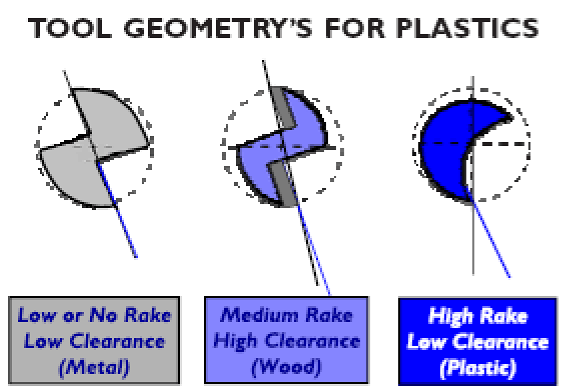
The Most Common Problems In Plastic Routing

The diversity of plastic material in the industry today makes it almost impossible to avoid some kind of machining problem. Plastic varies greatly through the manufacturing process, and these differences combined with a multitude of applications can serve as a precursor for problems. The focus of this discussion will be the most common of these plastic routing problems. However, before tackling the problems, a few basic premises should be reviewed.

All plastic is not created equal Many times, a user will know the trade or generic name of a plastic being routed, but fail to recognize there are physical properties of the material germane to the machining process. It is important to understand that even a change in color can drastically alter the way a plastic material reacts to a cutting tool. Luckily, there are resources, which will be addressed later to sort through these differences. However, as a beginning point for machining and tool selection purposes, plastic can be categorized as soft or hard plastic. This can be determined easily by the flexibility or rigidity of the material or the type of chip it produces in the routing process. When proper routing tools with plastic relevant geometry are utilized the soft plastic will curl a chip, while the hard plastic produces a splintered wedge. However, sometimes there can be soft and hard plastic characteristics within a generic group. For instance, cast acrylic is classified as a hard plastic, while extruded plastic falls on the soft side. They requiredifferent tooling considerations because of the way they machine in the routing process. The point is all plastics are notthe same and ignoring this fact can create problems from the beginning.



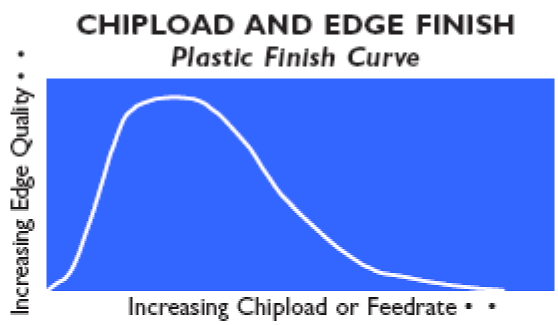
Cutting tool geometry is paramount With the diversity of plastic in mind, it is equally important to acknowledge router tool geometry is the key to success. From the beginning, it was self-evident that plastic machined much differently that other materials and special considerations were required. Through years of testing, tools specifically toleranced for plastic routing have been developed for hand fed and CNC applications. The common denominator in the success of these router tools is the presence of high rake and low clearance in the geometry of the tool.

Today, there are literally thousands of tools at the disposal of the plastic fabricator. By utilizing the soft and hard plastic categorization, a general tool selection process can be developed. Soft plastic utilizes “O” flute router tools in straight or spiral configurations **(Figure 1 and Figure 2).** Hard plastic tools may use “V” flute straight flute tooling or “O” flute spiral tooling with hard geometry considerations **(Figure 3 and Figure 4)**. The decision regarding using straight or spiral tooling hinges upon the direction the user wants to influence the chip or part. Straight tooling has a neutral effect, while spiral tooling can move chips in an upward or downward direction. As the most common problems are discussed, the premise is the correct tool has been chosen, but other consideration is needed to correct the problem. Although choosing the right-tool-for-the-job is key, properly applying it is the paramount.

FIGURE 1 61-000 "O" Flute Straight | FIGURE 2 63-750 "O" Flute Spiral | FIGURE 3 56-000P "V" Flute Straight | FIGURE 4 52-600 Double Edge Spiral "O" Flute

Common routing problem #1: Welding of plastic material Welding of chip during the routing of plastic parts is probably the most irritating problem encountered in the industry. It is costly in terms of time and scrap rate, but is avoidable. Besides inappropriate tool selection, it can occur because of improper chipload, small tool diametersize, influencing the chip improperly or direction of cut. Plastic is extremely sensitive to heat, and the act of routing at high feed and spindle speed rates creates a rather warm environment. Chipload, which is the thickness of the chip, is formed through the function of feedrate, spindle speed, and the number of cutting edges in the router tool. The chip is the mechanism by which the heat is transferred away from the tool and the part, thus maximizing it is critical. The secret in plastic routing is producing an adequate sized chip to remove heat, while accommodating finish requirements. The chipload formula is as follows: chipload = feedrate/ (RPM x # of cutting edges). sthe formula indicates, there are several ways to adjust chipload. Merely raising feedrate to achieve maximum chip thickness is not always the best approach. In the case of small parts for instance, where feedrate is limited, the other part of the equation, namely spindle speed should be utilized to maximize chipload. Welding can also occur because of small tool diameter size, direction of cut and the way the chip is influenced. Small diameter tools because of limited chip clearance capability can cause welding. Selecting the right geometry for the router tool will fail miserably, if the chip is influenced incorrectly. For example, using a downcut spiral in a blind slot will serve to recut chips and thus weld. Lastly, direction of cut may be the culprit. In most cases, conventional cutting direction is recommended.

Common problem #2: Poor finish Probably the most important consideration in the plastics industry is the surface finish of the final product. This is especially evident in plastic products such as exhibits, signs or P-O-P displays where the public constantly views the finished edge of the product. As with all plastic routing applications, the selection of the proper tool is essential to good edge finish. However, finish is heavily influenced by the chipload. In plastic routing the continuous generation of a properly sized chip will eliminate excessive knife marks in soft plastic and a cratered finish on hard plastic. The range of chipload for outstanding finish seems to occur between 0.004 and 0.012.



Only a very narrow range of chiploads (feedrates) will achieve an excellent edge finish. Typical ranges are from .004" to .012".

Besides chipload, the other areas of concern with finish lies with improperly holding parts and the condition of the CNC machine itself. CNC routers incorporate two different spoilboard systems, which utilize vacuum to hold parts. The dedicated spoilboard is most prevalent in thermoforming, while the flow-through system is more popular in sheet fabrication. In both cases, poorly designed spoilboard systems lead to inadequate part holddown and subsequently unacceptable part finish. Lastly, the condition of the machine and the tool holding system is critical to excellent edges finish. The best plastic cutting tool invented will not perform properly if the machine and the collet system are not maintained to industry standard. The tool must run in a concentric or true circle to function at optimum levels. If not, the finish will deteriorate and the scrap rate will accelerate. Resources This information serves as a starting point to identify and correct the most common problems associated with routing plastic. However, there are many resources to further study these areas of concern and receive more detailed data. These would include the plastics material manufacturer or supplier, the CNC machinery manufacturer, www.plasticrouting.com, and The IAPD Magazine article archives at www. theiapdmagazine.com, where specific articles regarding tool selection, collet maintenance, and spoilboard techniques can be found and researched. The most common problems of welding and poor finish are not insurmountthe able. The key is to understand the material being machined, select router tools with geometry specific to plastic and apply them with proper chipload recommendations. Rigidly holding parts and maintaining the integrity of the router machine through proper maintenance procedures will further enhance the process.