



MIRROWORX®

Milling instead of grinding - smooth surfaces with maximum economic efficiency



 **pokolm**
PREMIUMTOOLS. WE KNOW HOW.

MILLING RATHER THAN GRINDING

MIRROWORX is a Face Milling Cutter, specially developed for production of absolutely flat and smooth surface finish, simultaneously with highest economic efficiency. We enter into Grinding domains.

In using these Cutters, several operations can be combined. Usual grinding operations are eliminated completely.

This new line is designed with only two Indexable Inserts and has a simple but effective adjustment opportunity in μ -range by using two set-screws, eliminating axial run-out. This system allows processing optimum surface finish.

Furthermore this new tooling is impressive through its particular smooth running. Our new Milling Cutter is specially suitable for unstable components. Our concept, using only two Indexable Inserts, is an explicit proven design for milling components difficult to machine and which have a tendency to create vibrations.

Those **MIRROWORX**-Milling Cutters achieve Feedrates up to 10.000 mm/min and produce up to 90.000 cm² (13.950 sq. n.) surface, causing bottom-line costs. This is possible through our successively advanced development of cutting materials and carbide grades.



Shell type



DuoPlug®



Screw-on type

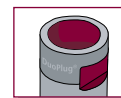
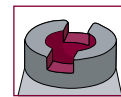
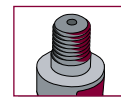
Types of Connection

MIRROWORX® tools are available as screw-on type and shell type milling cutter bodies.

The stand alone and patented

DUOPLUG®-

system for highest concentricity and maximum rigidity completes the programme.



YOU BENEFIT FROM FOLLOWING ADVANTAGES:

- ⊖ Surface Finish $R_z = < 2.5 \mu\text{m}$: your usual grinding operation is eliminated
- ⊖ Particular smooth running
- ⊖ Our setting-system adjusts your axial run-out
- ⊖ Suitable for unstable components
- ⊖ Very economic by using all 3 cutting edges from our Inserts

Practical video

⊖ **MIRROWORX®** in 1.2312



Due to successively advanced development of our own manufacturing performance and due to special carbide grades and latest coating technologies, tuned for every

possible machining process, Pokolm assists Tool- and Mould-makers in making difficult jobs more easy.



MIRROWORX® S

diam. 16 - 35 mm

Milling instead of grinding is our slogan for these finishing milling cutters. Developed for producing smooth and levelled surfaces with enormous feed rates. These tools enter into grinding domains.

Milling cutter bodies

Diagram	Catalogue no.											Accessories	Features		
	d ₁	l	r	l ₃	l ₂	l ₁	d ₂	d ₃	z						
	1 16 283 SG	16	8.2	0.5	25	1	-	M 10	15	1	A, B, C, D, E, F	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	2 20 283 SG	20	8.2	0.5	27	1	-	M 12	18.6	2	B, C, D, E, F	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	2 25 283 SG	20	8.2	0.5	32	1	-	M 16	23.5	2	C, D, E, F	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Threaded shank end mill bodies

Diagram	Catalogue no.											Accessories	Features		
	d ₁	l	r	l ₃	l ₂	l ₁	d ₂	d ₃	z						
	1 16 283	16	8.2	0.5	18	1	-	M 8	13.8	1	A, B, C, D, E, F	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	2 20 283	20	8.2	0.5	18	1	-	M 10	18	2	A, B, C, D, E, F	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	2 25 283	25	8.2	0.5	22.5	1	-	M 12	21	2	A, B, C, D, E, F	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	2 30 283	30	8.2	0.5	28	1	-	M 12	29	2	A, B, C, D, E, F	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
	2 35 283	35	8.2	0.5	28	1	-	M 16	29	2	A, B, C, D, E, F	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

Accessories

<p>25 500 Torx screw A > Page 8</p>	<p>07 500 Torx-screwdriver B > Page 8</p>	<p>TV 04-1 Screwdriver torque Vario®-S with window scale, C > Page 8</p>	<p>TV 500 Torque Vario® setter adjusting tool D > Page 8</p>	<p>T7 500 Torx interchangeable bit for Torque Vario® E > Page 8</p>	<p>T7 502, Torx MagicSpring compatible bit f. Torque Vario®, F > Page 8</p>
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Indexable inserts

