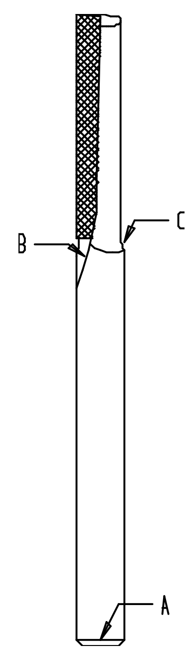
Routing with Air

Pneumatic (or air) routing has been a standard in many shops and plants for decades and its appeal only seems to increase as technology advances. Air routers are simple machines that use high tech tooling to produce parts that would be difficult or unsafe to machine in any other manner. They offer the advantages of a light weight, easy to maneuver design, no risk of electrical shock, and simple maintenance. Because of these advantages air routers are the router of choice for many industrial hand routing applications.

Air routers are used to cut most routable materials used today including, but not limited to: fiberglass or fiberglass/wood composites in the boat industry, aluminum in both the boat and aerospace industry, and plastics in a wide variety of production industries. Their applications include cut-out routing through the use of a template, trimming operations while following a fixture, free-hand trimming, and as technology grows: robotic applications. With the wide variety of materials and applications in use and only a few variations of the standard air router available, manufacturers must look to specialized tooling to provide the best solution to their cutting needs.

Tooling Requirements for Air Routers

Router bits for air routers are specialty tools. They look different, perform better, and, as opposed to standard router bits, are designed specifically for air routers. Air router tools have the following notable differences:



- *Longer Overall Lengths* – Air router tools must extend out of the collet, through the nose bushing, and out of the guard. For this reason the tools are typically 3-1/4” up to 4-1/2” long.
- *Undersized Cutting Edge Diameter (CED)* – Bits must pass through a support bushing or bearing. For this reason the CED is typically toleranced (-.001/-.008). Since hand routing is not normally an operation that requires high tolerance, this is an accepted method of protecting the cutting edge from damage due to contact with the bushing or nose guard.
- *Short Flute Fadeout (see diagram - B)* - This add strength to the tool by adding material where the most amount of stress is. Short fadeouts also allow the bushing to rest closer to the actual cutting surface.
- *Smooth, Large Radius Cam Fadeout (see diagram – C)* – Similar to the flute fadeout, this adds strength in a weak area of the tool. The back of the cutting edge usually does see much cutting action so this added material has only a minimal negative effect of the cutting action while decreasing the instances of breakage.
- *Large Chamfer (see diagram – A)* – Prevents damage to the bearings, bushings, and collet.

Air router bits offer the same variety of cutting geometries as standard bits. Just like standard tools, air router bits must be selected according to the material being cut, finish and feed desired, and operator fatigue. Operator fatigue is a variable not normally associated with bit selection in the current climate of diminishing hand routing operations in favor of CNC production. Reduced operator fatigue is normally at the expense of cutting tool life and this must be considered during tool selection. Some general recommendations for tool selection are as follows:

- ✍ Single flute tools are very aggressive. Use them where high feed rates are needed and finish is a secondary concern.
- ✍ Two flute tools are much more stable in the cut, are easier to control, and produce a better finish.
- ✍ A premium finish can be obtained by taking two passes: one roughing pass with a single flute tool and a second finishing pass with a three or four edge tool removing a thickness of material equal to approximately ¼ the diameter of the bit.
- ✍ If a spiral is desired, use a downcut. This ejects the chips away from the operator and can help hold the part in place.
- ✍ When cutting thin materials, use a straight tool. This will help stabilize the material.

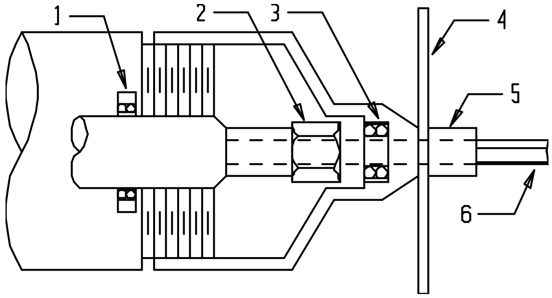
Operating Conditions and Maintenance

The recurring problem of inconsistent finishes, inconsistent tool life, or router bit breakage plagues all users. This is usually blamed on the tool because it is the item that is most visible and costly in a routing operation. There are a multitude of other factors that are much less visible and more likely to cause the problems listed above.

- ✍ **Air Pressure –** In general, routers need 90psi and 30cfm of dry, clean, lubricated air supply. If the router is receiving less than 70psi *or* 20cfm, then its usable horsepower is cut in half as well exhibiting a drop in its RPMs. Router bits are designed for specific RPMs and do not perform well at lower spindle speeds. Air pressure should not drop more than 10% from the static pressure when the router is turned on. Too many quick disconnects, too small of a supply line, or too many users on a line can cause these pressure problems. If air pressure drops while the spindle is under load, it may be an indicator that the router itself is in poor repair and may need an overhaul.
- ✍ **Wrong Spindle Speed –** Whether the result of low air pressure, a router in poor condition, or just the wrong router, spindle speed can greatly affect the performance of router bits. The smaller the diameter tool, the higher the spindle speed needed to cut at peak performance. 1/8” diameter tools work extremely well in some of the older turbine style routers that spin up to 40,000RPM.
- ✍ **Coolant –** If cutting aluminum is a problem, use coolant. Many manufacturers keep a block of beeswax or barsoap at each routing station. The operator dips the bit into the block before each cut and it greatly facilitates chip removal and produces more consistent finished parts.
- ✍ **Maintenance –** As with any machine, maintenance is critical. Air routers are extremely susceptible to particulate damage due to their operating environments and are notorious for not having regular maintenance and overhaul performed on them. The spindle and nose bearings (see diagram) are shielded but not sealed. They should be replaced a minimum of every 3-6 months. Vanes for the spindle should be

replaced every 6 months. Collets should be replaced every 2-6 months depending on material being cut and router use.

Spindles are usually concentric to .0005” from the factory. Regular use can cause this number to increase up to .002”. A damaged or dirty collet along with a used nose bearing can increase this and cause runout at the tool tip to exceed .010”. When there is this kind of collaborative runout (spindle, spindle bearing, collet, and nose bearing) the tool can have runout varying from zero to .010” each time it is seated and tightened down. What this translates to is when an operator is doing a repetitive operation, they will see one tool perform extremely well and get a maximum number of parts, while the next tool will be difficult to push, give a poor finished surface, and cut drastically fewer parts. The bit is always blamed, but is rarely the actual problem.



1. Spindle Bearing
2. Collet
3. Nose Bearing
4. Guard
5. Guide Bushing
6. Cutting Edge

✍✍ **Operator –** Air routing, without a doubt, is very “feel” oriented. An experienced operator can tell when a bit is dull or when performance of the tool and bit drop. New operators will *always* break more tools than an experienced counterpart. It just takes one hit of the tool on the fixture, one time when a single edge tool gets away from the operator, or one plunge to fast or erratic and the cutting edge will chip. This chip will immediately degrade performance and cause the tool to behave differently. This starts a chain reaction and the entire cutting edge is corrupted in a short time. When evaluating router and router bit performance, do not forget operator competency.

Conclusion

Air routing has been around for a long time and will continue to be an extremely viable method for trimming and/or manufacturing parts. With the correct tooling and an excellent maintenance program, air routers are more reliable and comfortable to use than electric routers in abusive or repetitive applications and can be a cost effective alternative to CNCs.