GROUTING PRODUCTS - APPLICATIONS & SPECIFICATIONS

This UNISORB® Grout publication presents detailed performance and product selection data covering the extensive line of Unisorb cement-based and epoxy grouting materials. Included are detailed mechanical data and independent laboratory reports presenting full performance profiles for individual products. It is our intent to provide you with a complete guide for the proper selection and application of these products.

UNISORB® grouting materials have been carefully developed to provide optimum performance, even in the toughest applications, along with unparalleled ease of preparation and placement.

The UNISORB® engineering staff and field representatives are readily available to provide design and on-site assistance with your projects to assure that maximum product performance is attained.

CONTACT ACORN TOLL-FREE AT:
1-800-523-5474

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http://www.acornindprod.com

APPLICATION CHART

ADDITIONAL SPECIALTY GROUTING PRODUCTS ARE AVAILABLE

APPLICATIONS*	GROUTING PRODUCTS												
	CEMENT-BASED				EPOXY								
	V-1® NON-SHRINK	V-2® CONSTRUCTION	UNISORB® CONCRETE REPAIR COMPOUND (UCRC)	STRUCTURAL REPAIR	STANDARD V-100®	DEEP POUR V-100®	ADHESIVE V-100®	ACID RESISTANT V-100®	DCR V-100®	CR V-100®	JOINT FILLER V-100®	HI-TEMP V-100® (UP TO 325°F.)	XTRA-TEMP V-100® (UP TO 425°F.)
ACID ENVIRONMENTS								●					
HIGH TEMPERATURE ENVIRONMENTS	●											●	●
CRANE RAIL SETTING	●					●			●	●			
EQUIPMENT ANCHORING	●				●	●			●	●			
ANCHOR BOLT SETTING	●		●		●	●			●	●			
LEVELING WEDGE SETTING	●				●				●	●			
GENERAL PURPOSE GROUTING		●											
REPAIRING CONCRETE FLOORS/FOUNDATIONS			●										
REPAIRING CONCRETE WALLS & CEILINGS				●									
EXPANSION JOINT FILLING											●		
MACHINE BED GROUTING	●				●	●							
SURFACE BONDING OF MACHINERY TO CONCRETE							●						

* Standard recommended applications.
Consult Unisorb Engineering for optional applications.

CEMENT-BASED PRODUCTS	
V-1® NON-SHRINK	A highly flowable product which develops extremely high compressive strengths in a very short time. The product will not shrink, and is perfect for grouting precision machinery as well as anchor bolt setting and other machinery grouting applications.
V-2® CONSTRUCTION	A flowable product intended for use in general purpose construction applications. It is chloride-free, and will not shrink below its original mixing volume.
UNISORB® CONCRETE REPAIR COMPOUND (UCRC)	A flowable, fast setting product designed for setting anchor bolts, and filling holes and large cracks in concrete floors, roads, sidewalks, etc.
STRUCTURAL REPAIR	A self-bonding, quick setting, trowelable wall and ceiling patching compound.
EPOXY PRODUCTS	
STANDARD V-100®	A superior quality product with excellent flowability, high resistance to impact, and extremely rapid cure time. It is an excellent choice where very high strength and low grout quantities are preferred.
DEEP POUR V-100®	A highly flowable product intended for use where larger pours are required, providing excellent compressive strength and rapid cure time.
ADHESIVE V-100®	A product developed to be used as a trowelable adhesive to place under steel plates, bonding them to concrete floors. This can be used in either temporary or permanent installations. This product bonds to most surfaces.
ACID RESISTANT V-100®	A product designed for applications requiring high mechanical strength as well as resistance to sulfuric acid, making it ideal for mining and oil field use.
DCR V-100®	A product designed for rail installations which require extraordinarily high strengths combined with resistance to temperature and humidity, and which will allow pours with 3/4" to 5" cross-sections.
CR V-100®	A product designed for crane rail and other extraordinarily severe applications where ultra-high strength combined with resistance to temperature and humidity are important.
JOINT FILLER V-100®	A product developed for sealing the exposed edge of Inertia Block isolation material at the floor level. It cures to a flexible solid state, preventing transmission of vibrations while protecting the edge of the isolation pad.
HI-TEMP V-100®	A product designed for applications where high mechanical strength and high temperature resistance over regular epoxy grout is required. It has a maximum service temperature of 325° F.
XTRA-TEMP V-100®	A product developed for applications where high mechanical strength and very high temperature resistance are required. It has a maximum service temperature of 425° F.

CEMENT-BASED VS. EPOXY GROUT

Often UNISORB® V-1® Non-Shrink cement-based grout or UNISORB® Standard V-100® epoxy grout will provide equally beneficial long range results in the same application. The following points describe the features of each of these products.

