TOOLING SYSTEMS PROCESS OPTIMIZATION CONSULTING IN MILLING STRATEGIES

EASTER BUNNY MOULD: NOBODY IS MILLING FASTER

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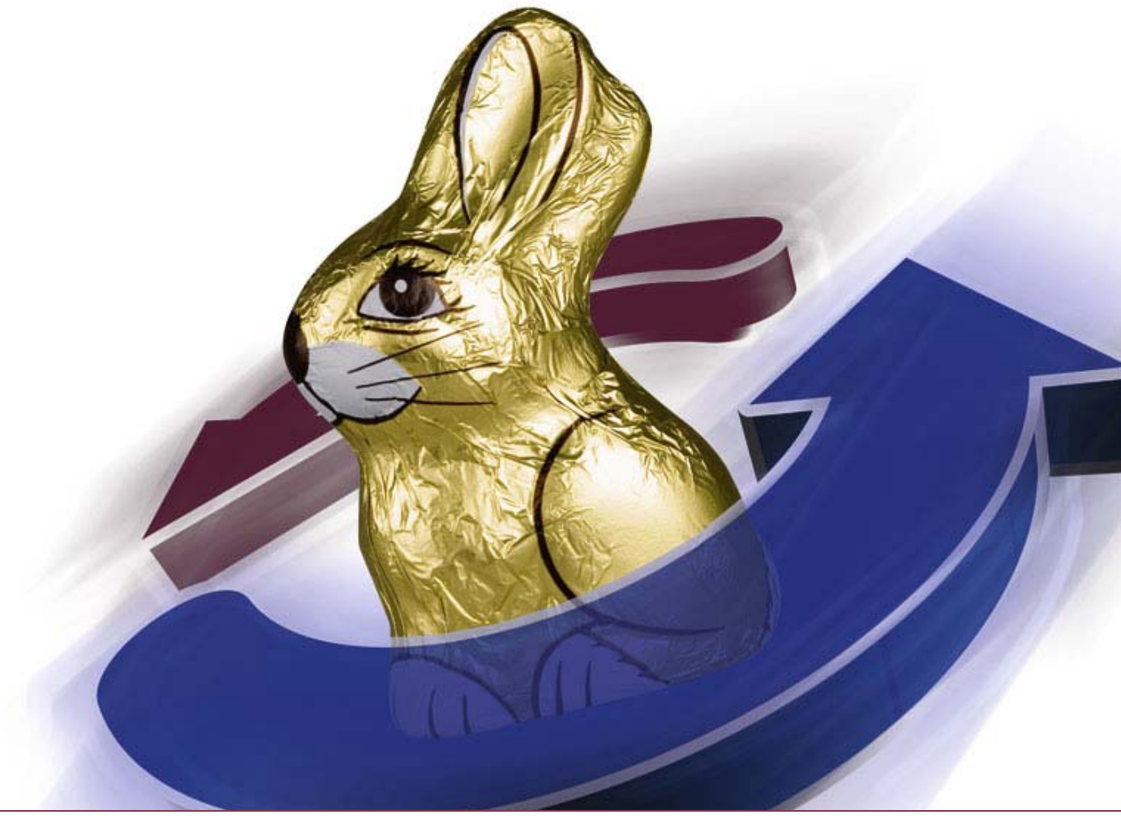
HIGH SPEED MACHINING AWARD 2006



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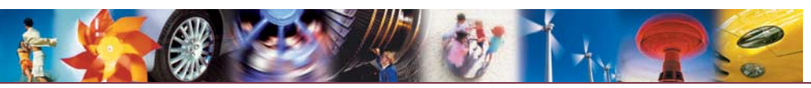

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FIRST RANK IN CATEGORY HARDMILLING

During the 14. »HSC«-conference in the Austrian city Steyr, the presentation of awards of the »7. European High Speed Machining Award 2006« took place. The first rank in the category »hardmilling« was achieved by Pokolm-Voha-Frästechnik.

