



MINIMASTER® PLUS
THE NEXT GENERATION OF MINIMASTER





Seco Tools has an established reputation as a leading manufacturer and supplier of carbide cutting tools and associated equipment and is a major force as a knowledge driven provider of machining solutions.

Seco has over 20,000 product lines ranging from spindle tooling to the cutting point, to cover even the most specialised machining applications.

Seco is well placed to offer strategic, technological and cost reduction partnerships to companies throughout the world.

THE NEXT GENERATION OF MINIMASTER

THE SUCCESS CONTINUES

Seco continues the success of Minimaster by launching the next generation. Once again showing the future direction of end mills with replaceable fluted inserts.

“Minimaster Plus is reaching the highest level of precision and productivity.”

SPEED? SURE!

When a used Minimaster Plus insert is replaced with a new one, the axial and radial position remain the same for maximum precision. It is also possible to replace the insert without removing the shank from the holder or machine and re-measuring the whole assembly, speeding up the process considerably.

COST EFFECTIVENESS? YOU GOT IT.

You only pay for the replacement of the insert once it is worn out, instead of the complete tool (for example, HSS or solid end mill). Exchangeable inserts for different shanks allow for higher cutting data, thus avoiding re-grinding and ensuring a consistent tool life.

WHAT'S IN IT FOR YOU?

- Increased productivity and precision.
- Flexible mix of inserts and shanks.
- Internal through coolant channels.
- Two-, three- and multi-flute insert versions.
- Excellent performance in all workpiece materials.

THE RESULT

A replaceable carbide milling insert with an internal thread and an external taper. The shank has an internal taper with a threaded centre pin plus a new feature; an axial stop. This keeps the position of the insert within the required tolerances.



MINIMASTER PLUS. PRECISE, FAST AND VERSATILE



THE EVOLUTION OF MINIMASTER

We have moved onwards and upwards; Minimaster Plus is taking milling technology to another level.

INTERFACE PRECISION WILL SAVE YOU TIME

It is now no longer necessary to measure the setting length when using Minimaster. And due to the interface precision, the insert can be changed in the machine saving you time and increasing productivity.

THE FEATURES OF MINIMASTER PLUS

- Radial run-out within 15µm.
- Setting length variation when changing inserts within 25µm.
- Long tool life plus flexibility.
- High productivity and endless versatility.

THE MINIMASTER PLUS RANGE CONSISTS OF SEVERAL SHANK TYPES FOR EACH INSERT DIAMETER

This means that, regardless of the machining requirements, there is always a shank that gives the optimum combination of stability, accessibility and precision. The risk of vibration is also reduced, resulting in better surface finish, closer tolerances and better tool life.



MINIMASTER PLUS COVERS MOST APPLICATIONS

MINIMASTER PLUS INSERTS AND GRADES COVER MOST APPLICATIONS

- Diameter range Ø10 – 16mm.
- 2 grades allow for machining all materials while 2 geometries provide a smooth cutting design.
- 2 to 8 flute insert range.
- 2 and 3 flute inserts with internal through coolant channels ensuring an accurate cooling system and efficient chip evacuation.
- Corner radii range from 0,4 up to 3,1mm.

Square shoulder

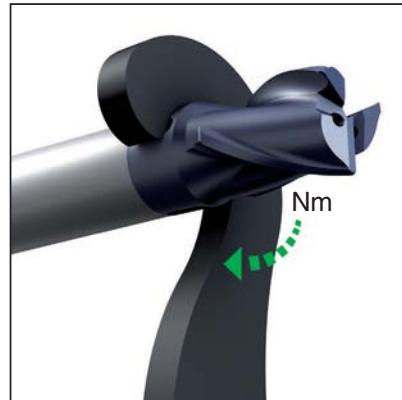
- 3 and 4 flute inserts the first choice for slotting (4-flute in stable conditions).
- 5 and 8 flute inserts the first choice for contouring (not recommended for slotting).

Ball nose (3D milling)

- The 3 flute insert is the first choice.
- The 2 flute insert is the first choice in unstable conditions.