COST

When comparing equal volumes of V-1® and Standard V-100®, the epoxy cost is up to six times greater. It is readily apparent there need to be some good reasons to use the more expensive product. In many cases there is not a great difference in the applied cost. This is a result of physical properties associated with the Standard V-100® that permits use of smaller quantities, as well as other operational benefits that reduce installation costs, as contained in the following paragraphs.

MIXING

V-1® (as with most cement-based products) requires only the addition of water. Mixing is usually done mechanically in a mortar mixer, with clean up requiring only the use of water. Standard V-100® uses pre-measured components, and includes a paddle type stirrer to be used with a variable speed drill.

TIME CONSTRAINTS

When time is an issue consider the following. V-1® should have a 24-hour cure before work continues, with a three day cure before final alignment. The Standard V-100® is stronger than the concrete foundation in less than 8 hours and final alignment can usually be done within 24 hours. In addition, epoxy grouts are used on dry concrete which eliminates the need for pre-soaking.

WORKING TIME

Working time should be considered when selecting grout. V-1® allows 30-45 minutes in which to finish pouring grout, while Standard V-100® allows only 10-15 minutes. With Deep Pour V-100® you have 45-60 minutes.

CROSS-SECTIONAL AREA

Standard V-100® is more fluid than V-1® and can easily flow into thin cross-sections while maintaining full strength. V-1® can only be made more fluid by using additional water, which lowers the strength. Directions on containers should always be followed to achieve optimum results.

Cement-based products require water to undergo a chemical reaction called hydration, and start to lose water as soon as they are placed. Water loss can result through evaporation or absorption into the concrete foundation. Because of water loss, sufficient cross-sectional thickness of the cement-based grout must be maintained to be sure that there is a large enough volume of water to fully hydrate all of the cement. For this reason a 1½" minimum grout pad thickness is recommended.

Because epoxy grout products do not undergo hydration, the Standard V-100® grout pad is often only ¼" to ½" thick. In some cases the grout "pad" is just a puddle with a leveling device setting in it.

ANCHOR HOLE SIZE

The two factors listed above (fluidity and water content) also affect the size of the anchor hole. A much smaller hole is required when using Standard V-100® which impacts cost in two ways:

(1) Volume is much smaller when using epoxy grout. In a typical anchor installation a 3" diameter hole would be used with V-1® while a 1½" diameter hole is recommended when using Standard V-100®. This reduces the volume by 75%, thus reducing the difference in material cost.

(2) Cost is also reduced in the process of placing smaller holes. In the example above, the 1½" diameter hole could be made with a hammer drill (a tool most shops have) using shop employees. The 3" diameter hole would be made with a core drill. The core drill is usually rented or the whole project contracted to someone who specializes in this field.

CHEMICAL RESISTANCE

Both V-1® and Standard V-100® are resistant to chemicals normally found in the industrial environment. This includes oils, coolants, and other fluids. A good rule to follow with V-1® is that if the concrete floor can be exposed to the chemical, the grout can be also. This puts V-1® in a class above other products that require sealing to maintain their properties.

It is reasonable to expect V-1® grout to react as the concrete would to chemicals since after cure it is basically sand and cement. Actually, it is often more chemically resistant and holds up longer than the floor around it. This is because it is a more dense material than the concrete and the chemical attack cannot penetrate the surface. Therefore, while the concrete is being attacked from within, the grout is only being etched from the surface. Needless to say, if it is known that there may be some chemical attack and the floor is sealed to resist this attack, the grout should also be sealed. Standard V-100® also offers excellent resistance to chemical attack.

TEMPERATURE CONSIDERATIONS

The mixing, placing and curing of both V-1® and V-100® are affected by ambient temperatures. In warmer temperatures grouts cure faster, resulting in both shorter work and cure times. In cooler temperatures these times are extended. At temperature extremes special procedures should be used to assure proper grout placement.

After cure, V-1® is suitable for elevated temperatures as high as 1000°F, with little loss in compressive strength. Standard V-100® is capable of withstanding temperatures up to 150°F. Hi-Temp V-100® and Xtra Temp are formulated for maximum service temperatures from 325°F to 425°F.

COMMONLY ASKED QUESTIONS

1. ***How long after a foundation is poured can a grout be used?***

V-1® *As soon as it is set enough to pre-soak, plus 24 hours.

V-100® *3 days (compression only), 7 days otherwise.

2. ***How long after grout is poured can a machine be aligned?***

V-1® *1 - 3 days

V-100® *8 - 24 hours

3. ***What is the min./max. grout thickness?***

V-1® 1½" nominal, ¾" min. - 2" max., (unconfined), up to 3" under plate.

Standard V-100®
Max. up to 1" (unconfined), up to 1½" under plate.

Deep Pour V-100®
1" min. - 6" max.

4. ***What is the min./max. thickness for V-1® & V-2® Grout with pea gravel?*** 2" min. - 8" max.

5. ***When aggregate is used, what is the proper proportion of grout to aggregate?***

See Page G5.