Problem was, to machine a form insert for a chocolate easter bunny of the pastry cook Roman Hauswirth from the city Kittsee according to pre-defined CAD-data. The component had a difficult geometry with various steep and shallow areas, which had to be machined in high precision surface finish and accuracy. Optimum machining of the component to meet the quality requirements was demanded.

Material: 1.2343, hardness 52 – 54 HRC
The contour accuracy of the concave mould should be +/- 0,015 mm and a centre line average roughness of </= 0,3 Ra. for the total surface was required.
The smallest of all necessary end mills for this concave mould was 2 mm diameter.
Surface finish of the parting surface should be 0,5 – 0,6 Ra.
Surface finish of the marking should be 0,8 – 1,0 Ra and the engraving tool for this operation had a diameter of only 1 mm.

Important criteria for the total rating was, besides the best possible fulfilment of all required tolerances, valuation of visual general impression, of surface quality and Ra-value of centre line average roughness for all surfaces. Besides this, milling- and machining strategies, machining time and surface accuracy of the concave mould, the parting surface and the marking as well as the innovation extent was evaluated.

Pokolm, as manufacturer of milling tooling, specially qualified for this segment of metal cutting, saw an excellent opportunity in this award, to demonstrate the capability and the know-how involved in his tools.

The statement, made in the invitation »optimum strategy is more important than correct milling« conforms absolutely with our company's philosophy. This was a fantastic example for a successful symbiosis between an optimum tuned tooling system, an essential strategy concept presented by our applications engineers. And, last but not least, other factors like a **TEBIS**-programming system, a qualified **HERMLE** C30 machining centre and the Solid Carbide End Mill range of **Voha-Tosec** were included.

Franz-Josef und Marco Pokolm, receiving this award

ANALYSIS AND STRATEGY

analysis of component »form insert«
- hardness of the component is no problem due to the size
- 90° walls have to be milling at the foot of the bunny model
- approx. 20 mm depth of cut means 10 times d1 for our 2 mm end mill
- there was not enough revolutions-supply for the engraving operation
- but: a high speed spindle with 60.000 rev./min would not have had enough performance for operating a 12 mm dia. Trigaworx-Solid Carbide End Mill

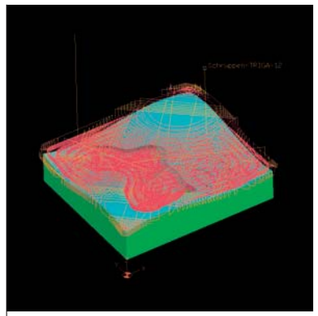
strategy definition
- the less tools, the better
- avoiding tool-change costs and downtime
- swivelling movement of the component allows shorter tools for machining foot area
- machining strategy: z-constant and reciprocal milling
- CAM-system: Tebis
- Machine: Hermle C30
- Tooling system: Pokolm-Voha

tooling strategy
- Trigaworx®-end mills where possible, these tools are ideal for milling those parts
- milling of remaining material possibly with toric end mills
- avoiding »zero«-speed situations at the ball centre
- ball nose end mills for finishing operations in the bunny-body
- toric end mills for finishing shallow parting plane by setting angle of spindle allows larger stepover for targeted centreline average roughness

Form insert for chocolate easter bunny

10 STEPS TO A PERFECT MOULD

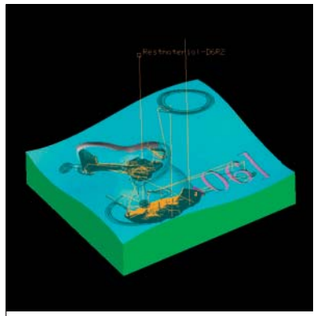
Step 1 of 10
roughing



strategy	roughing z-constant
milling cutter type	sol. carb. Trigaworx®
catalogue no.	0474 55 121
diameter d1	12
number of teeth	4
corner radius r_p	1
v_c m/min	125
n 1/min	3315
f_z mm/tooth	0,5
v_f mm/min	6625
a_p mm	0,4
a_e mm	9,0
machining time min	14’55“

