BUILDING TRUST
CONSTRUIRE LA CONFIANCE

PRODUCT DATA SHEET

SikaFlow®-649

(formerly MFlow 649)

High-strength, high-temperature, high-flow epoxy grout

PRODUCT DESCRIPTION

SikaFlow®-649 grout is a high-performance epoxy grouting material for support of heavy equipment. It ensures the proper transmission of static and dynamic loads to the equipment foundation.

WHERE TO USE

- Precision alignment of compressors, generators, pumps and electric motors
- Pour-back grouting for post-tensioning cables
- Crane rail grouting
- Grouting of crusher ball mills, slab tables and other equipment subject to high torque, impact and vibration
- Grouting of wind turbine tower bases
- Grouting of anchors, bars and dowels

CHARACTERISTICS / ADVANTAGES

- High early and ultimate strengths with low creep for rapid turnaround
- Superior physical properties at high temperatures increases the range of in-service temperatures
- Excellent bearing area of 85 % achievable (for even load distribution) when following proper grouting procedures
- Good chemical resistance
- Resists impact and dampens torque
- Durable bond to concrete and steel optimizes load transfer
- Meets the requirements of American Petroleum Institute (API); API Standard 610 and API Recommended Practice 686 for rotating equipment

PRODUCT INFORMATION

Composition / Manufacturing	Three-component modified epoxy-resin-based grout
Packaging	104.33 kg (230 lb) unit ▪ Comp. A: 10.1 kg (22.3 lb) pail ▪ Comp. B: 3.4 kg (7.6 lb) bottle ▪ Comp. C: 4 x 22.7 kg (4 x 50 lb) bags All components are packaged separately. SikaFlow®-649 may be ordered as a 3-bag high-flow unit.
Shelf Life	18 months (for both resin and hardener) when properly stored
Storage Conditions	Store in unopened containers in clean, dry conditions at temperatures between 16 and 27 °C (60 and 80 °F)

Density	Filled 5.75 :1	2064 kg/m³ (129 lb/ft³)	(ASTM C905)
	Filled 6.25 :1	2096 kg/m³ (131 lb/ft³)	
	Filled 6.75 :1	2128 kg/m³ (133 lb/ft³)	

TECHNICAL INFORMATION

Abrasion Resistance

Better than concrete

Resistance to Impact

Better than concrete

Compressive Strength

Compressive strength of 2 in x 2 in cubes, filled 6.25:1 when cured at: (ASTM C579 modified)

Time	13 °C (55 °F)	23 °C (73 °F)	32 °C (90 °F)
8 hours	-	5 MPa (700 psi)	65 MPa (9400 psi)
16 hours	-	48 MPa (7000 psi)	94 MPa (13 700 psi)
24 hours	9 MPa (1300 psi)	79 MPa (11 500 psi)	110 MPa (16 000 psi)
48 hours	65 MPa (9400 psi)	113 MPa (16 400 psi)	128 MPa (18 500 psi)
72 hours	96 MPa (13 900 psi)	118 MPa (17 100 psi)	131 MPa (19 000 psi)
96 hours	115 MPa (16 700 psi)	124 MPa (18 000 psi)	138 MPa (20 000 psi)

Tensile Strength in Flexure (ASTM C580)

Temperature	filled 6.25:1, cured 7 days at 23 °C (73 °F)
24 °C (76 °F)	32 MPa (4600 psi)
60 °C (140 °F)	29 MPa (4200 psi)
77 °C (170 °F)	14 MPa (2100 psi)

Modulus of Elasticity in Flexure (ASTM C580)

Test Temp.	Fill ratio: 5.75	Fill ratio: 6.25	Fill ratio: 6.75
24 °C (76 °F)	18 GPa (2.6 x 10^6 psi)	18 GPa (2.6 x 10^6 psi)	18 GPa (2.6 x 10^6 psi)
43 °C (110 °F)	15 GPa (2.2 x 10^6 psi)	16 GPa (2.3 x 10^6 psi)	16 GPa (2.3 x 10^6 psi)
52 °C (125 °F)	14 GPa (2.0 x 10^6 psi)	15 GPa (2.2 x 10^6 psi)	15 GPa (2.2 x 10^6 psi)
60 °C (140 °F)	11 GPa (1.6 x 10^6 psi)	12 GPa (1.7 x 10^6 psi)	12 GPa (1.7 x 10^6 psi)
68 °C (155 °F)	5 GPa (0.7 x 10^6 psi)	5 GPa (0.7 x 10^6 psi)	6 GPa (0.9 x 10^6 psi)

