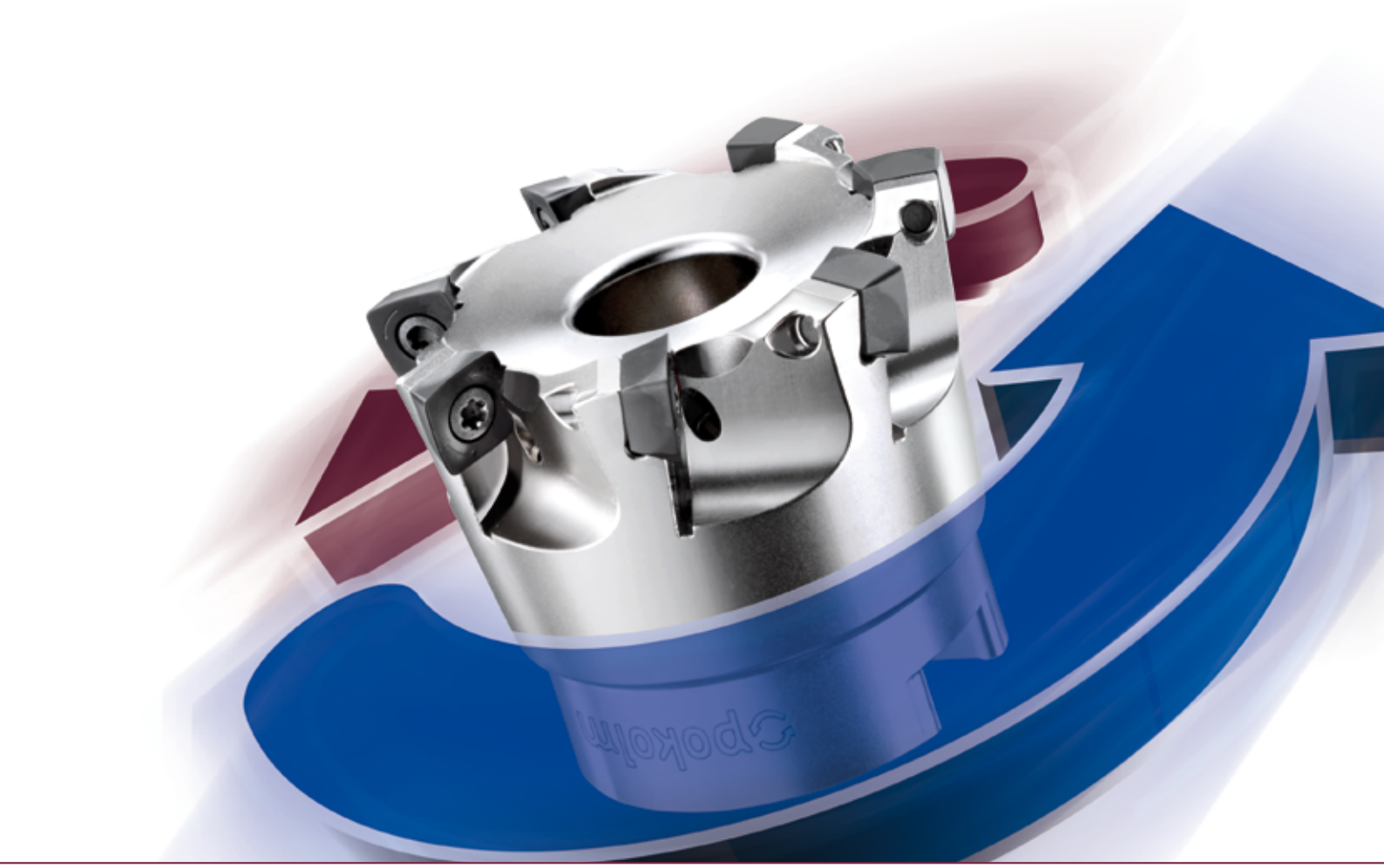
TOOLING SYSTEMS PROCESS OPTIMIZATION CONSULTING IN MILLING STRATEGIES

QUADWORX®

SQUARED FEED RATES



pokolm voha

PREMIUMTOOLS. WE KNOW HOW.

PRODUCTINFORMATION QUADWORX®

SQUARED FEED RATES

Quadworx® – this new Pokolm-development offers a high-feed milling possibility for universal applications. Huge feed-rates when roughing steel, cast iron or tempered steel care for efficient machining of your components and now -this is NEW- also for stainless- and acid-resistant materials. This new range of **Quadworx®**-milling cutters is providing more efficiency and machining capacity.

