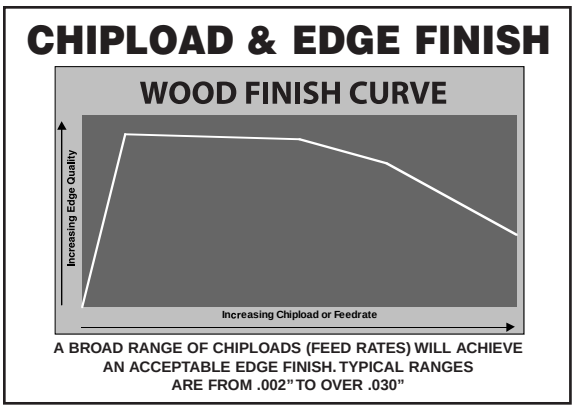


ROUTING WOOD

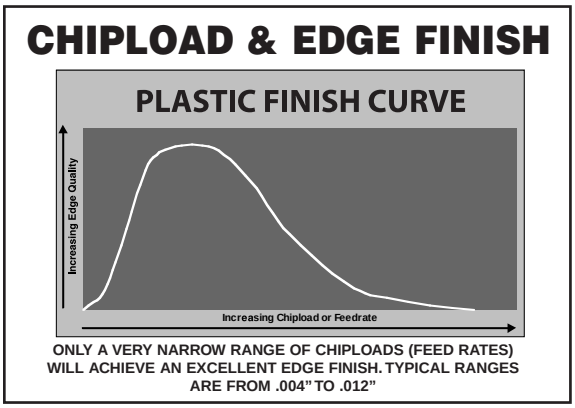
Wood, unlike plastic and aluminum, has a wide variance of chipload. The difference is varied because of the goal of each user. The fine furniture manufacturer has a much different concern for finish than the upholstered furniture manufacturer. The former has many exposed surfaces requiring a deeper concern for finish. While the upholstered manufacturer is concerned about some finish requirements, the bulk of product is covered with material and unexposed. Since feed rates determine chipload and subsequently finish, the range of acceptable edge finish is extremely wide in the wood industry.

In terms of types of wood, the field can be generally divided into natural wood, both hard and soft, man-made products, or wood by-products. The tooling considerations and machining techniques are different in many aspects.

Natural wood has always posed a difficult set of circumstances. As mentioned, wood may be soft or hard and geometry in the tool needs to be directed at those conditions. Basically, the rake angle is adjusted to higher angle of attack in soft than in hard wood. Wood has grain structure, which can aggravate tearout during the routing process and necessitate employing climb cutting as a technique to minimize part damage. Wood has moisture content and various natural oils, which can effect tool life.

Man-made products include MDF, particleboard, plywood, and laminate stock. Tool life problems many times occur because of glues and resins used to bind the materials. Laminated products and sometimes plywood can be problematic, not only because of glue lines but also in terms of top and bottom finish requirements. Consequently, tooling becomes an important factor in removing heat and how the direction of the chip is influenced.

Regardless of material, there are many tool selections available to promote finish and increase productivity.
Once again, log on the Internet at **www.onsrud.com** or contact **OC On-Call at 800-234-1560**.



ROUTING PLASTIC

Not so many years ago, the machining of plastics was more of an art than a science. The typical sheet fabricator or vacuum former utilized a variety of innovative techniques to perform some very challenging secondary machining functions. Unique fixturing of parts and positioning of machinery to attain the necessary results was commonplace. The use of electric and air driven routers and drills was the mode of operation with cutting tool selection based on availability at the local supply house. Metal and woodworking cutting tools were utilized without regard to effectiveness or efficiency. Basically, the plastic machining industry was accomplishing a great deal without the benefit of much outside assistance.

The situation changed significantly with the advent of the CNC router in both the three-axis and five-axis mode. It became evident almost from the beginning that the method of holding parts and cutting tool selections of the past would not perform in the feed and speed environment associated with these new era machines. Plastic fabricators demanded and Onsrud Cutter responded with application specific tooling and far more information on how these tools functioned.

In initial testing and development of router tools for plastic, the key issues were chipload and edge finish and how they were interrelated. Through testing of a multitude of materials associated with the plastic industry, several factors held true. There are two basic plastic conditions recognized including soft/flexible and hard/rigid. The soft plastic curled a chip during machining while the harder plastic produced a splintered wedge, which is actually broken off during the machining process. Regardless of material type, the optimum chipload to achieve the best finish seems to be in the range of .004" to .012". As the plastic router tooling developed, it became evident that the router bits of choice for the soft/flexible material usually involved the use of an "O" flute tool. These types of material are extremely prone to leaving knife marks on the edge when adequate chiploads are not maintained. The "O" flute tools with high rake and low clearance, along with proper chiploads, aid in eliminating the knife marks by slightly rubbing the part during the machining process. The hard/rigid materials are best routed with double edge "V" flute tools. When this style of tool is utilized with the proper chipload, the cratering effect at the edge finish can be avoided. This cratering phenomenon occurs when the shear strength of the material is exceeded during the routing process.

With the aforementioned issues in mind, the correct tool is relatively simple in the initial stages. The flexible/soft plastics tend to involve the use of single or double edge "O" flutes in straight or spiral edge configurations. While hard/rigid plastic materials lean more toward double edge "V" flutes, spiral, "O" flutes with hard geometry, or two and three flute finishers. All styles are available in solid micro grain carbide to withstand the conditions of CNC routing. For specific tooling recommendations by plastic material type, log onto the Internet at **www.plasticrouting.com.**

SPECIALTY TOOLS FOR PLASTIC

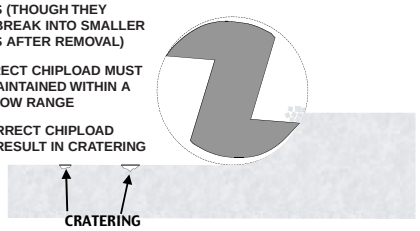
For many years, the plastic routing industry used a variety of approaches to solve difficult applications problems. Today, Onsrud Cutter has developed a whole selection of new products to aid in the resolution of tedious application concerns.

