Product Data

908 LENOIR ROAD • POST OFFICE BOX 1809
HICKORY, NORTH CAROLINA • 28603-1809
TELEPHONE (828) 328-1721
TOLL FREE (800) 334-5975
FAX (828) 328-4572

HK RESEARCH TOOLING GUIDE

It would be difficult to over-emphasize the importance of a quality polyester tool to the FRP manufacturer. The parts you make will be a mirror image of the tool you use. The surface of the pattern and the mold must reflect the quality of the surface you want on your FRP manufactured component. Extra care in design and construction of the pattern and the mold will be rewarded by reduced trimming and waste costs, as well as by reduced repair and touch-up costs.

Patience and meticulous care are two of the most important ingredients in the construction of a pattern and a mold. There is no quick and easy way to produce a quality mold.

The HK Research staff is not pattern or plug making experts and we have no intention of telling the many experts in this field how to accomplish this. We do, however, have some thoughts based on our experience that we will be happy to share, trusting that these thoughts may be of assistance to someone as they prepare their FRP mold.

HK RESEARCH'S PRODUCTS ARE DESIGNED FOR QUALITY TOOLING

HK Research Corporation products cover a wide **H**eat **D**istortion **T**emperature and Barcol (934-1) hardness range that offer customized properties for the tool producer. These products include the following families:

Tooling Gel Coats

	HDT °C/°F	Barcol Hardness
"B" Series Isophthalics	115 / 239	42-45
"B" Series VE Hybrids	155/310	48-52
"LHB" GRIZZLY™ LOW HAP*	155 / 310	48-52
"B" Series Urethane Modified -Vinyl Esters	200+ / 390	62-64

Tooling Laminating Resins

"R" Series Isophthalics	115 / 239	45-50
"R" Series Urethane Modified-Vinyl Esters	200+ / 390	60-65

* Meets or exceeds 40CFR 63 Boat and Composites NESHAP/MACT

PATTERN OR PLUG

We have already stated that extra care in design and pattern preparation can easily pay ten-fold dividends when the FRP manufacturer starts pulling his parts from the molds made from this pattern. Your choice of pattern making material is as broad as your imagination, keeping in mind that the completed part will essentially duplicate the surface of your pattern and the mold made from this pattern. The surface of this pattern or plug must be as glossy and free of defects as you can possibly make it because even the smallest defect will transfer to the mold and in turn show on the surface of the finished part.

APPLICATION OF TOOLING GEL COAT

When the pattern or plug is completed, sealed, waxed thoroughly and possibly coated with a polyvinyl alcohol (PVA) film, it is time to apply the HK Research Tooling Gel Coat. These specially formulated Tooling Gel Coats are designed to provide the hard, durable, high gloss surface required in a superior FRP tool. The toughness and chemical resistance of these tooling gel coats will develop within 48 hours after the mold is completed and removed from the plug or master.

HK Research Tooling Gel Coats are available in a choice of standard colors, viscosities and gel times. Please refer to the Tooling Gel Coat Data Sheets that are included with the guide. Your choice of gel coat color is a matter of personal preference. Some people have found a dual color system beneficial. In this system they spray 15-20 mils of their primary color choice first followed by an application of approximately 15 mils of a contrasting color. This two-color system serves as a warning to the molder. When the second color starts to appear on his mold surface, he knows that he has worn or sanded through the initial gel coat surface and is getting dangerously close to laminate backing, therefore some corrective action must be taken.

The manufacturer has a wide choice of gel coats presented to him. It is of primary importance to mold quality and service life that a tooling gel coat with high heat resistance and chemical resistance be chosen. Beyond this, the gel coat chosen will depend upon the equipment that you intend to use for application. We strongly recommend the use of air-atomizing cup or pressure pot spray systems where the gel coat is catalyzed in the cup or pot rather than externally in the fluid stream. This method insures the complete mixing of catalyst and gel coat that is so critical to the cure of the gel coat. This type of equipment offers the best opportunity of obtaining a smooth, even film that will be essentially free of porosity.

It is also important to check your gel coat temperature, plug surface temperature and room temperature to make sure that they are all in a range conducive to good air release and gel coat cure. We do not recommend spraying tooling gel coat at temperatures below 65°F or higher than 85°F and we consider a narrower range of 70-80°F to be even more desirable. If the liquid and mold surface are too cold the gel coat will not flow or level well, air release will be retarded and the cure will be hampered. If these temperatures are too hot the material may gel before air release is complete and porosity could be encountered.

