special focus

Major considerations in the routing of plastic

FABRICATION AND PLASTICS MACHINING

By Van Niser

Before the process of routing or machining different types of plastic, the user must evaluate the major considerations inherent to the operation.

Capability

The first consideration is in the area of machinery, which can vary widely in the world of plastics fabrication. Machines of choice include air and electric routers, pin routers and CNC machinery. These types of machines are prevalent in sheet fabrication, thermoforming, rotational molding and blow molding operations throughout the plastics industry.

Air, electric and pin routers, fall into the categories of hand-fed applications, and present an entirely different set of circumstances than a CNC application. Since these machines are heavily influenced by the skill of the individual operators, the tooling material of choice should be high speed steel or carbide tipped with a steel shank. These tool materials are more forgiving in a hand-fed application, and less likely to fail than solid carbide, which thrive best in the controlled environment of CNC.

Within hand-fed operations, one of the more prevalent machines is the air router. The air router has some characteristics, which has a direct effect on the tooling choices. Figure 1 illustrates that the air router has a nose or support bearing, a guard and a guide bushing. All these features have important functions, but they necessitate the use of router tooling specific to the air router.

These tools must be manufactured with long enough overall length to bottom out in the collet and extent beyond the guide bushing while making contact with the work piece. Also, the tools must be slightly undersized along the entire length of the tool to pass smoothly through the support or nose bearing. The forcing of on size tooling through the support bearing alters the bearing and negates the function of this critical mechanism, which adversely affects the concentricity of the cutting tool. Consequently, it is important to incorporate tooling properly toleranced for air routers.

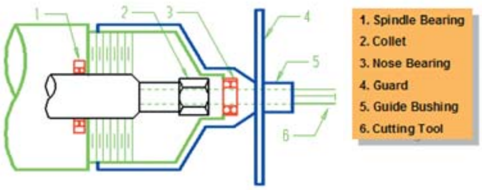

Figure 1
ASSEMBLY DIAGRAM

HIGH SPEED SINGLE EDGE "O" FLUTE

CARBIDE TIPPED DOUBLE EDGE

CNC routers are extremely popular among plastics fabricators with 3 axis and 5 axis machines fulfilling a variety of needs. Generally speaking, flat sheet fabricators utilize 3 axis, while thermoformers with a need to attack multi-shaped parts at an angle, account for most of the 5 axis machines. Solid carbide is the tooling material widely utilized because of its toughness, and the longevity of the cutting edge when chipload is properly maximized. Solid carbide router tools are available in a broad range of geometries and styles. Sheet fabricators usually prefer upcut spirals to aid in the extraction of potentially soft plastic chips. On the other hand, thermoformers with formed fixtures tend to use straight edge tooling, which has a neutral effect on the part. Downcut spirals can be utilized in some 5-axis applications, but the fixturing must be such that the chips fall away from the part. If the chips cannot fall freely from the part, recutting of plastic chips can cause wel ing to occur which is detrimental to th part and the router tool.

Regardless of the type of machine utilized, the ability to properly hold th part is critical. The three methods asso ated with part hold-down include mech anical, i.e., clamps, dedicated and flow through spoilboard systems. Dedicate and flow-through are the two most pr valent systems in the area of CNC rou ing. Flow-through has become the mo popular because of the ease of setup, b there is no question that the best a proach to solidly holding parts is a pro erly built dedicated spoilboard. The sa ings in reworked parts, scrapped parts a overall cycle time is well worth the effo (For a complete guide to spoilboards, r fer to "The Importance of Spoilboar in the Machining Process," Februar March 2002 issue of *The IAPD Magazin* www.the iapdmagazine.com.)

Lastly, in terms of capability and m chinery, the machinery is only as go as its maintenance schedule. The critic maintenance on a router as it relates cutting tools is the collet. Concentrici of the router tool can only be accom plished with a clean and well-maintaine collet system. (For more information, r fer to "Proper Colleting and Collet Mai tenance," February/March 2003 issue *The IAPD Magazine.)*

Tool selection

Once capability has been determined terms of properly maintained machine and rigidity of part to be machined, to selection becomes paramount. Rout tools for plastic cutting are applicati and material specific. In almost all case one cutting tool cannot be utilized acro a variety of plastic material.

Generally speaking, plastic can be cat gorized as either hard or soft plastic. S plastic will curl a chip and hard plast tends to produce a splintered wedg which is actually broken off in the m chining process. The use of "O" flu tools in straight and spiral configuration with high rake angles and low clearance will aid in eliminating the knife marks associated with soft plastic. Hard plastic is best routed with double edge "V" flutes, spiral "O" flutes with hard plastic geometry, or two and three edge finishers. These tools along with the proper chipload produce a crater free finish. Cratering in hard plastic occurs when the shear strength of the material is exceeded in the routing process.

SINGLE EDGE SPIRAL "O" FLUTE

DOUBLE EDGE "V" FLUTE

THREE EDGE FINISHER

The aforementioned tooling suggestions are accurate starting points, but extremely general in nature. For specific tooling recommendations by type of plastic material, log onto the Internet at www.plasticrouting.com. This web site was launched several years ago, and can be accessed via a link on IAPD's web site at www.iapd.org.

Chipload

Once tool selection has been finalized, chipload becomes a critical consideration. Chipload or the actual thickness of the chip is a function of the spindle speed (RPM), the travel speed of the cutting tool (IPM), and the number of cutting edges of the tool. In plastic, there is a very narrow range of chipload to maximize finish and cycle time. Since finish seems to be one of the most important factors in machining plastic, the range falls between .004 and .012. However, finish is always a personal decision and some applications may warrant a larger chipload at the expense of finish to increase productivity. In other words, don't be limited by the recommended range, but use it as a guide.

Conclusion

Plastic is material showing up in routin and machine shops everywhere. It is new material for many and it cannot b machined with the same tools or sam methods used for metal or wood. The sy tematic process of considering machin capability, tool selection, and a function chipload, which is the outcome of fee and speed is critical. Once this has bee accomplished, the user is prepared to e ter the world of machining plastic wit confidence.

For further information, contact Onsrud Cutter LP, 800 Libe Drive, Libertyville, IL 60048 USA; (800) 234-1560; fax (847) 3 5028, www.onsrud.com, www.plasticrouting.com.