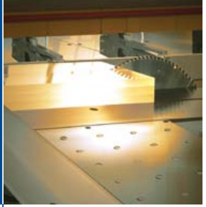

Achieving the best machined finish for critical PPSU parts

PLASTICS MACHINING AND EQUIPMENT

by Jack Sharp

Many designers and machinists have questions about fabricating critical tolerance parts for cutting edge industries like medical and life science equipment manufacturers. Following some basic machining guidelines can increase or reduce profitability for the machinist. Ensuring high yield is the key to any successful business, especially for processes with costly raw materials.

Let's take a look at a high-tech industry that we all can relate to . . . the medical industry. Advanced plastic materials are being integrated in biotechnology equipment, pharmaceutical processing equipment and surgical instruments/components. Because of the relatively small series, machining these components is often the practical choice.

A high performance material experiencing growth in the life sciences is colored PPSU (polyphenylsulfone). PPSU is an amorphous thermoplastic with thermal stability above 300°F (149°C) and offers superior hydrolysis resistance when compared to other thermoplastics as measured by steam autoclaving cycles to failure. In fact, PPSU has virtually unlimited resistance to steam sterilization making it ideal for medical devices which come in contact with the body or bodily fluids. This FDA and USP Class VI compliant material also withstands the rigors of repeated use and demonstrates high mechanical strength and stiffness.

Today, various colors of PPSU are being used for orthopedic trial implants and other surgical tools where size identification is required. Improper machining of critical-sized colored PPSU components can result in poor surface finish, improper tolerances or parts that do not meet customer specifications — and ultimately affect your bottom line.

To achieve the best machined finish and ensure proper dimensional control for critical tolerance parts, the incoming material should be allowed to stabilize in the environment in which it will be machined for 24 hours. Correct tooling, feeds and speeds are critical and using a water-based coolant is highly recommended.

For very tight tolerance work, rough machine components to within 0.020" to 0.030" on all surfaces and leave the parts rest for up to 48 hours to allow machined-in stress relief. Best results can be achieved with solid carbide, uncoated (polycrystalline diamond turning inserts work extremely well) cutting tools (two flute end mills and turning tools with .031" radius) because of their rigidity and long cutting life — although high speed cutters can be used.

Left: Radel® rod is intricately machined into smooth, comfortable handles used as structural components in medical applications. These handles offer superior impact resistance and autoclavability. Right: Endoscopic probe positioning ferrule for endoscopic surgical devices, a positioning ferrule on the instrument handle is intricately machined from Radel® R PPSU rod. (Prior material: stainless steel)

This Quadrant gray Radel® PPSU 1000 is being turned during the manufacture of a medical instrument handle. Quadrant's expanded line of Radel PPSU 1000 colors includes more sizes of rod and sheet and is used for many life science applications.

Coated tooling is not recommended for use with PPSU as the cut will not be as sharp and may "pull" at the material rather than cutting. This may impart excess heat and material movement causing a loss of stability.

Whether turning, milling or drilling, process at the highest reasonable RPM and use a feed rate for roughing of .010 to .020 inches per revolution. For finishing, feed rates should be .003 to .007 inches per revolution. This high speed approach moves the cutting tool quickly across the material and keeps heat generation to a minimum.

Remember these are just guidelines or starting points and may not be the optimum conditions for all types of equipment and setups. ■

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