

Working time is about 75% of the gel time for the geometry of the pot. It can be lengthened by increasing the surface area, working with a smaller mass, or cooling the resin and hardener prior to mixing. Material left in the pot will increase in absolute viscosity (measured at 75°F, for example) due to polymerization but initially decrease in apparent viscosity due to heating. Material left in the pot to 75% of gel time may appear quite thin (due to heating) but will actually be quite thick when cooled to room temperature. Experienced users either mix batches that will be applied almost immediately or increase the surface area to slow the reaction.

Although the cure rate of an epoxy is dependent upon temperature, the curing mechanism is independent of temperature. The reaction proceeds most quickly in the liquid state. As the cure proceeds the system changes from a liquid to a sticky, viscous, soft gel. After gelation the reaction speed slows down as hardness increases. Chemical reactions proceed more slowly in the solid state. From the soft sticky gel the system gets harder, slowly losing its stickiness. It becomes tack free and continues to become harder and stronger as time passes.

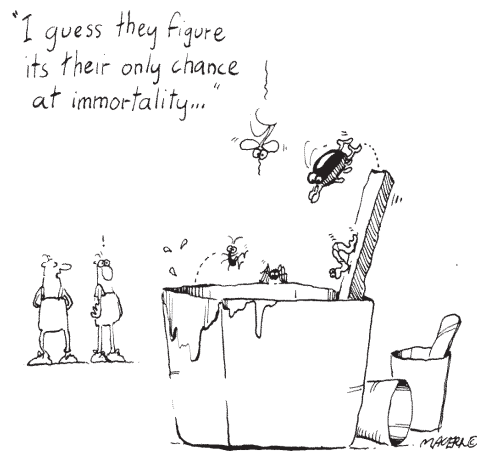
At normal temperatures the system will reach about 60 to 80% of ultimate strength after 24 hours. Curing then proceeds slowly over the next several weeks, finally reaching a point where no further curing will occur without a significant increase in temperature. However, for most purposes room temperature cured systems can be considered fully cured after 72 hours at 77°F. High modulus systems like Phase Two epoxy must be post-cured at elevated temperatures to reach full cure.

It is usually more efficient to work with as fast a cure time as practical for the application at hand if the particular system being used offers this choice. This allows the builder to get along to the next phase without wasting time waiting for epoxy to cure. Faster curing films with shorter tack times will have less chance to pick up fly tracks, bugs, and other airborne contaminants.

A surface film may form on some epoxy systems during the curing process. Technically, this surface film is an amine carbonate that can form in the presence of carbon dioxide and water vapor. More appears on cool damp days than on warm sunny days. This film, often called blush, is water-soluble and should be removed with a sponge and warm water before sanding or painting. Surface blush does not affect the clarity of the cured epoxy film. SilverTip Laminating Epoxy does not form a blush.

Unprotected epoxy resins are not ultimately sunlight resistant. After about six months of exposure to intense sunlight they begin to decay. Additional exposure will induce chalking, yellowing, and eventually the epoxy will disintegrate, losing its mechanical properties. The solution to this problem is to protect the epoxy with paint or with a varnish, which contains an ultraviolet light shield.

Caution must be observed when using epoxy resins along with polyester resins. Observe the general rule that epoxy resins may be applied over cured polyesters that have been dewaxed and well sanded but polyesters should never be used over cured epoxy resins. Unreacted amine in the epoxy inhibits the peroxide catalyst in the polyester causing an incomplete cure at the interface. Sanding does not get rid of unreacted amine. The result is a poor bond even though the surface appears cured. Debonding will be the inevitable result. Our SB-112 epoxy system was designed to get around the "polyester over epoxy" problem. Consult the SB-112 Technical Data Sheet for additional information.



SECTION IV - MEASURING AND MIXING

Measuring and mixing is really easy with most of our epoxy systems because they mix at a 2:1 or 1:1 volume ratio, but this doesn't mean you don't have to pay attention to what you're doing. First, read the label or Technical Data Sheet to see what the correct ratio is for the product you are using. Customers will call our Technical Support line suggesting that something is wrong with the epoxy because it didn't cure properly. We know of no situation where properly-mixed resin/hardener has gone bad or has been contaminated and wouldn't cure. It always resolves that the batch was either improperly measured or insufficiently mixed in the user's shop. Epoxy chemistry just will not allow it to work any other way.