Tensile Strength

Filled 6.25:1 : 16 MPa (2300 psi) (ASTM C307)

Shrinkage

0.00065 linear, in/in, filled 6.25:1 (ASTM C531)

Creep

Over 24 hours: 2.8 x 10^{-3}
Over 1 year: 3.7 x 10^{-3}
Over 10 years: 4.0 x 10^{-3} (Test Method STS 22.2)

Pull-Off Strength

Bond strength to steel (Michigan DOT)

23 °C (73 °F)	21 MPa (3100 psi)
60 °C (140 °F)	14 MPa (2000 psi)

Coefficient of Thermal Expansion	0–23 °C (31–74 °F)	21.2 x 10^{-6} cm/cm/°C (11.8 x 10^{-6} in/in/°F)	(ASTM C531)
	23–43 °C (74–110 °F)	23.4 x 10^{-6} cm/cm/°C (13.0 x 10^{-6} in/in/°F)	
	23–99 °C (74–210 °F)	39.2 x 10^{-6} cm/cm/°C (21.8 x 10^{-6} in/in/°F)	
Shear Adhesion Strength	Bond strength to steel		
	23° C (73° F)	34 MPa (5,000 psi)	(Michigan DOT)
	60° C (140° F)	14 MPa (2,000 psi)	
Water Absorption	0.076 % (filled 6.25:1)		(ASTM C413)

APPLICATION INFORMATION

Mixing Ratio

- The fill ratio is the weight of aggregate compared to the combined resin and hardener components. SikaFlow®-649 is used at a variable fill ratio from the standard 6.75:1 ratio to as low as 5.06:1 (high-flow version).
- The standard 0.049 m³ (1.73 ft³) unit of SikaFlow®-649 includes 85.3 kg (188 lb) of aggregate [or four (4) 22.7 kg (50 lb) bags]. This 6.75:1 fill ratio can be reduced to as low as three (3) bags or a 5.06:1 fill ratio yielding 0.038 m³ (1.34 ft³).
- For projects requiring a fill ratio different from the standard 4 bag mix, simply determine how many bags of aggregate will be used (number of bags x number of units) and purchase the components (resin, hardener, and aggregate) separately.

Fill Ratio Guideline
0.049 m³ (1.73 ft³) unit

Temperature	Very Thin Pours or Very Long Distances	Standard Pours
> 32 °C (> 90 °F)	-	-
21 to 32 °C (70 to 90 °F)	Up to 1/2 bag	-
10 to 21° C (50 to 70 °F)	1/2 to 1 bag	1/2 bag

The chart above provides guidelines for the amount of aggregate that can be removed from a 0.049 m³ (1.73 ft³) unit in order to optimize flow and cost per m³ (ft³). A maximum of 5.4 kg (12 lb) of aggregate can be removed from a 0.012 m³ (0.43 ft³) unit.

Yield

0.049 m³ (1.73 ft³) per 104.33 kg (230 lb) unit

Note: SikaFlow®-649 may be ordered as a 3-bag, high-flow unit, which will yield 0.038 m³ (1.35 ft³). When estimating project requirements, be sure to account for application variables.

Flowability

Materials Removed or Added

Temperature	Thin Pours or Long Flow Distances Under Equipment	Standard Pours	Thick Pours, Open Areas, or Short Flow Distances
Above 32 °C (90 °F)	-	-	1/2 – 1 bag (Add 3.8 L)
21 – 32 °C (70 – 90 °F)	Up to 1/2 bag	-	1/2 bag
10 – 21 °C (50 – 70 °F)	1/2 to 1 bag	1/2 bag	1/2 bag

Setting Time

The following chart shows the working time for a fresh grout mix at various ambient temperatures. The working time begins when the hardener is added to the resin. Do not let resin and hardener stand without adding aggregate. This material produces an exothermic reaction. If the material exotherms 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. These working times assume the product has been properly preconditioned for cold or hot weather use.

Working Time

Temperature	Time
32 °C (90 °F)	50 – 60 min
21 °C (70 °F)	90 – 120 min
10 °C (50 °F)	120 – 150 min

BASIS OF PRODUCT DATA

Product properties are typically averages, obtained under laboratory conditions. Reasonable variations can be expected on-site due to local factors, including environment, preparation, application, curing and test methods.

LIMITATIONS

SikaFlow®-649 is designed for professional use only; not for sale to or use by the general public.