HIGH PRECISION SHANKS

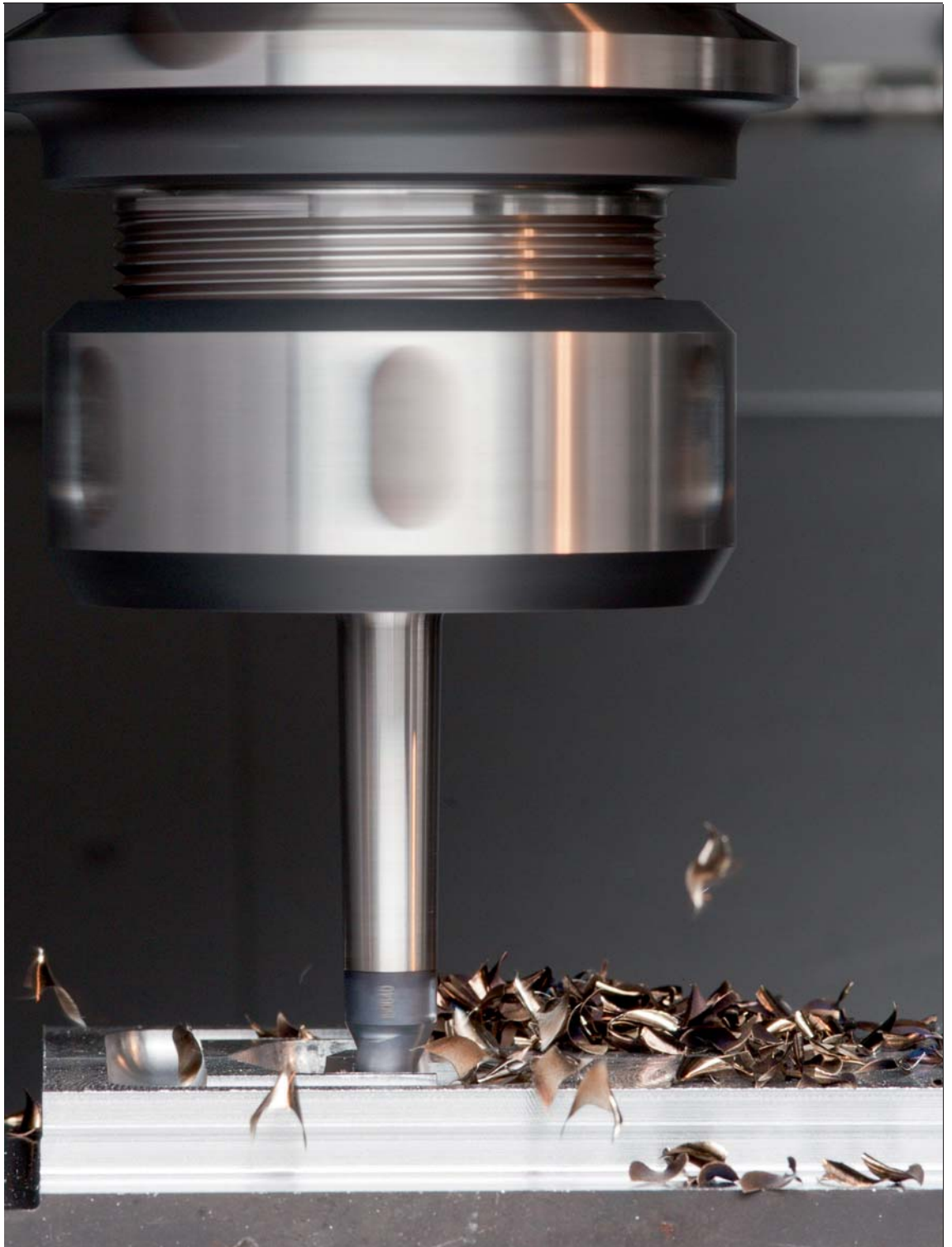
- 24 shank versions available.
- Different length versions give optimised stability.
- Different access length possibilities.
- Manufactured with the latest technology to achieve the highest precision.



**WE RECOMMEND USING A TORQUE KEY WHEN MOUNTING THE INSERT
FOR THE BEST PRECISION AND EXTENDED TOOL LIFE**

INSERTS AND SHANKS TO COVER MOST APPLICATIONS





Choice of insert, shank and cutting.**Select taper size**

- The design of the workpiece and the machining operations determines suitable taper size.
- Select the largest possible taper size for best strength and stability.

Select insert

- Use the tables beginning on page 563 in Milling 2009 to classify the workpiece material into a Seco material group.
- Look up the pages for the selected taper size and choose a suitable insert in the insert selection table.

Select shank

- Look up the pages for the selected taper size and choose a suitable shank in the tool data table.
- Always choose the shortest shank possible (to get maximum stability).

Select cutting data

- Maximum recommended axial cutting depth is in the cutting data conversion table. (See figure 1.)
- Cutting speed recommendations are in the cutting data tables, see pages 22 - 23. Notice that the recommendations are for a fully engaged cutter in stable machining condition.
- Maximum RPM that for safety reasons should never be exceeded, are shown on page 24.
- Feed per tooth f_z recommendations are in the cutting data conversion table.
- **If the cutter is not fully engaged** the feed per tooth and the cutting speed should be increased compared to the recommendations for a fully engaged cutter. The reason for that is to keep the chip thickness and the working temperature in the cutting zone at the same value as for a fully engaged cutter. (See figure 2.)
- Divide the radial cutting depth with the cutter diameter to get the actual cutter engagement percentage ($a_e/D_c\%$).
- Use the percentage to get a correct feed per tooth and cutting speed recommendation for the actual cutter engagement.
- **When calculating feed** per revolution and feed speed always use the z_c -value. That is the effective number of teeth to use for cutting data calculation. The z_c -value is in the insert selection table.

- Extended tables and formulae for calculating cutting data for side milling are found on page 558 in Milling 2009
- Notice that there will be a deterioration of the surface finish on the workpiece when the feed rate is increased (See figure 3).
- **When milling in corners** and bottoms of cavities the feed rate should be reduced due to the increase of the chip thickness. Use the feed per tooth recommendations for a fully engaged cutter. (See figure 4.)
- **When steep down copying** with an angle bigger than 40° or steep up copying with an angle bigger than 30° in combination with small depths of cut use the diameter (D_c) as working diameter instead of D_w (See figure 4)
- **Calculate surface finish.** Use the profile height value (H) from the cutting data conversion table to calculate the expected surface finish for the actual operation. (See figure 5.)