Quadworx®-tooling are available with threaded shanks, shell type with plain bores as well as with our patent protected **DuoPlug®**-system for highest concentricity and maximum rigidity. All tools are provided with internal coolant supply to ensure maximum process reliability and secure chip removal when machining deep cavities.

Four cutting edges per indexable insert in connection with our special macro-geometry -a combination of a large corner radius and a wiper edge- provide universal application opportunities in 2, 2.1/2 and 3-D machining. Re-engineered micro-geometries with polished surfaces help minimizing heat penetration to the inserts and care for a constant chip removal.

DuoPlug®

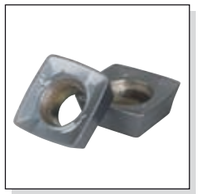
Threaded shank

Shell type

Increased tooth rigidity through **incorporated insert seats** allows for extended tool life of the cutter bodies, higher chip volume and increased productivity, simultaneously. Our high-accuracy indexable inserts in grades HSC05, P40, P25 and K10 as well as our newly developed grade M40 with chip guide steps and our latest, modified coating PVST are highly economic through its no. of cutting edges and its increased tool life.

BRIGHT PROSPECTS...

M40 and **PVST** are the new features for efficient machining of stainless- acid- and heat-resistant materials. Extremely tough and high-temperature-resistant carbide together with our modified AlTiN-coating reduce built-up cutting edges, increase thermal stability and reduce frictional heat at the same time. Orthogonal arranged insert seats in the cutter bodies together with the second clearance face of the inserts, provide a perfect and secure positioning of the inserts. This results in a maximum process reliability, even with highest possible chip volume and results in lower costs per component.



M40 PVST

...FOR MILLING STAINLESS MATERIALS

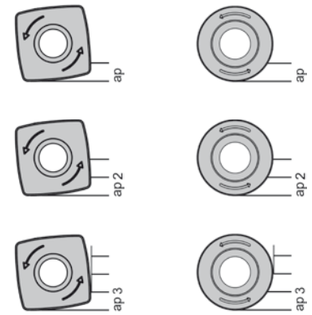
In case you need further information about our stainless range, you can download our current brochure from our homepage www.pokolm.com or ask by phone / e-mail under ⊙ contacts (see back page) for this brochure.

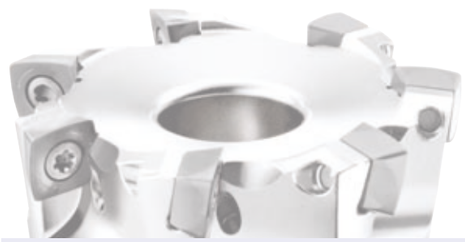
TECHNICAL INFORMATION

Due to the reduced arc of contact , when machining vertical moulds, less cutting forces influence milling cutters, inserts and machine spindle.

These following graphics explain the kind of geometry-influence to those cutting forces. One further element is the reduced power consumption of the machine, which allows more careful treatment of the machine

Comparing different arcs of contact for increasing cutting depths (a_p up to a_p 3) illustrate the reason of better running smoothness. As soon as the ap-value has exceeded the size of our **Quadworx®**-insert's minor cutting edge (a_p 3), the milling cutter gets a side clearance and thus it is cutting free and radial forces for milling cutter, inserts and machine spindle are decisively reduced.





Please take notice of the **theoretical cornerradius**, which has to be programmed. Also this type of milling cutters leaves a material stock, not pre-determinable. The r_p-values as well as operation data and measuring point diameter d_i will be mentioned on the following pages.

PRODUCTINFORMATION QUADWORX®

SUMMARY OF ADVANTAGES:

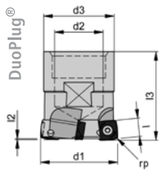
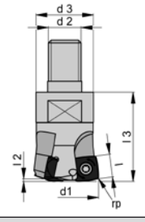
- 4 cutting edges per insert for extremely economic applications
- very high chip removal rates and very easy cutting actions
- thanks to the inserts positioning via its second clearance face and the orthogonal arranged insert seats in the cutter body, any twisting of the insert is avoided
- maximum process reliability specially in interrupted cutting applications
- wiper edge and large corner radius generate high accuracy surfaces, already in roughing operations

