KLINGSPOR fiberglass & gelcoat chart

	PRODUCT	DESCRIPTION	SUGGESTED GRITS	USES	COMMENTS	AVAILABLE FORMS
DISCS, SHEETS, AND BOARD FILE SHEETS	**PS 33 Base Product**	Beige in color; B and C weight paper backing; Aluminum Oxide grain resin over Resin bond; Stearate helps prevent premature loading	80C, 120C grit	Surface preparation for painting; fairing compound shaping	Aluminum Oxide grain cuts well, and leaves a good finish. Stearate helps lengthen the product life.	Discs, hook & loop and PSA
			220C grit	Sanding between coats of paint	Prepares the painted surface for the next coat.	Sheets, board file sheets; plain, PSA and hook & loop
			320C, 400C grit	Final sanding of primer paints	Adjust to the proper grit by testing with the specific primer.	
	PS36 Recommended Upgrade	Beige and Blue in color; Strong C and D weight paper backing; Alumina Zirconia grain; Resin over Resin bond; Stearate helps prevent premature loading	36D grit	Grinding out "crazing"; Cutting through old FRP for repair work	Lighter stock removal than fiber discs on angle grinders for small repairs.	Discs, hook & loop andPSA
			40C, 60D grit	Coarse sanding and paint removal; fairing compound shaping	Alumina Zirconia grain has the sharpest cut for the fastest removal, and the stearates gives the product long life.	Sheets, board file sheets; plain and PSA
			80C, 120C grit	Surface preparation for painting; fairing compound shaping	Sharp grains make quick work for paint preparation.	
			220C grit	Sanding between coats of paint	Prepares the painted surface for the next coat. Move quickly, this is an aggressive 220 grit material.	
	PS73W Base Product	Beige in color; B weight backing; Aluminum Oxide grain; Resin over Resin bond; Stearate helps prevent premature loading	600B grit	Dry sanding between coats of finish	Extra stearate helps keep the product from loading up quickly in fine grits.	Discs, hook & loop and PSA
			800B, 1200B grit	Pre-polish dry sanding	Alternative to wet sanding that is faster and reduces clean up time. Will not produce as nice of a finish as wet sanding.	
	PL35 Base Product	Grey in color; B and C weight paper backing; Silicon Carbide grain; Resin over Resin bond; Stearate helps prevent premature loading	120C grit	Surface preparation for painting	Silicon Carbide grain leaves the most consistent finish. Stearate helps lengthen the product life.	Discs, hook & loop and PSA
			180B, 220B grit	Sanding between coats of paint	Prepares painted surface for next coat.	Sheets
			320B, 400B grit	Final sanding of primer paints	Adjust to the proper grit by testing with the specific primer.	
	PS14 Base Product	Black in color; A and C weight paper backing; Silicon Carbide grain; Resin over Resin bond; Waterproof	600A grit	Wet sanding between coats of finish	Silicon Carbide grain leaves the most consistent finish.	Discs, hook & loop and PSA
			1200A grit	Pre-polish wet sanding	Wet sanding keeps the material from loading and provides the best finishes.	Sheets
			1500A, 2000A grit	Polish mold surfaces to help with release	Fine finish sanding for the mold shop.	
FIBRE DISCS (GRINDING)	**CS561 Base Product**	Reddish Brown in color; Vulcanized fiber backing Aluminum Oxide grain; Resin over Resin bond	16, 24, 36, 50 grit	Structural repair; Remove gelcoat; Repair deep gouges; Grind edges of new formed pieces	Quick stock removal. Cut through gel coat to prep for new Chamfer edges quickly Remove excess material from new parts	Disc Sizes: 4" x 5/8" • 4 1/2" x 7/8" • 5" x 7/8" • 7" x 7/8" • 9" x 7/8"
	CS565 Recommended Upgrade	Blue in color; Vulcanized fiber backing Alumina Zirconia grain; Resin over Resin bond	24, 36, 50 grit	Structural repair; Remove gelcoat; Repair deep gouges; Grind edges of new formed pieces	Alumina Zirconia provides the fastest cutting action for stock removal. Chamfer edges faster than AO discs; Remove excess material faster than AO discs ** Adjust grit according to aggressive cut.*	Disc Sizes: 4 1/2" x 7/8" • 5" x 7/8" • 7" x 7/8" • 9" x 7/8"
QUICK CONNECT DISCS	**QDC, QMC, QRC Aluminum Oxide (AO) Base Product**	Reddish Brown in color; Aluminum Oxide grain; Resin over Resin bond	24, 36, 50 grit	Structural repair; Remove gelcoat; Repair deep gouges; Grind edges of new; formed pieces	Great for small areas and tight spots. Cut through gelcoat to prep for new Chamfer edges. Remove excess material from new parts.	Disc Sizes 1", 1-1/2", 2", 3", 4" **1" and 4" sizes only available in QDC.*
	QDC, QMC, QRC Alumina Zirconia (AZ) Recommended Upgrade	Blue in color; Alumina Zirconia grain; Resin over Resin bond	24, 36, 50 grit	Structural repair; Remove gelcoat; Repair deep gouges; Grind edges of new formed pieces	Great for small areas and tight spots. Alumina Zirconia provides the fastest cutting action for stock removal. Chamfer edges faster than AO discs. Remove excess material faster than AO discs **Adjust grit according to aggressive cut.*	Disc Sizes 1", 1-1/2", 2", 3", 4" **1" and 4" sizes only available in QDC.*
CUT-OFF WHEELS	**Extra Cut Wheels**	Black in color; Silicon Carbide grain; Fiberglass reinforced	36, 60 grit	Cut away damaged area	Small cut-off wheels designed to use on a die grinder. Cuts in small spaces. 36 grit cuts faster, 60 grit leaves a smoother cut.	Wheel diameters are 3", 4", 4-1/2", 6"
	C24R Supra	Black in color; Silicon Carbide grain; Fiberglass reinforced	24 grit	Cut away damaged area	Versatile wheel can be used on an angle grinder. Flat or depressed center.	Wheel diameters are 4", 4-1/2", 5", 7", 9"
SANDING SPONGES	**Ultraflex Sanding Pads**	Black in color; Silicon Carbide grain; Premium Foam pad	220, 320 grit	Hand sanding difficult contours and molds	Corners and sharp angles in molds are difficult areas to work. Maximum flexibility allows the grain to do the work.	4-1/2" wide X 5-1/2" long