Figure 1

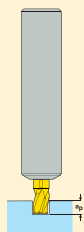


Figure 2

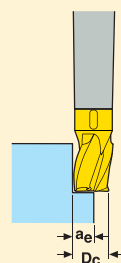


Figure 3

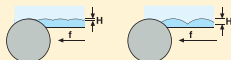


Figure 4

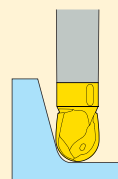
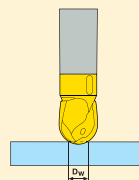
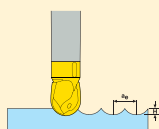
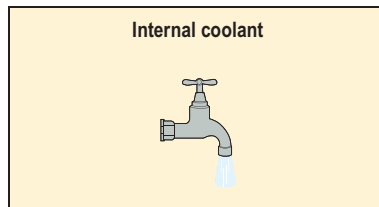
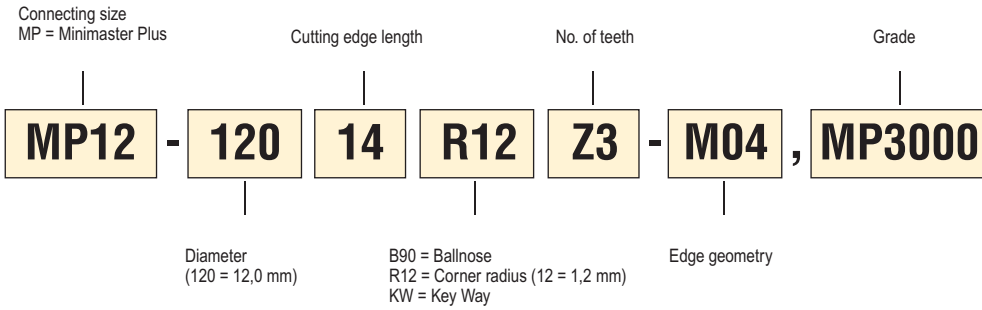
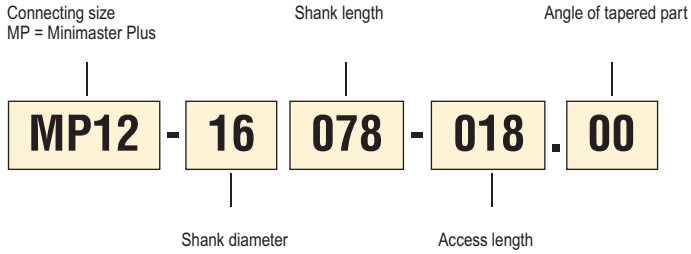


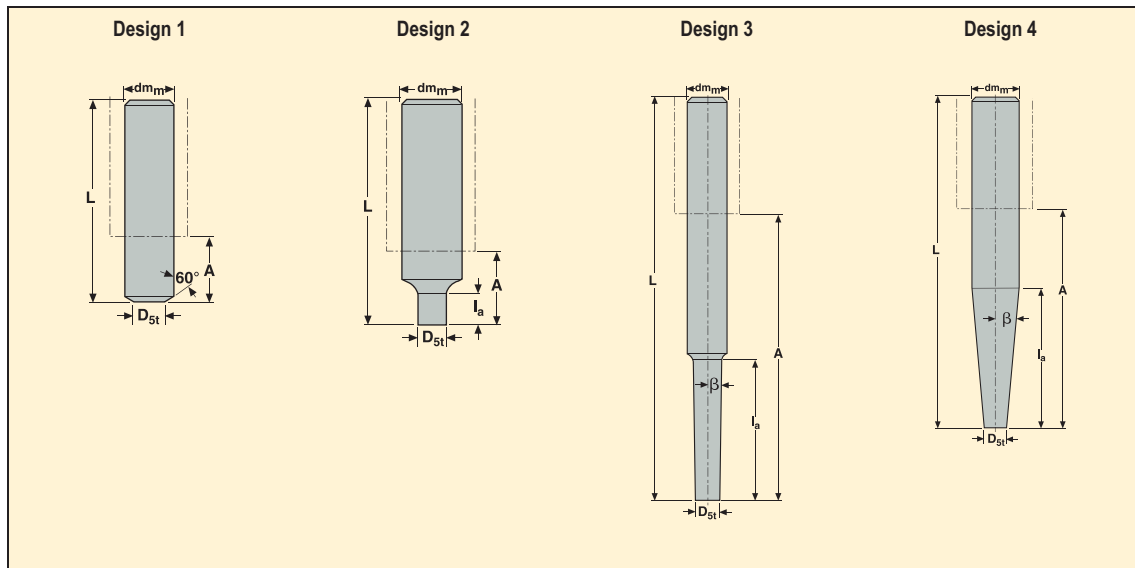
Figure 5



Code keys



MP10 Steel shanks



Shanks

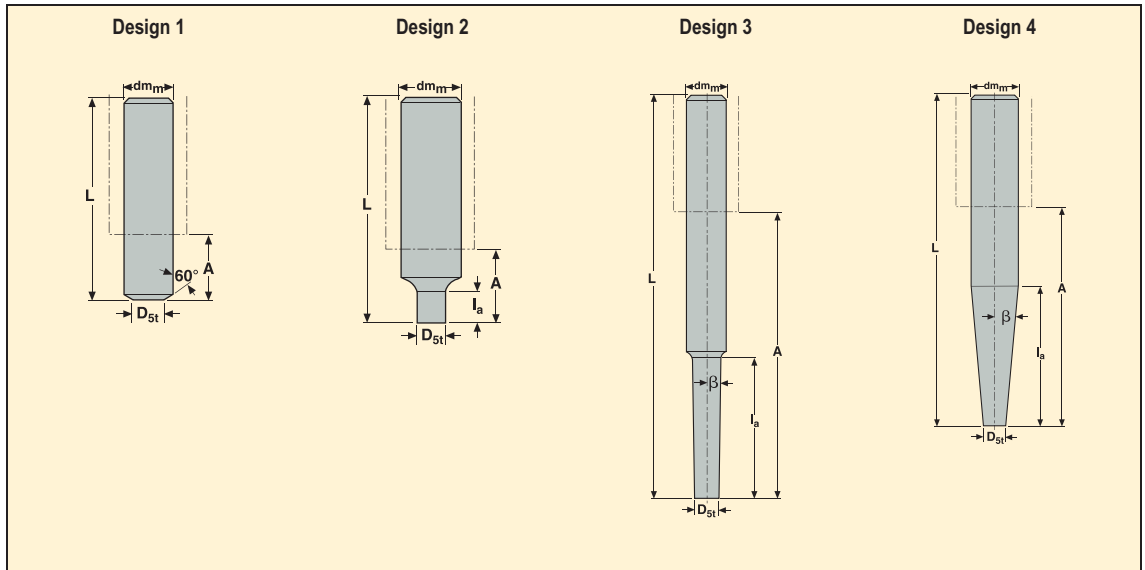
Part No.	Connecting size	Dimensions in mm								
		D _{st}	dm _m	L	A	l _a	β°	Design		
MP10 -16068-000.60	MP10	9,5	16	68	20	–	–	1	✓	0,1
-10055-010.00	MP10	9,8	10	55	15	10	0	2	✓	0,1
-16073-015.00	MP10	9,8	16	73	25	15	0	2	✓	0,1
-16118-035.01	MP10	9,5	16	118	70	35	1	3	✓	0,2
-16158-060.01	MP10	9,5	16	158	110	60	1	3	✓	0,2
-20100-045.03	MP10	9,5	20	100	50	45	3	3	✓	0,2
-20140-085.03	MP10	9,5	20	140	90	85	3	3	✓	0,3
-20140-090.05	MP10	9,5	20	140	90	60	5	4	✓	0,3