6. ***How long does it take grout to reach its max. strength?***

V-1® 28 days

Standard V-100®
7 days

Deep Pour V-100®
7 days

7. ***How do we choose whether to use V-1® or V-100® Grout?***

See "Cement-Based vs. Epoxy Grout" on Page G3.

8. ***How much working time do we have?***

V-1® *30 - 45 minutes

Standard V-100®
*10 - 15 minutes

Deep Pour V-100®
*45 - 60 minutes

9. ***Is grout pumpable?***

V-1® Yes

Standard V-100®
Yes

Deep Pour V-100®
Yes, if proper equipment is used to allow for pea gravel.

10. ***Can part of a bag/pail/kit be mixed?***

V-1® Yes, but make sure proper amount of water is used.

V-100® No

11. ***What is the most economical grout to use?***

See "Cement-Based vs. Epoxy Grout" on Page G3.

12. ***What is the strongest grout to use, V-1® or V-100®?***

V-100®

13. ***Which grout is best to use for high temperature applications?***

V-1® If epoxy grout is preferred use Hi-Temp V-100® or Xtra Temp V-100®. See pages E5 & E6.

14. ***Should grout be poured on a wet or dry surface?***

V-1® Wet

V-100® Dry

15. ***How can I keep grout from "seeping away" when I've had to core drill into the soil under the concrete floor?***

V-1® Sprinkle dry V-1® grout powder into hole, approximately ¼" deep, and level off, then pour grout.

V-100® Pour just enough V-100® grout to cover and seal the soil portion of the hole, and wait until it partially cures (about 1 hour). Then fill V-100® into hole with anchor bolt.

16. ***To what industry specifications has grout been tested?***

Unisorb grouts have been tested in accordance with industry recognized CRD and ASTM specifications.

V-1® See pages C1 & C2.

V-2® See page C3.

V-100® See page E1-1 thru E-6.

Contact Unisorb Engineering for additional test results.

17. ***What effect does temperature have on the viscosity of Standard V-100® Epoxy Grout?***

Viscosity varies greatly with temperature changes. For exact specifications refer to "Standard V-100® Temperature Considerations on Page E1-2.

18. ***Does temperature affect the curing process of V-100® Epoxy Grout?***

Yes. To achieve proper curing, V-100® should not be poured unless the ambient temperature exceeds 50° F.

19. ***What is the shelf life for Unisorb grouts?***

The shelf life should be considered one year in most cases. This is the time frame where the strengths, flow and cure time are consistent for normal storage conditions.

**Weather conditions, such as temperature, humidity, wind factor, rain or sunshine may affect figures given as follows:*

Warm, dry weather on a sunny day (if an outside application) will speed up curing and handling times on all grouts. Cold, wet weather will slow down curing and handling times on all grouts. If work is being done inside, and temperatures are in the 70° F to 80° F range, the median figures given should be quite accurate.

GROUT COMPARISON CHARTS / GROUT W/ AGGREGATE

The following products are typically used for machinery installation and summarized below for easy comparison:

PHYSICAL PROPERTIES				
PHYSICAL PROPERTIES	V-1® NON-SHRINK	V-2® CONSTRUCTION	UNISORB® CONCRETE REPAIR COMPOUND (UCRC)	STRUCTURAL REPAIR
Compressive Strength (psi)				
24 Hours	7,545	1,400	5,200	3,000
28 Days (Ultimate)	11,690	6,800	8,000	5,000
Tensile Strength (psi) (28 Days)	568	—	476	—
Flexural Strength (psi) (28 Days)	1,700	—	1,405	1,100
Allowable Thickness (Typical)	3/4" - 2"	3/4" - 2"	1/16" - 2"	1/2" - 3"
Working Time	30 - 45 minutes	20 - 30 minutes	15 minutes	10 minutes
Yield	.83 cu. ft./100#	.90 cu. ft./100#	.80 cu. ft./100#	.80 cu. ft./100#

PHYSICAL PROPERTIES	STANDARD V-100®	DEEP POUR V-100®	DCR V-100®	ADHESIVE V-100®
Compressive Strength (psi)				
6 Hours	9,000	—	11,200	—
3 Days	15,250	11,600	14,500	—
7 Days (Ultimate)	16,800	13,800	20,000	14,000
Tensile Strength (psi)	4,260	1,500	3,000	5,200
Flexural Strength (psi)	6,800	4,500	6,000	11,000
Allowable Thickness (Typical)	1/16" - 1"	1" - 6"	3/4" - 5"	—
Working Time	10 - 15 minutes	60 minutes	60 minutes	45 minutes
Yield	16.5 cu. in. per lb.	1 cu. ft. (1,728 cu. in. per kit)	1 cu. ft./kit	450 cu. in./kit

GROUT WITH AGGREGATE

CEMENT-BASED GROUT

Where grouting area and floor space are of sufficient size, up to 50% (by weight) of pea gravel aggregate may be used. Pea gravel should be standard size (3/8" dia.) and may be purchased from a local concrete or stone supplier. Prior to use, the pea gravel should be washed and dried. However, it is important to PRE-WET the pea gravel before it is added to the cement-based grout.

