

RETURN SERVICE REQUESTED

THE ECONOMIC EDGE

BY IAN MUNNOCH

While President Obama's stimulus package was a high price to pay, it does not appear to have made any noticeable change in the economic picture. If he wants to hold on to his job in 2012, then the unemployment rate must drop substantially, at least to the 6.5% to 7.5% range in my opinion. Right now it seems that anyone you talk to knows someone who is looking for employment or has had to work 2 or 3 low wage jobs just to make ends meet. The good news is recent employment data shows broad growth across many industries. Companies are hiring in many different sectors of the economy including, manufacturing (many automotive plants are hiring again), the hospitality industry, restaurants (McDonald's will hire 50,000), business services, sales and marketing, financial services, and of course probably one of the healthiest sectors, the health care industry. Productivity gains have been partially responsible for the

merger gains in the economy the last 5 quarters but are slowly reaching their peak which will soon force businesses to hire new workers. This is good news for the 13.5 million unemployed or under employed Americans. Once these folks begin to migrate back into the work force they will add to the economic growth. Expect new jobs to reach about 2 million this year.

The increase in food prices along with the rise in gas prices will act as a huge tax on the poor and middle class, flattening the growth curve. Some in the media are starting to question the wisdom of subsidizing the corn ethanol industry, which is currently consuming about 40% of the corn crop each year and effectively increasing the cost of food here in America as well as some parts of the world. Time will tell about the wisdom of this solution.

Other factors that can derail growth are continued unrest in the Arab world and the Japanese triple disaster. With the prospects of over \$100/barrel of oil going forward this summer hastening +\$4.00/gallon gas summer travel plans might be modified to closer to home trips or just barbeques in the backyard. I've already fired mine up for the year. I don't drive a Prius so trips to the pump really hurt.

In my opinion the current administration has been basically impenitent in its response to the economy; they are in most cases, Democrat or Republican. The heavy lifting must come from small business and corporate America to provide any sustainable positive direction. That is certainly happening as companies across America continue to show why we are the envy of the world through our innovation.

THE EDITORS

EDITOR-IN-CHIEF
IAN MUNNOCH

CONTRIBUTING AUTHORS





THOM MURRAY, NOEL TESSIER, TERRY WOLDORF

All photos included in this newsletter are obtained with permission by MSA Components, Inc. Copyright 2011 www.msacomponents.com

HYTAC SYNTACTIC FOAM MACHINING GUIDE

HYTAC materials are generally easy to machine, frequently requiring no extra polish or surface preparation. Following the guidelines listed below will improve surface quality of the finished plug and ensure consistency in plug performance.

1. **Tools designated for cutting hard plastic or hard abrasive plastic should be used when machining any syntactic foams.** Plastic cutting tools provide improved finish due to sharper edge, less plowing action, cleaner cut. Chips curl faster, transferring heat to the chip not the part. Large flute openings give more chip clearance, avoiding chip welding and improving chip evacuation.

END MILL SPECIFICATIONS	TYPICAL METAL CUTTING	TYPICAL PLASTIC CUTTING		
Flute Rake	100	300		
OD Primary Relief	160	220		
OD Secondary Relief	220	400		
Core Diameter	58%	42%		
TYPICAL CROSS SECTION	Standard 2 Flute 	0 Flute 	2 Flute 	Straight 2 Flute 

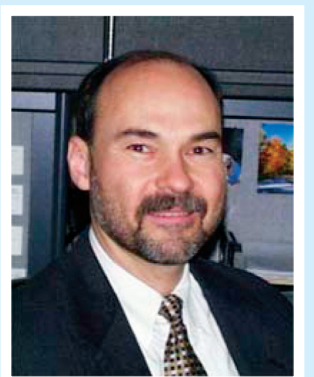
CONTINUED ON PG. 3 »

NEW MACHINING GUIDELINES

BY IAN MUNNOCH

This issue of the FormingEdge is devoted to the new CMT Materials machining guidelines. Terry Woldorf, CMT Materials General Manager, has spent many hours in tooling shops with the intent of developing a better understanding of the best practices for machining our syntactic HYTAC plug materials. The results have been dramatic improvements in surface finish. If you are interested in getting

better surface quality, then this is the issue that you'll want to spend some time reviewing. I am confident you will be pleased with the time invested. If you want me to stop by to go over the articles and talk about the direction these changes will make at your shop, please give me a call. As always we really appreciate your business and look forward to supporting your syntactic plug requirements.