Proper application is the responsibility of the user. Contact your local Technical Sales Representative for a pre-job conference to plan the installation. Field visits by Sika personnel are for the purpose of making technical recommendations only and not for supervising or providing quality control on the jobsite.

- Do not add solvent, water, or any other material to the grout.
- Do not alter the resin or hardener proportions.
- For guidelines on specific anchor-bolt applications, contact your local Technical Sales Representative.
- Always use a head box when placing less than 25 mm (1 in) depth.
- The substrate temperature must be greater than 10 °C (50 °F). Compliance with API 686 requires higher minimum temperatures.
- Cold material will exhibit decreased flowability and reduced strength development.
- The minimum placement thickness is 13 mm (1/2 in). Consult your local Technical Sales Representative before placing lifts more than 152 mm (6 in) in depth.
- Chamfering the concrete edge helps reduce thermal cracking. Following proper installation procedures also reduces the potential for cracking.

ENVIRONMENT, HEALTH & SAFETY

User must read the most recent corresponding Safety Data Sheets (SDS) before using any products. The SDS provides information and advice on the safe handling, storage and disposal of chemical products and contains physical, ecological, toxicological and other safety-related data.

APPLICATION INSTRUCTIONS

NOTES ON INSTALLATION

Figure 1 - Regular Equipment

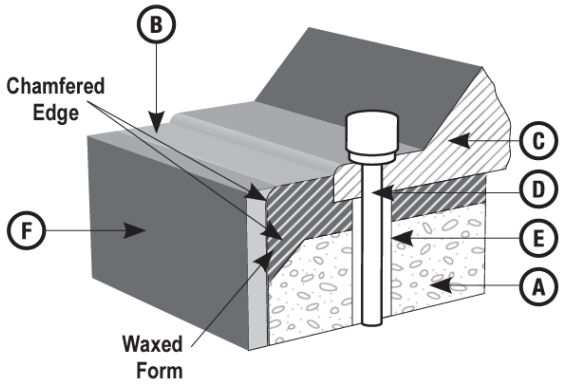


Figure 2 - Engine with Oil Pan

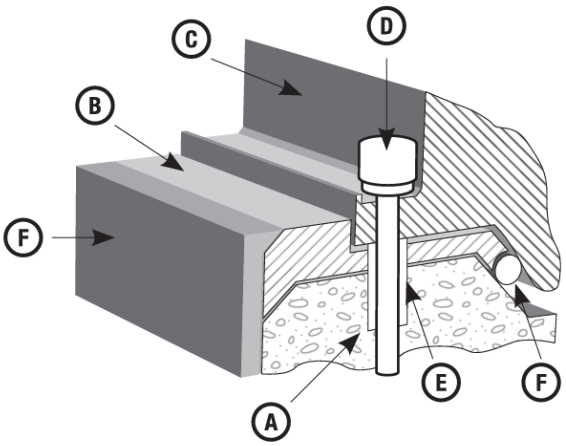


Figure 3 - Rail or Soleplate

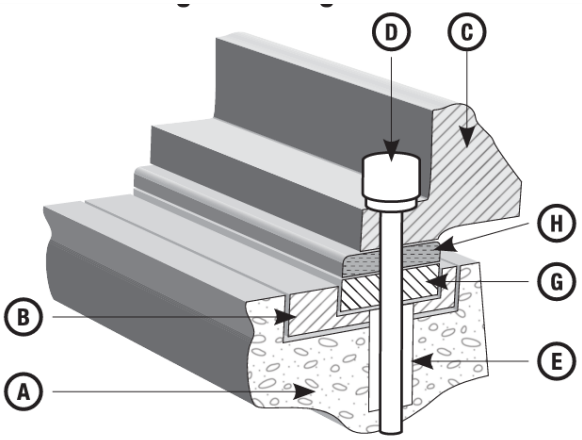


Figure 4 - Typical Rail With Expansion Joint Section

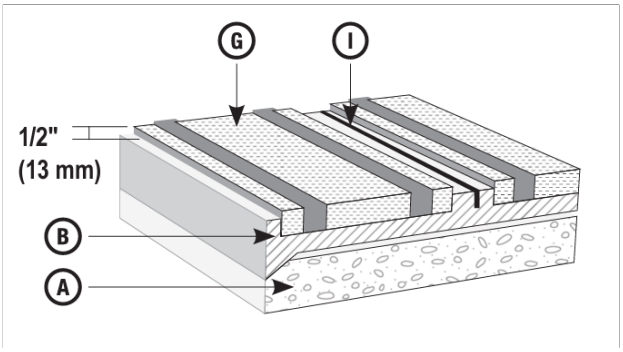
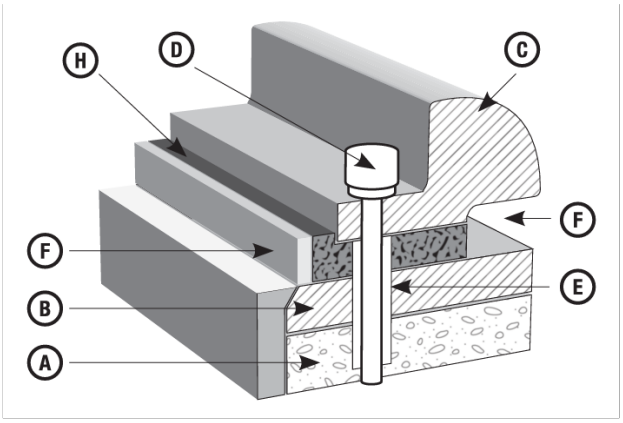


Figure 5 - Typical Epoxy Chock Application



Key

A.Concrete Foundation	B.Grout
C.Equipment Base	D.Anchor Bolt
E.Anchor Bolt Sleeve Seal	F. Form
G.Soleplate or Rail	H.Shim or Chock
I. Expansion Joint	

EQUIPMENT

1. If rust scale is present, abrade the bonding surfaces of the base to be grouted; it must be free of coatings, wax, grease, or scale. Mechanical methods, such as grinding or sanding, will suffice, but do not produce as high a bond strength as sandblasting.
2. 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, use SikaEmaco® ADH 1090 RS from Sika. If the primer has been on the surface for more than one (1) month, abrade and solvent wipe it so that no residue remains.
3. The grout should come up at least 19 mm (3/4 in) onto the equipment. Protect the area above it with masking tape.
4. To facilitate cleanup, wax or cover all surfaces where the grout may splash or spill.

SUBSTRATE PREPARATION