CONTENT

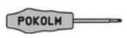
PRODUCTINFORMATION QUADWORX®

DIMENSIONS AND OPERATION DATA

The Quadworx® „S"-Range

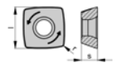
MILLING CUTTER BODIES	Catalogue No.	d_1	l	r_p	d_2	d_3	l_2	l_3	z	
Duo Plug®										
	2 16 247 SG	16	7	1,3	M 10	15	1	31	2	
	3 18 247 SG	18	7	1,3	M 10	15	1	31	3	
	3 20 247 SG	20	7	1,3	M 12	18,6	1	33	3	
	4 25 247 SG	25	7	1,3	M 16	23,5	1	35	4	
Threaded shank end mill bodies										
	2 14 247	14	7	1,3	M 8	13,8	1	28,5	2	
	2 16 247	16	7	1,3	M 8	13,8	1	28,5	2	
	3 18 247	18	7	1,3	M 8	13,8	1	28,5	3	
	3 20 247	20	7	1,3	M 10	18	1	28,5	3	
	4 25 247	25	7	1,3	M 12	21	1	32,5	4	

Accessories

ACCESSORIES	Catalogue No.	Description	Dimensions			
	25 500	Torx screw	M 2,5	L 5,0	T 7	
	07 500	Torx screwdriver	T 7			

Starting torque for Torx® screw 25 500 M_d: 1,28 Nm

Quadworx®-Inserts Size „S", DIN-Identification (SDMX/SDMT) 070205 SN

INDEXABLE INSERTS	Catalogue No.	DIN-Identification	Grade	Coating	l	s	r	M	
	02 47 837	SDMX 070205 SN	HSC05	PVTi	7	2,38	0,5	2,5	
	02 47 842	SDMX 070205 SN	P40	PVTi	7	2,38	0,5	2,5	
	02 47 896	SDMT 070205 SN	M40	PVST	7	2,38	0,5	2,5	

Cutting Speeds V_c in m/min

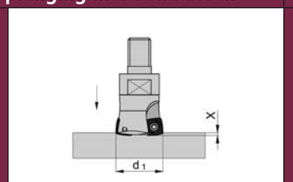
MATERIAL		r	l	Machining Rates	HSC05 PVTi	P40 PVTi	M40 PVST		
Steel		0,5	7	roughing finishing		100 – 200			
High-temperature alloys		0,5	7	roughing finishing			40 – 80 60 – 120		
Stainless Steel		0,5	7	roughing finishing			80 – 180 110 – 250		
Cast Iron		0,5	7	roughing finishing	160 – 300				
Hardened Steel		0,5	7	roughing finishing	100 – 180				

Application data (fz/ap)

MATERIAL		r	l	Machining Rates	HSC05 PVTi	P40 PVTi	M40 PVST		
Steel		0,5	7	f_z (mm) a_p (mm)		0,3 – 1,5 0,2 – 0,7			
High-temperature alloys		0,5	7	f_z (mm) a_p (mm)			0,2 – 0,8 0,1 – 0,5		
Stainless Steel		0,5	7	f_z (mm) a_p (mm)			0,2 – 1,0 0,1 – 0,5		
Cast Iron		0,5	7	f_z (mm) a_p (mm)	0,3 – 1,5 0,2 – 0,7				
Hardened Steel		0,5	7	f_z (mm) a_p (mm)	0,3 – 1,0 0,2 – 0,5				

EXTENDED OPERATION DATA

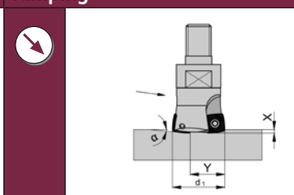
axial plunging into solid block



Cutter Diam. ø d_1 mm	x max. mm
14	1
16	1
18	1
20	1
25	1

x maximum plunge depth
f_z see operation data table, but reduce value to 30%

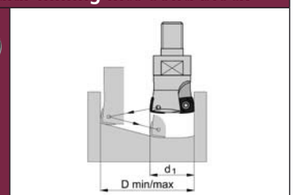
ramping



a°	y mm
< 13,5	4
< 8,8	6
< 6,6	8
< 5,2	10
< 3,3	15

y minimum travel
x maximum plunge depth
a_p/f_z see operation data table

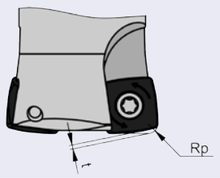
circular milling into solid block



D_{min} mm	D_{max} mm
18	28
22	32
26	36
30	40
40	50

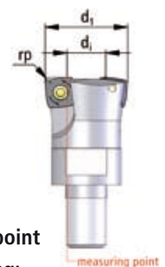
D_{min} minimum bore diameter depending on cutter diameter
D_{max} maximum bore diameter depending on cutter diameter
a_p/f_z see operation data table

