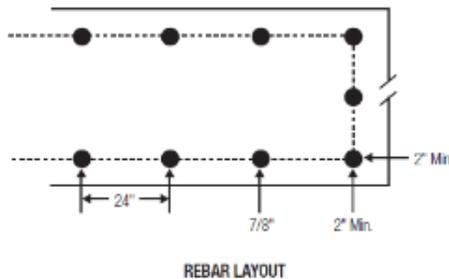


FIGURE 3



The horizontal rebar should be wired to vertical dowels that are grouted into the concrete base as shown in Figure 2. The horizontal and vertical bars are recommended to be constructed of 1/2 inch (13 mm) rebar and should be embedded to a depth of at least 6 inches (152 mm) in the concrete. If the holes in the concrete are at least 1-1/2 inches (38 mm) in diameter, the bars can be grouted in place using standard machinery grout. If it is desirable to use smaller holes (e.g., about 1 inch [25 mm] in diameter), the bars should be grouted with

a specially formulated rebar grout. None of the rebar should be closer than 2 inches (51 mm) to the nearest grout surface (Figure 3).

All rust, dirt and grease should be removed from the rebar prior to installation. Sandblasting will provide best adhesion.

Epoxy grouts can also be placed in lifts. Silica sand is broadcast onto the first lift to provide an intermediate bondable surface, and the subsequent lift can proceed after about 24 hours when the first lift has hardened and cooled to room temperature.

For epoxy grout pours above 6 inches (150 mm) or situations that preclude the installation of rebar, contact your local Master Builders Solutions Construction Systems sales representative. Additional epoxy grout products in the MasterFlow line are formulated specifically for pours greater than 6 inches (150 mm) and up to 18 inches (450 mm).

## Mixing of Epoxy Grout

### Tools

1. Clean and dry a mortar mixer (3 – 6 ft<sup>3</sup> size).
2. Clean and dry a wheelbarrow and buckets or shovels for transporting the grout.
3. Plenty of rags for wiping hands and tools.
4. A pail for citrus degreaser or solvent (T-430, xylol, lacquer thinner) for cleaning hands and tools – *Optional. MasterFlow 648 can be cleaned with soap and water.*
5. Rubber Gloves and other appropriate PPE.

### Grout Handling

1. Aggregate must be completely dry. It should be stored under cover and on pallets.
2. In cold weather, store in a warm place for at least 24 hours; 70° F (21° C) is preferred.
3. In hot weather, store in a relatively cool shaded area.

### Mixing

1. Do not add solvent, water or any other material to the grout. Do not alter the liquid to hardener proportions.
2. Pour the hardener (Part B) into a pail of grout resin (Part A) and stir by hand with a spatula or paint stir paddle until well mixed to a uniform amber color.
3. Pour the mixture into a horizontal shaft mortar mixer or a Kol type mixer without delay. Do not let liquid and hardener stand without adding aggregate. Epoxies produce an exothermic reaction. Without aggregate, the temperature can cause decomposition or gassing, releasing potentially hazardous fumes. If the catalyzed resin cannot be used immediately, spread the material over a large open surface, which will allow the heat to dissipate normally.
4. Add the grout aggregate, one bag at a time, and mix only until aggregate is completely wetted out to avoid air entrapment. The first batch may be slightly less fluid than later batches because some of the resin is retained on the walls of the mixer. Withholding ½ – 1 bag of aggregate from the first batch of a full unit will compensate for lost resin.
5. Discharge grout from mixer to the wheelbarrow or buckets.

**Note:** always add aggregate to the mixer after the premixed liquids have been poured in. Adjust the amount of aggregate used for the temperature and type of pour. The temperature of the grout, foundation, and equipment base are more important than the air temperature because they will affect the grout flow rate. The required flow is related to the grout thickness (between the foundation and base) and the flow distance.

