

MACHINING GLASS-REINFORCED RESINS

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SLOW SPEEDS ARE IMPORTANT IN MACHINING REINFORCED PLASTICS

Machining molded parts of “Zytel” nylon resin and “Delrin” acetal resin, especially stock shapes that are being made into prototypes or low volume production parts, has been likened to machining soft brass. The equipment required is basically the same and the techniques have been adequately covered in existing literature.

Working with glass-reinforced versions of these resins or two newer resins, “Minlon” mineral-reinforced nylon and “Rynite” glass-reinforced thermoplastic polyester is almost-but not quite- as simple. The principal concern of designers and fabricators working with these materials is the abrasive characteristics of the reinforcing material and the added tool wear they cause. Here are a few tips aimed not only at reducing this problem, but also at producing better parts more economically.

When machining plastics such as “Delrin” or “Zytel”, the critical factor to monitor is cutting speed. Speeds used to machine metal will melt and burn most plastics. However, if glass-reinforced “Zytel” or “Delrin” is used, a speed even slower than that recommended for the unreinforced material must be used. Besides the melting problem, a fast speed will rapidly wear out tool bits. The same is true for “Minlon” and “Rynite”.

Where shops have the proper setup, lubricants or coolants may be used to extend the life of a cutting edge. They are not necessary, however, and often result in time consuming clean up.

ANNEALING

If high tolerance parts are required, an annealing step may be necessary before light finish machining or grinding. Such heat treatment in circulating air ovens or hot oil bath can remove stress inherent in the part (most stock shapes are pre-annealed) or induced by machining. Temperatures will vary with material but should be 75% of melting point with a 60-minute exposure in oil and 30 minutes in air. At a lower temperature, say 28°C (50°F) below the melt point, exposure time would be doubled. Extensive annealing operations on large parts should take place in a well-ventilated area.

DRILLING, CUTTING and TAPPING

Drilling, cutting and tapping are some of the most conventional forms of plastics machining. A hand drill is an acceptable means of placing a hold in a glass-reinforced part, providing the hole is 6.35 mm (0.25 in) or less in diameter. Reasonably fast speed, up to 350rpm, can be used. Drilling larger holes requires slower speed –no faster than 11 rpm- and a regular drill press is the best means of accomplishing this. The part should be securely clamped to assure stability.

The band saw is the best means of cutting a reinforced part. The recommended blade speed is 305M (1000 ft) per minute but the slowest speed on the machine can be used to reduce blade wear. If an alloy steel blade is available, any safe speed can be used. Smoothing may be needed after sawing.

Though self-threading screws often eliminate the need for tapping, glass- or mineral- reinforced DuPont plastics can be hand or machine tapped. First a hole is drilled slightly smaller than the tap-size of the hole depending on size and quality of the tap. Fine threads require larger holes than coarse threads. Machine tapping is a faster means than hand tapping; a drill press can be used with a high-speed tap.

MILLING and TURNING

Reinforced engineering plastics can be milled, but wear may occur. To increase the life of the bit, especially where milling a flat part, a carbide tip blade is recommended. Use of a coolant may also be beneficial. A slow speed should be used --400 rpm for grooves 6.35mm (0.25 in.) in width or less and 200 rpm for larger grooves. A slow speed increases the life of the blade and will usually provide a smoother finish.

With a lathe, a carbide tip blade should be used for production operation. Slow speed will again increase blade life. The spindle speed should not exceed 350 rpm per inch of travel for parts less than 102mm (4 in.) in diameter and should not exceed 200 rpm for parts 102mm or greater in diameter. Cross travel feed should be in the range of 1.2 to 1.4 mm/min (0.004 to 0.0045 ft.), but 1.8 to 2.1 mm/min (0.006 to 0.007 ft.) can be tolerated for large production runs.

A tool bit can be attached to a shape and used at a slow speed --e.g., 635mm (25 in.) per minute. However, the milling process is usually recommended when that is a feasible alternative.

Glass- and mineral- reinforced parts, are also possible. In belt sander operations, water should be used to keep the plastic cool. Speed is not critical, but it is important not to bear down too heavily, as this increases the friction force and would lead to melting or burning.

If grinding is necessary, then a wet grind is recommended. Because grinding ordinarily causes frictional heat, sanding is usually faster, easier and preferable in the long run.

For a glossy finish, use a polishing wheel. If the surface is rough, it should be smoothed first with a wet pumice wheel. Then a buffing wheel can be used with the same rouge recommended for metals. Finally, the polishing wheel completes the process. Glass-reinforced "Zytel", as an example, takes more time to polish than unreinforced "Zytel", but will give a glossy surface.