TECHNICAL INFORMATION



Please take notice of the theoretical corner radius, which has to be programmed. The face milling cutter leaves a material stock not pre-determinable. In order to consider this fact for following tooling , we have estimated this value.
This dimension "t" is 0.51 mm.

Catalogue No.	d_1	d_i	Size of remaining stock t
2 16 247 SG	16	5,7	0,51
3 18 247 SG	18	7,7	0,51
3 20 247 SG	20	9,7	0,51
4 25 247 SG	25	14,8	0,51
2 14 247	14	3,7	0,51
2 16 247	16	5,7	0,51
3 18 247	18	7,7	0,51
3 20 247	20	9,7	0,51
4 25 247	25	14,8	0,51



Definition of measuring point for Laser-linear-monitoring:
Please use diameter: d_i

FROM PRACTICE TO PRACTICE

JOB TITLE:

Process optimizing of a component from material 1.4534 (X3CrNiMoAl13-8-2). This is equal to the US-alloy PH 13-8Mo, a high-tensile stainless steel with aircraft- and space conditions. Previously, a slot was produced with a Pokolm threaded shank end mill body No. 3 15 235/12 (15 mm diam., r=3.5). The slot is curved and open on both ends. Dimensions are: 150 mm long, 20 mm wide and 70 mm deep. With this tool mentioned, the customer could produce 1 complete slot. After that, inserts had to be turned in order to secure continued process reliability. This additional downtime had significant influence on the component's costs. The customer had to find a solution, to reduce machining time as well as down-time. The new tool **Quadworx®** "S" was selected to be the right tool for this application. It was assumed, that the milling cutter 2 16 247 (16 mm diam., rp 1,3) together with our new insert 2 47 896 should be the correct selection for this job.

MACHINE	MATERIAL	PROGRAMMING SYSTEM
DMU 60 P	1.4534	MillPlus

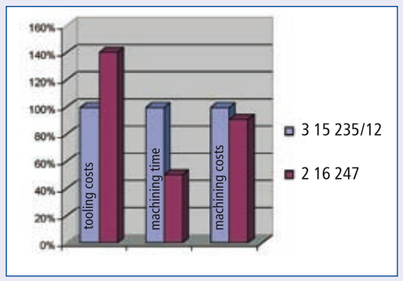
The slots of this component have been produced countour-parallel in z-constant cycle in climb milling as well as conventional milling. Regarding machining time, the feed rate and the chip volume have been more than doubled. This **Quadworx®** "S" combination allows a 7-times increase of tooth load compared with the previous end mills with round inserts. The high tensile and forged component was machined using constant coolant supply, in order to avoid any heating up of the component.

EXAMPLE FROM PRACTICE:

	previously	now
machining:	slot	
material:	1.4534 (PH13-8)	
arbor:	00 16 750 S	
	(16 mm diam., SK 40)	
extension:	40 08 601	
cutter body:	3 15 235/12	2 16 247
	(15 mm diam., r = 3.5)	(16 mm diam., r_p = 1,3)
Insert:	01 07 895	02 47 896, M40
coating:	PVGM	PVST
overhang:	73 mm	73 mm
v_c (speed):	170 m/min	170 m/min
v_f (feed rate):	900 mm/min	1.800 mm/min
S (revolutions):	3.400 1/min	3.400 1/min
f_z (feed per tooth):	0,083 mm	0,59 mm
a_p (depth of cut):	0,3 mm	0,3 mm
a_e (width of cut):	5 – 15 mm	4 – 16 mm
chip volume:	2,13 cm^3/min	4,32 cm^3/min
	= 0,13 cu. in./min	= 0,264 cu. in./min
machining time:	**40 min**	**20 min**

RESULT:

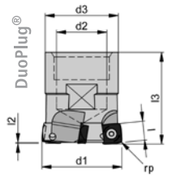
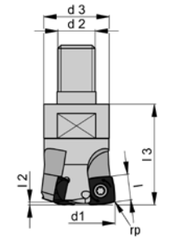
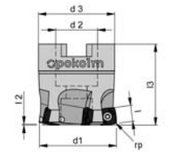
Machining time of this component has been reduced from 40 to 20 minutes. At the same time, tool life increased to 2 components with these new inserts **Quadworx®** "S" 02 47 896, without any insert change. Even the increased costs for using this new **Quadworx®** "S"-combination has already payed itself off after machining only 1 component.