Spare parts

Connecting size	Dynamometric Key*	Dynamometric blade	Wrench	Torque values Nm
MP10	MP00-10.080	MP00-10	MP10-10	8,0

*Including blades

MP12 Steel shanks



Shanks

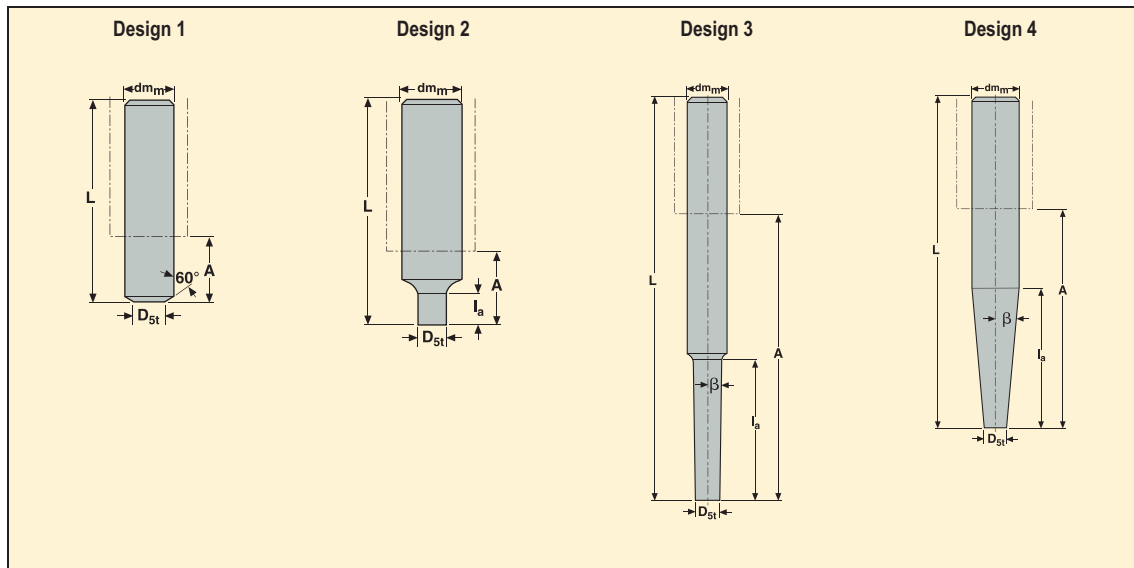
Part No.	Connecting size	Dimensions in mm							Design		
		D _{St}	dm _m	L	A	I _a	β°				
MP12 -16068-000.60	MP12	11,5	16	68	20	—	—	1	✓	0,1	
-12060-012.00	MP12	11,5	12	60	15	12	0	2	✓	0,1	
-16078-018.00	MP12	11,5	16	78	30	18	0	2	✓	0,1	
-16153-042.01	MP12	11,5	16	153	105	42	1	3	✓	0,2	
-20170-072.01	MP12	11,5	20	170	120	72	1	3	✓	0,3	
-20110-055.03	MP12	11,5	20	110	60	55	3	3	✓	0,2	
-20150-100.03	MP12	11,5	20	150	100	81	3	4	✓	0,3	
-20155-105.05	MP12	11,5	20	155	105	48	5	4	✓	0,3	

Spare parts

Connecting size	Dynamometric Key*	Dynamometric blade	Wrench	Torque values Nm
MP12	MP00-12.120	MP00-12	MP12-12	12,0

*Including blades

MP16 Steel shanks



Shanks

Part No.	Connecting size	Dimensions in mm								
		D _{st}	dm _m	L	A	l _a	β°	Design		
MP16 -20070-000.60	MP16	15,2	20	70	20	–	–	1	✓	0,2
-16068-016.00	MP16	15,2	16	68	20	16	0	2	✓	0,1
-20090-024.00	MP16	15,2	20	90	40	24	0	2	✓	0,2
-20190-056.01	MP16	15,2	20	190	140	56	1	3	✓	0,4
-20195-095.01	MP16	15,2	20	195	145	95	1	3	✓	0,4
-25136-075.03	MP16	15,2	25	136	80	75	3	3	✓	0,4
-25181-125.03	MP16	15,2	25	181	125	93	3	4	✓	0,6
-25181-125.05	MP16	15,2	25	181	125	56	5	4	✓	0,6