Diagram	Catalogue no.											Accessories	Features	
	DIN Specification	Carbide Grade	Coating	l	s	r	M							
	03 83 835	TOHX 063005 ER	HSC 05	PVTi	8.2	3	0.5	M 2.5						
	03 83 836	TOHX 063005 ER	HSC 05	PVTiH	8.2	3	0.5	M 2.5						

Feed per tooth (fz) | d.o.c. (ap)

Material		steel	stainless steel	cast iron	non-ferrous materials	high-temperature alloys	hardened steel
Quality Coating	Feed per tooth d.o.c.						
HSC 05 PVTi	f _z (mm)	0,2-1	0,1-0,8	0,2-1	0,1-1,5	0,1-0,7	0,1-1
	a _p (mm)	0,02-0,15	0,02-0,1	0,02-0,15	0,02-0,2	0,02-0,1	0,02-0,15
HSC 05 PVTiH	f _z (mm)	0,2-1	0,1-0,8	0,2-1	0,1-1,5	0,1-0,7	0,1-1
	a _p (mm)	0,02-0,15	0,02-0,1	0,02-0,15	0,02-0,2	0,02-0,1	0,02-0,15

Cutting speed (Vc in m/min)

Material		steel	stainless steel	cast iron	non-ferrous materials	high-temperature alloys	hardened steel
Quality Coating	Application						
HSC 05 PVTi	roughing	-	-	-	-	-	-
	finishing	150 275 400	100 150 200	200 275 350	100 450 800	40 70 100	100 175 250
HSC 05 PVTiH	roughing	-	-	-	-	-	-
	finishing	150 275 400	100 150 200	200 275 350	200 500 800	40 70 100	100 175 250



MIRROWORX® M

diam. 42 - 100 mm

Milling instead of grinding is our slogan for these finishing milling cutters. Developed for producing smooth and levelled surfaces with enormous feed rates. These tools enter into grinding domains.

Safety instructions:

Every Milling Cutter Body has setscrews for elimination of run-out. These screws have to be fixed with prestress prior to usage. This is absolutely necessary!!! Otherwise, there is danger of automatic unscrewing during operation. This leads to damage for operators, tools and components. If you don't need those set-screws, we recommend to remove it from the Body prior to usage.

Milling cutter bodies	Catalogue no.										Accessories	Features
	d ₁	l	r	l ₃	l ₂	l ₁	d ₂	d ₃	z			

Shell-type milling cutter bodies												
	2 42 384	42	14.32		43	1	-	diam. 16	35	2	A, B, C, D, E, F, G, H	<input checked="" type="checkbox"/>
	2 52 384	52	14.32		43	1	-	diam. 22	48	2	A, B, D, E, F, G, H	<input checked="" type="checkbox"/>
	2 66 384	66	14.32		53	1	-	diam. 27	60	2	A, B, D, E, F, G, H	<input checked="" type="checkbox"/>
	2 80 384	80	14.32		53	1	-	diam. 27	60	2	A, B, D, E, F, G, H	<input checked="" type="checkbox"/>
	2 100 384	100	14.32		53	1	-	diam. 32	70	2	A, B, D, E, F, G, H	<input checked="" type="checkbox"/>







Accessories					
<p>35 500 L Torx screw A > Page 8</p>	<p>45 500 L Torx screw B > Page 8</p>	<p>GWSTPS8ISK hexagon socket set screw C > Page 8</p>	<p>15 500 Torx-screwdriver D > Page 8</p>	<p>20 500 Torx-screwdriver E > Page 8</p>	<p>TV 2-8, Screwdriver torque Vario®-S with window scale, F > Page 8</p>
<p>T15 500 Torx interchangeable bit for Torque Vario® G > Page 8</p>	<p>T15 502 Torx MagicSpring compatible bit f. Torque Vario® H > Page 8</p>				

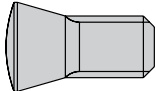


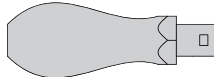
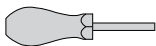


Indexable inserts	Catalogue no.							
	DIN Specification	Carbide Grade	Coating	l	s	r	M	
	04 84 835	TEHX 16T3 ZF	HSC 05	PVTi	14.32	4	-	M 3.5

Feed per tooth (fz) | d.o.c. (ap)

