

# HARD IMPROVEMENT FOR HARD METALS

VHM 238 / 239 HX63

VHM 238 / 239 HX70



Jongen Werkzeugtechnik GmbH & Co. KG

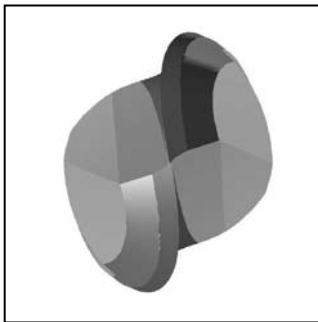


## Advantages

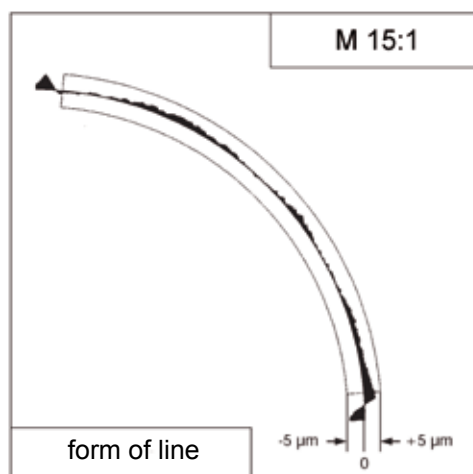
- » Shorter machining process through high cutting parameters
- » Long tool life
- » Stable working procedure
- » Brilliant application characteristics
  - excellent running smoothness
  - very good surfaces
- » High working precision
- » Available in two different length versions
- » For a well-practicable functionality the tools are reduced (settled) by grinding

## The Tool

- » Ball-shaped end mill available in a long and a short version
- » Holding shafts made to DIN 6536-HA
- » Spiral slot angle 30°
- » Reduced (settled) by grinding for a well-practicable functionality
- » Cutting edge geometry specifically designed for machining hard metals
- » Improved micro geometries
- » Cutting edges working in centre strengthened against eruption



- » Contour preciseness within 10  $\mu\text{m}$
- » Radius correctness  $\pm 5 \mu\text{m}$



## Cutting Material „HX63”

### Hard metal:

- » Ultra finest-grain carbide type \*ISO: K10-K30\*
- » Specifically designed for machining hard materials, applicatio areas up to 63 HRC

### Coating type:

- » AlTiN-Nanocomposit coating exclusively developed for machining hard materials
- » Finest coating structure
- » High oxidation stability and hot hardness
- » Extreme high tenacity
- » Very hard material type

## Cutting Material „HX70“

### Hard metal:

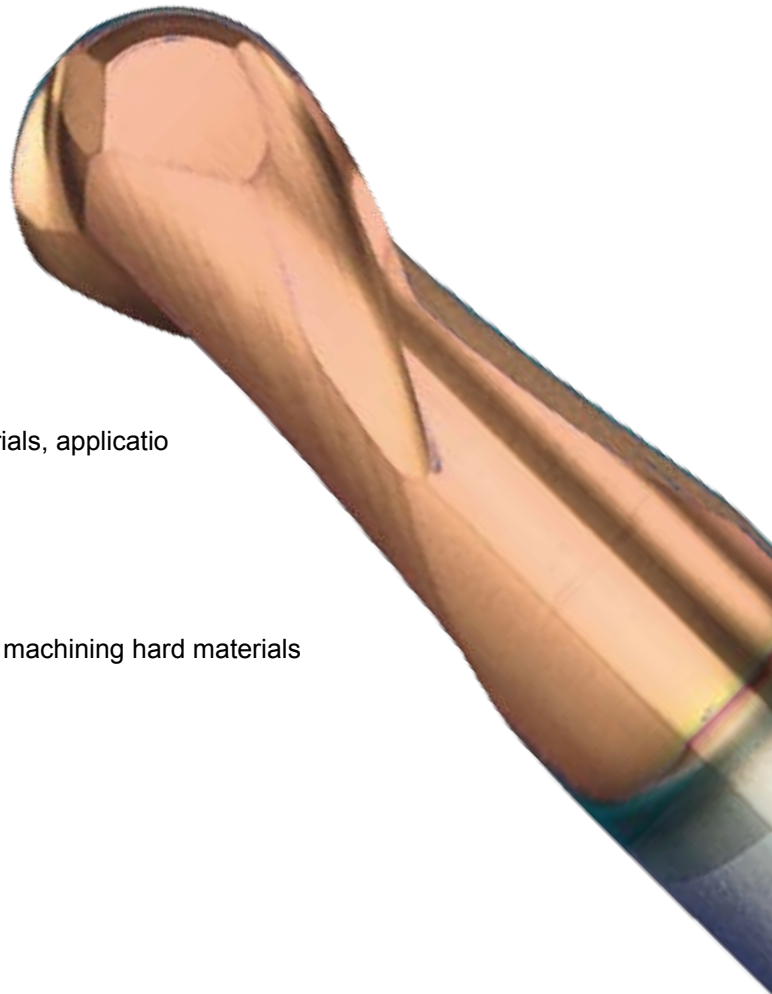
- » Ultra finest-grain carbide type \*ISO: K10-K20\*
- » Specifically designed for machining hard materials, applicatio areas up to 70 HRC