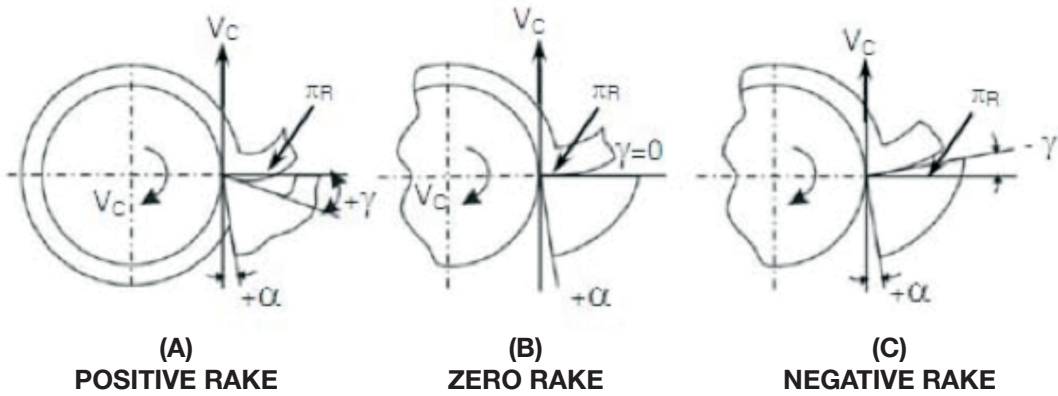


HYTAC SYNTACTIC FOAM TURNING GUIDE

HYTAC materials are generally easy to work with. Following the guidelines listed below will improve surface quality of the finished plug and ensure consistency in plug performance.

Cutter type and geometry is critical to producing a smooth, consistent surface when turning any syntactic foam. Recommendations:

CUTTER TYPE AND GEOMETRY	<ul style="list-style-type: none">Positive edge geometry, carbide non-coated insert. Must be sharp. Dull cutters will result in poor surface quality.
CLEARANCE ANGLE	<ul style="list-style-type: none">5°
POSITIVE RAKE ANGLE	<ul style="list-style-type: none">Neutral to 5°
CUTTING SPEEDS	<ul style="list-style-type: none">400 – 700 ft/min (150 – 210 m/min)
ROUGH FEED RATE	<ul style="list-style-type: none">0.007 in/rev (0.18 mm/rev)
FINISH FEED RATE	<ul style="list-style-type: none">0.005 in/rev (0.13 mm/rev) at minimum nose radius depth
COOLANT	<ul style="list-style-type: none">For HYTAC-B1X, FLX, FLXT, A or B: None or AirFor HYTAC-W, WF, WFT or Rx Series: None or Non-aromatic, water soluble
PERSONAL PROTECTION	<ul style="list-style-type: none">For HYTAC-B1X, FLX, FLXT, A or B: Safety GogglesFor HYTAC-W, WF, WFT or Rx Series: Enclose chip space, dust extraction, safety goggles, dust mask, protective gloves



APPLICATION AND MACHINING CONSIDERATIONS:

HYTAC PRODUCT									
Attribute	W	WF	WFT	FLX	FLXT	B1X	A	Rx-L1	Rx-H1
Ease in Machining	1	2	3	4	4	5	5	3	2
Eliminates Dust in Machining	1	2	3	4	4	5	5	3	2
Resistance to Abuse	2	3	3	4	4	5	4	3	3
Durability with Fine Detail	2	3	3	4	4	5	4	3	3
Material Distribution	3	4	4	5	5	5	2	4	4
Polishing	2	4	5	4	5	3	5	4	4
Use with Transparent Plastic	3	3	4	4	4	4	5	4	4
Minimal Scratch of Sidewall	2	3	4	4	4	4	5	4	4
Low Stick Surface	2	3	5	2	5	3	3	5	2
High Friction Surface	3	2	0	4	0	3	3	0	5
Deep Draw Use	3	4	4	5	5	5	5	4	5
Multi-layer Use	2	3	4	4	5	3	2	5	4
Meets FDA Guidelines for Food Contact	5	5	5	5	5	5	5	0	0
Has FDA Drug Master File on record	0	0	0	0	0	0	0	5	5
Heavy Gage, Large Part forming	2	2	3	3	3	3	0	0	0