KLINGSPOR
fiberglass & gelcoat reference guide

TERMS USED IN THE FIBERGLASS INDUSTRY

AWLGRIP - brand name for a polyurethane coating applied to replace gelcoat. Next best choice to gelcoat for a durable high-gloss finish.

BLISTERS - porosity in the gelcoat layer allows water to penetrate it, and the water dissolves any unbound chemicals in the first layer beneath. The resultant acidic solution has a higher solute concentration and induces more water to join it through the gelcoat by a process calls "osmosis".

BOAT POX - blistering of gelcoat on the underwater surfaces of a boat. Usually not a threat to the structural integrity of the hull.

CARBON FIBERS - (Graphite) very light, strong fibers that can be worked into ordinary laminates to give them added stiffness and strength. Used on high performance boats.
See Composites

CERAMIC FIBERS - strong fibers that can resist temperatures of up to 3,000 degrees Fahrenheit. Not usually used on boats unless composites are used. *See Composites*

CHOPPED STRAND MAT - mat of short strands laid down in random positions (not woven or arranged in any pattern), compressed into a flat sheet, and held together with a binder that is resin soluble. Sold in rolls in a number of widths.

CHOPPER GUN - strand roving is fed into a gun, and sprayed as chop. Catalyst and resin are injected separately, mixed in the gun barrel, and sprayed from the nozzle. Materials combine on the surface to make a laminate.