### Coating type:

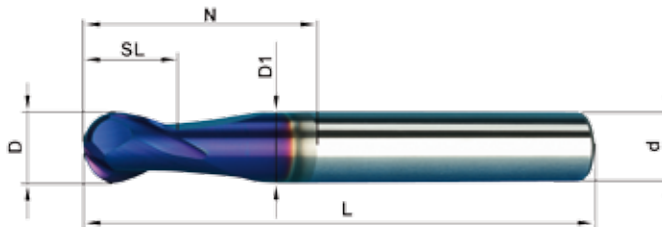
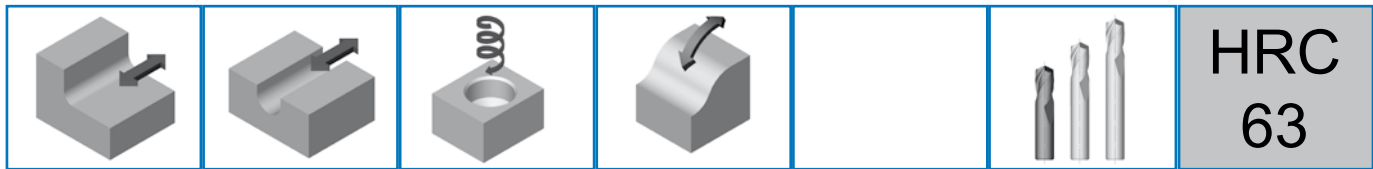
- » TiAlN/TiAlSiN coating exclusively developed for machining hard materials
- » Finest coating structure
- » High oxidation stability and hot hardness
- » Extreme high tenacity
- » Very hard material type

## Application Areas

- » Suitable for pre-finishing and finishing of all tempered steels
- » HX63 applicable up to 63HRC
- » HX70 applicable up to 70HRC



## Technical Data VHM 238-...



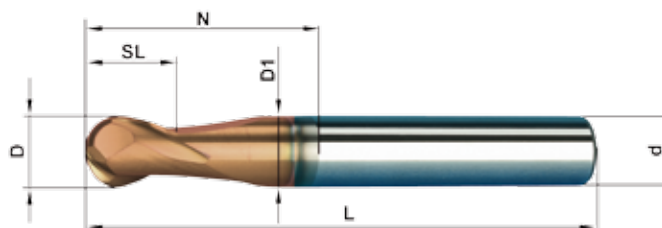
Tolerance  $\varnothing$ :

$$\varnothing 2,0 - 8,0 = \begin{matrix} -0,008 \\ -0,018 \end{matrix}$$

$$\varnothing 10,0 - 16,0 = \begin{matrix} -0,013 \\ -0,028 \end{matrix}$$

### VHM 238... HX63

Order-No	D	SL	D1	N	d <sub>h6</sub>	L	Z
VHM 238-02 HX63	2	2	-	6,8	6	58	2
VHM 238-03 HX63	3	3	-	10,3	6	58	2
VHM 238-04 HX63	4	4	-	13,8	6	58	2
VHM 238-05 HX63	5	5	-	17,2	6	58	2
VHM 238-06 HX63	6	6	5,6	21,0	6	58	2
VHM 238-08 HX63	8	8	7,6	27,0	8	64	2
VHM 238-10 HX63	10	10	9,6	32,0	10	73	2
VHM 238-12 HX63	12	12	11,6	38,0	12	84	2
VHM 238-16 HX63	16	16	15,6	44,0	16	93	2