## Placement of Epoxy Grout

1. Pour the grout into a wheelbarrow or buckets for transporting to pour-site. Remove it from the wheelbarrow within 15 minutes.
2. For flat bottom plates and bases, pour the grout from one side through to the other across the short dimension.
3. When grouting closed areas, prevent air entrapment by starting at one end of the form and filling the cavity completely while advancing toward the other end.
4. MasterFlow 648 grout will flow, but it can be aided with pushing tools like banding straps or plywood strips. Push with long, slow strokes rather than short jabs until no air pockets remain under the frames. DO NOT VIBRATE.
5. Where grout cannot be adequately worked to fill the cavity (because of large size or limited space), a head box will greatly assist flow. Use a sturdy wooden box (as described earlier, or sheet metal funnel about 1–2 feet (0.3–0.6 m).
6. Check frequently for leaks in the form. Leaks do not self-seal. If not stopped, they will cause voids.
7. After the pour is complete, remove uncured epoxy from the mixer, wheelbarrow and tools with soap and water or a citrus degreaser. Cured material must be removed mechanically. A smooth finish on the grout shoulder may be obtained by spraying or brushing the surface with Solvent T-435. Best results can be obtained by smoothing the surface several times just prior to the hardening of the grout surface.
8. If a multi-pour installation is necessary, sprinkle a small amount of MasterFlow 648 aggregate on the first pour's surface as the grout solidifies. Before placement of the second pour, brush the loose aggregate from the first pour's surface. Another method is to sandblast and brush clean the first pour's surface.

## Hot Weather Grouting

Avoid high temperatures while grouting. If the packaged grout is above 90°F (32°C), chill the sealed pails of grout liquid in a tub of ice, or cover the pails with water-soaked burlap/hessian. When grouting under hot conditions, it is necessary to cool the grout components and aggregate below 72°F (25°C).

Provide shade from summer sunlight for at least 24 hours before and 48 hours after grouting.



## Cold Weather Grouting

Temperatures below 60°F (15°C) make the grout stiff and hard to handle; the time required for set and strength gain is significantly increased. Do not use at ambient temperatures of less than 60°F (15°C) unless artificial means of heating can be used to assist cure.

It is important that the grout components be transported and stored to prevent freezing. Prior to grouting in cold weather, pails of grout liquid should be warmed to between 70°F and 90°F (21°C and 32°C). Consider reducing the aggregate content by ½ to 1 bag (as per data sheet recommendations).

An enclosure should be erected around the equipment and foundation to be grouted (typical materials are polyethylene or canvas). Forced air or infrared heaters may be used to provide the necessary heat to increase the base plate and foundation temperatures above 50°F (10°C). Condition the grout mixing and transportation equipment also by placing it inside the enclosure prior to grouting, and be mindful of the speed of temperature change when discontinuing the heat source. Too fast will cause cracks and possibly damage the foundation.



*A final important note:* The molds and equipment used for testing the grout on site must be conditioned to the appropriate temperature just like the foundation and equipment, and kept at a stable temperature as per ASTM C 579 while in the field and in the lab prior to testing. And the molds must be allowed to reach initial set before transport to the lab.

### **Accelerator**

MasterFlow Grout Accelerator may be used for installations down to 40°F (4.5°C). See specific data sheet for minimum grouting temperature. In general, epoxy grouting is not recommended below 45°F (7°C).

## **Pumping MasterFlow 648**

Condition all grouting materials as close to 70°F (21°C) as possible. If an accelerator is used, a grout temperature of 60–65° F (15 –18° C) is acceptable.

Proper equipment is critical to successful pumping of epoxy grouts. Peristaltic and piston pumps are recommended.

Grout should be pumped through the shortest distance possible. The maximum distance should be limited to 50 feet (15.2 m). For pumping distances greater than 10 feet (3 m), a 1.5 inch (38 mm) diameter, PVC pipe should be used to convey grout from the pump outlet to the base of the equipment being grouted. A flexible, seamless, clear vinyl hose should be attached to the end of the PVC pipe to manipulate the grout into the grouting holes or around the forms.

Prime the pump and pump lines with the neat epoxy resin or vegetable oil before using and after each cleaning or hose replacement. Never prime the pump and hose with water or any other material that can contaminate the epoxy grout. Purge the pump, pipe and hose of all priming material prior to pumping the grout.

High flow mixes (three bags of aggregate per full units of resin and hardener) are much easier to pump than fully loaded mixes (four bags of aggregate). Jobsite and weather conditions will influence the aggregate loading that can be pumped successfully. Never use less than three bags or more than four bags of aggregate fill per full unit of resin and hardener. Regardless of required aggregate fill ratio, begin pumping with a three-bag mix, to ensure wet-out of the pump and lines. If a four-bag mix is desired, the aggregate loading should be increased on subsequent mixes in half bag increments.

Once the grouting operation begins do not allow the pump to run out of material until the piece of equipment is completely grouted. Install the tip of the pump line through the grout holes in the equipment or between the formwork and the baseplate. Try to keep the tip of the grout line in sight whenever possible. Keep the pump line submerged in the grout and slowly withdraw it as the grout fills up under the application area. Avoid creating air pockets at all times.

As the grout fills the space beneath the baseplate, and can be seen at the next grout hole or at the edge of the formwork on the opposite side, move the pump line to the next grout hole or down the length of the form and continue pumping.