EXAMPLE: Truckload mixing of V-1® Non-Shrink grout with pea gravel using the following quantities:

- (51) 48# bags of V-1® Non-Shrink grout (2,448 lbs.)
- (16) 75# buckets of WET pea gravel (1,200 lbs.)
- (50 - 55) Gallons of water

A 5-gallon bucket of pea gravel weighs approximately 75 lbs. In this example, a mixing ratio of approximately 50% pea gravel (by weight) was used to obtain one cu. yd. of grout (27 cu. ft.).

YIELD	
Grout Type	Yield With 50% (By Wgt.) Aggregate
V-1®	.53 cu.ft./48# bag
V-2®	.60 cu.ft./50# bag
UCRC	.53 cu.ft./50# bag

EPOXY GROUT

Unisorb recommends the use of Deep Pour V-100® epoxy grout for large or deep pours. This product includes the proper size and amount of aggregate. If Deep Pour V-100® is not readily available, or time constraints are an issue, crushed granite or the equivalent may be used as an aggregate with Standard V-100® epoxy grout.

The crushed granite should be washed and dried before using, however it is important that it is NOT pre-wet. Fill the grout cavity with crushed granite and then fill the voids with Standard V-100® epoxy grout.

NOTE: The addition of aggregate filler may affect the final strength of cement-based and epoxy grouts by ±20%.

Physical properties shown are the result of independent laboratory testing performed per industry recognized test procedures. Laboratory properties aid in determining suitability of the product for the intended application. Field test results may vary due to procedures or ambient conditions such as temperature and humidity. Laboratory reports are available on request.

GROUT VOLUMES FOR ANCHOR HOLES

STANDARD GROUT PACKAGING & YIELD

The grout volume chart below was prepared to help determine the amount of grout required for various size grout holes. The chart assumes the grout holes are cylindrical in shape.

To determine the amount of grout required refer to the following:

1. Determine the grout hole diameter and depth. Read the volume in the chart, i.e., a 3" diameter x 10" deep hole equals 70.7 cu. in.
2. Multiply the 70.7 by the number of holes, i.e., if there are 30 grout holes, multiply 70.7 cu. in. x 30 to get 2,121 cu. in.
3. Divide this number (2,121 cu. in.) by the rated yield of the standard grout package. In the previous illustration to make a grout pour using 11# Kits of Standard V-100® epoxy grout you would divide 2,121 cu. in. by 173 cu. in. per kit (12.3 kits). This can be rounded to (13) 11# Kits of Standard V-100® epoxy grout.
4. Keep in mind that the above calculations are exact and offer no safety factor for more material usage than is planned, i.e., if the holes are slightly larger. You will need to allow for your own margin of safety.

VOLUME OF GROUT REQUIRED FOR ONE HOLE (Cubic Inches)								
Hole Depth - Inches	Hole Diameter - Inches							
	1.5	2	2.5	3	3.5	4	5	6
4	7.1	12.6	19.6	28.3	38.5	50.3	78.5	113.1
5	8.8	15.7	24.5	35.3	48.1	62.8	98.2	141.4
6	10.6	18.8	29.5	42.4	57.7	75.4	117.8	169.6
7	12.4	22.0	34.4	49.5	67.3	88.0	137.4	197.9
8	14.1	25.1	39.3	56.5	77.0	100.5	157.1	226.2
9	15.9	28.3	44.2	63.6	86.6	113.1	176.7	254.5
10	17.7	31.4	49.1	70.7	96.2	125.7	196.3	282.7
12	21.2	37.7	58.9	84.8	115.5	150.8	235.6	339.3
14	24.7	44.0	68.7	99.0	134.7	175.9	274.9	395.8
16	28.3	50.3	78.5	113.1	153.9	201.1	314.2	452.4
18	31.8	56.5	88.4	127.2	173.2	226.2	353.4	508.9
20	35.3	62.8	98.2	141.4	192.4	251.3	392.7	565.5

STANDARD GROUT PACKAGING & YIELD				
V-1® Non-Shrink	48# Bag	=	.40 cu. ft.	(691 cu. in.)
	100# Bag	=	.83 cu. ft.	(1,434 cu. in.)
V-2® Construction	50# Bag	=	.45 cu. ft.	(778 cu. in.)
	100# Bag	=	.90 cu. ft.	(1,555 cu. in.)
UNISORB® Concrete Repair Compound (UCRC)	20# Pail	=	.16 cu. ft.	(276 cu. in.)
	50# Pail	=	.40 cu. ft.	(691 cu. in.)
	50# Bag	=	.40 cu. ft.	(691 cu. in.)
Structural Repair	20# Pail	=	.16 cu. ft.	(276 cu. in.)
	50# Pail	=	.40 cu. ft.	(691 cu. in.)
	50# Bag	=	.40 cu. ft.	(691 cu. in.)
Standard V-100®	11# Kit	=	.10 cu. ft.	(173 cu. in.)
	22# Kit	=	.21 cu. ft.	(363 cu. in.)
	55# Kit	=	.53 cu. ft.	(916 cu. in.)
Deep Pour V-100®	Three Part Kit	=	1 cu. ft.	(1,728 cu. in.)
DCR V-100®	63# Kit	=	.40 cu. ft.	(691 cu. in.)
	125# Kit	=	1.00 cu. ft.	(1,728 cu. in.)
Adhesive V-100®	28# Kit	=	.26 cu. ft.	(450 cu. in.)