CLOTH, FIBERGLASS - fabric, plain woven, composed of two or more strands twisted together. Supplied for boatbuilding in weights ranging from a few ounces to 10 ounces per square yard.

COMPOSITES - exotic materials that add properties beyond the capabilities of fiberglass. Materials such as S glass, Ceramic fibers, Carbon fibers, and Kevlar.

CRACKS - star shaped cracks, and stress cracks are caused by wrinkling or bending the laminate more than the gelcoat will allow.

EPOXY RESIN - stronger glue than polyester resin, and more resistant to chemical degradation by water. More expensive, more toxic, long cure times, and they are hard to use.

FAIRING - term for creating smooth curves where a repair has been made. Done with a "fairing" compound similar to body filler.

FOAM - used to fill the interior of boats to make them buoyant.

FRP - "Fiber Reinforced Plastic". Another name for fiberglass mixed with resin.

GELCOAT - pigmented resin compounded with other additives to make it more weather and wear resistant. Usually applied to a thickness of 15 to 20 mils.

GRINDERS - heavy duty, right angle disc grinders. Used in boat building and repair for heavy stock removal. Fiber discs in 24, 36, and 50 grit.

IMRON - brand name for polyurethane coating applied to replace gelcoat. Next best choice to gelcoat for a durable high-gloss finish.

KEVLAR - tough, organic fiber woven into a fabric. Lightest most impact resistant fiber on the market. Difficult to sand because sanding raises a fuzz on it. Used on small boats such as canoes and kayaks.

LAMINATE - general term for the layers of resin and reinforcement that have been built up under the gelcoat.

MOLD - a shaped form that has been highly polished to perfection so that hundreds of mirror image parts can be taken from it without building a finish on each one.

PUTTY - comes in several different forms: gelcoat putty, polyester putty, and epoxy putty. Resins mixed with filler used to fill in gashes and gouges.

REGELCOATING - replacing the surface with a new layer of gelcoat. Forms a strong chemical bond to fiberglass of the part.

S GLASS - stronger and stiffer reinforcing material than E glass. Used on high performance boats to gain strength with light weight. See Composites.

UNDERCURE - a condition which the resin fails to cure into fiberglass. Very rare. Leaves a water permeable substance.

WAX - added to some gelcoats to keep the air off until they cure completely.

GELCOAT

In new boat construction gelcoat is sprayed on to a highly polished, waxed mold to form the outer layer of a new boat after lamination is complete.
Gelcoat is, essentially, pigmented resin compounded with other additives to make it more weather and wear resistant. It is applied in a thickness of 15 to 20 mils, which gives it depth to survive considerable water sanding, compounding, and repolishing. The resin base causes it to bond very well with the laminate.
Gelcoat is not perfect. If not compounded properly, or if applied too thickly, it can craze or crack like dried mud. If it is not backed up with fiberglass everywhere, the air bubbles under it will "break out" when pressured or struck. If the laminate under it bends too far it will crack. If it is porous, and if the water is warm, it can allow water in between the layers and cause blistering. However, despite the problems there is no other substance with half the cosmetic and protective life expectancy of gelcoat.