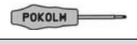
PRODUCTINFORMATION QUADWORX®

DIMENSIONS AND OPERATION DATA

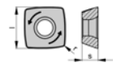
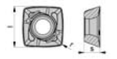
The Quadworx® „M"-Range

MILLING CUTTER BODIES	Catalogue No.	d_1	l	r_p	d_2	d_3	l_2	l_3	z
Duo Plug®									
	2 22 248 SG	22	9	1,5	M 12	18,5	1,5	35,5	2
	3 25 248 SG	25	9	1,5	M 16	23,5	1,5	40	3
Threaded shank end mill bodies									
	2 22 248	22	9	1,5	M 10	18	1,5	29	2
	3 25 248	25	9	1,5	M 12	21	1,5	33	3
	4 30 248	30	9	1,5	M 16	29	1,5	42	4
	4 35 248	35	9	1,5	M 16	29	1,5	42	4
	5 35 248	35	9	1,5	M 16	29	1,5	42	5
	5 42 248	42	9	1,5	M 16	29	1,5	42	5
Shell type milling cutter bodies									
	5 42 348	42	9	1,5	16	40	1,5	42,5	5
	6 52 348	52	9	1,5	22	40	1,5	52,5	6

Accessories

ACCESSORIES	Catalogue No.	Description	Dimensions			
	30 500	Torx screw	M 3,0	L 7,0	T 10	
	10 500	Torx screwdriver	T 10			

Quadworx®-Inserts Size „M", DIN-Identification (SDMX/SDHX/SDMT) 09T307 SN

INDEXABLE INSERTS	Catalogue No.	DIN-Identification	Grade	Coating	l	s	r	M
	03 48 842	SDMX 09T307 SN	P40	PVTi	9	3,5	0,7	3,0
	03 48 852	SDMX 09T307 SN	P25	PVTi	9	3,5	0,7	3,0
	03 48 860	SDHX 09T307 SN	K10	PVTi	9	3,5	0,7	3,0
	03 48 896	SDMT 09T307 SN	M40	PVST	9	3,5	0,7	3,0

Cutting Speeds V_c in m/min

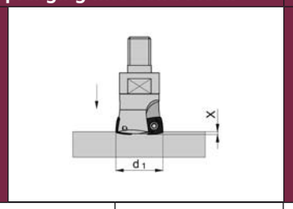
MATERIAL		r	l	Machining Rates	K10 PVTi	P40 PVTi	P25 PVTi	M40 PVST
Steel		0,7	9	roughing finishing		100 – 200	150 – 250	
High-temperature alloys		0,7	9	roughing finishing				40 – 80 60 – 120
Stainless Steel		0,7	9	roughing finishing				80 – 180 110 – 250
Cast Iron		0,7	9	roughing finishing	180 – 300			
Hardened Steel		0,7	9	roughing finishing	120 – 180			

Application data (fz/ap)

MATERIAL		r	l	Machining Rates	K10 PVTi	P40 PVTi	P25 PVTi	M40 PVST
Steel		0,7	9	f_z (mm) a_p (mm)		0,5 – 2,0 0,3 – 1,0	0,5 – 2,0 0,3 – 1,0	
High-temperature alloys		0,7	9	f_z (mm) a_p (mm)				0,3 – 0,9 0,2 – 0,7
Stainless Steel		0,7	9	f_z (mm) a_p (mm)				0,3 – 1,2 0,2 – 0,9
Cast Iron		0,7	9	f_z (mm) a_p (mm)	0,5 - 2,2 0,2 - 1,2			
Hardened Steel		0,7	9	f_z (mm) a_p (mm)	0,2 - 1,0 0,2 - 0,5			

EXTENDED OPERATION DATA

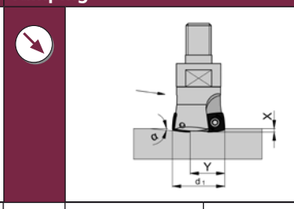
axial plunging into solid block



Cutter Diam. ø d_1 mm	x max. mm
22	1,5
25	1,5
30	1,5
35	1,5
42	1,5
52	1,5

x maximum plunge depth
f_z see operation data table, but reduce value to 30%
a_p/f_z see operation data table