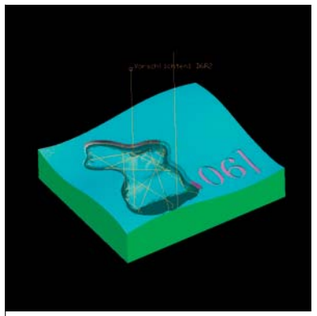
r_p= only for programming

Step 2 of 10
remaining material



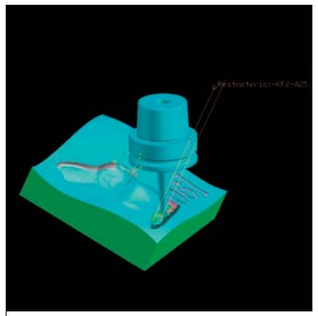
strategy	roughing remaining material z-constant
milling cutter type	sol. carb. toric end mill
catalogue no.	0172 56 060
diameter d1	6
number of teeth	2
corner radius r	2
v_c m/min	245
n 1/min	13.000
f_z mm/tooth	0,2
v_f mm/min	5.300
a_p mm	0,2
a_e mm	1,0
machining time min	10’28“

Step 3 of 10
pre-finishing



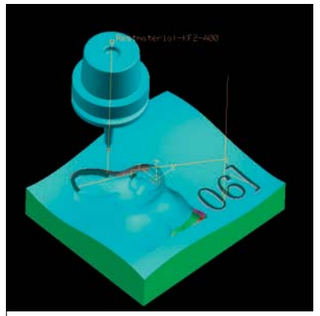
strategy	pre-finishing z-constant and reciprocal milling
milling cutter type	sol. carb. toric end mill
catalogue no.	0172 56 060
diameter d1	6
number of teeth	2
corner radius r	2
v_c m/min	340
n 1/min	18.000
f_z mm/tooth	0,2
v_f mm/min	7.200
a_p mm	0,5
a_e mm	0,5
machining time min	12’30“

Step 4 of 10
remaining material foot area



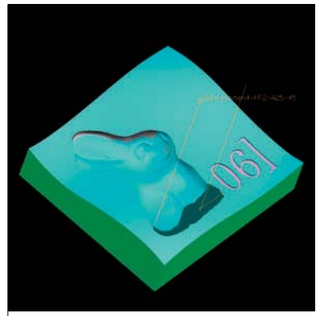
strategy	remaining material pencil milling
milling cutter type	sol. carb. ball nose end mill
catalogue no.	1222 56 0201
diameter d1	2
number of teeth	2
corner radius r	1
v_c m/min	113
n 1/min	18.000
f_z mm/tooth	0,04
v_f mm/min	1.440
a_p mm	–
a_e mm	0,15
machining time min	3’15“

Step 5 of 10
remaining material ear area



strategy	remaining material z-constant
milling cutter type	sol. carb. ball nose end mill
catalogue no.	1222 56 0201
diameter d1	2
number of teeth	2
corner radius r	1
v_c m/min	113
n 1/min	18.000
f_z mm/tooth	0,04
v_f mm/min	1.440
a_p mm	–
a_e mm	0,15
machining time min	3’20“

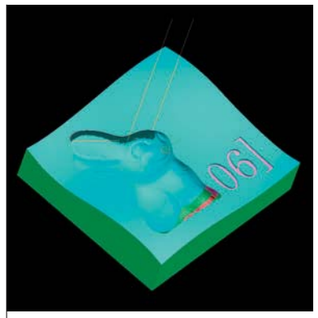
Step 6 of 10
finishing foot area



strategy	finishing (oscillating) setting angle of spindle 25°
milling cutter type	sol. carb. ball nose end mill
catalogue no.	1222 56 020
diameter d1	2
number of teeth	2
corner radius r	1
v_c m/min	113
n 1/min	18.000
f_z mm/tooth	0,05
v_f mm/min	1.800
a_p mm	–
a_e mm	0,07
machining time min	13’27“