Material		steel	stainless steel	cast iron	non-ferrous materials	high-temperature alloys	hardened steel
Quality Coating	Feed per tooth d.o.c.						
HSC 05 PVTi	f _z (mm) a _p (mm)	0,5-2 0,05-0,2	0,5-1 0,05-0,1	0,5-2 0,05-0,2	0,5-2 0,05-0,25	0,2-1 0,05-0,1	0,2-1 0,05-0,1

Cutting speed (Vc in m/min)

Material		steel	stainless steel	cast iron	non-ferrous materials	high-temperature alloys	hardened steel
Quality Coating	Application						
HSC 05 PVTi	roughing finishing	- 150 275 400	- 100 150 200	- 200 275 350	- 100 450 800	- 40 70 100	- 35 143 250

Accessories		Catalogue no.	Description			
Torx®screws Torx®screws						
	25 500	Torx screw M 2.5 L 5.0 T 7	M 2.5	L 5.0	T 7	
	35 500 L	Torx screw M 3.5 11 T 15	M 3.5	11	T 15	
	45 500 L	Torx screw M 4.5 14.5 T 20	M 4.5	14.5	T 20	
Additional screws and washers hexagon socket set screw						
	GWSTPS8ISK	hexagon socket set screw M 8x1.25 M8x0.75 hexa. size 4	M 8x1.25	M8x0.75	hexa. size 4	
Spanners / screwdrivers Torx-screwdriver						
	07 500	Torx-screwdriver T 7	T 7			
	15 500	Torx-screwdriver T 15	T 15			
	20 500	Torx-screwdriver T 20	T 20			
Torque screwdrivers and accessories Torque screwdrivers						
	TV 2-8	Screwdriver torque Vario®-S with window scale from Nm 2.0 up to 8,0 Nm with scale	from Nm 2.0	up to 8,0 Nm	with scale	
	TV 04-1	Screwdriver torque Vario®-S with window scale from Nm 0.4 up to 1,0 Nm with scale	from Nm 0.4	up to 1,0 Nm	with scale	
Torque screwdrivers and accessories Torque Vario® setter adjusting tool						
	TV 500	Torque Vario® setter adjusting tool				
Torque screwdrivers and accessories Torx bits, standard						
	T7 500	Torx interchangeable bit for Torque Vario® T 7 L 175 max. 0.9 Nm	T 7	L 175	max. 0.9 Nm	
	T15 500	Torx interchangeable bit for Torque Vario® T 15 L 175 max. 5.5 Nm	T 15	L 175	max. 5.5 Nm	
Torque screwdrivers and accessories Torx bits with retaining spring						
	T7 502	Torx MagicSpring compatible bit f. Torque Vario® T 7 L 175 max. 0.9 Nm	T 7	L 175	max. 0.9 Nm	
	T15 502	Torx MagicSpring compatible bit f. Torque Vario® T 15 L 175 max. 5.5 Nm	T 15	L 175	max. 5.5 Nm	

ASSEMBLING INSTRUCTIONS

Set-screw for **MIRROWORX® M** shell type milling cutter bodies

In order to maintain optimum and safe use of these tools, you should pay attention to following notice if you assemble set-screws GWSTPS815K:

Assembling set-screw:

Step 1

Screw set-screw into cutter body up to limit-stop contact. This is guaranteed for every tool in Pokolm's warehouse. In rare exceptional cases, this set-screw can become unfastened during transport. In that case, the set-screw has to be re-adjusted prior to usage.

Step 2

For assembling, put milling cutter body on to arbor. Make sure, there is a remaining gap of 4 mm between milling cutter body and arbor. (this is guaranteed, when using genuine Pokolm-arbors).