Proper catalyzation is critical to obtaining good gel coat cure and mold life. We recommend that HK Research ISO Tooling Gel Coats be catalyzed with 2.0% of Methyl Ethyl Ketone Peroxide, such as Norox MEKP-9 or RCI 46-702, and HK Research Vinyl Ester Hybrid tooling gel coats (this includes the GRIZZLY™ Low HAP) be catalyzed with 2.0 % of a high dimer Methyl Ethyl Ketone Peroxide such as Witco Hi Point 90 or Norox MEKP-925H. The Urethane Modified -Vinyl Ester Gel Coats must be initiated (catalyzed) at 1%-1.5% with TBPB which is normally supplied with the Gel Coat. The catalyst level of the Isophthalic and Vinyl Ester Gel Coats can be varied depending upon working conditions but we do not recommend using less than 1.8% or more than 2.5% catalyst with these gel coats. HK Research provides a range of gel times in our gel coat formulations and we strongly recommend that you choose a product with a gel time that fits your individual requirements. The HK Research laboratories are always ready to assist with this choice.

The following catalyzation chart gives the proper catalyst levels (in grams or cc's) to use per quart or per gallon of gel coat at various catalyst percentages.

CATALYZATION CHART

% MEKP	GRAMS/CC'S PER QUART	GRAMS/CC'S PER GALLON
1.8	18	80
2.0	20	88
2.2	22	97
2.4	24	106
2.6	26	115

Specific applications technique, recommended spray equipment and suggested pressure settings are given in the following excerpts from our "Description/Application - HK Research Gel Coats" as shown below. The complete bulletin is included with this guide.

APPLICATION - SPRAY

The spray application of HK Research gel coats can be done with a variety of equipment including pressure pot and air assisted-airless equipment.

HK Research gel coats can be sprayed with conventional air atomized pressure pot systems equipped with a relatively large orifice, such as a 63 or 67 orifice (equipped with the corresponding needle). These guns can be used with either a one or two quart pressure pot, or pressure tanks. Generally, 15-35 psi of pot pressure is required to deliver the gel coat to the spray nozzle and 40 - 50 psi is required on a 5 or a 10 gallon tank depending on the hose length. The atomizing air pressure should be set at 60-90 psi. The fluid supply valve should be set so that the desired delivery rate is obtained, and then open the atomizing valve far enough to break up the liquid stream into a very fine spray. If the gun sputters or spits, gradually close the fluid supply valve until the spray pattern is even. When applying the gel coat by air-atomized spray, spray the gel coat evenly onto the prepared mold surface to a thickness of 15-20 mils, using 3-4 passes with a steady even movement of the gun while holding the gun 18-24 inches (vertical) from the mold surface. When finished, it is necessary to immediately clean out the pot gun and the gun itself with a solvent such as acetone. Be sure that the equipment is free of solvent and moisture before adding the next batch of gel coat. After the first 15-20 mils have cured sufficiently (usually1-2 hours) apply another 15 mils (preferably a different color) in the same manner as before. Allow this to cure sufficiently before any lamination begins (usually 1-2 hours). Do not wait longer than 4 hours before applying a skin coat.

Many fine air-assisted airless systems are available in the market place that can be utilized and will do the job properly. The advantages of the air-assisted airless systems are that they minimize the "overspray" which reduces the loss of gel coat in the exhaust system and, in general, keeps the immediate environment around the mold cleaner. Since the catalyst is injected externally, a pot life is not a limiting factor with air-assisted airless spray equipment.

These systems generally will supply catalyst to the gel coat stream through the utilization of a pressure pot and/or a "slave pump". In either case it is essential that the catalyst concentration be monitored on a regular basis, i.e. once a day. Since pump configurations and ratios vary greatly, it is difficult to recommend a starting point for fluid pressure for the fluid pressure pump. In general, however, the fluid pump pressure should be progressively adjusted upward until the "fan" emitted from the nozzle is uniform over the entire spray pattern. When "tails" are noted on either end of the spray pattern, the pressure needs to be increased. If the spray pattern has a thick section towards the center the fluid pump pressure needs to be decreased. When a satisfactory spray pattern is obtained it then is a good time to calibrate the equipment. It is recommended that a 30 second sample be taken from the gel coat nozzle and likewise from the catalyst nozzle.

In the case of the air-assisted airless where air atomization is used to assist the airless pump and spray tip as well as "break up" the catalyst, it generally requires a minimum of 20 psi and frequently 30-40 psi to accomplish adequate catalyst break up. The air pressure required will vary from piece of equipment to piece of equipment but can be determined by visually inspecting the atomized catalyst stream alone. The catalyst, when sprayed alone and atomized, should be emitted as a very fine mist with no droplets falling from the spray pattern. The fine catalyst mist assures adequate mixing within the gel coat stream and minimizes porosity and non-uniform cure. With air-assisted airless systems, it is necessary to apply the gel coat in multiple passes of 3-7 mils per pass. To allow for adequate mixing of the catalyst and gel coat streams as well as to allow adequate break up of the gel coat itself, the gel coat should be applied from a minimum distance of 24 inches from the mold and with the gun as nearly perpendicular to the mold as possible. After a film thickness of 15-20 mils has been attained, the gel coat should be allowed to cure for a minimum of 45 minutes prior to further processing. After the first 15-20 mils have cured sufficiently (usually1-2 hours), apply another 15 mils (preferably a different color) in the same manner as before. Allow this to cure sufficiently before any lamination begins (usually 1-2 hours). Do not wait longer than 4 hours before applying a skin coat.