The pump and hose should be cleaned every 1-1/2 to 2 hours. If cleaned more frequently, soap and water will be effective; otherwise, a citrus degreaser should be used and followed with a final flush using vegetable oil. When the installation is complete, immediately clean the pump and lines.

Contact the pump equipment manufacturer for additional information on the use and operation of their pumps.

## Curing of Epoxy Grout

Epoxy grouts develop high compressive strengths in as little as 12 hours and develop nearly 100% of their ultimate strength in seven days. See individual product data sheets for specific curing rates.

Curing rates are retarded at lower temperature, and can be accelerated in many cases through the addition of an accelerator designed for use with the particular grout. See individual accelerator data sheets or contact a local Master Builders Solutions representative.

For most epoxy grouts, curing will not occur below 40°F (4°C).

## Anchor Bolt Grouting

1. Bolts must be deformed bar, threaded rod, with nut or head preferred.
2. Bolts must be free of oil, grease and rust. Solvent wipe before placement with thinner. Grit blasting or abrasive wheel may be required.
3. **Holes** drilled dry must have dust blown out and be free of oil and grease. Wet drilled holes must have free water rinse to remove drilling slurry. Formed holes must be chipped to remove laitance and form oil residue. If polystyrene was used for forms, do not melt with petrol or thinner because a sticky residue will remain. Mechanically remove polystyrene and clean hole with wire brush or scraper on a vibrating hammer.

Hole Dimensions:

Depth = 12 times bolt diameter.

Diameter = 1.5 times bolt diameter.

Anchor bolt depths greater than 24 feet (600 mm) deep, a minimum bolt diameter of greater than 2 inches (50 mm) is recommended.

Hole Spacing: Edge spacing and space between holes is bolt diameter x 8. Shear loads acting to the edge of concrete will need to be considered separately.

## **Cracking**

Epoxy-based grouts will sometimes develop cracks. Cracking is generally caused by thermal stresses and temperature differences from season to season, as well as operating to non-operating temperatures.

Cracking can occur on the shoulder surface near sharp corners of the baseplate and at anchor bolts, due to lack of restraint at that point. Horizontal edge cracks may occur just below the grout-concrete interface, most often in outdoor installations, due to the differential thermal movement, and the crack will be limited to the shoulder area.

In most cases cracking does not impact the support and alignment performance of the grout. If there is concern regarding the likelihood of cracks allowing oil or chemical contamination of the concrete substrate, the cracks should be filled with a grout binder or other material. Contact your local Master Builders Solutions Construction Systems representative for recommendations.

The likelihood of cracking can be significantly reduced by: proper foundation preparation, correct form geometry, chamfering edges of foundation and grout, installation of reinforcement and expansion joints, controlling the rate of heat generation and proper installation procedures, all discussed in this manual.

## Expansion Joints

### *The Need for Expansion Joints*

In order to maintain alignment of grouted equipment, epoxy machinery grouts are designed to be rigid and have high resistance to creep. By their composition, epoxy grouts have a dissimilar coefficient of thermal expansion compared to concrete. As a result, stresses that occur during cure and subsequent temperature changes may result in cracks.

Grout cracks do not directly affect the ability of the grout to support the equipment, but they do provide an entrance point for oils and other contaminants that can eventually lead to problems in the foundation. Expansion joints should be used when the span of the grout exceeds 5 feet (1.5 m) in any direction to prevent excessive stresses on the grout/concrete interface from building up, which can cause cracking, edge lifting etc.

### *Location and Design of Expansion Joints*

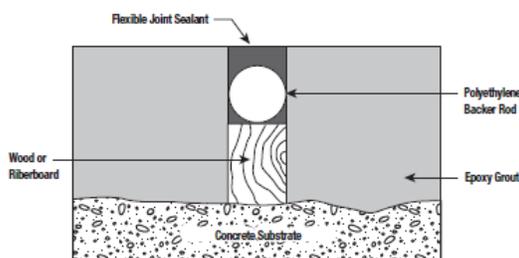
It is normally recommended that expansion joints be located at 3 – 6 foot (0.9 – 1.8 m) intervals. More expansion joints may be needed if the grout will experience a temperature drop of more than 40°F (4°C) below the installation temperature. Joints should be placed so as not to interfere with sole plates, chocks or anchor bolts. For best results, they should be spaced evenly between anchor bolts or sole plates. There are a variety of techniques for preparing expansion joints in epoxy grout. Different joint designs are appropriate for different types of installations. Two basic types of joints are discussed below.

