# Real World Routing Solutions: Part 1

Sometime in the early 1980's, dedicated router tooling for plastics began to take shape. Since then there have been leaps in technology from all areas in the primary plastics market including material composition, fabrication, machines, and machining. Each area has gone through growth spurts that has surpassed the capabilities of the other areas, which in turn has led the other industry sectors to improve their R&D work and leap ahead again. While this rapid growth has created a large and viable plastics market, it has also lead to confusion about methods and practices when it comes to producing these in-demand plastic products. With an ever increasing burden on the plastics fabricator to produce parts faster and with better finishes, companies are looking for more and more technical assistance from suppliers in solving these problems.

Onsrud Cutter has spent twenty years visiting these plastic producers and plastic fabricators as well as the machinery manufacturers that utilize the router tooling market in order to gather information to help with both advanced tooling design and application support. Over this time, a number of application problems have been observed that are significant to a large segment of primary and secondary fabricators. In line with this experience, OC will present 12 scenarios over the course of the next 4 articles that illustrate real life applications and the actual tooling solutions that were implemented to solve either a manufacturing problem or a production problem.

**SCENARIO 1**

**Material Cut**: ABS
**Product**: Thermoformed tractor shrouds and fuel tanks Router
**Type**: Hand held air router
**Feeds & Speeds**: Manual operation at 21,000 RPM
**Initial Tooling**: HSS Pilot bits and standard Carbide Tipped V flute bits

**Problems**:

Tool breakage
Production bottleneck
Poor part finish

The first problem in this plant was the tooling choice. Earlier articles have stated the need for dedicated plastic tooling to achieve maximum feed rates and optimal finishes. Tooling that works well in ABS probably won't perform as well in polycarbonate. Tooling that leaves a clear edge in cast acrylic may melt and scar extruded acrylic. With this in mind, the single edge solid carbide straight "O" flute was replaced with a similar spiral "O" flute. This replacement had geometry designed specifically for melt-prone plastics. This instant solution cleared up the melt problem and saved on both inspection and rework time for the fabricator.

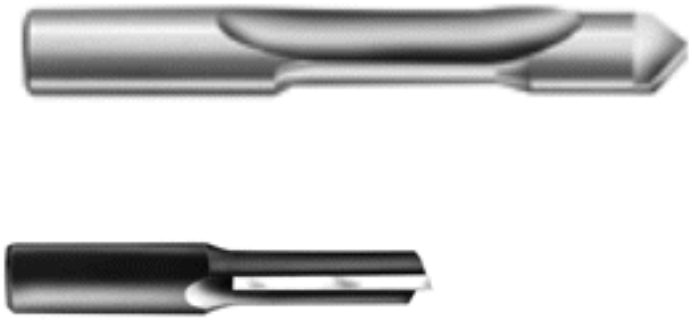

FIGURE A

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The solution for the second problem, the wrap-up of the paper masking, followed as a direct result of the correct tool choice. The plastic geometry spiral "O" flute was designed to handle a high chip load and thereby reduce heat build up during cutting. By doubling the feed rate to 200ipm and reducing the spindle speed to 14,000RPM the cutter stayed cool enough to prevent the tacky glue from warming and adhering to the cutter body while still maintaining a good part finish. By changing cutters to a dedicated plastic tool, the fabricator walked away from this problem with a number of benefits: production speed nearly doubled, inspection time was reduced and rework time due to machining inconsistencies nearly eliminated. The tooling was nearly identical in dimensions to the original and therefore required no reprogramming or refixturing. (see Figure C)

**SCENARIO 2**

**Material Cut**: Extruded (soft) Acrylic
**Product**: Various Point-of-Purchase displays
**Router Type**: 3-axis CNC in excellent condition
**Feeds & Speeds**: 100ipm at 18,000 RPM
**Initial Tooling**: Generic solid carbide "O" flute