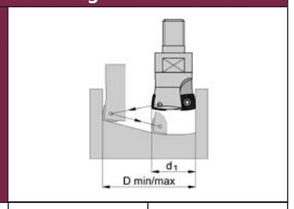
ramping



a°	y mm
< 13,7	6
< 9,2	9
< 5,8	14
< 4,3	19
< 3,1	26
< 2,1	36

y minimum travel
x maximum plunge depth
a_p/f_z see operation data table

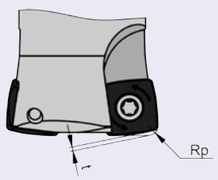
circular milling into solid block



D_{min} mm	D_{max} mm
28,5	44
34,5	50
44,5	60
54,5	70
68,5	84
88,5	104

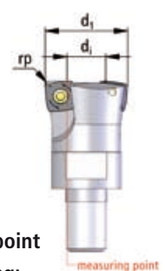
D_{min} minimum bore diameter depending on cutter diameter
D_{max} maximum bore diameter depending on cutter diameter
a_p/f_z see operation data table

TECHNICAL INFORMATION



Please take notice of the theoretical corner radius, which has to be programmed. The face milling cutter leaves a material stock not pre-determinable. In order to consider this fact for following tooling , we have estimated this value.
This dimension "t" is 0.65 mm.

Catalogue No.	d_1	d_i	Size of remaining stock t
2 22 248 SG	22	7,1	0,65
3 25 248 SG	25	9,8	0,65
2 22 248	22	7,1	0,65
3 25 248	25	9,8	0,65
4 30 248	30	14,7	0,65
4 35 248	35	19,6	0,65
5 35 248	35	19,8	0,65
5 42 248	42	26,5	0,65
5 42 348	42	26,5	0,65
6 52 348	52	36,5	0,65



Definition of measuring point for Laser-linear-monitoring:
Please use diameter: d_i

FROM PRACTICE TO PRACTICE

JOB TITLE:

VEMO Vereinigte Modellbau GmbH from the town of Kindsbach has been formed in 1971 as a company merger of 2 model making companies. Their more than 30 years experience as supplier of automotive industry and machine-tool makers are the basis of their success today. With latest CNC-machining centres in combination with different CNC-programming systems, VEMO offers optimum qualification for a prosperous co-operation with their customers. A base plate, equipped with 4 mould inserts, should be prepared up to the pre-finished condition in the shortest possible time. The goal was, finding the optimum between cost for tooling, process reliability and machining time. The roughing operation of those 4 mould inserts has been settled in less than 72 minutes by the largest diameter cutter body from our **QUADWORX®** "M"-range (6 52 348). The following operation of removing remaining material should be realized with a **QUADWORX®** "M"- cutter body 3 25 248, in a preferably manless operation without any machine downtime.

MACHINE	MATERIAL	PROGRAMMING SYSTEM
ZPS 2080	1.2312	DEPO-CAM / Euklid

These mould inserts for the foundry pattern have been machined in a z-constant cycle from inside to outside, with the focus for a maximum possible manless machining time. A base plate, fixed on the machine table with power clamps, cares for correct clamping on a ZPS 2080 machine with Selca control. With a combination of a Pokolm reduction sleeve (SK 50 to MTS 3) and a Morse Taper Adapter with M10 internal thread, together with the cutter body 3 25 248 from our **Quadworx®** "M"-range, this operation could be finished, slim and rigid. The complete machining time for those 4 inserts from roughing to pre-finishing was 128 minutes, all this with minimum tool costs and maximum cutting parameters.

EXAMPLE FROM PRACTICE:

component:	mould insert
material:	1.2312
arbor:	50 3 710 (SK 50 to MTS 3)
extension:	30 610
cutter body:	3 25 248
	(25 mm diam., r_p = 1.5)
insert:	03 48 842, P40
coating:	PVTi
overhang:	113 mm
v_c (speed):	196 m/min
v_f (feed rate):	8.000 mm/min
S (revolutions):	2.500 1/min
f_z (feed per tooth):	1,07 mm
a_p (depth of cut):	0,7 mm
a_e (width of cut):	15 mm
chip volume:	84 cm^3/min = 5,13 cu. in./min
machining time:	**56 min**

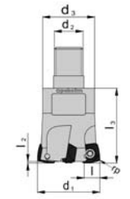
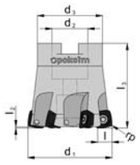
RESULT:

Machining time for roughing and removing remaining material was less than 130 minutes without any insert changes. This has contributed to an optimum use of the inserts and essential operation time. The increased chip volume as well as an almost manless roughing operation have contributed to a considerable cost reduction and remarkable time gaining for all following operations.