### *Standard Single Seal Expansion Joint*

Grooves must be placed in the grout for this design. It is preferable to create the groove with the formwork. Dividers are placed in the form where the joints are to be located. The dividers consist of an interior portion of ¾ inch (19 mm) wood or fiberboard expansion joint material and an outer removable portion consisting of ¾ inch (19 mm) lumber covered with polyethylene or duct tape to prevent bonding. The outer removable portion should extend above the finished grout to facilitate removal. The removable portion of the divider should be sized to provide a finished groove in the grout that is approximately ¾ inch (19 mm) wide and 1-1/2 inch (38 mm) deep.

When the grout is sufficiently hardened, the exterior portions of the dividers are removed. A standard 1 inch (25 mm) foam polyethylene backer rod is forced into the bottom of the groove and the rest of the groove is filled with a good quality joint sealant. The surface of the expansion joint material can be tooled to a neat concave or flat surface as shown in Figure 1.

FIGURE 1



### *Composite Joints Containing Both a Primary and a Secondary Seal*

A composite joint that contains an interior wood portion and an exterior portion of closed cell foam (See Figures 2, 2A) provides double protection against oil intrusion. The wooden interior is set in place using an epoxy mortar that acts as a secondary seal to prevent oil and other fluids from penetrating the concrete. The grout bonds to the closed cell foam forming a tight primary seal against oil penetration.

FIGURE 2

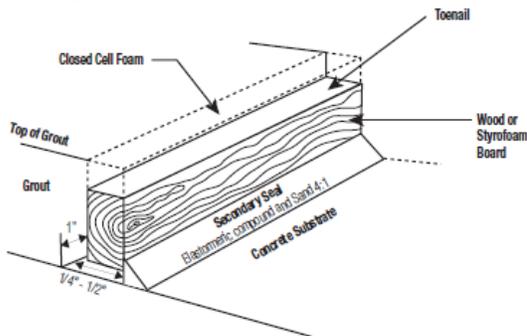
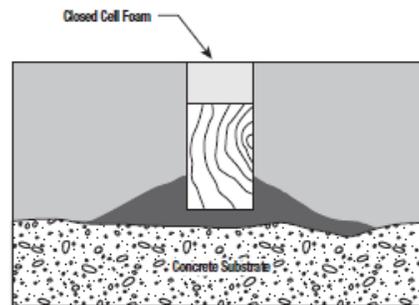


FIGURE 2A



The wooden portion of the joint should be made from standard finished lumber that has a nominal thickness of 1 inch (25 mm). Actual thickness will be about  $\frac{3}{4}$  (19 mm). Cedar is an excellent choice. It is resistant to water and oil, and is easily compressible.

The wood is installed after the concrete surface has been chipped and the forms have been built. A mixture of one part expansion joint compound and four parts dry blasting sand is used to prepare a flexible mortar for the secondary seal. This material is applied to the concrete in strips about 2–3 inches (51–76 mm) wide by 1 inch (25 mm) deep, running the entire length of the joint. The lumber should be immediately embedded to a depth of about  $\frac{1}{2}$ – $\frac{3}{4}$  inch (13–19 mm).

The lumber should be smaller than the completed joint by 1 inch (25 mm) to allow for attachment of a primary seal consisting of 1 inch by 1 inch (25 by 25 mm) chemical resistant closed cell foam (see Figure 2). The closed cell foam may be attached to the wooden portion of the expansion joint in one of several ways.

1. Glue the foam to the wood using epoxy adhesive.
2. Glue the foam to the wood using silicone sealant (RTV).
3. Nail the foam to the wood by toenailing from the side (Figure 2).

**CAUTION:** Do not drive nails through the top of the foam as this destroys the foam's sealing ability.

If the foam has a tough skin on one side, this portion of the foam should be faced outward. The vertical face of the expansion joint should be sealed also. This can be done by extending the foam down the vertical face as shown in Figure 3. If a notch is cut into the foam as shown in Figure 4, it aids in the foam's conforming to the bend in the expansion joint.