If you're working on a project that requires you mix many small resin batches, develop a measuring technique that is sufficiently

accurate and stay with it. Doing it the same way each time will minimize the chance for error. Measuring errors are insidious and can pop up when least expected. The reasons that errors occur are always because the technique changed, too little time was taken, someone else mixed a batch, or just not enough care was taken.

If using a graduated cup or a straight-sided can, get in the habit of measuring the same way each time. If you pour the resin first, then always pour the resin first. Before adding the hardener, notice how much resin is already in the container, divide this by two (for a 2:1 system) and then add hardener to bring the total to the correct mark. Measuring in the same order each time will avoid the common error of two parts of hardener to one part of resin.

Using a vertically held stir stick marked in a two to one ratio will only work for vertical sided containers. Don't use this method on containers with sloping sides.

If using the "two measures/one measure" method and mixing in a separate container, scrape the sides each time you pour from the measuring cups to the mixing container.

Double check that the graduations on disposable paper cups look right. Some cups are not rolled correctly when made. The first graduation is sometimes too high or too low.

Use the System Three AccuMeasure Kit (see Product Catalog) when working with amounts smaller than three fluid ounces. It's inexpensive and very accurate down to about one half ounce. Many of our customers have completed large projects measuring with just the AccuMeasure Kit and 14-ounce graduated disposable paper cups. You really don't need to invest a lot of money in metering devices to measure a 2:1 or 1:1 volume ratio products successfully. Good technique and common sense go a long way.

System Three Resins offers white plastic plunger pumps for those who want a mechanical device to measure by volume. These fit on the pint, quart, half-gallon, one-gallon, 2.5 and five-gallon containers. These pumps are the kind that you find at the ballpark that are used to get mustard out of the jar to put on your hot dog. They can be used at two squirts to one squirt or the hardener pump can be modified to operate at one squirt of hardener to one squirt of resin. Complete instructions come with each plunger pump kit. They do not work for high-viscosity systems measured at 1:1.

We can refer those willing to invest large sums in fast, accurate mechanical devices to outside vendors. System Three Resins no longer offers these following the advent of low cost digital scales.

Any mechanical device can go haywire, lying to you with a straight face. Valves can stick causing backflow into the reservoirs. Pumps should be checked for accuracy periodically using scales or graduated cups. If you aren't prepared to spend the time to properly maintain these mechanical pumps, then consider measuring by weight. This is the method we use and find it faster and more accurate than measuring by volume.

Excellent reliable digital scales can be had for under a hundred dollars. This is about a third of the cost of lowest price mechanical devices excepting the mustard pumps. A digital scale with a capacity of 500 grams with 0.1 gram divisions can weigh batches of less than one-half fluid ounce reproducibly with confidence that it is dead on each and every time.

Scales offer two other distinct advantages: The old style "chemistry set" approach utilizing powder fillers greatly benefits when the fillers are also weighed. One ends up with consistent mixes each time when thickened batches are needed. Second, the SilverTip series contains products like EZ-Fillet, QuikFair and MetlWeld which, being semi-pastes, cannot accurately be measured by volume since they do not "self-level" and often contain air pockets when plopped into a measuring cup.

Don't make the mistake of using the volume ratio when measuring by weight. We formulate products to be used by simple volume ratios (2:1, for example) as much for packaging purposes as any other reason. Weight ratios are usually expressed in parts of hardener to 100 parts of resin. Volume ratios of 2:1 are often equivalent to weight ratios of 43/100 because the hardener is less dense than the resin. Check the Product Data Sheet to get the correct weight ratio if you measure by weight.

With the resin and hardener accurately measured, mix thoroughly. For batches of a gallon or less, stir well, scraping the container sides, and mix from the bottom to the top. Keep stirring until that mixture is no longer hazy. Don't worry about a few air bubbles. That's normal. Scrape the mixing stick several times on the side of the container. Mixing takes anywhere from 15 seconds to a minute depending on the size, shape of the container, and temperature and viscosity of the mix. A sure-fire way to make sure that material is thoroughly mixed is to use the "two-container method". Mix in one container and then transfer the contents into a second container scraping the first into the second. Then mix again. You will have an absolutely uniform batch if you do this and avoid having partially cured spots in your coating or pour.