Step 3

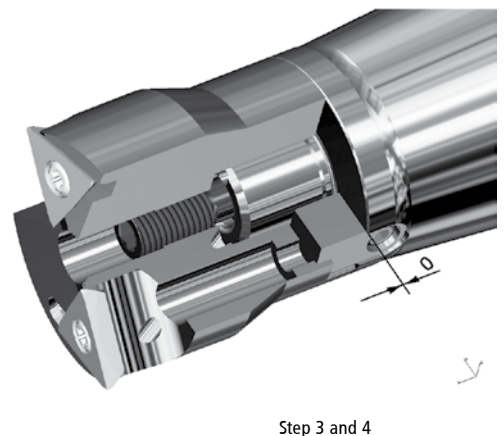
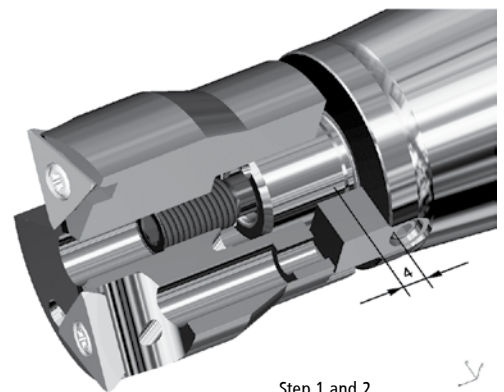
Now, please screw the set-screw into the arbor uniformly, until there is no remaining gap between arbor and milling cutter body by using an Allen-key 4 mm opening.

Step 4

If, beyond expectations, a gap remains, please dismantle your cutter body from the arbor. Unscrew the set-screw by ½ revolution. Continue with step 2.



Please consider:
Maximum torque = 10 Nm



If you have any further question regarding milling systems with set-screw please do not hesitate to contact us.

APPLICATION EXAMPLES FROM OUR PRACTICE

JOB TITLE

Every supporting surface of upper punch and bottom ram have to be machined to absolute level in order to leave no visible trace amounts on all lateral faces of a formed component. And the surface finish of a compression-moulding-die is always in customers view. For these applications, our new de-

signed Milling Cutter **MIRROWORX®** is exactly the right tool. Through already described characteristics of this new tool – and knowing about our customers requirements- we have put these tools through several endurance tests. Result: every test proved successful!

MACHINE

Deckel Maho DMC 64 V SK 40

MATERIAL

1.2343 hardened to 55 HRC

CAD/CAM-SYSTEM

Mastercam

For milling the surface flat of a bottom ram, a real spiral for milling from inside to outside has been programmed. The contour of the mould has been used for axial plunging. The component has been set-up very rigid on the machine table of a Deckel-Maho machining centre DMC 64 V with vertical spindle and machine connection of SK 40/DIN 69871A. Before trying

our new Cutter, our customer has used a normal Face-Milling Cutter with round inserts for this process.

This cutter had fulfilled all requirements, except adequate surface finish. With our new tool, we have reached a mirrorfinished surface!

FIRST EXAMPLE

Component:	drawing mould
Material:	1.2343 55 HRC
Arbor:	25 22 750 (diam. 22; SK 40)
Milling Cutter Body:	2 52 384 (diam. 52)
Indexable Inserts:	04 84 835, HSC 05
Coating:	PVTi
Overhang:	approx 68 mm
V_c (speed):	204 m/min
V_f (feed/min):	1,120 mm/min
S (Revolutions):	1,250 1/min
f_z (feed per tooth):	0.448 mm
a_p (Depth of cut):	0.05 mm
a_e (Width of cut):	5 mm

RESULT

We have milled 10 steps in z-axis with a feed-motion of 0.05 mm each. After that, there was no wear-land on our cutting edges. The milled surface had a mirror finish and a waviness (90 % in feed direction) of < 0.06 mm.

This was more than sufficient regarding to customer's requirements.



A further example originates from our Pokolm-Demo-Centre. It shows how precise and effective our new Milling Cutters **MIRROWORX**[®] operates.

On a Deckel-Maho machine type DMC 103 with SK 40 machine connection we have made tool-life tests. But also here, particularly process capability and surface finish have been in our view.

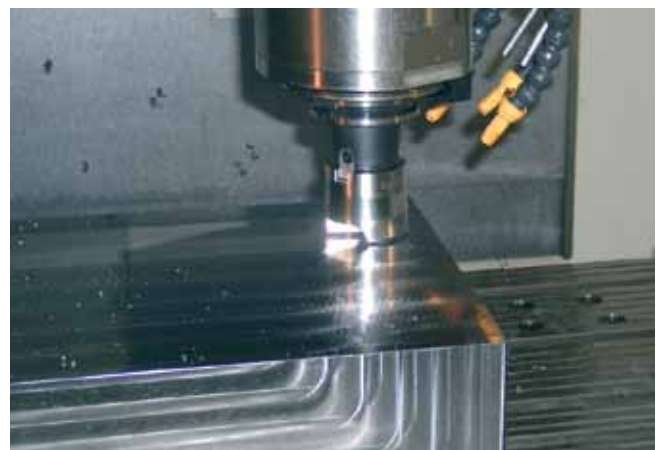
For these tests, we have machined a square piece of 1.2312 tool-steel size: 400 × 250 × 250 mm, with very rigid set-up

on machine table. We had to machine a surface of 0.1 m² (1.08 sq.ft.). We were able to create a continuous and final valuation very fast.