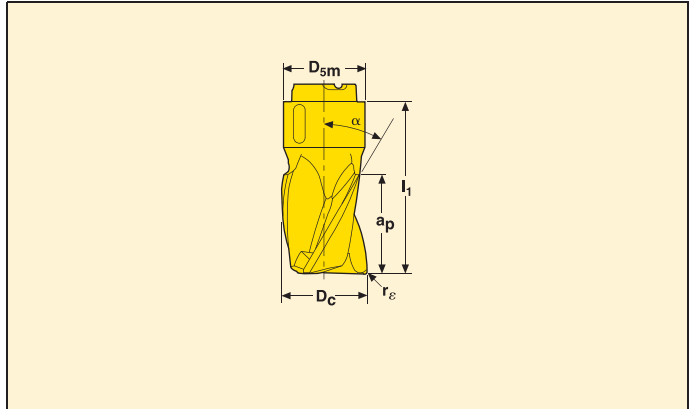
Spare parts

Connecting size	Dynamometric Key*	Dynamometric blade	Wrench	Torque values Nm
MP16	MP00-16.160	MP00-16	MP16-16	16,0

*Including blades

MP10 Square shoulder

Slotting and contouring

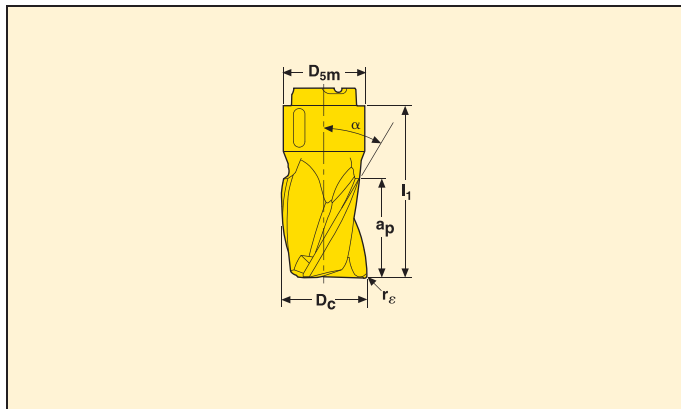


Inserts	Part No.	Dimensions in mm						z _c -value		Grades				
		D _c	r _ε	a _p	D _{5m}	l ₁	α			Coated				
										F40M	MP3000			
	MP10 -09812KWZ3-E03	9,8	0,3	12	9,6	21	30°	3	✓	■				
	-10012R04Z3-M03	10	0,4	12	9,6	21	30°	3	✓	■				
	-10012R04Z3-E03	10	0,4	12	9,6	21	30°	3	✓	■				
	-10012R05Z3-E03	10	0,5	12	9,6	21	30°	3	✓	■				
	-10012R08Z3-M03	10	0,8	12	9,6	21	30°	3	✓	■				
	-10012R08Z3-E03	10	0,8	12	9,6	21	30°	3	✓	■				
	-10012R12Z3-M03	10	1,2	12	9,6	21	30°	3	✓	■				
	-10012R12Z3-E03	10	1,2	12	9,6	21	30°	3	✓	■				
	-10012R16Z3-E03	10	1,6	12	9,6	21	30°	3	✓	■				
	-10012R20Z3-E03	10	2,0	12	9,6	21	30°	3	✓	■				
-10012R24Z3-E03	10	2,4	12	9,6	21	30°	3	✓	■					
-10012R31Z3-E03	10	3,1	12	9,6	21	30°	3	✓	■					
	MP10 -10012R04Z4-M02*	10	0,4	12	9,6	21	50°	4			■			
	-10012R04Z4-E02*	10	0,4	12	9,6	21	50°	4		■				
	-10012R05Z4-E02*	10	0,5	12	9,6	21	50°	4		■				
	-10012R08Z4-M02*	10	0,8	12	9,6	21	50°	4			■			
	-10012R08Z4-E02*	10	0,8	12	9,6	21	50°	4		■				
	-10012R12Z4-E02*	10	1,2	12	9,6	21	50°	4		■				
	-10012R12Z4-M02*	10	1,2	12	9,6	21	50°	4			■			
	-10012R16Z4-E02*	10	1,6	12	9,6	21	50°	4		■				
-10012R20Z4-E02*	10	2,0	12	9,6	21	50°	4		■					

* Slotting only in stable conditions.