10 STEPS TO A PERFECT MOULD

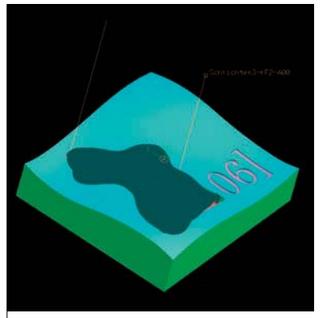
Step 7 of 10
finishing ear area



strategy **finishing (oscillating) setting angle of spindle 25°**

milling cutter type	sol. carb. ball nose end mill
catalogue no.	1222 56 020
diameter d1	2
number of teeth	2
corner radius r	1
v_c m/min	113
n 1/min	18.000
f_z mm/tooth	0,05
v_f mm/min	1.800
a_p mm	–
a_e mm	0,07
machining time min	2’39”

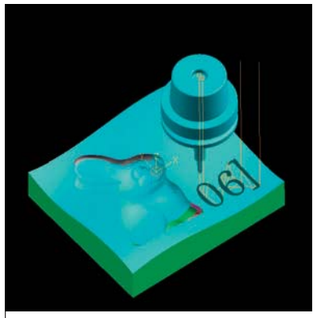
Step 8 of 10
fin. remaining contour of mould



strategy **finishing (oscillating)**

milling cutter type	sol. carb. ball nose end mill
catalogue no.	1222 56 020
diameter d1	2
number of teeth	2
corner radius r	1
v_c m/min	113
n 1/min	18.000
f_z mm/tooth	0,05
v_f mm/min	1.800
a_p mm	–
a_e mm	0,07
machining time min	55’05”

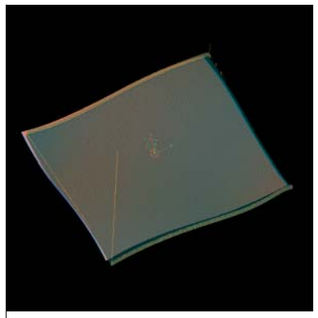
Step 9 of 10
engraving title



strategy **finishing (oscillating) and engraving z-constant**

milling cutter type	sol. carb. end mill
catalogue no.	0222 56 0101
diameter d1	1
number of teeth	2
v_c m/min	56
n 1/min	18.000
f_z mm/tooth	0,02
v_f mm/min	640
a_p mm	0,05
a_e mm	0,05
machining time min	22’53”

Step 10 of 10
finishing parting plane



strategy **surface finishing with 30° setting angle of spindle**

milling cutter type	sol. carb. corner radius end mill
catalogue no.	0280 56 160
diameter d1	16
number of teeth	6
corner radius r	2
v_c m/min	804
n 1/min	16.000
f_z mm/tooth	0,08
v_f mm/min	7.680
a_p mm	0,03
a_e mm	0,4
machining time min	11’20”

summary:

step	tool	dia.	radius	strategy	machining time
1	sol. carb. Trigaworx	12	1	roughing z-constant	14’55”
2	sol. carb. toric end mill	6	2	roughing remaining material Z-constant	10’28”
3	sol. carb. toric end mill	6	2	pre-finishing z-constant and pendulum milling	12’30”
4	sol. carb. ball nose end mill	2	1	remaining material pencil milling	3’15”
5	sol. carb. ball nose end mill	2	1	remaining material z-constant	3’20”
6	sol. carb. ball nose end mill	2	1	finishing (oscillating) setting angle of spindle 25°	13’27”
7	sol. carb. ball nose end mill	2	1	finishing (oscillating) setting angle of spindle 25°	2’39”
8	sol. carb. ball nose end mill	2	1	finishing (oscillating) sol. carb. ball nose end mill	55’05”
9	sol. carb. end mill	1		finishing (oscillating) and engraving z-constant	22’53”
10	sol. carb. corner radius end mill	16	2	surface finishing with 30° setting angle of spindle	11’20”
				total machining time	**149’52”**