We have reached a machined surface of 25.000 mm² (3875 sq.in.) with below mentioned operation data and surface finish.

SECOND EXAMPLE

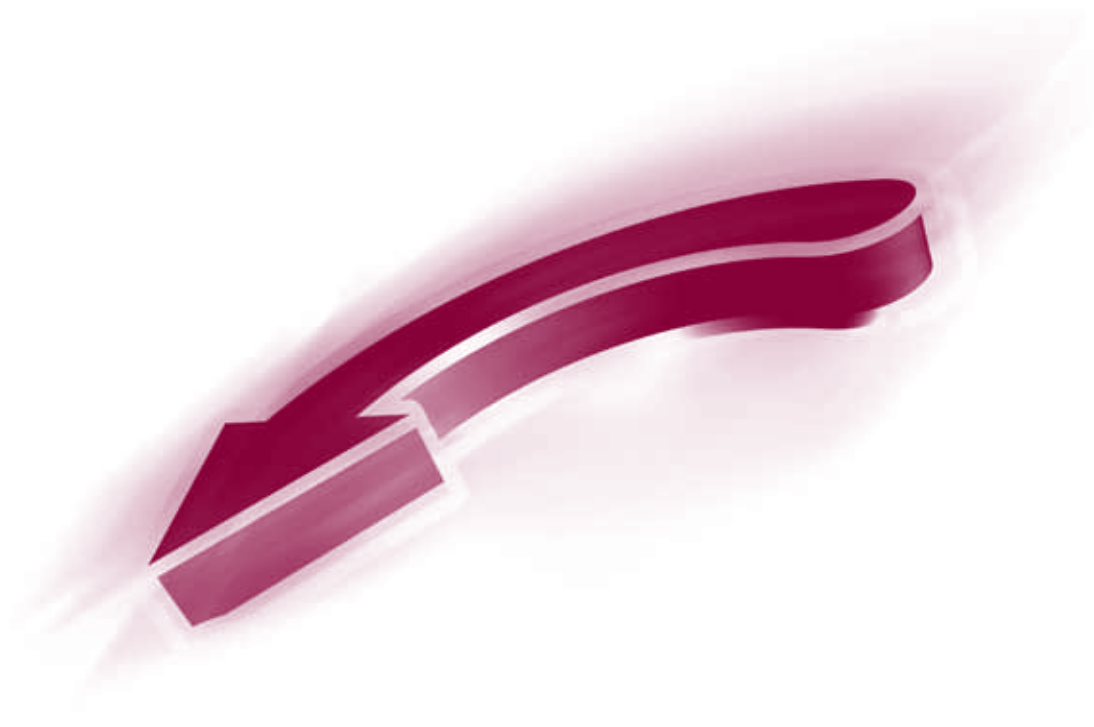
Kind of machining:	finishing
Material:	1.2312
Arbor:	25 22 750
Milling Cutter Body:	2 52 384
Indexable Inserts:	04 84 835, HSC 05
Coating:	PVTi
Overhang:	approx 68 mm
V_c (speed):	204 m/min
V_f (feed/min):	5,000 mm/min
S (Revolutions):	1,250 1/min
f_z (feed per tooth):	2 mm
a_p (Depth of cut):	0.1 mm
a_e (Width of cut):	40 mm
Obtained Surface Quality:	R _z 2.56 μm



ONE FURTHER CUSTOMER REACTION

„For us, this new **MIRROWORX**[®] Milling Cutter is a real troubleshooter. It machines a mirror-finish surface withoutstanding surface roughness values.“

(Reiner Meier/ foreman of mechanic department at Benteler Machine Tools GmbH & Co. KG in Bielefeld)



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