MP12 Square shoulder

Slotting and contouring

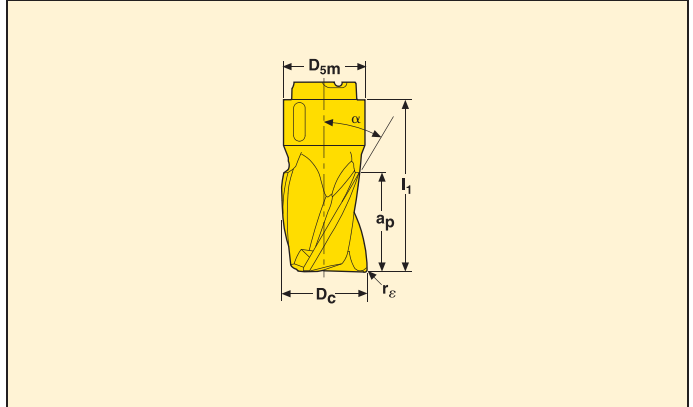


Inserts	Part No.	Dimensions in mm						z _c -value		Grades								
		D _c	r _ε	a _p	D _{5m}	l ₁	α			Coated								
										F40M	MP-3000							
	MP12 -11714KWZ3-E04	11,7	0,3	14	11,5	24	30°	3	✓	■								
	-12014R04Z3-M04	12	0,4	14	11,5	24	30°	3	✓	■	■							
	-12014R04Z3-E04	12	0,4	14	11,5	24	30°	3	✓	■								
	-12014R05Z3-E04	12	0,5	14	11,5	24	30°	3	✓	■								
	-12014R08Z3-M04	12	0,8	14	11,5	24	30°	3	✓	■	■							
	-12014R08Z3-E04	12	0,8	14	11,5	24	30°	3	✓	■								
	-12014R12Z3-M04	12	1,2	14	11,5	24	30°	3	✓	■	■							
	-12014R12Z3-E04	12	1,2	14	11,5	24	30°	3	✓	■								
	-12014R16Z3-E04	12	1,6	14	11,5	24	30°	3	✓	■								
	-12014R20Z3-E04	12	2,0	14	11,5	24	30°	3	✓	■								
	-12014R24Z3-E04	12	2,4	14	11,5	24	30°	3	✓	■								
-12014R31Z3-E04	12	3,1	14	11,5	24	30°	3	✓	■									
	MP12 -12014R04Z4-M03*	12	0,4	14	11,5	24	50°	4			■							
	-12014R04Z4-E03*	12	0,4	14	11,5	24	50°	4			■							
	-12014R05Z4-E03*	12	0,5	14	11,5	24	50°	4			■							
	-12014R08Z4-E03*	12	0,8	14	11,5	24	50°	4			■							
	-12014R08Z4-M03*	12	0,8	14	11,5	24	50°	4			■	■						
	-12014R12Z4-E03*	12	1,2	14	11,5	24	50°	4			■							
	-12014R12Z4-M03*	12	1,2	14	11,5	24	50°	4			■	■						
	-12014R16Z4-E03*	12	1,6	14	11,5	24	50°	4			■							
	-12014R20Z4-E03*	12	2,0	14	11,5	24	50°	4			■							
	-12014R24Z4-E03*	12	2,4	14	11,5	24	50°	4			■							

* Slotting only in stable conditions.

