Bits, Speeds, and Feeds

Collected from ShopBot Forum (and Slightly Edited) by Frank J. Mihm.

Additions and Corrections are Requested. Please send them to the Forum or to me by Email.

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ID	Material	Bits	Speeds	Feeds	Misc.
1	Aluminum				For clean cuts, use 6061 or 6063. Use CRC 03410 TrueTap Foamy Foaming Cutting Fluid sprayed on the surface being cut, I cut 1/4" aluminum in one pass at 0.6 to 0.7ips. Should work with a 1/8" or 1/4" ball-end mill with very small stepover for good detail.
2	Aluminum 0.040" - 0.080"	1/8" bit for tight corners; 1/4" single-flute up-cut spiral for larger shapes.	21,000rpm	1/8": 0.65ips; 1/4": 2.0ips	Screw work directly to the spoilboard with nothing between work and spoilboard.
3	Aluminum	Single-flute spiral-O bit.	13-15,000rpm	1.0ips	Ramp into the AL rather than plunging straight down. Can be cut dry using no lube/WD40. Air cooling not required for most alloys.
4	Aluminum 1/8", 1/4" and 1/2"	1/4" O-Flute 65-025 Onsrud bit	10,000rpm	0.75ips	Cut climb, use some air to blow chips clear and cool, ramp all cuts, 0.07" passes
5	Aluminum Sheet, but cut with a router.	Either a 2-flute straight end mill (OSG Brand) or single-flute spiral-O bit.	15,000rpm	0.8 to 1.2ips	Use ramped Z entry. The 2-flute straight end mill (NOT a router bit) can cut up to 2.2ips.
6	Baltic Birch 3/4"	0.25" : Down-spiral bit	15-19,000rpm	1.67ips	0.25" stepdown each pass with a small offset, then come back and clean the edge in a single pass.
7	Baltic Birch	I usually use a 3/8" compression			3/4" BB: When I need 1/4" for nesting, I cut at 5ips 13K rpm, 0.6 deep climb cut first pass, then 0.010 into the spoiler in the conventional direction. 1/2" BB: 6ips 13K rpm, .400 deep climb cut first pass, then 0.010 into the spoiler in the conventional direction.
8	Corian	1/16 ball	13,000rpm	3.5ips	
9	Corian		16,000rpm	3ips v-carving; 2ips regular	
10	Corian	Onsrud 90-degree 1-1/4" carbide bit	19,000rpm	0.6ips.	You can use your table saw with a carbide blade to cut the blanks. Saw at a reasonably slow rate, and the cuts are very nice.
11	Corian	Onsrud 0-flute bit		1.5ips.	
12	DiBond	Straight-flute carbide bit worked fine; not up-cut or down-cut Single flute 2-flute straight O-flutes (Onsrud 56-600 series)	About 16,000rpm.	1/4" bit: About 2ips -- probably could be faster. About 1.7ips, cutting it in a single pass.	Use double-stick carpet tape to hold down DiBond. In addition, we put screws on the corners of the panel for added security. On the thinner material we cut everything in one pass, but use two passes for the thicker material. Have a jet nozzle of compressed air shooting on the bit as it cuts -- just to keep things cool and remove shavings.

13	Expanded PVC (Komotex, Sintra, Azek, Celtec)	Use a 1/4" or 3/8" double-spiral O-flute	~13,000rpm		Expanded PVC trim board (Komotex, Sintra, Azek, Celtec)
14	Same	I use a 2-flute straight bit to cut it, but if I were running faster, I'd probably use an o-flute to clear the chips.	5,000 to 21,000rpm (little difference in cut quality)	A touch over 4ips	
15	Same			1ips; this gives a much cleaner edge than faster speeds. It puts no pressure on the sheet to move, and PVC does not seem to like a very fast feed rate.	I just screw two diagonally opposing corners down and occasionally the middle if needed. I run Komatex at just 1ips and I generally get 8 or 10 sign blanks from a sheet with the classic rectangular-with-an-oval-on-top being the most popular style. This is cheaper for them than buying the individual blanks by about half. Even at 1ips, it takes just 15 minutes to do a sheet as they are pretty basic shapes.
16	Same	Use Onsrud double spiral-O-bit from MSC. I use an Onsrud 52-624 1/4" to cut all types of PVC sheet. The difference in quality is unreal. Don't use down-cut spiral to cut Komatex - you will get a lot of chip welding	13,500rpm	2ips as a start - you want nice, big chips	A double-edge spiral O-flute will let you move at twice the speed as the single-flute at the same RPM, and in my experience will give you a better finish than the single-flute tool.
17	Same	I use a 1/4" double-flute up-spiral bit.			
18	Same	Used both 2-flute and single up-cut "super O-flute" (Super polish and sharp) from onsrud with good results. Depending on the size and detail with a 1/8" or even a 1/16" bit	12,000 to 13,000rpm	1.5 to 2ips.	
19	Same	Single-flute up-spiral Belin bit	7,900rpm	1.3ips	I get a nice edge at these slower speeds
20	Same	We use either 1/8 or 1/4 CED bits, single-flute spiral.			
21	Expanded PVC w/ 0.040" Alum. Faces	Belin O single-spiral flute	1/8" CED 18,000, 1/4" CED 12,200rpm	1/8" 0.4ips, 1/4" 1ips	I always laminate the sheets with a 3M VHB tape, then rout. Hold down with Home Depot Carpet tape. For a clean edge, don't use a down-spiral bit because it will trap the cut chips, and you will get gouges on the sides of your letters.