Tolerance  $\varnothing$ :

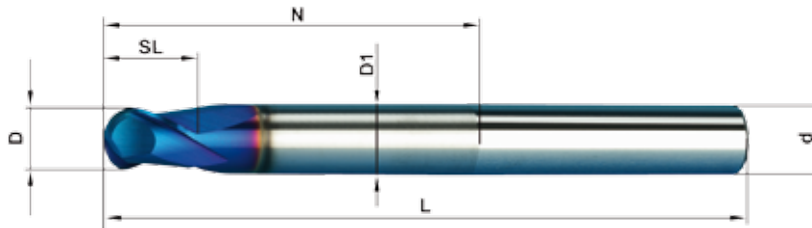
$$\varnothing 2,0 - 8,0 = \begin{matrix} -0,008 \\ -0,018 \end{matrix}$$

$$\varnothing 10,0 - 16,0 = \begin{matrix} -0,013 \\ -0,028 \end{matrix}$$

### VHM 238... HX70

Order-No	D	SL	D1	N	d <sub>h6</sub>	L	Z
VHM 238-02 HX70	2	2	-	6,8	6	58	2
VHM 238-03 HX70	3	3	-	10,3	6	58	2
VHM 238-04 HX70	4	4	-	13,8	6	58	2
VHM 238-05 HX70	5	5	-	17,2	6	58	2
VHM 238-06 HX70	6	6	5,6	21,0	6	58	2
VHM 238-08 HX70	8	8	7,6	27,0	8	64	2
VHM 238-10 HX70	10	10	9,6	32,0	10	73	2
VHM 238-12 HX70	12	12	11,6	38,0	12	84	2
VHM 238-16 HX70	16	16	15,6	44,0	16	93	2

Technical Data VHM 239-...

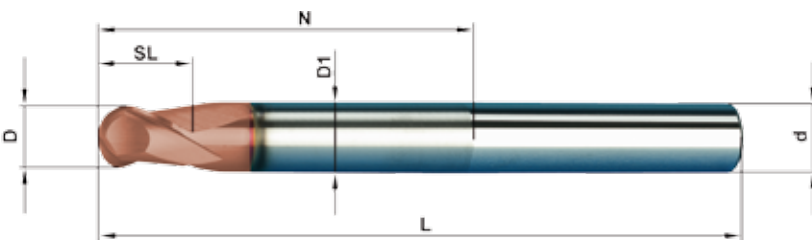


Tolerance  $\varnothing$ :

$\varnothing$  2,0 - 8,0 = -0,008  
 -0,018  
 $\varnothing$  10,0 - 16,0 = -0,013  
 -0,028

VHM 239... HX63

Order-No	D	SL	D1	N	d <sub>h6</sub>	L	Z
VHM 239-02 HX63	2	2	-	10,9	6	73	2
VHM 239-03 HX63	3	3	-	17,0	6	73	2
VHM 239-04 HX63	4	4	-	22,8	6	73	2
VHM 239-05 HX63	5	5	-	28,5	6	73	2
VHM 239-06 HX63	6	6	5,6	36,0	6	73	2
VHM 239-08 HX63	8	8	7,6	47,0	8	84	2
VHM 239-10 HX63	10	10	9,6	52,0	10	93	2
VHM 239-12 HX63	12	12	11,6	64,0	12	110	2
VHM 239-16 HX63	16	16	15,6	91,0	16	140	2



Tolerance  $\varnothing$ :

$\varnothing$  2,0 - 8,0 = -0,008  
 -0,018  
 $\varnothing$  10,0 - 16,0 = -0,013  
 -0,028