FIGURE 3

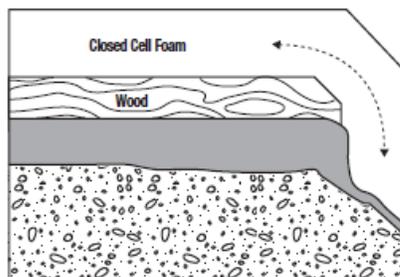


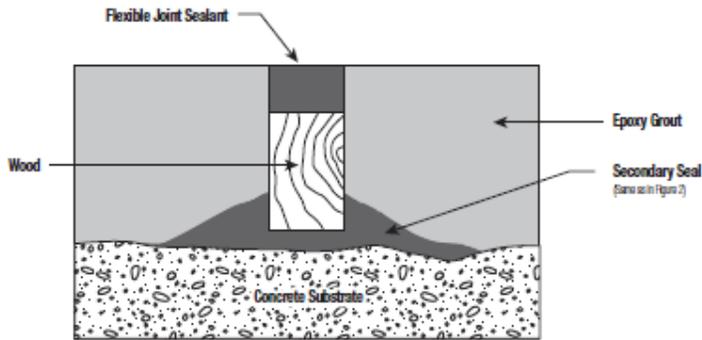
FIGURE 4



For shallow pours of 1–2 inches (25–51 mm), the wooden portion of the joint can be eliminated. Closed cell foam with notches to conform to vertical sides (see Figure 3) should be bonded directly to the concrete with or without a secondary seal.

A variation of the above design is to use an epoxy joint sealant as the external joint. Using this method the wood joint is initially brought up to the surface of the finished grout. After the grout is then placed and cured, the wood is removed to a depth of 1/4–1/2 inch (6–13 mm) below the grout surface. The typical width of the joint is twice the depth (see Figure 5).

FIGURE 5

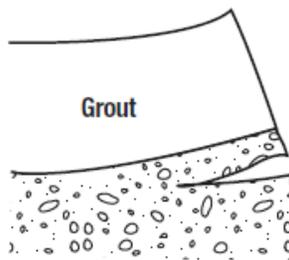


## Causes and Prevention of Edgelifting in Epoxy Grouts

Edgelifting is a term generally used to refer to horizontal cracks around the edges and corners of grouted foundations (see Figure 1). The crack starts on the vertical concrete surface just below the grout/ concrete interface and may extend back under the grout from 2–6 inches (51–152 mm). This cracking is usually accompanied by slight upward movement at the edge. This movement is called “edgelifting” or “curling.”

The initial cracking occurs when the shear stress near the concrete/grout interface exceeds the strength of the concrete. The shear stresses are a result of a combination of factors. When the grout cures there is a certain level of trapped stress caused by the combination of the curing shrinkage and the exotherm of the grout. Additional stresses occur as the grout and foundation undergo thermal cycling. Stresses created during thermal cycling are caused by uneven heating and cooling in various parts of the structure and by differences between the coefficient of thermal expansion of the grout and the concrete.

FIGURE 1



The potential for edgelifting is increased by these factors:

1. High maximum curing temperatures increase the stress that causes edgelifting. Conditions contributing to high maximum curing temperatures include: pouring large amounts of grout in one pour, placing the grout at high ambient temperatures without taking precautions to reduce the exotherm or using an epoxy grout that is not designed for large pours.
2. Large temperature swings will increase the tendency to edgelift by increasing the effects of the differential coefficient of expansion. In cold weather the grout will tend to curl up as it tries to shrink more than the concrete.
3. Wide overpours and long grout lengths have a greater tendency to edgelift.
4. Low concrete strength or inadequate surface preparation increases the tendency to edgelift since the poor quality concrete will fail at lower stress levels than good quality concrete.
5. Grout that has been placed with less than the manufacturer's specified amount of aggregate has an increased tendency to edgelift. There are two reasons for this tendency. First, the exotherm of the grout will be higher than intended, and second, the coefficient of thermal expansion will be higher than expected.

The following precautions can be taken to minimize edgelifting:

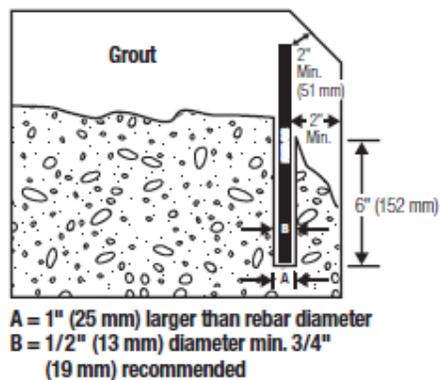
1. The concrete surface should be prepared by chipping down to sound concrete (3,500 psi [24 MPa] minimum compressive strength). Loose and broken pieces must be removed. The surface should be dry and dust-free before the grout is poured.
2. Where possible, the edges of the concrete foundation should be chamfered at least 2–4 inches (51–102 mm) at approximately a 45 degree angle.
3. The overpour should be reduced to a practical minimum. When large overpours cannot be eliminated.