22	General Tips				1) Does the edge look clean? 2) Am I pulling off nice big chips without bogging down the router? 3) Do I smell burning? 4) Does it sound 'right' when I am cutting? 5) Is my bit sharp? Mainly when cutting plastics, it makes a big difference when you do a few passes, with let's say 0.020" allowance left on the part and a bottom skin (don't cut all the way thru) and then go back and finish the cut full depth with no allowance. This gives you a nice clean edge, no step-down marks and keeps the tool moving.
23	Hardboard /tempered Masonite, 1/4"	Try the Onsrud 65-010 (1/8) a single flute spiral. Try the Carbi-Tool TSPL04, a single-flute spiral solid carbide 1/8" bits. They also have a TSPL08 that is 1/4".			
24	Marble	1/2" 90-degree bit (CMT 3/4" V90 or 1/2" V60)	13,000rpm	0.1 -- 1ips	I found that I could cut the job in a single pass without water if my cuts were 1/4" or less. Cooling: I held a shop vacuum nozzle near the bit which kept lots of air moving. At the end of the run the bit and collet were warm, but not hot. We have had good luck with marble, cultured marble, sandstone/limestone, and soapstone.
25	Marine Plywood	Onsrud 3/8" compression spiral with good results		Start at 1.5ips and adjust on the fly from there.	Make a lead in to your contour so the upcut entry is away from your finished edge to start.
26	Marine Plywood	I'm sold on Onsruds 60 series, mostly 60-121 single flutes.	3/8" bit: 17,000rpm	8 to 10 inches a minute	You need the short upcut for 1/2" material.
27	Marine Plywood	With a compression spiral, you'll have no trouble with a full 1/2" cut.	16,000rpm	You might try it at 1.5ips	You should be able to single pass the 1/2", even with a 1/4" compression spiral. I've run single flute tools in 1/2" at 8ips - single pass without breaking tools.
28	MDF - 1/4"	CarbiTool TSPL 04S, a solid carbide single-flute bit "O" spiral. 1/8 CED and 1/2 CEL. It produces a cut that requires no sanding. Belin as good. Onsrud and CMT have poor cut quality.	13,000rpm	4.25ips	
29	Melamine, veneer ply	Straight carbide 2-flute 5mm cutter			3 passes w/one bit: drill, dado, and cut out.
30	Oak	Onsrud 1/2" down-spiral	10,000rpm	2+ips	1/2" pass depth, increase move speed till good chips fly, it'll keep the bit cool.

31	Oak	1/2" down-cut spiral	14,000rpm	3-4ips	1/2" pass depth, create a toolpath that is wider than the bit -- a 3/4" wide trough for a 1/2" bit, so the bit is not rubbing the walls of the cut on both sides as it gets deeper into the material. The allowance cut can be conventional or climb, but the finish cut should be climb
32	Oak, white	1/4"bit, up- and down-spirals	16,000rpm	2.5ips	0.2" pass depth
33	Pink foam, blue foam	1/8" tapered ballnose 1/4" ballnose	18,000rpm 10-22,000	<= 4ips 6ips	Pink foam may cut better
34	Plywood, plastics, and MDF	1/8" single-flute down-spiral, Carb-I-Tool TSPL04S. CARB-I-TOOL, Australia, sales@carbitool.com.au Maybe "1/8" plastic cutting single flute spiral bit."			Little or no sanding of the MDF cut is required with the Carb-I-Tool cutter. The other important factor is hold down: We use a combination of vacuum and screws. This reduces the vibration of the workpiece and results in better cut quality. Also care with your toolpath strategy and not using our dust collector during the cutting process helps, but it's a bit messy. There is a surprising amount of difference in the cut quality of nominally similar bits from different manufacturers.
35	Scooter Board	1/8" up-spiral	9,000rpm	2ips	
36	Scooter Board	1/4 O-bit	11,500rpm	2.5ips	
37	Trupan	Single-flute 3/8" compression	11-12,000rpm	1.8ips	I cut full single passes in 3/4" stock.
38	Trupan	I use O-flute bits with very little rake in the tip -- rake is more for plastics.			