RECOMMENDATIONS FOR GROUTING MACHINERY

By **WAYNE H. WHITTAKER**, V.P./G.M., Unisorb Installation Technologies, Jackson, MI

The grouting of machine base plates and bearing plates, and of anchoring/alignment equipment to a foundation are low-cost approaches that provide a high quality machine-to-foundation connection. A successful installation depends on: proper grout selection, based on application; foundation preparation; forming method employed; and careful attention to the actual application of the grouting material.

Grout Selection — Selecting grout for a particular application should include an evaluation of these factors:

1. **Cost** — Compare the cost of mixed grout, ready for placement. Yields can vary considerably from one manufacturer to another, and dry powder to price comparisons are misleading, as the amount of mixing water required will also vary.
2. **Strengths** — Applied loads should be evaluated carefully to ensure that the bearing capacity of the grout is not exceeded. Compressive strengths reported by manufacturers are based on tests run under lab conditions; actual field-cured values for cementitious grouts will be approximately 80 percent of the lab result.
3. **Ease of handling and placement**—The following factors are important:
   A. **Flowability.** The ease with which the material enters small cavities and travels under larger base plates is usually measured either by the Flow Table (ASTM-C230 or CRD-C226) or Flow Cone (ASTM-C939 or CRD-C611). For the flow table test, the results are expressed as a dimensionless number ranging from 100 to 150, with 150 the most flowable. The Flow Cone results range from 30 seconds to 10 seconds, with 10 seconds the most flowable.
   B. **Tendency to separate** when mixed or handled excessively. In some materials that use metallic additives or have aggregates of widely varying sizes, the aggregates tend to separate if the material is overmixed or handled excessively.
   C. **Ability to be pumped** or vibrated, particularly on larger installations. Again, separation is the problem. The ability to be vibrated or pumped is a prime concern when grouting cavities are small, when placement is difficult, or when grout must be flowed long distances.
   D. **Expansion or nonshrink** properties. The main objective is to select a material that will expand enough to assure full bearing contact with machine base and foundation (a few tenths to 1 percent or so is normal). When large grout-to-machine contact areas are encountered, a grout with a controlled internal pressure development should be selected to prevent the grout's expansion from disturbing alignment. The actual expansion of a grout is typically measured by either the ASTM C-1090-88 or ASTM-C827-87 early volume change method; the result is expressed as a percentage.
   E. **Maintenance requirements.** What will be required to keep the grout functional in the environment into which it will be placed is the main concern. For example, a grout that is to be used in an oily environment should be a relatively impermeable type. A grout with a porous structure will require a paint coat to prevent penetration by oils and other chemicals.

Other special considerations include ability to withstand thermal cycling and high temperatures, ability to resist acids, and susceptibility to spalling under freeze-thaw cycling.

Materials in use today range from slightly modified sand and cement mixtures to chemically sophisticated epoxy materials with strengths five to six times that of standard concretes.

Cementitious Grouting Materials—The simplest grouting material consists of sand and cement mixed at approximately a 50/50 ratio. Simple sand and cement mixtures shrink on curing, usually from 2 to 3 percent, making their use in high load or precision applications questionable. Cementitious grouts in use today have

GROUTING ADVANTAGES

1. Foundation forming and finishing tolerances may be relaxed. Because grout provides the final link between the machine and the foundation, the foundation is usually finished 1½ to 3 in. below the desired machine base level. A thicker or thinner grout pad can be used, as the specific situation requires, to compensate for the variances encountered in actual foundation construction, eliminating the need for precision foundation work.
2. Grouting provides a rigid machine-to-foundation connection. As the grout is placed into the cavity, in the plastic or fluid state, it conforms precisely to the machine base and to the foundation, providing a 100 percent bearing contact between foundation and grout pad, and grout pad and machine base.
3. Anchoring/alignment equipment can be positioned within a precast or core-drilled grouting cavity at the time of machine installation. As the foundation is constructed, grouting cavities are created by precasting or core drilling (while the foundation is green) at the approximate location of each support or anchor point. When the foundation has cured sufficiently to support machine loads, the machine is moved into position on the foundation and supported by temporary blocks. The anchoring/alignment equipment is then assembled to the machine base with the anchor bolt and base of the alignment device (if one is being used) projecting into the grouting cavity. Grout is then placed into the cavity and allowed to cure, completing the machine-to-foundation connection. This approach eliminates the requirement for time-consuming, precise presetting of anchor bolts or alignment equipment, significantly lqwering the cost of more complex installations.
4. Existing foundations may be easily adapted to new equipment. Core drilling an existing foundation to accept new anchoring/alignment equipment, which is in turn grouted into permanent position, eliminates the need for removing and replacing an otherwise sound foundation if the equipment it supports is being relocated or replaced. When properly installed, these anchors exhibit holding power equal to or better than that of anchors set into the foundation as it was constructed.