VHM 239... HX70

Order-No	D	SL	D1	N	d <sub>h6</sub>	L	Z
VHM 239-02 HX70	2	2	-	10,9	6	73	2
VHM 239-03 HX70	3	3	-	17,0	6	73	2
VHM 239-04 HX70	4	4	-	22,8	6	73	2
VHM 239-05 HX70	5	5	-	28,5	6	73	2
VHM 239-06 HX70	6	6	5,6	36,0	6	73	2
VHM 239-08 HX70	8	8	7,6	47,0	8	84	2
VHM 239-10 HX70	10	10	9,6	52,0	10	93	2
VHM 239-12 HX70	12	12	11,6	64,0	12	110	2
VHM 239-16 HX70	16	16	15,6	91,0	16	140	2

## Cutting Data Recommendations/ Values for Roughing

Material	Mode			Diameter of the tool [mm]								
				2,0	3,0	4,0	5,0	6,0	8,0	10,0	12,0	16,0
Tool steel (25-35HRC)	High Speed	$a_p=0,06-0,08 D$	$n \text{ (min}^{-1}\text{)}$	47.800	31.800	23.900	19.000	18.000	13.500	10.800	9.000	6.800
			$V_C \text{ (m/min)}$	300	300	300	300	340	340	340	340	340
		$a_e=0,3 D$	$V_f \text{ (mm/min)}$	2.870	3.180	3.350	3.450	3.960	4.050	3.890	3.420	2.570
			$f_z \text{ (mm/Zahn)}$	0,03	0,05	0,07	0,09	0,11	0,15	0,18	0,19	0,19
	General	$a_p=0,06-0,08 D$	$n \text{ (min}^{-1}\text{)}$	19.100	15.900	11.900	10.200	9.600	7.200	5.700	4.800	3.580
			$V_C \text{ (m/min)}$	120	150	150	160	180	180	180	180	180
		$a_e=0,3 D$	$V_f \text{ (mm/min)}$	1.150	1.590	1.670	1.830	2.110	2.160	2.050	1.820	1.260
			$f_z \text{ (mm/Zahn)}$	0,03	0,05	0,07	0,09	0,11	0,15	0,18	0,19	0,19
Pre-tempered steel (35-45 HRC)	High Speed	$a_p=0,06-0,08 D$	$n \text{ (min}^{-1}\text{)}$	47.800	31.800	23.900	19.000	18.000	13.500	10.800	9.000	6.780
			$V_C \text{ (m/min)}$	300	300	300	300	340	340	340	340	340
		$a_e=0,3 D$	$V_f \text{ (mm/min)}$	2.870	3.180	2.870	3.050	3.240	3.510	3.460	3.060	2.300
			$f_z \text{ (mm/Zahn)}$	0,03	0,05	0,06	0,08	0,09	0,13	0,16	0,17	0,17
	General	$a_p=0,06-0,08 D$	$n \text{ (min}^{-1}\text{)}$	19.100	15.900	11.900	10.200	9.600	7.200	5.700	4.800	3.580
			$V_C \text{ (m/min)}$	120	150	150	160	180	180	180	180	180
		$a_e=0,3 D$	$V_f \text{ (mm/min)}$	1.150	1.590	1.430	1.420	1.730	1.870	1.820	1.630	1.220
			$f_z \text{ (mm/Zahn)}$	0,03	0,05	0,06	0,07	0,09	0,13	0,16	0,17	0,17
Tempered steel (45-55 HRC)	High Speed	$a_p=0,05-0,06 D$	$n \text{ (min}^{-1}\text{)}$	38.200	27.600	20.700	16.500	14.900	11.100	8.900	7.400	5.570
			$V_C \text{ (m/min)}$	240	260	260	260	280	280	280	280	280
		$a_e=0,25 D$	$V_f \text{ (mm/min)}$	2.290	2.210	2.480	2.300	2.680	2.660	2.490	2.220	1.670
			$f_z \text{ (mm/Zahn)}$	0,03	0,04	0,06	0,07	0,09	0,12	0,14	0,15	0,15
	General	$a_p=0,05-0,06 D$	$n \text{ (min}^{-1}\text{)}$	15.900	12.700	9.600	7.600	7.400	5.600	4.500	3.700	2.800
			$V_C \text{ (m/min)}$	100	120	120	120	140	140	140	140	140
		$a_e=0,25 D$	$V_f \text{ (mm/min)}$	640	1.020	960	900	1.180	1.230	1.170	1.040	780
			$f_z \text{ (mm/Zahn)}$	0,02	0,04	0,05	0,06	0,08	0,11	0,13	0,14	0,14
Tempered steel (55-63 HRC)	High Speed	$a_p=0,03-0,04 D$	$n \text{ (min}^{-1}\text{)}$	28.700	21.200	15.900	12.700	12.700	9.600	7.600	6.400	4.800
			$V_C \text{ (m/min)}$	180	200	200	200	240	240	240	240	240
		$a_e=0,25 D$	$V_f \text{ (mm/min)}$	1.150	1.700	1.590	1.500	2.030	1.920	1.980	1.790	1.240
			$f_z \text{ (mm/Zahn)}$	0,02	0,04	0,05	0,06	0,08	0,10	0,13	0,14	0,14
	General	$a_p=0,03-0,04 D$	$n \text{ (min}^{-1}\text{)}$	12.700	10.600	8.000	6.400	6.400	4.800	3.800	3.200	2.390
			$V_C \text{ (m/min)}$	80	100	100	100	120	120	120	120	120
		$a_e=0,25 D$	$V_f \text{ (mm/min)}$	510	640	800	760	900	860	910	830	620
			$f_z \text{ (mm/Zahn)}$	0,02	0,03	0,05	0,06	0,07	0,09	0,12	0,13	0,13
Tempered steel (63-70 HRC)	High Speed	$a_p=0,02-0,03 D$	$n \text{ (min}^{-1}\text{)}$	19.100	12.700	9.600	7.600	8.500	6.400	5.100	4.200	3.200
			$V_C \text{ (m/min)}$	120	120	120	120	160	160	160	160	160
		$a_e=0,2 D$	$V_f \text{ (mm/min)}$	760	1.020	960	900	1.360	1.280	1.330	1.180	890
			$f_z \text{ (mm/Zahn)}$	0,02	0,04	0,05	0,06	0,08	0,10	0,13	0,14	0,14
	General	$a_p=0,02-0,03 D$	$n \text{ (min}^{-1}\text{)}$	8.000	5.300	4.000	3.820	4.200	3.200	2.500	2.100	1.520
			$V_C \text{ (m/min)}$	50	50	50	60	80	80	80	80	80
		$a_e=0,2 D$	$V_f \text{ (mm/min)}$	320	320	400	460	590	580	600	550	420
			$f_z \text{ (mm/Zahn)}$	0,02	0,03	0,05	0,06	0,07	0,09	0,12	0,13	0,13