RESTORING THE GELCOAT FINISH

Gelcoat can remain extraordinarily new looking for 10 years, and may not need to be bad enough to refinish for more than 20 years. Usually maintenance consisting of cleaning, waxing and polishing will keep the gelcoat in good condition. However, if a boat is not well cared for, it will build up a film of dirt, stains, and the color will fade at the surface of the gelcoat. Sometimes the finish can be restored by compounding. Compounding is polishing with a paste containing a fine grit. Any wax or build up is removed from the surface with acetone, and then compound is applied to the surface using an electric polisher with a soft pad.
If compounding does not work (or takes too much time) water sanding becomes necessary. Water sanding involves sanding with waterproof Silicon Carbide paper (PS14).
Start with the finest grit that will take off the dulled surface in a reasonable time, since the use of coarser paper than necessary will leave deeper scratches which might penetrate any thin spots in the gelcoat. Grits used in this process can start as low as 100 grit and go up to 1000 or 1200 grit, it all depends on the condition of the gelcoat finish. Once the faded layer is sanded away, the surface must be brought back to a highly polished condition with a series of progressively finer grits then with compound. Wrap the sandpaper around a sanding block or pad to insure the most uniform finish. This process can also be accomplished with a dry sanding method. The same rule applies with dry sanding: start with the finest grit that will take off the dulled surface in a reasonable time. Grits can range from 100 grit and go up to 1000 - 1200 grit. Using a sandpaper with a dry lubricant is very important to prevent loading and premature failure (PS36, PS73W, PL35).
Random orbital motion works best in these applications due to the delicate nature of the finish, and to prevent sanding through the gelcoat.

STRESS CRACK REPAIR

Stress cracks are created when the laminate is overbent and the gelcoat breaks. Sometimes called "crazing", these small fractures in the surface are unsighlty and will begin a process called "blistering". A simple addition of more gelcoat is not sufficient. The gelcoat needs to be ground off using an angle grinder with fiber discs (sometimes called grinding discs). Once the area with the stress crack has been properly reinforced to prevent another stress crack, the gelcoat is ground of with a 24, or 36 grit fiber disc. The coarseness of the grit is determined by the size of the job, and the rate of cut required.
The area that is ground down should include some of the laminate layers of glass material and some layers of new glass materials need to be added to stiffen them,then refinish.

BLISTERING

Sometimes call "boat pox", it is the building of small dome shaped bubbles in the surface under the gelcoat. While it is rarely a serious threat to the structural integrity of the hull, it can be an ugly nuisance. Blistering gets underway when porosity in the gelcoat allows water to penetrate it, and the water dissolves any unbound chemicals - such as solvents, accelerators, and other additives in the first layer beneath. The resultant acidic solution has a higher solute concentration than even seawater, and induces more water to join it through the gelcoat by the process of osmosis (the tendency of ion poor liquids to diffuse through ion rich ones). The solution may also attack resin, particularly any local pockets of undercured resin. The continuing reaction presses outward and upward raising the gelcoat over it into a dome or blister.

FIXING BLISTERS

If there is not an overwhelming number of blisters, it is a simple matter to grind them out, dry them, and fill the craters with body putty. The most effective way to grind out the blisters is with an angle grinder and fiber discs in 24 or 36 grit. An epoxy based putty is more adhesive and much more water resistant, but polyester body putty is much less expensive when you need a large quantity. This is a good way to "patch" the boat temporarily, but there is a good chance that more blisters will reappear during the next boating season. In order to permanently fix the problem of blisters a much more drastic approach is necessary. First, all of the gelcoat must be removed from the underbody up to the waterline by grinding or sandblasting. Second, all of the rough places need to be smoothed out with body putty (fairing) and sanded smooth.
Depending on the putty work, sanding may begin at 40 or 80 grit and continue to 120 grit for paint preparation. The 40 and 80 grit work is usually done with "airfile" sanders or 8" discs. When moving to the 120 grit, the finish is usually accomplished with a random orbital sander in either 5" or 6" discs. Finally, the bottom is painted with no fewer two coats of epoxy paint to seal it watertight. If the vessel is for saltwater use, another layer of antifouling bottom paint needs to be spread over the two coats of epoxy paint.