been modified to expand rather than shrink on curing.

There are several basic expansion mechanisms in use today. One involves the addition of iron filings to the sand-cement mixture. The filings expand slightly when water is added to the mixture, causing the desired expansion.

Other systems include the use of carbon particles (evolved gas causes expansion) and the use of chemically compensated "Type K" cements (which promote growth within the cement paste).

Epoxy Grouting Materials—The epoxy grouts consist typically of a base resin and hardener that are mixed at the jobsite immediately before placement. (Some systems may also require the addition of a filler at this point.) An advantage of epoxy materials is the ability to withstand significantly higher shock loads than cementitious materials. Epoxies also can be used in much thinner cross sections than cementitious materials; this feature may be desirable in certain applications.

The epoxy grouts typically exhibit slight shrinkage on curing but usually the thinner section used (and extremely small amount of overall shrinkage encountered) minimizes the problem.

When the application is unusually severe from a shock loading standpoint or is to be used in a very thin section requiring high flowability, high strength, and rapid cure rate, an epoxy grout should usually be chosen rather than a cementitious one. Setting anchor bolts is an application particularly well suited to the epoxy material because a relatively small quantity is used and the short cure time is an advantage. Epoxy grouts are widely used for applications such as installing large engines, compressor units, crushers and shredders, and other equipment imparting large dynamic loads to their foundations.

Foundation Preparation—The concrete surfaces to which the grout will be applied must be carefully cleaned, leaving the surface free from all foreign material, grease, oil, etc. If an old foundation is being reused, be sure that the upper surfaces are sound. If unsound concrete is encountered, it will be necessary to chip back to sound concrete. The objective is to place grout against sound, clean concrete only.

Forming Recommendations — In preparing forms for retaining fluid grout, keep in mind that the most effective means of achieving a good machine base-to-grout contact is to place the material from one side only. The material should flow under the machine being grouted, and, while it is flowing, contact between the upper surface of the advancing grout and the machine base should be maintained. This approach will ensure that no air becomes trapped between the grout and machine base, Fig. 1.

It is important to maintain clearances between the machine base, foundation, and forms. Adequate clearance should be provided between the form and base plate on the pour side to permit material to be introduced rapidly enough to maintain grout base contact. Use of a sheet metal or wooden chute may prove helpful in introducing the mixed grout into the form. The forms should also be high enough to permit the fluid grout to be brought up the side of the machine base about ½ inch to make sure that full bearing contact is realized. Sufficient grout must be available so that the entire cavity is filled in a single, continuous pour.

The form should be carefully designed and constructed to prevent leakage because modern grouts are much more flowable than concrete. It is recommended that caulk or a construction adhesive be used to seal the individual form components to each other and to seal the completed form to the foundation. Epoxy grouts, which are extremely flowable, require extra attention to the sealing to prevent possible form leaks.

Application—It is desirable, in some cases, to grout anchoring/alignment equipment in place, pouring a bearing pad and setting an anchor bolt simultaneously, Fig. 2. The anchor bolt cavity must be completely filled with grout. A filled cavity can be attained by pouring the grout slowly at first to make sure no air is trapped. For unusually deep holes, it may be advisable to use an air bleed tube that is withdrawn when the cavity is full, Fig. 3.

An alternate approach is the funnel and hose method. A highly flowable grout is required for this approach, and the tip of the hose should be inserted

DO'S AND DON'TS

For Cementitious Grouts

- Don't exceed recommended water levels in an attempt to achieve greater flowability. Using more water than specified by the manufacturer may result in segregation of the material or may interfere with the nonshrink mechanism.
- Don't overmix or undermix. Refer to the grout manufacturer's minimum and maximum mixing time recommendation. Overmixing may cause segregation in metallic-type materials and unnecessary air entrainment in other materials. Undermixing may not accomplish adequate blending of dry ingredients and may prevent proper wetting of materials which could result in the grout's "false setting" and other problems.
- Don't use curing compounds or bonding agents unless specifically approved by the grout manufacturer.
- Do wet the foundation thoroughly. Otherwise, water will be drawn from the newly placed grout too quickly, interfering with proper curing.
- Do use clean mixing water. Chemical contaminants may interfere with the proper expansion of the material.
- Do read the individual manufacturer's instructions, especially when placing grout at temperatures below 40°F (5°C) and above 90°F (35°C) as the requirement for special measures varies considerably.