ARBOR MOUNTED SAW BLADES

One such application involved the use of a three-axis CNC router to machine or trim formed parts. Since the router bit could only function in a three-axis mode, there was no way to adequately trim flashing from thermoformed parts without time consuming secondary operations. In order to trim these parts by cutting on the horizontal from a vertical tool position, a carbide tipped saw blade and arbor has been developed. The saw blades are available in various diameters with multi-tooth cutting action. The geometry is specific in terms of soft and hard plastic and slow and fast feedrate. The five-axis CNC router user has also embraced this tool because of the reversibility of the blade for left or right hand rotation spindles.

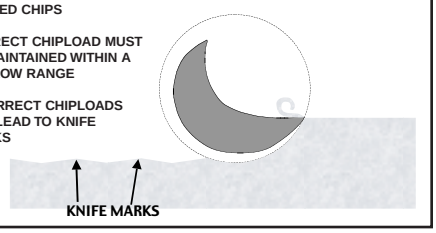
FORMATION OF EDGE FINISH

- BEST EDGE FINISH IS FORMED THROUGH THE CONTINUOUS GENERATION OF PROPERLY SIZED CHIPS (THOUGH THEY MAY BREAK INTO SMALLER CHIPS AFTER REMOVAL)
- CORRECT CHIPLOAD MUST BE MAINTAINED WITHIN A NARROW RANGE
- INCORRECT CHIPLOAD CAN RESULT IN CRATERING



FORMATION OF EDGE FINISH

- BEST EDGE FINISH IS FORMED THROUGH THE CONTINUOUS GENERATION OF PROPERLY SIZED CURLED CHIPS
- CORRECT CHIPLOAD MUST BE MAINTAINED WITHIN A NARROW RANGE
- INCORRECT CHIPLOADS CAN LEAD TO KNIFE MARKS

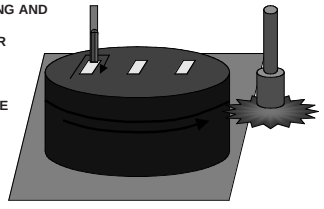


ROUGHING/FINISHING PASSES IN PLASTIC

- AMOUNT TO LEAVE FOR A FINISH CUT
  - 1/8" CED: .015" TO .030"
  - 1/4" CED: .030" TO .080"
  - 3/8" CED: .060" TO .125"
  - 1/2" CED: .060" TO .125"
  - NEVER LESS THAN .015"

CNC ROUTER SAWS

- FLUSH MOUNTS THERMOFORMED PIECE REMOVAL TYPICALLY SMALL DIAMETERS (< 2")
- ARBOR MOUNTS TRIMMING, SLOTTING AND PIECE REMOVAL TYPICALLY LARGER DIAMETERS (2"-4")
- HARD AND SOFT PLASTIC AVAILABLE (BE CAREFUL1)



SOLID CARBIDE FINISHING TOOLS

The refinements of plastic routing continues to be enhanced through the development of edge finishing, shape, and bottom surfacing tools. Although the basic operation of these kinds of tools has been around in the metal and woodworking industry, the tool geometry for plastic machining was lacking. Onsrud Cutter in tune with the plastic materials and the cutting characteristics of these materials has developed a variety of tools to make the production of finished edges, shapes, and bottom surfaces a routine occurrence.

EDGE ROUNDING BITS

Edge rounding router bits are available in "O" flute, "V" flute, or spiral "O" flute configurations with single or double edges. Generally speaking, the user would select the "O" flute for soft plastic, the "V" flute for hard plastic, and the spiral "O" flute when the user wants to influence the chip in an upward direction. The double edges provide a better finish and the single edge promotes faster chip flow. The tools are best utilized on a raised spoilboard to center the radius and avoid unnecessary plunging into the spoilboard.

SOLID CARBIDE ROUT AND CHAMFER

The solid carbide rout and chamfer bit was designed to provide up to 1/16" top face chamfer and a finished edge on plastic sheets or parts. The multi-faceted design allows the CNC user to perform what was ordinarily a two-step process and complete the task in one pass without a tool change.

SOLID CARBIDE DOUBLE EDGE BOTTOM SURFACING

The bottom surfacing router bit in solid carbide upcut geometry provides a swirl free bottom in pocketing or lettering applications. The tool utilizes a near flat point with radiused corners to create a smooth bottom with aesthetically pleasing results.

SOLID CARBIDE DOUBLE EDGE UPCUT SPIRAL BALL NOSE

Solid carbide double edge ball nose tools are readily available for use in carving and modeling operations or as decorative round bottoms in plastic parts. These tools are offered in most nominal sizes and with extended lengths for five-axis CNC router where reach needs to be optimized.

PLASTIC DRILLS WITH SPECIAL POINT

The plastic machining industry has been at the mercy of inappropriately designed drills for years. The jobber drill and other similar tools were inadequate in terms of providing clean holes in plastic. A new style drill designed by Onsrud Cutter is available which allows fast plunge speeds with reduction of chip wrap in soft plastics and crazing in hard plastic. A 60° point and flat face rake provide the best plunging point to date in a wide variety of plastics. The new point reduces the stresses introduced into the hole walls and will provide a clean hole surface without clouding or crazing typical in standard drills.

TOOL EXTENDERS

Tool extenders are ideal for use with five-axis routers for trimming/routing of formed parts where extended reach is required.