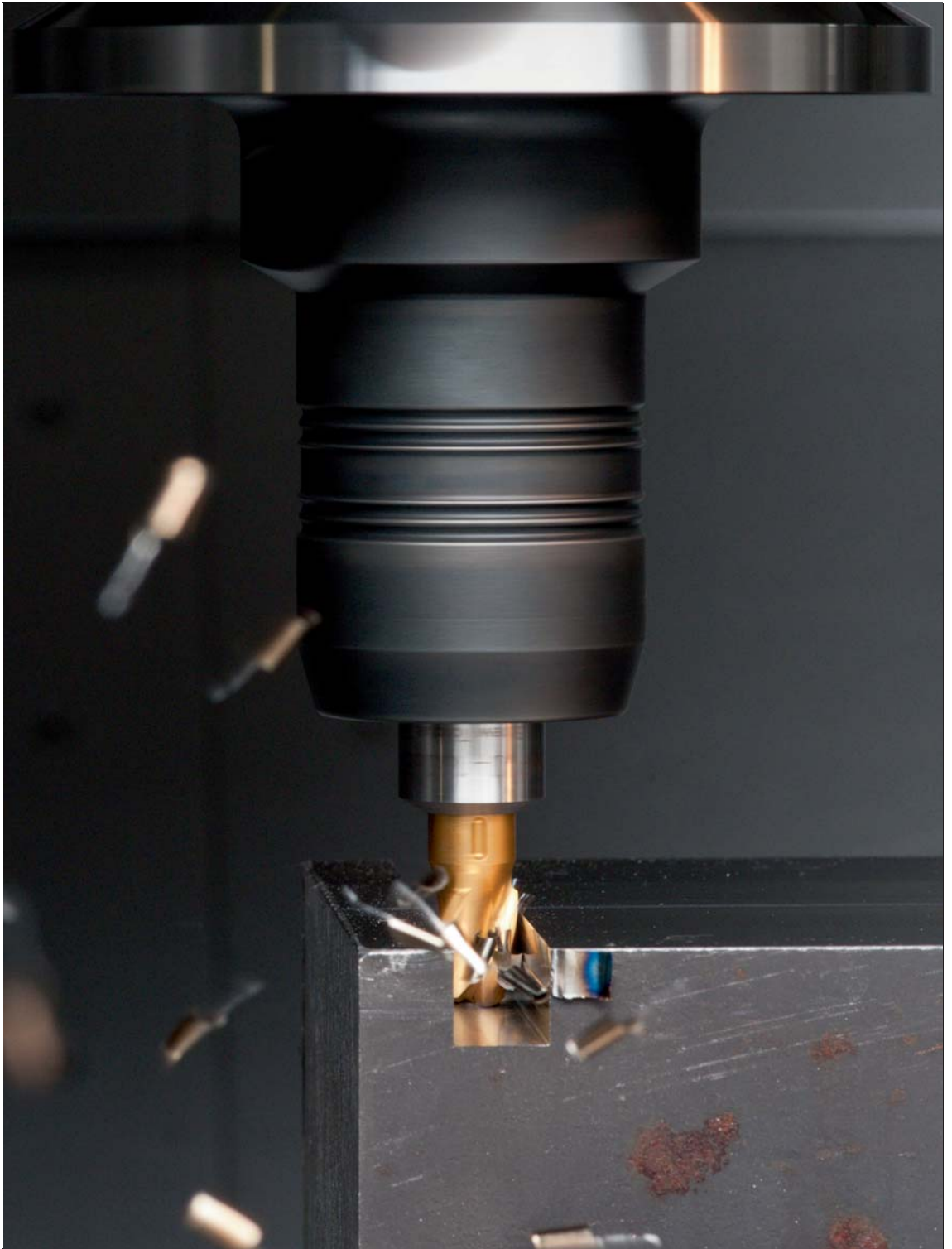
MP16 Square shoulder

Slotting and contouring



Inserts	Part No.	Dimensions in mm						z _c -value		Grades											
		D _c	r _e	a _p	D _{5m}	l ₁	α			Coated											
										F-40M	MP-3000										
	MP16 -15719KWZ3-E05	15,7	0,3	19	15,4	32,6	30°	3	✓	■											
	-16019R04Z3-M05	16	0,4	19	15,4	32,6	30°	3	✓	■	■										
	-16019R04Z3-E05	16	0,4	19	15,4	32,6	30°	3	✓	■											
	-16019R05Z3-E05	16	0,5	19	15,4	32,6	30°	3	✓	■											
	-16019R08Z3-M05	16	0,8	19	15,4	32,6	30°	3	✓	■	■										
	-16019R08Z3-E05	16	0,8	19	15,4	32,6	30°	3	✓	■											
	-16019R12Z3-M05	16	1,2	19	15,4	32,6	30°	3	✓	■	■										
	-16019R12Z3-E05	16	1,2	19	15,4	32,6	30°	3	✓	■											
	-16019R16Z3-E05	16	1,6	19	15,4	32,6	30°	3	✓	■											
	-16019R20Z3-E05	16	2,0	19	15,4	32,6	30°	3	✓	■											
-16019R24Z3-E05	16	2,4	19	15,4	32,6	30°	3	✓	■												
-16019R31Z3-E05	16	3,1	19	15,4	32,6	30°	3	✓	■												
	MP16 -16019R04Z4-E04*	16	0,4	19	15,4	32,6	50°	4		■											
	-16019R04Z4-M04*	16	0,4	19	15,4	32,6	50°	4		■	■										
	-16019R05Z4-E04*	16	0,5	19	15,4	32,6	50°	4		■											
	-16019R08Z4-E04*	16	0,8	19	15,4	32,6	50°	4		■											
	-16019R08Z4-M04*	16	0,8	19	15,4	32,6	50°	4		■	■										
	-16019R12Z4-E04*	16	1,2	19	15,4	32,6	50°	4		■											
	-16019R12Z4-M04*	16	1,2	19	15,4	32,6	50°	4		■	■										
	-16019R16Z4-E04*	16	1,6	19	15,4	32,6	50°	4		■											
	-16019R20Z4-E04*	16	2,0	19	15,4	32,6	50°	4		■											
	-16019R24Z4-E04*	16	2,4	19	15,4	32,6	50°	4		■											

* Slotting only in stable conditions.



Cutting data - Slot milling

SMG	Cutting speed (m/mm)		MP10		MP12		MP16	
	MP3000	F40M	Feed mm/tooth	Max depth of cut	Feed mm/tooth	Max depth of cut	Feed mm/tooth	Max depth of cut
1	315	285	0,04 - 0,06	5,0	0,05 - 0,09	6,0	0,06 - 0,10	8,0
2	280	250	0,04 - 0,06	5,0	0,05 - 0,09	6,0	0,06 - 0,10	8,0
3	235	205	0,03 - 0,05	5,0	0,04 - 0,07	6,0	0,06 - 0,08	8,0
4	215	190	0,03 - 0,05	5,0	0,04 - 0,07	6,0	0,06 - 0,08	8,0
5	175	155	0,03 - 0,05	5,0	0,04 - 0,07	5,0	0,06 - 0,08	6,5
6	140	110	0,03 - 0,05	4,0	0,04 - 0,07	4,5	0,06 - 0,08	6,0
7	50	35	0,03 - 0,05	2,0	0,04 - 0,06	3,0	0,05 - 0,07	4,0
8	155	145	0,03 - 0,05	5,0	0,04 - 0,07	6,0	0,06 - 0,10	8,0
9	140	135	0,03 - 0,05	5,0	0,04 - 0,06	6,0	0,06 - 0,08	8,0
10	120	115	0,03 - 0,05	4,0	0,04 - 0,06	4,5	0,06 - 0,08	6,0
11	95	90	0,03 - 0,05	4,0	0,04 - 0,06	4,5	0,06 - 0,08	6,0
12	220	205	0,03 - 0,06	5,0	0,05 - 0,09	6,0	0,06 - 0,10	8,0
13	195	185	0,03 - 0,05	5,0	0,04 - 0,07	6,0	0,06 - 0,08	8,0
14	180	175	0,03 - 0,05	5,0	0,04 - 0,07	6,0	0,06 - 0,08	8,0
15	145	140	0,03 - 0,05	5,0	0,04 - 0,06	6,0	0,06 - 0,08	8,0
16	900	850	0,04 - 0,08	5,0	0,05 - 0,09	6,0	0,06 - 0,12	8,0
17	750	700	0,04 - 0,08	5,0	0,05 - 0,09	6,0	0,06 - 0,12	8,0
20	60	55	0,03 - 0,05	3,0	0,03 - 0,06	3,5	0,04 - 0,08	4,5
21	35	30	0,03 - 0,05	2,0	0,03 - 0,06	2,5	0,04 - 0,08	3,5
22	65	60	0,03 - 0,05	3,0	0,03 - 0,06	3,5	0,04 - 0,08	4,5

Bold figures represent first choice in each material group

Cutting data - Side milling ($\kappa=90^\circ$)

Operation	a_e/D_c	Recommended feed per tooth (mm)			Max a_p (mm)	Speed factor
Full engagement	100%	0,03	0,05	0,08	0,5 x D_c	1,0
Side milling	25%	0,08	0,10	0,12	0,75 x D_c	1,3
	10%	0,13	0,16	0,19	1,2 x D_c	1,5
	5%	0,18	0,22	0,27	1,2 x D_c	1,6
Average chip thickness (h_m)		0,02	0,04	0,05		

Drilling - parameters

MP Size	Max depth ($a_e = 100\%$)	Feed (mm/r)
MP10	7,5*	0,04
MP12	9,0*	0,05
MP16	12,0*	0,06

Plunging - Parameters

Diameter \varnothing (mm)	Max radial step (mm)	Feed (mm/tooth)
10	3,0	0,04
12	3,5	0,05
16	4,8	0,06

