Innovative Tooling Materials for Thermoforming

HYTAC materials are generally easy to machine. Following the guidelines listed below will improve surface quality of the finished plug and aid consistency of plug performance.

Recommended Cutting Type

- o Solid carbide
- o 2-flute plastic cutting tools
- o SHARP TOOLS are required. Syntactic foams are abrasive. Check cutting edges and monitor plug surface/tool temperature for evidence of dull tooling.

Machine Settings

- o Varies by tool geometry and size.
- o Applicable to virtually any machining center by using **Chip Load** (defined by tool manufacturer to identify the size chip each cutting edge will remove during one rotation) and your machine spindle RPM to calculate Feed Rate. The formula to calculate Feed Rate is:

Feed Rate = Chip Load x Spindle RPM x # of flutes.

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. Use 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.

KEY SUCCESS FACTORS

Do not use liquid cooling!
Use none, or air coolant. Generated chips/dust must be cleared from the tool area. Re-cutting chips will quickly dull a tool and may create a fire hazard.

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.

Safety:
For HYTAC-W, WF or WFT: Enclose chip space, dust extraction, safety goggles, dust mask, protective gloves

For HYTAC-XTL, B1X, FLX, FLXT or C1R: Safety Goggles

<u>Double Flute Upcut Spiral:</u> 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 # (Available from Onsrud Tool or CMT Materials)	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** $RDOC^i$= see below $ADOC^{ii}$=up to $4xD^{iii}$		*Floors** $RDOC^i$ = 40-65% $ADOC^{ii}$= see 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

High Finish Ball Nose: 3D contouring of HYTAC materials. Unique geometry and highly polished surface result in a smooth surface without tool marks.

Part # (Available from Onsrud Tool or CMT Materials)	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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Part # (Available from Onsrud Tool or CMT Materials)	Cutting Diameter	Flute Length	Shank Diameter	Overall Length	Flutes	Angle per Side	Radius	Slotting Parameters* RDOCi = 100%	Profiling Parameters* RDOCi = 100%
								Chip load	Chip load
77-102	1/8"	1-1/2"	1/4"	3"	3	10	1/16"	.002 - .0035"	.003"
77-104	1/8"	1"	1/4"	3"	3	30	1/16"	.003 - .004	.005
77-112	1/4"	2"	1/2"	4"	2	30	1/8"	.003 - .004	.005
77-114	1/4"	1-3/8"	1/2"	4"	2	50	1/8"	.004 - .005	.006
77-102M	3mm	39mm	6mm	76mm	3	10	1.6mm	.05 - .09mm	.07mm
77-104M	3mm	25mm	6mm	76mm	3	30	1.6mm	.07 - .10	.25
77-112M	6mm	50mm	12mm	100mm	2	30	3.2mm	.07 - .10	.13
77-114M	6mm	35mm	12mm	100mm	2	50	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.