The various spray systems have advantages and disadvantages in particular applications. Regardless of the system used, it is essential that they be maintained in "tip top" condition. Special attention to the spray nozzles, their cleanliness and normal "wear" should be made. The high pressure air-assisted airless tips can and do wear, causing a poor spray pattern. These tips should be replaced as soon as a poor spray pattern is noted. Don’t forget the “catalyst tips” as these do wear and will influence the uniform catalyzation of the Gel Coat.

Application of polyester gel coats requires techniques which are learned from practical experience (or watching someone who knows how) and are very difficult to learn from the written word. A spray gun operator should be trained to visually recognize what a well atomized spray pattern should look like and how to maintain that spray pattern. The pressures suggested are only a starting point since they are highly dependent on the length of the lines involved as well as the size of the nozzles used in the gun and will vary from one piece of equipment to another.

Under normal conditions the gel coat is ready to "lay up" in 1 to 2 hours. The "time to laminate" is dependent on the room temperature, humidity and air movement, as well as the catalyst concentration and the film thickness. A wet film thickness of at least 18 to 20 mils is recommended for proper hiding, cure, and performance properties. However, the 30-35 mil “two coat system” mentioned earlier will provide superior performance properties. These products should not be used when the temperature conditions, both mold and ambient, are below 65^{o}F as the curing may be adversely affected.

LAMINATION WITH TOOLING RESIN

The laminate behind the gel coat on a polyester mold is nearly as critical as the gel coat itself to the service life and quality of the mold. We recommend the use of a high heat distortion, high strength Isophthalic-based laminating resin such as the HK Research R-0533 Tooling Resin for standard molds and The R-0537 Urethane VE Tooling Resin for High Performance Molds.

The most critical part of this lamination process is the application of the skin coat (the initial laminate directly in contact with gel coat surface). Any defect, such as air bubbles, dry glass, catalyst droplets and other impurities, will be readily transferred through the gel coat film and quickly show as a blister, void or break in the mold surface.

We recommend the application of 3/4 - 1 1/2 ounces of chopped glass strands, well wet with tooling resin and rolled meticulously in order to remove all air bubbles, voids or dry spots. If chopped strand mat is used care should be taken to place the soft side of the mat against the gel coat surface with the stiff binder side facing up. The glass content of this laminate should be 30-35% and careful calibration of the catalyst level is recommended to ensure complete cure of this skin coat.

Once the skin coat has gelled and cured, subsequent laminate layers can be added. R-0533 Tooling Resin exhibits a very low exotherm, which allows the user to build his tool because several layers of laminate can be built at one time (after the skin coat is complete). The unique formula of this resin will give essentially the same cure as measured by Barcol hardness whether you are laminating one layer or several layers at once.

R-0533 Tooling Resin will cure in 24-48 hours to a hard, rigid laminate with the excellent physical strength and high heat distortion required of a quality FRP mold.

MOLD BREAK-IN

The next critical phase of your mold preparation is the proper break-in of the new FRP Tool. Many molders have their own favorite method for doing this but we offer the following suggestions as one method that we have found to be satisfactory.

Once the mold surface is ready to use, apply a minimum of seven coats of a good quality mold release wax following the manufacturers' instructions explicitly. This usually involves allowing sufficient time between coats to ensure complete solvent evaporation of each wax layer. Once the waxing is complete some people choose to apply a PVA (polyvinyl alcohol) mold release film as added insurance of good release of these initial parts. Repeat this procedure for at least the first two parts pulled from a new mold. If PVA is not practical for a particular application, it is recommended to apply a “peel coat” of production gel coat before the first part is laminated in the mold. Depending on how easy (or hard) the “peel coat” is removed from the mold, another 2-7 coats of wax may be necessary.

It is further recommended that for at least the first two or three parts formed in a new mold, the gel coat be sprayed with a "hot-pot", a pressure pot system where the catalyst is mixed directly in the gel coat before spraying. This virtually eliminates sticking problems that can be created by catalyst droplets attacking the new mold surface. If the parts are pulling easily it may be necessary to apply only two coats of wax on the third and fourth pull. If they continue to pull easily then you need wax only as necessary to maintain good mold release. At this point the mold should be considered to be "broken in" and ready for a full service life.

MOLD MAINTENANCE

High quality FRP molds should last for many parts and you can extend that mold life with a well-planned mold maintenance program. A regular mold preparation schedule based on your experience and mold usage can prevent problems before they occur. You will know from your own experience how often a mold needs to be glazed and polished; stripped and rewaxed; or even repaired, sanded, glazed and rewaxed.

The most important part of this program is to treat your molds with care. Take care of little problems before they become bigger problems and inspect and service your molds on a regular schedule. This is the best way to maintain the high quality and long life you anticipated from your FRP Tools when you chose HK Research Tooling Gel Coats and Tooling Resins.