PRODUCTINFORMATION QUADWORX®

DIMENSIONS AND OPERATION DATA

The Quadworx® „L"-Range

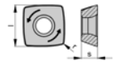
MILLING CUTTER BODIES	Catalogue No.	d_1	l	r_p	d_2	d_3	l_2	l_3	z	
threaded shank										
	3 35 249	35	10	2,3	M 16	29	2,5	42	3	
	4 42 249	42	10	2,3	M 16	29	2,5	42	4	
shell type										
	4 42 349	42	10	2,3	16	35	2,5	42	4	
	5 52 349	52	10	2,3	22	40	2,5	52	5	
	7 66 349	66	10	2,3	27	48	2,5	52	7	
	8 80 349	80	10	2,3	27	60	2,5	52	8	

Accessories

ACCESSORIES	Catalogue No.	Description	Dimensions			
	40 505 K	Torx screw	M 4,0	L 9,35	T 15	
	15 500	Torx screwdriver	T 15			

Starting torque for Torx® screw 40 505 M_d: 5,15 Nm

Quadworx®-Inserts Size „L", DIN-Identification (SDMX/SDHX/SDMT) 100510 SN

INDEXABLE INSERTS	Catalogue No.	DIN-Identification	Grade	Coating	l	s	r	M	
	04 49 842	SDMX 100510 SN	P40	PVTi	10	5	1	4,0	
	04 49 852	SDMX 100510 SN	P25	PVTi	10	5	1	4,0	
	04 49 860	SDHX 100510 SN	K10	PVTi	10	5	1	4,0	
	04 49 896	SDMT 100510 SN	M40	PVST	10	5	1	4,0	

Cutting Speeds V_c in m/min

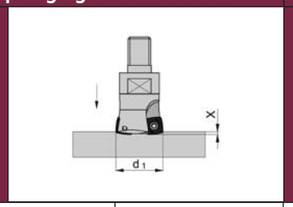
MATERIAL		r	l	Machining Rates	K10 PVTi	P40 PVTi	P25 PVTi	M40 PVST	
Steel		1	10	roughing finishing		100 – 200	150 – 250		
High-temperature alloys		1	10	roughing finishing				40 – 80 60 – 120	
Stainless Steel		1	10	roughing finishing				80 – 180 110 – 250	
Cast Iron		1	10	roughing finishing	140 – 250				
Hardened Steel		1	10	roughing finishing	80 – 160				

Application data (fz/ap)

MATERIAL		r	l	Machining Rates	K10 PVTi	P40 PVTi	P25 PVTi	M40 PVST	
Steel		1	10	f_z (mm) a_p (mm)		0,3 – 2,5 0,3 – 1,5	0,3 – 2,5 0,3 – 1,5		
High-temperature alloys		1	10	f_z (mm) a_p (mm)				0,35 – 1,0 0,25 – 0,9	
Stainless Steel		1	10	f_z (mm) a_p (mm)				0,35 – 1,5 0,25 – 1,5	
Cast Iron		1	10	f_z (mm) a_p (mm)	0,3 – 2,5 0,3 – 1,7				
Hardened Steel		1	10	f_z (mm) a_p (mm)	0,3 – 1,5 0,3 – 0,8				