4. Eliminate sharp corners in the grout to reduce stress concentration at the corners. Chamfer the edge of the grout corners by 1–2 inches (25–51 mm) using chamfer strips on the forms.
5. Do not deviate from the manufacturer’s specifications for placement temperature limits, and do not leave out more aggregate than is suggested by the manufacturer.

Procedures for using dowels or wickets to prevent edgelifting:

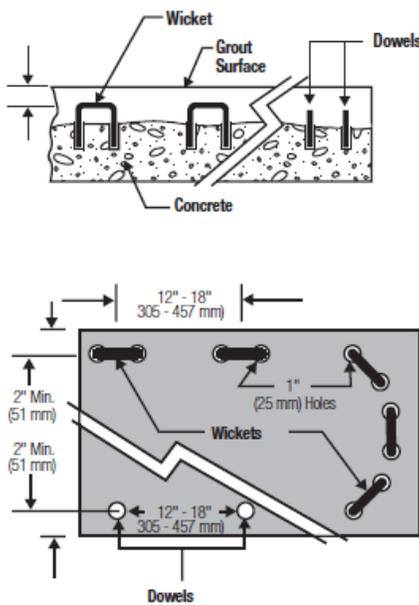
1. Dowels should be preplaced at strategic locations around the base of the concrete as shown in Figure 2. The dowels are similar to the vertical reinforcing steel described earlier and are installed in the same way.

FIGURE 2



2. Wickets provide the strongest anchor between the grout and the concrete base. They are made from U-shaped pieces of rod or rebar and are installed as shown in Figure 3. If wickets are not used, dowels should be utilized instead.

FIGURE 3



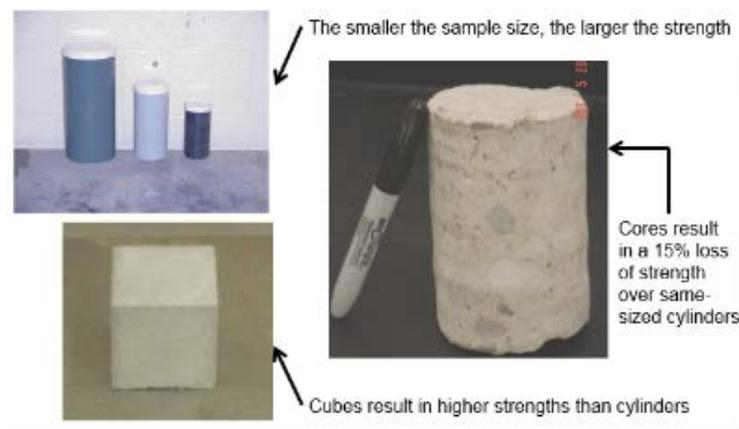
## Compressive Strength & Compressive Strength Testing

Compressive strength is a measure of the maximum load the grout can withstand before failure. Since the purpose of a grout is to transfer loads from the equipment to the concrete foundation, it makes sense that the grout compressive strength is greater than the base, and able to accept the load demands of the machinery being supported. Compressive strength alone doesn't guarantee satisfactory performance, but it is critical, and an important indicator for other performance parameters.

On many projects, specifications call for the testing of the epoxy grout to confirm compressive strength properties. Proper testing of epoxy grouts is vitally important, and the success of the test relies heavily on the collection and preparation of grout samples in the field.

There are many ways to test for a material's compressive strength. Different test methods and protocols yield different results, so it is equally important that the design documents specify the test method, and provide clarity and instruction on the procedure for taking samples in the field.

The correct ASTM test method for determining compressive strength of **polymer grouts** is ASTM C579. Method B of this standard, which calls for casting and testing 2" (50 mm) CUBES, provides more accurate values, as opposed to other methods which use cylinder samples. This is similar to the ASTM C1107 testing protocol used for cementitious grouts and mortars.



## Preparing Epoxy Grout Samples in the Field for ASTM C579 Testing

### ***Ensure proper cube molds are used***

- Use metal/brass cube molds, with 2" (50 mm) sides. **NEVER USE PLASTIC INSERTS!!**



- Seal the edges with wax. Apply mold release
- Place on a flat, level surface, where they can remain undisturbed until set.
- The molds must be conditioned to temperature just like the foundation and equipment.

### **Mix Grout**

Care must be taken to ensure proper mixing. Ensure correct temperatures of grout components, mixing and transportation tools, and testing apparatus (molds, etc.). Never pull material from the first mixing batch and the sample should be taken from the middle of the grout mass.

### **Fill the Molds**

- Fill molds halfway, then consolidate grout per ASTM C109 using a tamper and pattern.



- Fill molds to top, and consolidate again.