**Problems**:

Tool breakage
Production bottleneck
Poor part finish

This company had “lived with” the routing department as it was for quite some time and only recently completed a study that pointed to that area as a root cause for some less than desirable production bottlenecks. After visiting the plant it was apparent that the routing group needed both a tooling and an application change. The HSS pilot bits were being used with a guide template to cut holes in the fuel tanks but were breaking when used for fast, hand fed free routing operations. The continuing bit breakage was causing short but frequent downtime when the collets and nose guards were disassembled to replace the tooling. The carbide tipped bits were resistant to the breakage associated with the pilot bits, but were producing a poor finish with evident chatter. (see Figure A)

FIGURE C

HSS double edged O flutes designed specifically for air-routers were tested on site and were able to immediately replace the carbide tipped double edge V flutes. These O flutes are dedicated plastic tools designed for cutting soft plastics and their open flute shape allowed the ABS to naturally curl when cut, eliminating the chatter of the straight faced carbide tipped tooling. Their feed was

FIGURE B

also more controlled while still being easier to push – eliminating some production personnel complaints. When the HSS double edge “O” flutes were tested against the pilot bits their feed speed and pressure were an improvement but they lacked a method of guiding on the templates used for production of the fuel cells. In order to solve this problem in previous applications, the air-router O flute design had been changed to give an extended overall length. This allowed the tool to seat normally in the collet, protrude through the nose bearing of the router (giving important extra stability) and through an additional guide bushing. By utilizing this guide bushing, the routing department made new templates for the fuel cells and virtually eliminated breakage. (see Figure B)

**SCENARIO 3**

**Material Cut**: ½” to 1” Thick corrugated paper core with plastic laminate (both sides)
**Product**: Custom packaging
**Router Type**: 5-axis CNC
**Feeds & Speeds**: variety tested, initial production run
**Initial Tooling**: variety tested, initial production run

**Problems**:

Unable to cleanly cut the material
Lifting of material from vacuum fixturing

More and more router owners in the plastic industry have questions about corrugated or honeycomb panels that have plastic, composite, or aluminum laminated skins. The high strength-to-weight ratio of these structures has led to their use in aerospace and marine applications. Their high cost and technical machining requirements, however, had previously kept them from widespread market acceptance. With falling prices and advanced tooling rising to the challenge, markets that had previously ignored composite sandwich panels are starting to use them in everyday applications such as custom packaging.

FIGURE D

This particular fabricator had tried both high speed steel and solid carbide straight and spiral tooling in this application. The HSS tooling wore down quickly due to the abrasive paper core and the solid carbide straight tooling could not produce an optimal edge on both the top and bottom surface. The solid carbide downcut spirals worked the best – solving the fabricators hold down problem, but still leaving a frayed bottom panel.

The final tooling solution was a special compression router bit that was designed for the wood composites market and has been a staple in the honeycomb and laminated composites industry for many years. The mortise compression spiral is a hybrid cutter that uses a .200” long upcut spiral near the tip of the tool and an extended downcut spiral that overlaps the upcut by about .060” and continues up the cutting edge. While it is a non-traditional plastic tool, the combined cutting action of the opposing spirals in conjunction with the location of the overlap allowed this tool to shear the laminated materials toward the center of the corrugated materials and produce an excellent edge finish on both the top and bottom of the part. The short upcut allowed the router to run without tool changes because the same tool could cut materials ranging in thickness from ¼” to 1-½”. (see Figure D)

The best edge finish of both the paper core and the plastic laminate was obtained at 450ipm and 18,000 RPM, but at these feed rates the material normally lifted from the fixture with other types of tooling. Because of the long downcut length of the mortise compression spiral, extra downward holding pressure was generated from the router bit itself and the material stayed securely fixtured.

The right tool for the job is a critical component of each fabrication or trimming process. As materials change and multiply, tooling must keep pace. New router bits for plastic are designed every month and their proper use can help ensure optimum productivity. Look for more specific applications in the months ahead.