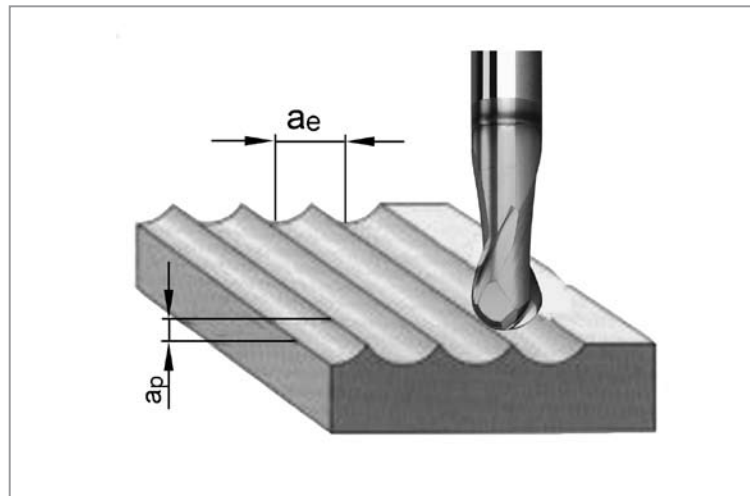
The above-mentioned data are standard values that may vary depending on processing, type of machine and material grade. For processing use a machine with the highest preciseness and rigidity. Should the available rotation number be lower of that given in the table, reduce feed rate proportionally.