PAINTING

Although gelcoat makes the best protective coating for a fiberglass part, it is not most repairers' choice for recoating an entire part whose gelcoat has been destroyed or removed.
Even though it makes a great finish out of a highly polished mold, when applied to an exterior surface (no matter how smooth) gelcoat will cure with many surface imperfections.
These imperfections must be sanded and polished out to make it smooth and glossy (see restoring the gelcoat finish). This sanding and polishing process is worthwhile on a minor area, but the labor to polish a large area makes it too expensive to justify. The next best option to achieve a highly polished finish is a polyurethane paint.
A couple of these paints, such as Awlgrip and Imron, were used on aluminum airplanes before they spread into the boat painting business. When applied properly and allowed to dry in a dust and moisture free environment, they develop a nice gloss. Their ability to maintain that cosmetic excellence, while less than half that of gelcoat's, is better than most other paints. However, the cost of these paints are quite high compare to regular marine paints. A polyurethane paint is relatively tough and elastic, and nearly nonporous. It should be noted that all of the outstanding properties associated with polyurethane paints come from the use of two-part coatings rather than one-part paints.
The two part systems form a cross-linked polyurethane plastic coating on the surface as they cure. Depending on the paint manufacturer's recommendation sanding between coats can be done with 180 to 400 grit discs (PL35 or PS73W) by hand or with random orbital motion sanders. Polyurethane paints have many restrictions, controls, and hazards requiring skill and safety equipment. However, there is another kind of paint which can be applied to boats by the average boat owner - marine paints.
Many different marine paints exist requiring different products, primers, and special thinners. The best advice is to read the manufacturer's instructions carefully and follow them down to the letter. After physically repairing the boat all surfaces must be filled with body putty, fairing putty, or epoxy putty, and finally brought down to a fine sanded surface. Even if the part needs no repair to the laminate and if the gelcoat is in well preserved condition except for scratches and fading, it will need sanding all over.
Surface preparation can be done with 40, 80, and 120 grit (PS36, PS33) depending on the desired final finish, and the amount of roughness desired for good adhesion.

GRINDING

Fiberglass is ground to cut away damaged material so that it can be replaced with sound new material, to make a depression so that a patch can be built up flush with the original part, to taper the edges of the depression so that a proper joint can be made, and to remove wax, dirt, grease, paint, gelcoat, and other debris for a proper bond.
The depression created to make the repair flush with original surface serves two purposes, one is for cosmetic reasons, and the other is to create the strongest possible bond between the original surface and the repair. The edges of the depression should be tapered to form a scarf joint. A scarf joint is a tapered joint with a large amount of glued surface area because it is tapered out to 12 times the thickness of the laminate. In other words, a repair that is 1 inch thick should be tapered out 12 inches around the edges to form a proper scarf joint. Right angle grinders are the tool of choice for grinding away fiberglass with speed either with a small 4 1/2 inch disc grinder or a larger 7 or 9 inch grinder. Coarse fiber discs in 16, 24, and 36 grit are commonly used (CS561 or CS565) to aid in quick removal and to promote good surface adhesion of the repair.

CUTTING

Sometimes an entire area needs to be removed and replaced. The area can be cut away with small saws or an abrasive cut off wheel. Special cut off wheels are available to fit on small die grinders to cut small areas (ECO wheels) and others are made to fit on angle grinders (C24R Supra wheels).

MOLDS

All production fiberglass boat hulls, decks, and small parts are built in molds, except for a handful that are built over a wooden inner shell or lining that is left in place in the finished part. Once a mold has been built and polished to perfection, hundreds of mirror image parts can be taken from it without building a finish on each one. Regular repolishing and resurfacing are required to keep the mold in peak condition which will insure the best quality part, and fewer reworks. Depending on the quality of the mold, a new surface can be created by wet sanding through a grit sequence that ends at P1200 - P1500 (PS11). Sometimes the contours of the mold are best resurfaced with flexible sanding pads (Ultraflex 320) before finishing with wet sanding. All surfaces must be buffed and cleaned well to insure a good mold release.

REFERENCE MANUALS

Sailboat Hull & Deck Repair; by Don Casey. International Marine/Ragged Mountain Press; 1996.
Sailboat Refinishing; by Don Casey. International Marine/Ragged Mountain Press; 1996.
The Fiberglass Boat Repair Manual; by Allan H. Vaitses. International Marine/Ragged Mountain Press; 1988.