SHEET MATERIAL									
ABS	Y	Y	R	Y	Y	R	N	Y	Y
APET	Y	R	Y	R	Y	R	Y	Y	R
PETG	Y	R	Y	R	Y	R	Y	Y	R
CPET	Y	R	R	R	R	R	N	R	Y
RPET	Y	R	R	R	R	R	Y	Y	R
EVOH	N	Y	R	Y	R	Y	Y	R	Y
HIPS	Y	Y	Y	R	Y	R	N	R	Y
LDPE	R	Y	R	Y	R	R	N	Y	Y
HDPE	R	R	Y	Y	Y	R	N	Y	Y
PMMA	Y	R	R	Y	Y	Y	Y	Y	Y
PC	N	R	R	Y	Y	Y	R	Y	Y
PLA	N	Y	Y	R	Y	R	Y	Y	R
PP	Y	R	Y	R	Y	R	R	Y	R
Rigid PVC	R	R	Y	Y	Y	R	N	Y	Y
PS	R	Y	R	Y	Y	R	N	Y	R

LEGEND:

- 0 = Not recommended → 5 = Best performance R = Recommended Y = Acceptable N = Not Suitable
Chart usage: 1. Select a product listed as suitable for use with your material to be formed.
2. Select attributes based on what is most critical to the part to be formed.
3. Sum up the attribute score to determine the optimal plug material for your application.

NOTE: There is no one size fits all when determining the best choice of plug assist material. Review your requirements with a CMT specialist to determine the actual suitability of any HYTAC material prior to use. This chart is for directional reference only.

CMT HYTAC SELECTOR GUIDE

INNOVATIVE TOOLING MATERIALS FOR THERMOFORMING



CMT Materials, Inc. is the acknowledged leader in plug assist thermoforming materials. Working directly with thermoformers, tool & mold makers and machine builders, we have developed a family of products that allow our customers to utilize the right material for their specific part and sheet application. HYTAC® products are available in rod, sheet and block, in a wide variety of sizes. Customer needs are also met with a one-part castable system, custom cast and custom cutting. A large inventory of product on-hand is available for shipment on the day of order.

HYTAC-W (Thermoset Syntactic)
Entry level thermoset for use with PVC, PS or PE

HYTAC-WF (Thermoset Syntactic)
High strength, high clarity for smooth surface finish

HYTAC –WFT (Thermoset Syntactic)
Teflon® impregnated, ultra smooth surface

HYTAC-FLX (Thermoset Syntactic)
Optimized for easy polishing for transparent plastics

HYTAC-FLXT (Thermoset Syntactic)
Teflon® impregnated, easy release for multi-layer or barrier plastics

HYTAC-B1X (Thermoplastic Syntactic)
Industry leading syntactic for machining and fine detail

HYTAC-A (Solid Polymer)
Tough material for deep draw transparent PP applications

HYTAC-Rx-L1 (Thermoset Syntactic)
Specifically formulated and registered for pharmaceutical blister packaging. Low Stick surface version.

HYTAC-Rx-H1 (Thermoset Syntactic)
Specifically formulated and registered for pharmaceutical blister packaging. High Stick surface version

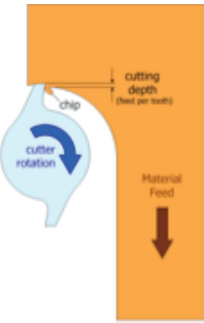
CUSTOM CAST For unique shapes/sizes/requirements, CMT offers both custom casting/cutting capability and a premixed yet uncured castable product that may be cast/poured at a customer site. Contact CMT with your requirements.

Product	Color	Service Temperature		Thermal Conductivity		Flexural Toughness (ASTM D790)		Typical CNC Finish (µin) Ra*	Coefficient Thermal Expansion	
		°F	°C	BTU/hr-ft-0F	W/m 0K	Psi	MPa		x10-6in/in0F	x10-6 m/m/ oC
HYTAC-W	White	350	176	0.07	0.11	2.7	.186	54	22	41
HYTAC-WF	White	450	232	0.11	0.19	4.7	.032	28	18	32
HYTAC-WFT	Light Green	425	218	0.11	0.19	4.5	.031	24	20	37
HYTAC-FLX	Almond	350	176	0.07	0.11	7.6	.052	22	23	42
HYTAC-FLXT	Dark Green	350	176	0.10	0.17	7.2	.050	21	20	36
HYTAC-B1X	Light Blue	350	176	0.11	0.19	11.6	.080	39	38	68
HYTAC-A	Amber	400	204	0.07	0.11	63.6**	.438**	7	31	56
HYTAC-Rx-L1	White	450	232	0.10	0.17	3.9	.027	24	25	46
HYTAC-Rx-H1	Cream	450	232	0.08	0.14	4.3	.030	22	25	46

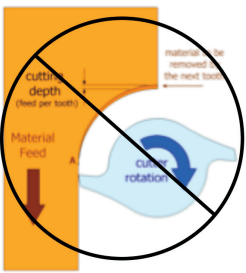
* Ra values from CNC milled surface using 2 straight flute plastic cutting end mill. Measurements taken with Mahr Federal Pocket Surf III.
** Samples did not break. Toughness value at 5% strain reported.

