

Preparing for Plastic Routing

Part 1

As companies make the transition from the routing of wood or aluminum to the machining of plastics, there are a number of preliminary procedures and considerations that can help ease the conversion and ensure a smooth transition. Periphery factors in the routing of wood and aluminum can become some of the most significant aspects of plastics machining. Good planning and preparation can help ease these factors and the costs associated with the startup of a new machining process. This article is the first of a two part series that discusses the need to have active preparation when making the transition from wood routing to plastic routing. Part 1 discusses the CNC router and its associated hardware. Part 2 will discuss tooling and material selection.

Preparation of the CNC Router

Routine maintenance of CNC routers is a critical factor for ensuring a high level of precision and repeatability in finished parts. These maintenance operations are defined by the router manufacturers and are absolutely essential when plastic parts are to be machined. Minor spindle vibration, gantry or bridge shake, and servo positioning errors frequently have minor or unnoticeable impacts in wood but can result in scrap or expensive finishing operations in plastic. The severity of these problems are the direct result of machine quality and adherence to the manufacturers recommended maintenance schedule. Besides preventative maintenance, there are additional steps that fabrication companies can take to help ensure a successful first run. Listed below are some recommended actions to consider before machining plastic.

Preparation of the CNC Router

Routine maintenance of CNC routers is a critical factor for ensuring a high level of precision and repeatability in finished parts. These maintenance operations are defined by the router manufacturers and are absolutely essential when plastic parts are to be machined. Minor spindle vibration, gantry or bridge shake, and servo positioning errors frequently have minor or unnoticeable impacts in wood but can result in scrap or expensive finishing operations in plastic. The severity of these problems are the direct result of machine quality and adherence to the manufacturers recommended maintenance schedule. Besides preventative maintenance, there are additional steps that fabrication companies can take to help ensure a successful first run. Listed below are some recommended actions to consider before machining plastic.

Runout

The spindle, spindle mount, and colleting system should be checked for the amount of TIR (Total Indicator Runout). Tools required for verifying TIR are a .001" or better dial indicator, a magnetic indicator base, a 6" or longer indicator stand assembly, and a long shank solid carbide tool, a blank drill rod or blank solid carbide round.

The first verification should be made inside the spindle taper (**see Figure 1**). The router or spindle manufacturer should be able to provide you with an acceptable upper limit for TIR. An acceptable value is

typically .001" TIR or better on older spindles and .0005" TIR or better on newer spindles. There should be no play in the radial direction of the spindle at any time.

The second verification should be with a rod inserted into the collet. Measure the TIR at the furthest point from the spindle (**see Figure 2**). This measurement needs to be taken multiple times with the rod being re-chucked and rotated after each measurement. TIR is an additive property and can vary depending on how the taper, collet, chuck nut, and rod align. The maximum reading is an indication of true TIR. The colletting system should be better than .002" total TIR for older machines and .001" total TIR for newer machines.

The third verification is dependent on whether the routing involves any surface milling, pocketing, or lettering. If these operations are performed and require a high degree of surface finish, the spindle should be verified perpendicular to the work surface. This typically involves removing any spoilboards and setting the indicator as shown in **Figure 3**. By finding the amount of tilt the spindle mount has in both the X and the Y-axis, it is possible to determine the degree of apparent machining marks that will be seen on the bottom of a pocket cut.

Once the dial indicator is mounted in the spindle and zeroed on the main table surface, rotate the spindle 180° by hand and record the amount of TIV (Total Indicator Variance) along both the X and Y-axis. The larger the TIV, the more delimitation will be seen during parallel pocketing cuts. This effect is exaggerated by the use of larger diameter tools.

Collets

All collets and collet mating surfaces should be examined and cleaned. Well used collets should be considered for replacement even if they are not showing obvious signs of wear. LMT Onsrud recommends collet replacement at the following times:

- After 400-600 hours of runtime
- A tool has broken in the shank



Figure 1



Figure 2



Figure 3

- A tool has spun in the collet
- A tool has been "short shanked" within the collet
- The collet has been sprung.

Unlike the machining of wood where collet condition typically has the greatest affect on tool life and breakage, collet condition becomes apparent much sooner in plastics machining where the products edge finish rapidly deteriorates. There are specially designed felt and brass brushes shaped for cleaning the insides of tapers and collets and these should be used during every shift change, every manual tool change, and every time a collet is changed.

There are various chemical cleaning products available for routine collet maintenance and they do a good job of removing buildup that brushes cannot always eliminate. Petroleum products should be avoided due to their ability to attract and trap dust within the colleting system. Alcohol, citrus cleaners, and other formulations are good alternatives.

Vacuum

Vacuum systems should be evaluated for their ability to hold small or thin parts. Many plastic sheet parts and/or thermoformed parts are much more difficult to hold due to their size, shape, and comparably light weight. By taking steps to increase the amount of usable vacuum, fabricators can reduce the amount of time spent on custom fixtures and typically achieve higher feed rates with better cycle times.

Flow through systems should be evaluated for:

- Pump Size - 800cfm or greater for a 4x8 table
- Spoilboard - lightweight, porous MDF with a reasonable thickness and the edges sealed to reduce air leakage
- Supply Lines - evaluate for diameter and quantity. Flow through systems benefit greatly from multiple large diameter supplies. Consider using 2 or more 4" or larger supplies for each table.

Discreet (or dedicated) systems should be evaluated for:

- Pump Size - 25 inHg or better vacuum at full sealed vacuum conditions
- Spoilboard - should be channeled to provide best vacuum dispersion and sealed all around to prevent leaks.
- Supply Lines - multiple ½" diameter or larger lines are recommended.

Dust Collection

It is possible to have both too much and not enough dust collection at the same time. Dust collection systems serve two purposes: to remove the chips from the work area and to keep the spindle and tool cool. Dust collectors that are under-powered can reduce spindle life and produce poor quality finishes by not extracting chips from the cut path. These chips and their associated heat can ruin otherwise acceptable finishes. Over-powered dust collection with rigid dust brushes can overwhelm vacuum hold

down fixtures for small parts and cause part movement or part ejection. Care should be given to the evaluation of the role of the dust collector for each job.

Coolant

While mist or liquid coolants typically are an unacceptable addition for most CNC plastic routing applications, air coolant systems should be seriously considered. A simple air nozzle (**see Figure 4**) directed at the cutting bit can dramatically improve cut quality and tool life. The air serves to cool the tool and cut path, remove warm chips, and reduce the instances of chip wrap around the cutter.



Figure 4

Another option is to use a cooling nozzle. These devices go by various names (cool gun, cold gun, Venturi gun) and use a venturi orifice to significantly reduce the temperature of the air flowing from the nozzle. By using chilled air,

cutter life and cut quality can be considerably extended. A drawback is that the velocity of the air is significantly reduced. This reduces the ability of the nozzle to remove chip wraps and requires that it be placed closer to the router bit to overcome the air dispersal associated with the dust collector.

By evaluating the above machine factors before beginning a plastic routing operation, the chances of success and profitability can be significantly improved. The next article will cover the topics of tool selection and material selection before actual machining takes place.

Van Niser

For more information about the company's cutting tools, call (800) 234-1560 or visit www.onsrud.com