## Cutting Data Recommendations/ Values for Finishing

Material	Mode			Diameter of the tool [mm]								
				2,0	3,0	4,0	5,0	6,0	8,0	10,0	12,0	16,0
Tool steel (25-35HRC)	High Speed	$a_p=0,05-0,1 D$	$n \text{ (min}^{-1}\text{)}$	47.800	31.800	23.900	19.000	15.900	13.900	11.100	9.300	6.900
			$V_C \text{ (m/min)}$	300	300	300	300	300	350	350	350	350
		$a_e=0,02-0,6 D$	$V_f \text{ (mm/min)}$	5.740	4.450	4.300	3.440	3.500	3.340	2.890	2.600	1.950
			$f_z \text{ (mm/Zahn)}$	0,06	0,07	0,09	0,09	0,11	0,12	0,13	0,14	0,14
	General	$a_p=0,05-0,1 D$	$n \text{ (min}^{-1}\text{)}$	19.100	19.100	14.300	11.500	9.600	8.000	6.400	5.300	4.000
			$V_C \text{ (m/min)}$	120	180	180	180	180	200	200	200	200
		$a_e=0,02-0,6 D$	$V_f \text{ (mm/min)}$	2.290	2.670	2.570	2.050	2.110	1.920	1.660	1.480	1.120
			$f_z \text{ (mm/Zahn)}$	0,06	0,07	0,09	0,09	0,11	0,12	0,13	0,14	0,14
Pre-tempered steel (35-45 HRC)	High Speed	$a_p=0,05-0,1 D$	$n \text{ (min}^{-1}\text{)}$	47.800	31.800	23.900	19.000	15.900	13.900	11.100	9.300	7.000
			$V_C \text{ (m/min)}$	300	300	300	300	300	350	350	350	350
		$a_e=0,02-0,6 D$	$V_f \text{ (mm/min)}$	5.740	4.450	4.300	3.440	3.500	3.340	2.890	2.600	1.950
			$f_z \text{ (mm/Zahn)}$	0,06	0,07	0,09	0,09	0,11	0,12	0,13	0,14	0,14
	General	$a_p=0,05-0,1 D$	$n \text{ (min}^{-1}\text{)}$	19.100	19.100	14.300	11.500	9.600	8.000	6.400	5.300	4.000
			$V_C \text{ (m/min)}$	120	180	180	180	180	200	200	200	200
		$a_e=0,02-0,6 D$	$V_f \text{ (mm/min)}$	2.290	2.670	2.570	2.050	2.110	1.920	1.660	1.480	1.120
			$f_z \text{ (mm/Zahn)}$	0,06	0,07	0,09	0,09	0,11	0,12	0,13	0,14	0,14
Tempered steel (45-55 HRC)	High Speed	$a_p=0,05-0,08 D$	$n \text{ (min}^{-1}\text{)}$	39.800	26.500	19.900	15.900	14.900	11.100	8.900	7.400	5.570
			$V_C \text{ (m/min)}$	250	250	250	250	280	280	280	280	280
		$a_e=0,02-0,4 D$	$V_f \text{ (mm/min)}$	3.980	3.180	3.180	2.860	3.280	2.660	2.310	2.070	1.560
			$f_z \text{ (mm/Zahn)}$	0,05	0,06	0,08	0,09	0,11	0,12	0,13	0,14	0,14
	General	$a_p=0,05-0,08 D$	$n \text{ (min}^{-1}\text{)}$	19.100	13.800	10.400	8.900	8.000	6.000	4.800	4.000	2.980
			$V_C \text{ (m/min)}$	120	130	130	140	150	150	150	150	150
		$a_e=0,02-0,4 D$	$V_f \text{ (mm/min)}$	1.910	1.660	1.660	1.600	1.760	1.440	1.250	1.120	840
			$f_z \text{ (mm/Zahn)}$	0,05	0,06	0,08	0,09	0,11	0,12	0,13	0,14	0,14
Tempered steel (55-63 HRC)	High Speed	$a_p=0,04-0,06 D$	$n \text{ (min}^{-1}\text{)}$	31.800	21.200	15.900	14.000	13.300	10.000	8.000	6.600	4.980
			$V_C \text{ (m/min)}$	200	200	200	220	250	250	250	250	250
		$a_e=0,02-0,4 D$	$V_f \text{ (mm/min)}$	3.180	2.540	2.540	2.520	2.660	2.200	1.920	1.720	1.300
			$f_z \text{ (mm/Zahn)}$	0,05	0,06	0,08	0,09	0,10	0,11	0,12	0,13	0,13
	General	$a_p=0,04-0,06 D$	$n \text{ (min}^{-1}\text{)}$	19.100	12.700	9.600	8.300	8.000	6.000	4.800	4.000	3.000
			$V_C \text{ (m/min)}$	120	120	120	130	150	150	150	150	150
		$a_e=0,02-0,4 D$	$V_f \text{ (mm/min)}$	1.910	1.520	1.540	1.490	1.600	1.320	1.150	1.040	780
			$f_z \text{ (mm/Zahn)}$	0,05	0,06	0,08	0,09	0,10	0,11	0,12	0,13	0,13
Tempered steel (63-70 HRC)	High Speed	$a_p=0,02-0,04 D$	$n \text{ (min}^{-1}\text{)}$	23.900	15.900	11.900	10.800	10.600	8.000	6.400	5.300	4.000
			$V_C \text{ (m/min)}$	150	150	150	170	200	200	200	200	200
		$a_e=0,02-0,03 D$	$V_f \text{ (mm/min)}$	2.390	1.910	1.900	1.950	2.120	1.760	1.540	1.380	1.040
			$f_z \text{ (mm/Zahn)}$	0,05	0,06	0,08	0,05	0,10	0,11	0,12	0,13	0,13
	General	$a_p=0,02-0,04 D$	$n \text{ (min}^{-1}\text{)}$	14.300	9.600	7.200	6.400	6.400	4.800	3.800	3.200	2.400
			$V_C \text{ (m/min)}$	90	90	90	100	120	120	120	120	120
		$a_e=0,02-0,03 D$	$V_f \text{ (mm/min)}$	1.430	1.150	1.150	1.150	1.280	1.060	910	830	620
			$f_z \text{ (mm/Zahn)}$	0,05	0,06	0,08	0,09	0,10	0,11	0,12	0,13	0,13