For Epoxy Grouts

- Don't place epoxy grouts when water is present (once cured, water is no problem).
- Do be sure the foundation is clean and free from oil or grease.
- Do design for thin sections, avoiding large pours.
- Do familiarize jobsite personnel with the manufacturer's recommended handling and safety precautions.

RECOMMENDATIONS FOR GROUTING MACHINERY

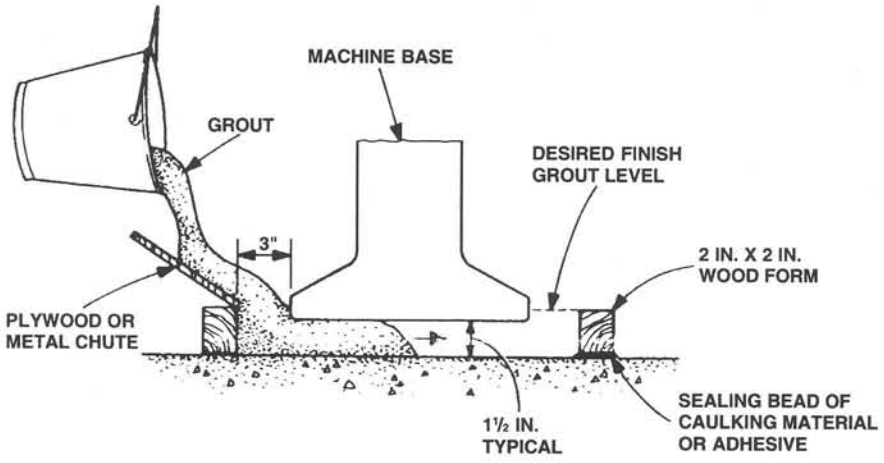

Fig. 1. The grouting material should be placed from one side only to achieve good machine base-to-grout contact. This approach ensures that no air is trapped between the grout and machine base.

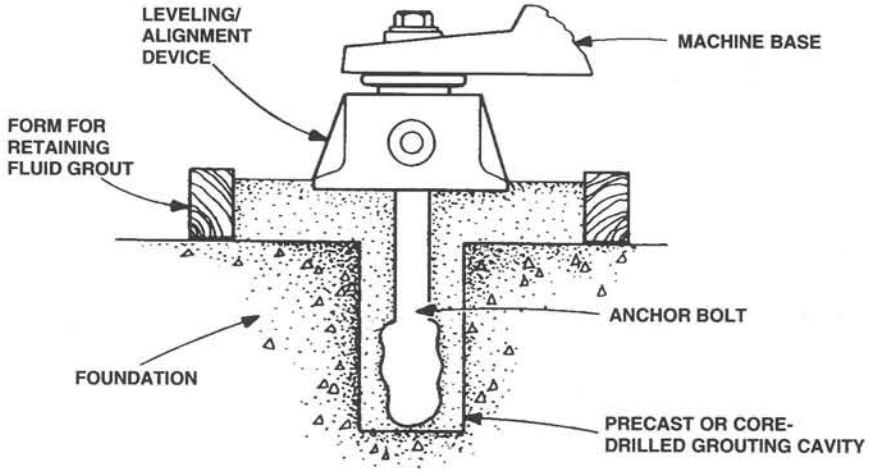

Fig. 2. This application, recommended when leveling/alignment equipment is grouted, simultaneously providing a bearing pad and anchor bolt.

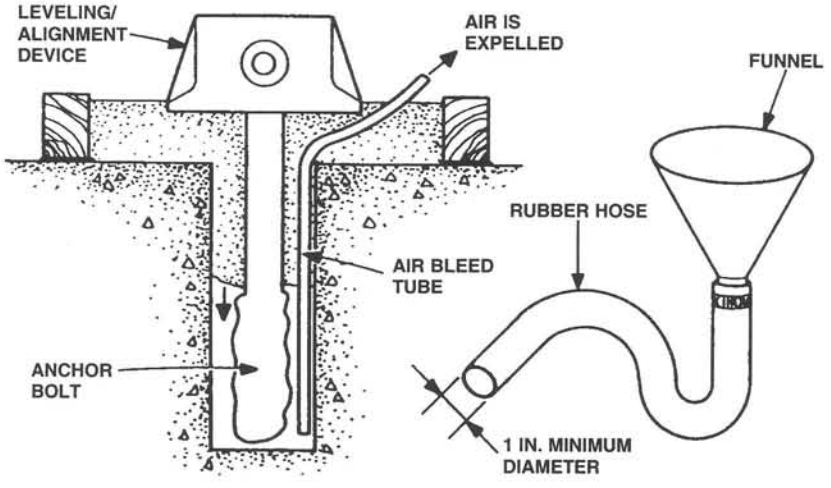

Fig. 3. If the anchor bolt cavity is very deep, an air bleed tube might be advisable. It should be withdrawn after the cavity is filled. An alternate approach is to use a funnel and hose. A highly flowable grout is required, and the tip of the hose should be withdrawn slowly as grout level rises.

