ENGINEERED SYNTACTIC SYSTEMS

PLEASE – BEFORE YOU TRY IT YOUR WAY, TRY IT OURS!

Syntactic Foam Machining Guide

Syntactic materials are generally easy to machine, frequently requiring no secondary polishing or surface preparation. Following the guidelines listed below will improve surface quality of the finished part and ensure consistency in performance. Cutting tools are available from ESS or Onsrud Cutter directly (800) 234-1560.

Cutter Type

- Solid Carbide.
- **2 Flute, Plastic Cutting Tools**
- **SHARP TOOLS** are required. Syntactic foams are abrasive. Check cutting edges and monitor plug surface for evidence of dull tooling.

Speed and Feed

- Varies by tool geometry and size.
- **Use "Chip Load"** (the measurement of thickness of material removed by each cutting edge during a cut) from tooling manufacturer to develop feed rate.
- Calculate Feed Rate (inches/minute) using the formula:
  Feed Rate = Chip Load x Spindle RPM x # of flutes.
- For ESS supplied tools from this guide, the following feed rate calculations apply:

Number shown in **bold** is feed rate in inches/minute. Use formula above for metric tool calculations.

Chip Load \ *Spindle RPM*	*2500*	*5000*	*7500*	*10000*	*12,500*	*15000*	*17,500*	*20,000*
0.002	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**
0.003	**15**	**30**	**45**	**60**	**75**	**90**	**105**	**120**
0.0035	**18**	**35**	**53**	**70**	**88**	**105**	**123**	**140**
0.004	**20**	**40**	**60**	**80**	**100**	**120**	**140**	**160**
0.005	**25**	**50**	**75**	**100**	**125**	**150**	**175**	**200**
0.006	**30**	**60**	**90**	**120**	**150**	**180**	**210**	**240**
0.007	**35**	**70**	**105**	**140**	**175**	**210**	**245**	**280**
0.009	**45**	**90**	**135**	**180**	**225**	**270**	**315**	**360**
0.01	**50**	**100**	**150**	**200**	**250**	**300**	**350**	**400**

Optimization techniques

1. Experiment with the maximum possible chip size. Use feed rate as determined from the chip load rating and your machine RPM.
2. Increase feed rate until the part finish begins to deteriorate. Decrease feed rate 10%.
3. Decrease RPM by some set increment until surface finish begins to deteriorate. Once this happens, increase RPM until finish is again acceptable. Speed and feed are now optimized in your process.
4. Usage of separate tools for roughing and finishing allows rotation of finish tool into roughing position when part finish deteriorates.
5. Clear removed chips to prevent premature tool wear.

NOTE: Too low a feed rate will generate excess heat and reduce tool life. Proper settings will result in a tool operating at or near room temperature. Too high a feed rate will cause poor surface finish or part movement during machining.

Coolant

- **None, or air**

Protection

- Enclose chip space, dust extraction, safety goggles, dust mask, protective gloves

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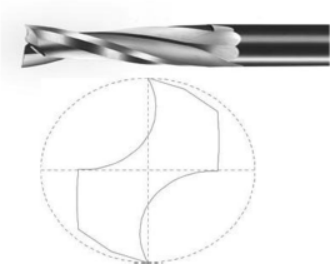
Syntactic Foam Machining Tools

Double Flute Upcut Spiral

High helix geometry with a special point for upward chip flow, smooth sidewall and improved bottom finish.

Conventional cutting for roughing and finishing is recommended with these tools.



Part #	Cutting Diameter	Flute Length	Shank Diameter	Overall Length	Roughing Parameters		Finishing Parameters			
					Slotting* RDOC[i]= 100% ADOC[ii]= up to 1xD[iii]	***Profiling**** RDOC[i]= 100% ADOC[ii]= up to 1xD[iii]	***Walls**** RDOC[i] = below ADOC[ii] = up to 4xD[iii]		***Floors**** RDOC[i] = 40-65% ADOC[ii] = below	
					Chip load	Chip load	Chip load	RDOC[i]	Chip load	ADOC[ii]
52-703	1/8”	1/2"	1/4"	2”	.002 - .003”	.002 - .004”	.002”	.01”	.002”	.005”
52-707	1/4"	7/8”	1/4"	3”	.003 - .004	.003 - .005	.003	.02	.003	.01
52-710	3/16”	5/8”	1/4"	2-1/2”	.003 - .004	.003 - .005	.003	.01	.003	.005
52-709	3/8”	1”	3/8”	3”	.003 - .005	.003 - .007	.004	.03	.004	.01
52-702	1/2”	1-1/4”	1/2"	4”	.004 - .007	.004 - .009	.004	.04	.004	.015
52-706	1/2”	2-1/8”	1/2”	4”	.004 - .007	.004 - .009	.004	.04	.004	.015
52-712	5/8”	1–3/4"	5/8”	5”	.004 - .008	.004 - .010	.004	.04	.004	.02
52-724	3/4"	2-1/2”	3/4"	5”	.004 - .008	.004 - .010	.005	.05	.005	.02
52-742	12mm	35mm	12mm	100mm	.10 - .18mm	.10 - .23mm	.10mm	1mm	.10mm	.4mm
52-744	12mm	45mm	12mm	100mm	.10 - .18	.10 - .23	.10	1	.10	.4
52-746	12mm	55mm	12mm	100mm	.10 - .18	.10 - .23	.10	1	.10	.4
52-752	16mm	45mm	16mm	120mm	.10 - .20	.10 - .25	.10	1	.10	.5
52-754	16mm	55mm	16mm	120mm	.10 - .20	.10 - .25	.10	1	.10	.5
52-764	20mm	65mm	20mm	125mm	.10 - .20	.10 - .25	.13	1.3	.13	.5