The above-mentioned data are standard values that may vary depending on processing, type of machine and material grade. For processing use a machine with the highest preciseness and rigidity. Should the available rotation number be lower of that given in the table, reduce feed rate proportionally.

## Theoretical Surface Finish by Milling ( $\mu\text{m}$ )



$R_{th}$ [ $\mu\text{m}$ ]		$a_e$ [mm]							
		0,05	0,075	0,1	0,15	0,2	0,3	0,4	0,5
Diameter of the tool [mm]	2,0	0,31	0,70	1,25	2,82	5,01	11,31	20,20	31,75
	3,0	0,21	0,47	0,83	1,88	3,33	7,50	13,33	20,83
	4,0	0,16	0,35	0,63	1,41	2,50	5,63	10,03	15,69
	5,0	0,13	0,28	0,50	1,12	2,00	4,50	8,00	12,50
	6,0	0,10	0,23	0,42	0,94	1,67	3,75	6,67	10,43
	8,0	0,08	0,18	0,31	0,70	1,25	2,81	5,00	7,82
	10,0	0,06	0,14	0,25	0,56	1,00	2,25	4,00	6,25
	12,0	0,05	0,12	0,21	0,47	0,83	1,88	3,33	5,21
	16,0	0,04	0,09	0,16	0,35	0,63	1,41	2,50	3,91

**Theoretic formula**

$$R_{th} = \frac{a_e^2}{4 \cdot D} \text{ [}\mu\text{m]}$$

or:

$$R_{th} = \frac{D}{2} - \sqrt{\frac{D^2 - br^2}{4}} \text{ [}\mu\text{m]}$$

### Formula for feed rate/rotation (mm)

$$f = \sqrt{\frac{R_{th} \cdot 4 \cdot D}{10000}} \text{ [mm]}$$