RECOMMENDATIONS FOR GROUTING MACHINERY

"The time spent in thoroughly planning the grouting installation will pay off in fewer problems in the machine's performance."

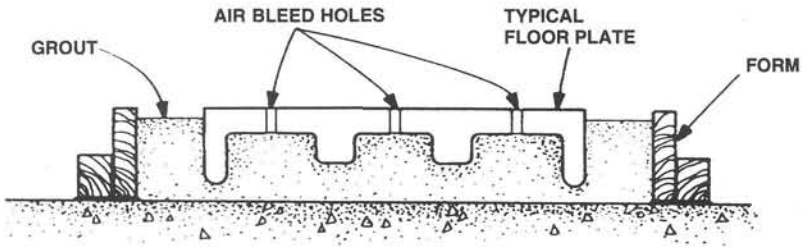

Fig. 4. Air bleed holes should be provided when blind cavities are grouted. The holes also provide visual assurance that all cavities are filled.

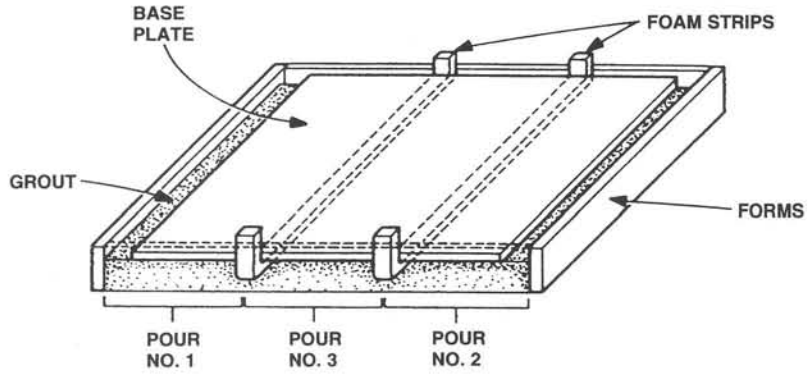

Fig. 5. When large areas are grouted, the pour should be divided into sections. Sections 1 and 2 should be poured and allowed to set before the center section is poured.

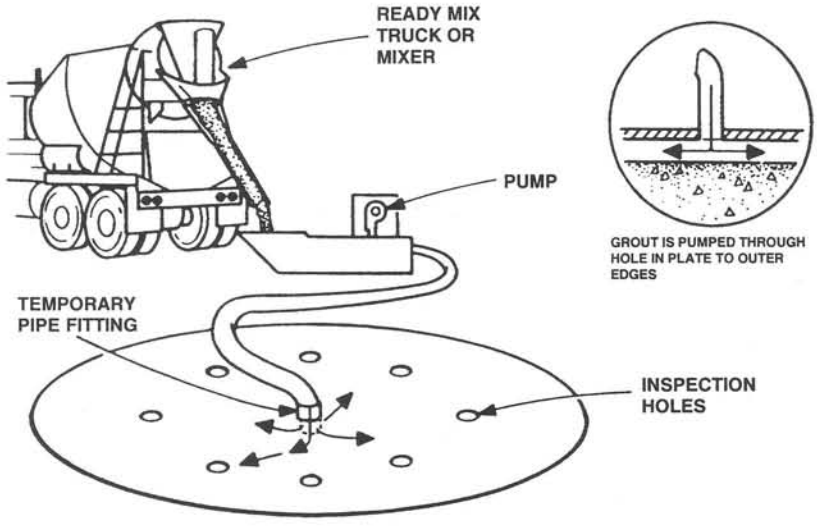

Fig. 6. For large pours, a ready-mix truck and concrete pump are recommended.

into the anchor bolt cavity and withdrawn slowly as the grout level rises.

Air bleed holes should be provided when blind cavities are grouted, Fig. 4. The air bleed holes serve a second function of providing visual assurance that all cavities are filled.

When working with a larger pour, it may be advisable to break the pour into sections for more convenient handling by using polyethylene foam strips, Fig. 5. The outside cavities are filled first, and the grout is allowed to set before the foam strips are removed. The remaining center cavity is filled last.

Many of the currently available grouting materials can be pumped with a standard concrete pump. This approach is frequently used when extremely large pours are required. The main problem is mixing the necessary amount of material quickly enough to permit a single continuous pour. A standard ready-mix truck and concrete pump work well, Fig. 6.

A first-quality grouting installation is the key to successful machine installation. The time spent in thoroughly planning the installation will pay off in fewer problems in the machine's performance. ■

Information in this article has been updated to meet product and application standards in use in 1997.

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