INNOVATIVE TOOLING MATERIALS FOR THERMOFORMING — CONTINUED FROM PG. 1 »

- 2. Dull or incorrect tool geometry will cause VERY POOR SURFACE QUALITY.
- 3. The use of climb milling improves surface finish.



Climb milling (left): Each tooth engages the material at a definite point, and the width of the cut starts at the maximum and decreases to zero. The chips are disposed behind the cutter, leading to easier swarf removal. The tooth does not rub on the material, and so tool life may be longer.



Conventional milling (right): The chip thickness starts at zero thickness, and increases up to the maximum. The cut is so light at the beginning that the tool does not cut, but slides across the surface of the material, until sufficient pressure is built up and the tooth suddenly bites and begins to cut. This deforms the material and dulls the tool. The sliding and biting behavior results in poor surface finish.

DETERMINING TOOLS, FEEDS AND SPEEDS

CUTTER TYPE	<ul style="list-style-type: none">Solid Carbide.Tool designed for Hard, Abrasive Plastics.Straight 2 Flute Geometry recommended for all HYTAC materials except HYTAC-A (best with 2 Flute Spiral).SHARP TOOLS are required. Syntactic foams are abrasive. Check cutting edges and monitor plug surface frequently for evidence of dull tooling.
SPEED AND FEED	<ul style="list-style-type: none">Varies by tool geometry and size.Obtain “Chip Load” (the measurement of thickness of material removed by each cutting edge during a cut) from tooling manufacturer.Calculate Feed Rate (inches/minute) using the formula: Chip Load = Feed Rate / (RPM x # of flutes). As an example, if Chip Load specified by the tooling manufacturer is 0.009 inches, CNC spindle speed is 7,500 RPM and the tool is 2 fluted, feed rate can be determined as 0.009 = Feed rate/(7,500 x 2). Feed rate = 135 inches/minute.To optimize speed and feed, experiment to obtain the maximum possible chip size to remove the largest chip size possible. Use feed rate determined above as a starting point. Increase feed rate until surface finish quality begins to deteriorate. Decrease the feed rate by 10% and use as the program setting. Next, decrease RPM until surface finish again begins to deteriorate. Increase RPM by 10%. The process is now optimized to provide the best tool life and surface finish conditions.
CUT DEPTH	<ul style="list-style-type: none">It is critical to allow room for chips to be removed from cutting area.At 100% of cutter diameter, use 100% of recommended chip load.At 200% of cutter diameter, use 75% of recommended chip load.At 300% of cutter diameter, use 50% of recommended chip load.
COOLANT	<ul style="list-style-type: none">None, or air
PROTECTION	<ul style="list-style-type: none">For HYTAC-B1X, FLX, FLXT, A or B: Safety GogglesFor HYTAC-W, WF, WFT or Rx Series: Enclose chip space, dust extraction, safety goggles, dust mask, protective gloves

HYTAC INSERT INSTALLATION GUIDE

CMT Materials recommends the use of bonded inserts for ease of plug attachment to a supporting base structure. Following the guidelines listed below will improve surface quality of the finished plug and ensure consistency in plug performance.

These guidelines were established using CMT scored aluminum inserts. If using alternative inserts, depth calculations must be performed to ensure installation flush with the surface of the plug and ID clearance calculations to ensure proper bond strength of the insert to the plug wall.

1.

DO NOT USE COOLANT. Coolant will affect adhesive bond strength.
2.

Face mill bottom surface of plug.
3.

For US size inserts with ¼-20 internal thread (CMT part number “INSERT STD THREAD”)

a.

Drill 0.3125” diameter hole to 0.750” depth at insert locations.

b.

Cut 0.500” diameter hole with a finish end mill to 0.490” depth at insert locations.
4.

For Metric size inserts with 6 mm internal thread(CMT part number “INSERT METRIC THREAD”)

a.

Drill 8 mm diameter hole to 19 mm depth at insert locations.

b.

Cut 12 mm diameter hole with a finish end mill to 11.75 mm depth at insert locations.
5.

Thread a screw into the dot side of inserts to facilitate adhesive application and insertion into hole.
6.