- Strike off excess grout and level the surface.
- The filled molds must be kept warm as per as per ASTM C 579 while in the field and in the lab prior to testing.

*This is a key differences between cementitious and epoxy grout testing. Cementitious grouts are usually fluid or flowable. They need very little compaction so a light poking with a finger or tamper is all that's needed to ensure that there's no air trapped in the corners of the mold. Only stiff (or plastic) grouts need to be tamped 16 times per layer following the ASTM pattern.*

### **Curing**

After striking off the excess grout from the mold, leave the material undisturbed for a minimum of 24 hours. Make sure it is in a temperature controlled location away from vibrating equipment.

Epoxy grout samples air cured and molds are stacked to contain heat. If the samples are being used to determine in-situ strength gain, then the molds should be left on site, next to the installation.

The molds must be allowed to reach initial set before transporting them.

*This is another difference in testing epoxy grouts. When preparing samples for cementitious grouts, the grout cubes must be restrained, so the molds are stacked, and/or a plate is firmly clamped on top and then they are sealed in plastic bag and/or wrapped in to create a moist, temperature controlled curing environment.*

## PreJob Meetings

Planning and communication can prevent unnecessary confusion and mistakes on projects. Master Builders Solutions Construction Solutions technical sales personnel work closely with owners, engineers and contractors to ensure the best outcome. Pre-job Meetings are strongly recommended to outline the specifics of the work and document roles, responsibilities and expectations.

Below is a sample of a Pre-Job Meeting Checklist. This can be downloaded from the Master Builders Solutions website for use on your projects: <https://assets.master-builders-solutions.com/en-us/project%20pre-job%20checklist%20form.pdf>

### Pre-Job Meeting Checklist

Project Name:	Project ID Number:
Date:	Location:

#### IN ATTENDANCE ON BEHALF OF (NAME, TITLE, PHONE & EMAIL)

Owner:
Engineer:
General Contractor:
Specialty Contractor:
Equipment Manufacturer:
Testing Agency:

#### AGENDA ITEMS COVERED

Review of Project Details Form for accuracy and understanding.	<input type="checkbox"/> Yes <input type="checkbox"/> No
Review of scope of work and product(s) being installed.	<input type="checkbox"/> Yes <input type="checkbox"/> No
Review of all parties experience with selected products. Notes:	<input type="checkbox"/> Yes <input type="checkbox"/> No
Review project specifications.	<input type="checkbox"/> Yes <input type="checkbox"/> No
Review jobsite conditions. (Environment, weather, site access, product storage, etc.) Notes:	<input type="checkbox"/> Yes <input type="checkbox"/> No

Review all current material data sheets, MSDS and Installation Guides for selected product(s).	<input type="checkbox"/> Yes <input type="checkbox"/> No
Ensure Testing Agency is familiar with test methods and materials for product(s) being installed.	<input type="checkbox"/> Yes <input type="checkbox"/> No
Confirm project schedule.	<input type="checkbox"/> Yes <input type="checkbox"/> No
Confirm crew leads are in attendance and will be supervising installation.	<input type="checkbox"/> Yes <input type="checkbox"/> No
Review training requirements: 1. Basic Safe Handling Information      Date: _____ 2. Grout 101      Date: _____ 3. Additional Training      Date: _____ Notes:	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Yes <input type="checkbox"/> No

#### Completed by:

Notes:
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# Grout Placement Report

Careful planning and documentation of the equipment grouting operation will be required on some projects, and is recommended on all, as the process to capture the data invariably leads to a better planned and executed grouting operation.

Below is a sample of a Grout Placement Report. This can be downloaded from the Master Builders Solutions website for use on your projects: [https://assets.master-builders-solutions.com/en-us/p\\_i%20grout%20placement%20report%20form.pdf](https://assets.master-builders-solutions.com/en-us/p_i%20grout%20placement%20report%20form.pdf)