- Protect the foundation and equipment from rain or moisture. Water will prevent grout bond and inhibit cure.
- Areas that will not be grouted will have to be sealed

off.

- Place forms no greater than 152 mm (6 in) away from the edge of the individual base rail or sole- plate on the sides where the grout is not being poured. Excessive edges create thermal stress and result in excessive cracking. Formwork edges should allow enough room to accommodate pouring of the grout and accommodate a headbox, is used. Shoulders should be a maximum of 152 mm (6 in) in width. However, this may vary depending on the application. Moderate to large-size equipment and difficult or narrow placement applications should utilize an extended head form (headbox) to create additional head pressure and to enhance placement. Consult your Sika representative for specific recommendations.
- Before erecting the forms, cover them with extra-heavy coats of paste wax. Forms can be shellacked before waxing to improve release. Keep wax off concrete and steel surfaces. As an alternative to waxing, a polyethylene or other non-bondable film may be used as a release agent. The top of the form should extend at least 19 mm (3/4 in) above the bottom of the rail or plate.
- Forms must be liquid tight. Seal forms to vertical concrete surface by applying putty, foam, or caulk below top of concrete and then press form into place.
- Expansion joints will reduce the possibility of cracking. On multiple soleplate installations, each soleplate may be isolated. Expansion joints can be made with any material that is resistant to oils and chemicals in the environment and will not allow penetration to the concrete foundation. Oil resistant, closed-cell foam works best. For more information contact your Sika representative or Technical Service.

SURFACE PREPARATION

Cure the foundation until design strength of the concrete is achieved and foundation is dry. Use the recommended procedure according to ACI 351.1R, Grouting Between Foundations and Bases for Support of Equipment and Machinery. The surface to be grouted must be clean, strong, and roughened to a CSP of 5–10, following ICRI Technical Guideline No. 310.2 to permit proper bond. Do not use a bushing hammer. Chamfer the edge of the concrete 45 degrees to about a 51 mm (2 in) width. 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. Seal the anchor bolt hole with felt, foam rubber, or other means. Cover all shims and leveling screws with putty or clay to keep the grout from adhering. Use model clay, glazing putty, or anything with a putty consistency that will stick but not harden. Shims or jack pockets may be formed with wood, and forms filled with damp sand. Remove shims or jack screws after the grout cures. Shade the foundation from direct sunlight for at least 24 hours before and 48 hours after grouting.