Apply Loctite 495 (instant cure cyanoacrylate adhesive, www.loctite.com) to the outer surface of insert.

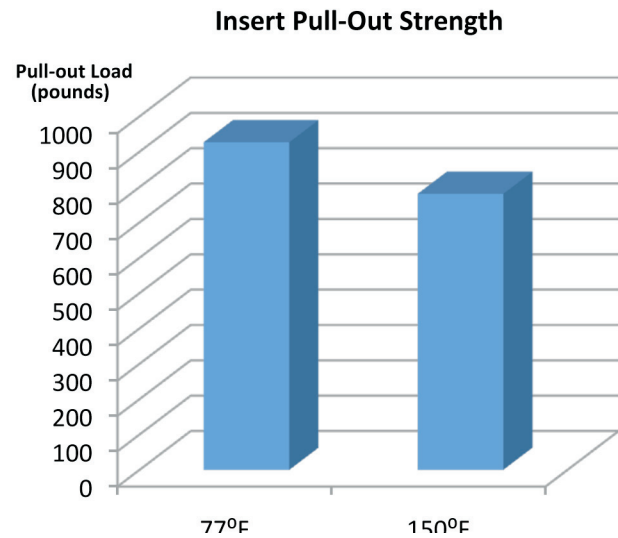
7.

Immediately push insert to the bottom of hole with dot facing up/out and ensure insert is installed to bottom of hole. The adhesive will begin to cure within 5 - 15 seconds of application to the insert.
8.

Remove screw.
9.

Repeat steps 5 – 8 for all inserts.
10.

Face mill bottom of plug making sure insert and bottom of plug are flush.



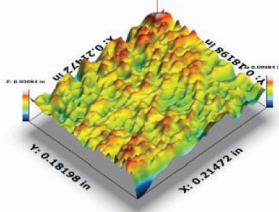
KEY SUCCESS FACTORS for this simple process include the elimination of coolant during cutting (for proper adhesive bonding) and face milling the bottom of the plug after insert installation (to ensure a flush mating surface for the plug to the base is created). Pull out tests performed after a 24-hour period are shown in the chart to the right.

HYTAC SYNTACTIC FOAM POLISHING GUIDE

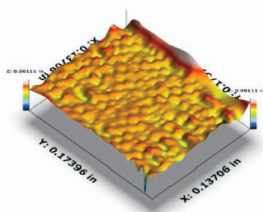
When required for high gloss or high clarity, HYTAC materials may be polished to a very smooth surface finish condition. Following the guidelines listed below will improve surface quality of the finished plug and ensure consistency in plug performance.

1.

Syntactic foams are a variety of combinations of epoxy, plastic and hollow glass microspheres. The same properties that make these foams the top choice for plug assist can create challenges in polishing. The goal of sanding is to smooth any microscopic peaks and valleys into even more microscopic rolling hills. It is important to note that friction increases in an inverse relationship with smoothness – therefore the goal is to identify the proper balance between friction and smoothness to ensure part clarity and material distribution.



Computer image simulating typical machined surface. Color changes represent height variation from peak to valley. This surface would feel smooth to the touch and be used for all but high clarity requirements.



Computer image showing polished surface. Color changes represent height variation from peak to valley. Rounded peaks prevent scratching for high part clarity yet valleys still allow plastic to release from the plug.

2.

Thermoset (HYTAC-W,WF,WFT, Rx Series) and Copolymer (HYTAC-FLX , FLXT) epoxy based are generally easier to polish than Thermoplastic (HYTAC-B1X, A) based materials. Using tools designed to cut hard, abrasive plastics and experimenting with machining feed and spindle rates as noted in the HYTAC Machining Guide will often eliminate the need for polishing.

HYTAC-W,WF, WFT, FLX, FLXT or Rx Series	Wet or dry sand using random motion. Begin with 220 grit, then subsequent finer grits up to 600 for finish rub until desired surface is achieved.
HYTAC-B1X, A	Incorrectly machined surfaces resulting in a melted surface cannot be sanded out. Smooth surfaces can polish to a higher gloss with Nylon Mesh Silicon Carbide Pads - start with Very Fine, Ultra Fine, then MicroFine, or Silicon Carbide Sandpaper (400 grit, 600 grit, 1200 grit then 1500 grit until desired surface finish is achieved. Wash with any standard plastic cleaner.
For High Gloss Surface on all HYTAC products	Polish sanded plug surface with scratch removing polish for polycarbonate windows or lenses.Wash thoroughly with plastic cleaner to remove residue.