*Interupted drilling cycle required

Cutting data - Copy milling

$(a_e / D_c \leq 100\%)$

SMG	Cutting speed (m/min)	MP10		MP12		MP16	
		MP3000	Feed mm/tooth	Max depth of cut (mm)	Feed mm/tooth	Max depth of cut (mm)	Feed mm/tooth
1	315	0,07 - 0,10	5,0	0,09 - 0,12	6,0	0,10 - 0,12	8,0
2	280	0,07 - 0,10	5,0	0,09 - 0,12	6,0	0,10 - 0,12	8,0
3	235	0,06 - 0,08	5,0	0,08 - 0,10	6,0	0,10 - 0,12	8,0
4	215	0,06 - 0,08	5,0	0,08 - 0,10	6,0	0,10 - 0,12	8,0
5	175	0,06 - 0,08	5,0	0,08 - 0,10	5,0	0,10 - 0,12	6,5
6	140	0,06 - 0,08	4,0	0,08 - 0,10	4,5	0,10 - 0,12	6,0
7	50	0,06 - 0,08	2,0	0,08 - 0,10	3,0	0,10 - 0,12	4,0
8	155	0,06 - 0,08	5,0	0,08 - 0,10	6,0	0,10 - 0,12	8,0
9	140	0,06 - 0,08	5,0	0,08 - 0,10	6,0	0,10 - 0,12	8,0
10	120	0,06 - 0,08	4,0	0,08 - 0,10	4,5	0,10 - 0,12	6,0
11	95	0,06 - 0,08	4,0	0,08 - 0,10	4,5	0,10 - 0,12	6,0
12	220	0,06 - 0,08	5,0	0,08 - 0,10	6,0	0,10 - 0,12	8,0
13	195	0,06 - 0,08	5,0	0,08 - 0,10	6,0	0,10 - 0,12	8,0
14	180	0,06 - 0,08	5,0	0,08 - 0,10	6,0	0,10 - 0,12	8,0
15	145	0,06 - 0,08	5,0	0,07 - 0,09	6,0	0,08 - 0,10	8,0
16	900	0,04 - 0,08	5,0	0,10 - 0,12	6,0	0,10 - 0,14	8,0
17	750	0,04 - 0,08	5,0	0,10 - 0,12	6,0	0,10 - 0,14	8,0
20	60	0,06 - 0,08	3,0	0,07 - 0,10	3,5	0,09 - 0,12	4,5
21	35	0,06 - 0,08	2,0	0,07 - 0,10	2,5	0,09 - 0,12	3,5
22	65	0,06 - 0,08	3,0	0,07 - 0,10	3,5	0,09 - 0,12	4,5

Feed selection

Roughing application						
D.O.C a_p (mm)	Working diameter D_w (mm)			a_e/D_c		
	MP10	MP12	MP16	20%	40%	100%
				Feed recommendations f_z (mm/tooth)		
8,0	-	-	$1,00 \times D_c$	0,16	0,14	0,10
6,0	-	$1 \times D_c$	$0,94 \times D_c$	0,16 - 0,20	0,10 - 0,14	0,10 - 0,12
5,0	$1 \times D_c$	$0,97 \times D_c$	$0,90 \times D_c$	0,12 - 0,25	0,08 - 0,19	0,06 - 0,14
4,0	$0,96 \times D_c$	$0,94 \times D_c$	$0,83 \times D_c$	0,14 - 0,25	0,10 - 0,19	0,10 - 0,19
3,0	$0,92 \times D_c$	$0,87 \times D_c$	$0,75 \times D_c$	0,15 - 0,30	0,12 - 0,25	0,10 - 0,25
2,0	$0,80 \times D_c$	$0,75 \times D_c$	$0,63 \times D_c$	0,17 - 0,30	0,13 - 0,25	0,13 - 0,25
1,0	$0,60 \times D_c$	$0,55 \times D_c$	$0,46 \times D_c$	0,20 - 0,35	0,17 - 0,35	0,17 - 0,35
Speed factor				$1,30 \times V_c$	$1,20 \times V_c$	$1,00 \times V_c$

Reduce f_z by 30% for Material group No.7. Multiply speed value by speed factor

Feed selection

Finishing application						
D.O.C a_p (mm)	Working diameter D_w (mm)			a_e/D_c		
	MP10	MP12	MP16	2%	5%	10%
				Profile height, H (mm)		
					0,002	0,008
				Feed recommendations, f_z (mm/tooth)		
1,5	$0,70 \times D_c$	$0,66 \times D_c$	$0,55 \times D_c$	0,12 - 0,18	0,20 - 0,30	0,15 - 0,25
1,0	$0,60 \times D_c$	$0,55 \times D_c$	$0,46 \times D_c$			
0,6	$0,47 \times D_c$	$0,43 \times D_c$	$0,36 \times D_c$	0,10 - 0,16	0,25 - 0,35	0,18 - 0,30
0,4	$0,38 \times D_c$	$0,35 \times D_c$	$0,29 \times D_c$			
0,2	$0,26 \times D_c$	$0,24 \times D_c$	$0,21 \times D_c$	0,08 - 0,14	0,20 - 0,30	0,25 - 0,40
0,1	$0,20 \times D_c$	$0,18 \times D_c$	$0,15 \times D_c$			
Speed factor				$1,60 \times V_c$	$1,40 \times V_c$	$1,30 \times V_c$

Normally there is no need for balancing tools for RPM up to 10 000. However in some cases balancing is necessary, for instance when using heavy tools and toolholders in small machines

Over 10 000 RPM:

We recommend balancing of tool and toolholders at least separately.

Over 20 000 RPM:

Both tool and toolholders must be balanced at least separately.

Over 30 000 RPM:

Tool and tool holders must be balanced as a unit.

The max RPM in the tables should never be exceeded.

The exception is the Minimaster®Plus programme where the values are given in the table below.

Minimaster®Plus

Cutter	D _c min	Torque values (Nm)	Max RPM
MP10 -Steel shank	10	8	80000
MP12 -Steel shank	12	12	72700
MP16 -Steel shank	16	16	63600

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