EXTENDED OPERATION DATA

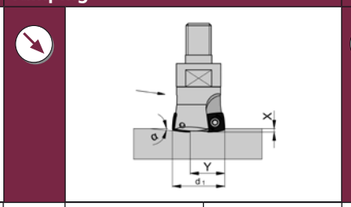
axial plunging into solid block



Cutter Diam. ø d_1 mm	x max. mm
35	2,5
42	2,5
52	2,5
66	2,5
80	2,5

x maximum plunge depth
f_z see operation data table, but reduce value to 30%

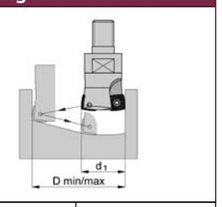
ramping



a°	y mm
< 8,3	17
< 5,9	24
< 4,2	34
< 2,9	48
< 2,3	62

y minimum travel
x maximum plunge depth
a_p/f_z see operation data table

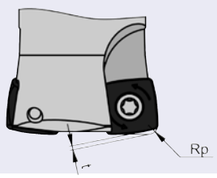
circular milling into solid block



D_{min} mm	D_{max} mm
52	70
66	84
86	104
114	132
142	160

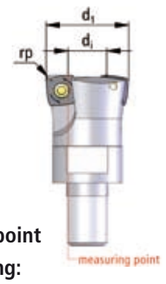
D_{min} minimum bore diameter depending on cutter diameter
D_{max} maximum bore diameter depending on

TECHNICAL INFORMATION



Please take notice of the theoretical corner radius, which has to be programmed. The face milling cutter leaves a material stock not pre-determinable. In order to consider this fact for following tooling , we have estimated this value.
This dimension "t" is 0.83 mm.

Catalogue No.	d_1	d_i	Size of remaining stock t
3 35 249	35	17,7	0,83
4 42 249	42	24,7	0,83
4 42 349	42	24,7	0,83
5 52 349	52	34,7	0,83
7 66 349	66	48,7	0,83
8 80 349	80	62,7	0,83



Definition of measuring point for Laser-linear-monitoring:
Please use diameter: d_i

FROM PRACTICE TO PRACTICE

JOB TITLE:

The company WWS Metallformen GmbH from the town of Hatzenbühl manufactures prototype- and duplicate products together with the required metal forming moulds since more than 20 years. Specially, their service from design of those prototype components, conversion into CAD/CAM systems up to production of the metal forming moulds and the first tryouts, is very much appreciated by their customers. WWS supplies into all fields of sheet fabricating industry, from consumer goods industry, medical technology, automotive engineering and last but not least, complex deep-drawing parts for aircraft- and spaceware. Up to now, WWS machines their metal forming moulds with cutter bodies for round inserts from Pokolm. The milling cutter 52 310/7 (52 mm diam., r=6) offers most universal application possibilities and has been very much appreciated by our customers. But, the power consumption related to the chip volume, causes some problems for our customers in certain machining operations, specially, when female moulds with small draft angles have to be produced. Due to the geometric characteristics of the round inserts and those radial forces which occur during milling, vibrations arise suddenly, again and again. Feed rates and cutting depths have to be reduced, in order to secure process reliability.

MACHINE	MATERIAL	PROGRAMMING SYSTEM
ZPS 1060	St 52-3	Cimatron

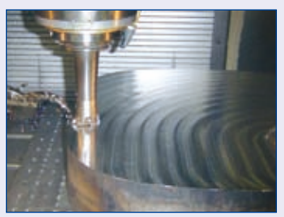
The male and female die of a deep-drawing mould for a truck-muffler has been machined in a z-constant circular-pocket cycle from inside to outside. Main focus was the maximum achievable chip volume with smallest possible spindle load. The component, clamped solid, was machined on a ZPS milling machine type 1060 with Selca control. There was no difficulty in maching material ST 52-3 itself, but the problem is a process reliable machining of those burn-out contours with a hardness of > 50 HRC. Those requirements habe been fulfilled and exceeded by our **Quadworx®** "L" tooling.

EXAMPLE FROM PRACTICE:

component:	female drawing die
material:	St 52-3
arbor:	100 22 710
	(22 mm diam., SK 50)
cutter body:	5 52 349
	(52 mm diam., r_p = 2,3)
insert:	04 49 852, P25
coating:	PVTi
overhang:	153 mm
v_c (speed):	212 m/min
v_f (feed rate):	8.000 mm/min
S (revolutions):	1.300 1/min
f_z (feed per tooth):	1,23 mm
a_p (depth of cut):	1,5 mm
a_e (width of cut):	31 mm
chip volume:	372 cm^3/min = 22,7 cu.in./min
machining time:	45 min

RESULT:

Machining time for roughing this female drawing die has been reduced by 50 %. And this with an only 5 % increase of spindle load, better smoothness of running and less vibrations. Increased chip volume together with the small increase in spindle load, have reduced the costs for roughing operations by more than 50 % and the customer achieved a considerable time gaining for his following operations.



QUADWORX®

PV-F-QW-E 0808

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