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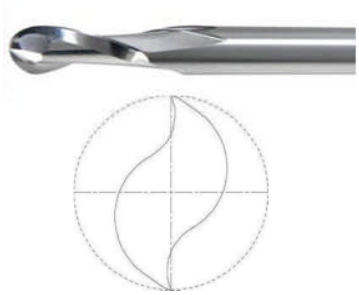
Syntactic Foam Machining Tools

High Finish Ball Nose

3D contouring of syntactic materials. Unique geometry and highly polished surface result in a smooth surface without tool marks.

Conventional cutting is recommended for roughing and finishing with these tools.



Part #	Cutting Diameter	Flute Length	Shank Diameter	Overall Length	**Roughing Parameters*** RDOC[i] = 33% ADOC[ii] = up to 2xD[iii]	**Finishing Parameters***		
					Chip load	Chip load	RDOC[i]	ADOC[ii]
65-210B	1/8”	1/2”	1/8”	2-1/2”	.002 - .004”	.002”	.002 - .003”	.005”
65-225B	1/4"	1-1/8”	1/4”	3”	.003 -.005	.003	.002-.003	.01
65-215B	3/16”	1/2"	1/4”	2-1/2”	.003 -.005	.003	.002-.003	.005
65-250B	3/8”	1-1/8”	3/8”	3”	.003 -.007	.004	.004-.006	.01
65-280B	3mm	12mm	3mm	64mm	.05 -.10mm	.05mm	.05-.07mm	.13mm
65-285B	6mm	20mm	6mm	76mm	.07 -.13	.07	.05 - .09	.25
65-290B	8mm	25mm	8mm	76mm	.07 - .15	.10	.01 - .15	.25
65-295B	10mm	30mm	10mm	76mm	.07 - .18	.10	.10 - .15	.38

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Syntactic Foam Machining Tools

Tapered Ball Nose

Available with a variety of taper angles and optimized geometry to produce a good edge finish.

Part #	Cutting Diameter	Flute Length	Shank Diameter	Overall Length	Flutes	Angle per Side	Radius	**Slotting Parameters*** RDOC[i] = 100%	**Profiling Parameters*** RDOC[i] = 100%
								Chip load	Chip load
77-102	1/8”	1-1/2”	1/4”	3”	3	1^0	1/16”	.002 - .0035”	.003”
77-104	1/8”	1”	1/4"	3”	3	3^0	1/16”	.003 - .004	.005
77-112	1/4”	2”	1/2”	4”	2	3^0	1/8”	.003 - .004	.005
77-114	1/4”	1-3/8”	1/2”	4”	2	5^0	1/8”	.004 - .005	.006
77-102M	3mm	39mm	6mm	76mm	3	1^0	1.6mm	.05 - .09mm	.07mm
77-104M	3mm	25mm	6mm	76mm	3	3^0	1.6mm	.07 - .10	.25
77-112M	6mm	50mm	12mm	100mm	2	3^0	3.2mm	.07 - .10	.13
77-114M	6mm	35mm	12mm	100mm	2	5^0	3.2mm	.10 - .13	.15

[i] RDOC: Radial Depth of Cut – the depth of the tool along its radius in the work piece as it makes its cut. Parameters referenced as a percentage (%) mean the tool should engage an amount of material equal to the % specified of the tool diameter. Areas referenced with a specific dimension should engage the dimension listed.

[ii] ADOC: Axial Depth of Cut – the depth of the tool along its axis in the work piece as it makes its cut. Parameters referenced as a percentage (%) mean the amount of material surface cut away will equal the cutting tool diameter at the % specified. Areas referenced with a specific dimension should cut the depth material at the depth dimension listed.

[iii] D: Cutting Diameter of Tool.

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