Avoid large batches if possible. It's better to make three 12-ounce batches rather than one 36-ounce batch. If your job is big and you must work with large batches then use a Jiffy Mixer. Attached to a drill it will make short work of mixing batches larger than a gallon. Use the two-container method also when mixing large batches, and don't forget to scrape the sides of the mixing container. Keep in mind that large batches take longer to mix, have a much shorter pot

life, and if you get side tracked cost more when they gel in the pot. Epoxy paperweights are expensive.

If you measured or mixed incorrectly and a batch doesn't properly cure about the only thing to do is scrape it off and start over. A hot air gun will help to soften the partially cured material. Then try removing any residual material with lacquer thinner (but not with the hot air gun or source of ignition around). Wear solvent resistant gloves and have plenty of ventilation when doing this. Then examine your technique to find out what went wrong.



If your measuring/mixing error is not apparent do the following gel time test to convince yourself that the product is not at fault.

Accurately measure resin and hardener in the same container, use a total of three to six fluid ounces or at least 50 grams. Mark down the time you started mixing the two components. Mix thoroughly and record the approximate starting temperature of the mixture. Stir occasionally and note the time that the material gels (solidifies). Refer to Technical Data Sheet for the product being tested to see if the gel time is about what it is supposed to be for the given starting temperature. A minute or two either way is not important. If your test material cured properly then the error is in measuring or mixing.

If, after all this, you remain convinced that “something is wrong with the product”, take it back to the store. If your System Three dealer can’t talk you through the problem, call us. Keep in mind that we have tested the batch you are using and lots of other customers are using material from this same batch.

All System Three epoxy products are formulated systems, meaning that we start with basic raw materials produced by large chemical manufacturers, and modify them to make them suitable for our customers’ use. These modifications take many forms, and are the heart of epoxy resin formulating.

For instance, in a clear laminating resin, a modification might include viscosity reduction by the addition of diluents or low viscosity solvents, which are also epoxies. Lower viscosity makes a laminating resin thin enough to wet fiberglass cloth, coat and penetrate wood, coat concrete, stone, or metal, and bind various fillers to produce gap filling glues and putties. Because the diluents we use are also epoxies, they are called reactive diluents, reacting with the amines the same way the basic resin reacts, becoming a part of the cured system. Other reactive materials protect against long-term embrittlement and improve resiliency and impact resistance.

In the case of several of the SilverTip marine epoxy Series products we add various fillers, pigments and thixotropes in a unique process that removes any dispersed air. SculpWood moldable epoxy putty is a “filled” product taken to an extreme: There is so much filler in the product that it is friable rather than wet. It takes specialized equipment to make products like this.

Many of our products use trace materials that are designed to lower surface tension, promote substrate wetting, reduce cratering and “fisheye” formation, aid in breaking bubbles and detaining air. Some additives promote adhesion while others increase toughness.

These modifications are what make our epoxy products unique, different, and we think preferable to our competitor’s products. We not only develop the chemical formulations for both the resin and hardeners, we manufacture our products, giving us ultimate control over the quality of the final system. Every batch manufactured in our factory goes through appropriate quality control testing in the laboratory, depending on its intended end use. Nothing is shipped to a customer that does not meet our high standards. Everything we ship will perform as advertised if properly measured, thoroughly mixed, and applied according to instructions.

System Three Resins is well qualified to formulate and produce epoxy resin products. Our technical staff includes one of the owners, a chemical engineer who has worked with polymers since 1963. He has built a 34-foot wood/epoxy sailboat and more recently a composite kit aircraft, which he regularly flies. We also have a polymer chemist with over 30 years of formulating and manufacturing experience in our employ.

This background gives us the ability to know and apply epoxy technology that is on a par with any other companies in the industry, including the multinational conglomerates. The development, manufacture, and distribution of System Three products is our only business.

The dominant factor in the design, development, and evolution of System Three epoxy resin products has been this:

AN EPOXY SYSTEM SHOULD ADAPT TO THE CONDITIONS OF THE USER - NOT THE OTHER WAY AROUND.