SURFACE PREPARATION

Hot Weather Grouting

Special care must be exercised when grouting at elevated temperatures, to reduce risks of premature hardening and subsequent cracking. If the packaged grout is above 32 °C (90 °F), chill the sealed pails of grout resin in a tub of ice or cover the pails with water-soaked burlap to cool the grout to 21 °C (70 °F). Provide shade from direct sunlight for at least 24 hours before and 48 hours after grouting.

Cold Weather Grouting

Temperatures below 16 °C (60 °F) make the grout stiff and hard to handle and significantly increase the cure time. The baseplate and foundation may be much cooler than room temperature. In cold weather, store materials in a warm place. For best handling, the temperature of the grout components and mixing equipment should be at least 21 °C (70 °F). When baseplate and foundation temperatures (measured by a contact thermometer) are less than 10 °C (50 °F), heating of the area may be necessary. If heating is required, erect an enclosure around the equipment and foundation to be grouted. Forced air or infrared heaters may be used to obtain the necessary heat to increase the baseplate and foundation temperatures to 10 to 21 °C (50 to 70 °F). Avoid local hot spots. Apply heat 1–2 days in advance of grouting to achieve uniform baseplate and foundation temperatures. Avoid exposure to exhaust from heating equipment. Remove heat during grout placement. For temperatures from 4 to 10 °C (40 to 50 °F), consider using SikaFlow®-640 Grout Accelerator to accelerate strength development.

MIXING

Precondition all components to 21 C (70 °F) for 24 hours before using. Aggregate must be completely dry.
Pour the hardener (Part B) into a pail of grout resin (Part A) and stir by hand, using a spatula or paint stirring paddle, until well mixed to a uniform amber color. Pour the mixed liquids into a horizontal shaft mortar mixer or a Kol type mixer without delay. Add the grout aggregate, one bag at a time, and mix only until aggregate is completely wetted out to avoid air entrapment. Start the mixer just prior to adding the last bag of aggregate.

Caution: Always add aggregate to the mixer after the premixed liquids have been poured in.

Pour the grout into a wheelbarrow or buckets for transporting to pour-site. Remove it from the wheelbarrow within 15 minutes. 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.

APPLICATION

Pumping SikaFlow®-649

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

Condition all grouting materials as close to 21.1 °C (70 °F) as possible. If an accelerator is used, a grout temperature of 15.6–18.3 °C (60–65° F) is acceptable.

Pumping equipment preparation

Prime the pump and pump lines with the neat epoxy resin or vegetable oil. 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.

Important considerations for pumping application:

- Grout should be pumped through the shortest distance possible. The maximum distance should be limited to 15.2 m (50 ft) For pumping distances greater than 3 m (10 ft), a 38 mm (1-½ in) 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.
- High flow mixes (3 bags of aggregate per full units of resin and hardener) are much easier to pump than fully loaded mixes (4 bags of aggregate). Jobsite and weather conditions will influence the aggregate loading that can be pumped successfully. Never use less than three (3) bags or more than four (4) bags of aggregate fill per full unit of resin and hardener. Regardless of required aggregate fill ratio, begin pumping with a 3-bag mix, to ensure wet-out of the pump and lines. If a 4-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.

Placement

Pour the grout into a wheelbarrow or buckets for transporting to pour-site. Remove it from the wheelbarrow within 15 minutes. For flat bottom plates and bases, pour the grout from one side through to the other across the short dimension. 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. SikaFlow®-649 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. 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 or sheet metal funnel about 0.3–0.6 m (1–2 ft). Check frequently for leaks. Leaks do not self- seal. If not stopped, they will cause voids. If a multi-pour installation is necessary, sprinkle a small amount of SikaFlow®-649 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. Use expansion joints as necessary to minimize cracking. Consult Technical Service for recommendations.

CURING TREATMENT

Cold Weather Curing

For cold weather grouting use SikaFlow®-640 Grout Accelerator. Refer to the SikaFlow®-640 Accelerator data sheet.

The foundation and the equipment base will probably be cooler than room temperature unless room temperature has been constant for some time. Use the foundation and engine temperature, therefore, in estimating cure time. Temperature variances between day and night, ambient and substrate or baseplate, require field judgment for assessing when the grout has cured. Cured

grout should have a solid, almost metallic feel when struck with a hammer. Be sure to check as close to the base of the equipment as possible.

CLEAN UP

After the pour is complete, remove uncured epoxy from the mixer, wheelbarrow and tools with soap and water or a citrus degreaser. Cured material can only be removed mechanically.

LEGAL NOTES

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