Grout Placement Report		
<b>PROJECT IDENTIFICATION</b>		
Project name:	Project ID number:	
Location		
Product placed:	Date:	
Quantity of material:		
<b>Lot Numbers</b>		
Part A:	Part B:	Part C:
Accelerator:		
<b>TEMPERATURE AT TIME OF PLACEMENT (C° or F°)</b>		
Ambient	Plata/Equipment	Foundation
Stored Grout	Fresh Mixed Grout	In Place (1 hour)
<b>JOBSITE CONDITIONS</b>		
Environment: Describe weather conditions (e.g. summer, hot, windy, winter, cold, snow, rain):		
Describe methods/materials used to protect installation (shaded from direct sunlight and wind, tented, heated, etc.):		
Is the base concrete and/or substrate properly prepared and clean? Describe method:		
<b>INSTALLATION SPECIFICS</b>		
Mixer type:	Placing method:	
Pump (if used):	Bags per mix:	
Head box <input type="checkbox"/> Yes <input type="checkbox"/> No		
Straps <input type="checkbox"/> Yes <input type="checkbox"/> No		
Control joints <input type="checkbox"/> Yes <input type="checkbox"/> No		
Sleeves <input type="checkbox"/> Yes <input type="checkbox"/> No		
Shims/Wedges <input type="checkbox"/> Yes <input type="checkbox"/> No		
Other:		
<b>TESTING INFORMATION</b>		
Testing protocol (describe):		
Date test data received:	Details of test data received:	
<b>ADDITIONAL COMMENTS</b>		
Form Completed by:		

## **Conclusion**

Master Builders Solutions Construction Systems division offers advanced chemical solutions for new construction, maintenance, repair or renovation of structures and infrastructure under the Master Builders Solutions brand. The brand builds on the strengths of many legacy Master Builders Solutions brands and products and represents our experience of more than 100 years in the construction industry.

We are part of Master Builders Solutions, the largest chemical company in the world, serving customers in almost every conceivable industry: from Automotive to Agriculture, from Plastics to Personal Care, from Energy to Electronics. We Create Chemistry for a Sustainable Future.

Being part of the largest chemical company in the world has many advantages. Key among them is the ability to serve our customers wherever their projects take them. Our world is becoming increasingly connected, and in many industry sectors global owners, engineers and contractors work across continents, countries and cultures on new construction and refurbishment projects. Traditional boundaries have been removed.

At Master Builders Solutions, we are uniquely positioned to supply and service these projects, because with this increased globalization comes the need for consistency in the products that are specified and installed.

Across the globe, engineers, equipment manufacturers, contractors and owners can confidently specify and install MasterFlow grout products with confidence. Master Builders Solutions teams on every continent provide reliable, dependable product availability and technical support.



## Master Builders Solutions

The Master Builders Solutions brand brings all of MBCC Groups expertise together to create chemical solutions for new construction, maintenance, repair and renovation of structures. Master Builders Solutions is built on the experience gained from more than a century in the construction industry.

The know-how and experience of a global community of MBCC Group construction experts form the core of Master Builders Solutions. We combine the right elements from our portfolio to solve your specific construction challenges. We collaborate across areas

of expertise and regions and draw on the experience gained from countless construction projects worldwide. We leverage global MBCC Group technologies, as well as our in-depth knowledge of local building needs, to develop innovations that help make you more successful and drive sustainable construction. The comprehensive portfolio under the Master Builders Solutions brand encompasses concrete admixtures, cement additives, chemical solutions for underground construction, waterproofing solutions, sealants, concrete repair and protection solutions, performance grouts and performance flooring solutions.

## Master Builders Solutions products for the Construction Industry:

### MasterAir®

Solutions for air-entrained concrete

### MasterBrace®

Solutions for concrete strengthening

### MasterCast®

Solutions for manufactured concrete product industry

### MasterCem®

Solutions for cement manufacture

### MasterEmaco®

Solutions for concrete repair

### MasterFinish®

Solutions for formwork treatment

### MasterFlow®

Solutions for precision grouting

### MasterFiber®

Comprehensive solutions for fiber reinforced concrete

### MasterGlenium®

Solutions for high-performance concrete

### MasterInject®

Solutions for concrete injection

### MasterKure®

Solutions for concrete curing

### MasterLife®

Solutions for enhanced durability

### MasterMatrix®

Advanced rheology control solutions for self-consolidating concrete

### MasterPel®

Solutions for water tight concrete

### MasterPolyheed®

Solutions for high-performance concrete

### MasterPozzolith®

Solutions for water-reduced concrete

### MasterProtect®

Solutions for concrete protection

### MasterRheobuild®

Solutions for super-plasticized concrete

### MasterRoc®

Solutions for underground construction

### MasterSeal®

Solutions for waterproofing and sealing

### MasterSet®

Solutions for retardation control

### MasterSure®

Solutions for workability control

### MasterTop®

Solutions for industrial and commercial floors

### Ucrete®

Flooring solutions for harsh environments

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**Constructions Systems US, LLC**  
 889 Valley Park Drive  
 Shakopee, MN 55379 USA

**Customer Service** (800) 433-9517  
**Technical Service** (800) 243-6739  
[master-builders-solutions.com/EN-US](http://master-builders-solutions.com/EN-US)



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