



**Cerini**<sup>®</sup>

CUTTING TOOLS MANUFACTURING



Standard endmills  
HPC endmills  
Endmills for tempered steels  
T-slot cutters

# Steel Milling





*We develop products and processes  
to propose advanced solutions*

Since 1971 Cerin has been among the Italian leaders in precision engineering. For more than 50 years of activity the company has been closely involved in solid carbide technological development as well as its many fields of application, both traditional and highly innovative.

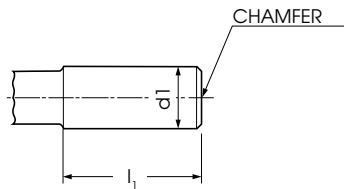
Today, Cerin provides its customers with the benefit of a long experience by offering a complete range of high performance cutters dedicated to the machining of ferrous materials.



COMPANY WITH  
QUALITY SYSTEM  
CERTIFIED BY DNV GL  
= ISO 9001 =

## Shank design (for drilling and milling tools) DIN 6535

### Straight cylindrical shank - Shape HA

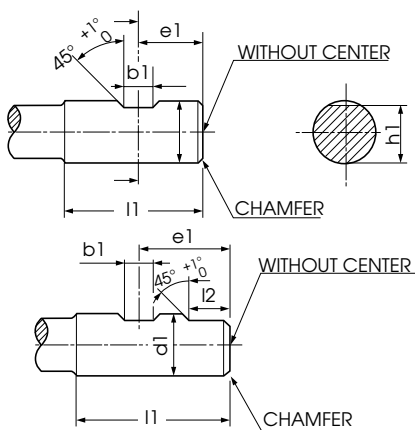


$d_1$	$l_1$	$d_1$	$l_1$	$d_1$	$l_1$
<b>h6</b>	<b>+2/0</b>	<b>h6</b>	<b>+2/0</b>	<b>h6</b>	<b>+2/0</b>
2	28	8	36	18	48
3	28	10	40	20	50
4	28	12	45	25	56
5	28	14	45	32	60
6	36	16	48		

### Cylindrical shank - Shape HB

one Weldon flat -  $d_1 = 6$  to 20 mm

two Weldon flats -  $d_1 = 25$  to 32 mm

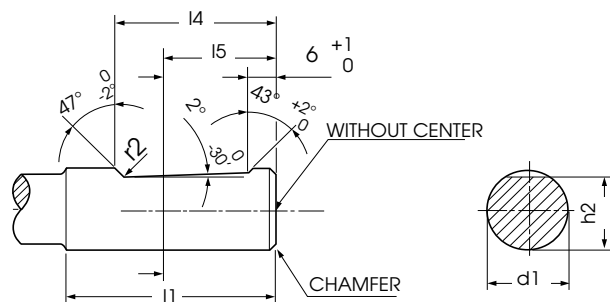


$d_1$	$b_1$	$e_1$	$h_1$	$l_1$	$l_2$
<b>h6</b>	<b>+0,05/0</b>	<b>0/-1</b>	<b>h11</b>	<b>+2/0</b>	<b>+1/0</b>
6	4,2	18	5,1	36	
8	5,5	18	6,9	36	
10	7	20	8,5	40	
12	8	22,5	10,4	45	
14	8	22,5	12,7	45	
16	10	24	14,2	48	
18	10	24	16,2	48	
20	11	25	18,2	50	
25	12	32	23	56	17
32	14	36	32	60	19

### Cylindrical shank - Shape HE

one slope flat -  $d_1 = 6$  to 20 mm

one slope flat -  $d_1 = 25$  to 32 mm



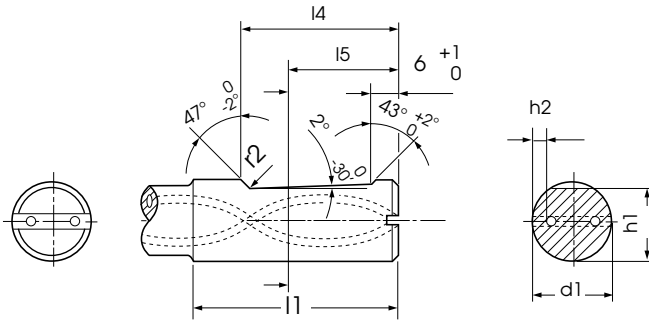
$d_1$	$(b_2)$	$(b_3)$	$h_2$	$(h_3)$	$l_1$	$l_4$	$l_5$	$r_2$
<b>h6</b>			<b>h11</b>		<b>+2/0</b>	<b>0/-1</b>	<small>Nominal size</small>	<small>min.</small>
6	4,3		5,1		36	25	18	1,2
8	5,5		6,9		36	25	18	1,2
10	7,1		8,5		40	28	20	1,2
12	8,2		10,4		45	33	22,5	1,2
14	8,1		12,7		45	33	22,5	1,2
16	10,1		14,2		48	36	24	1,6
18	10,8		16,2		48	36	24	1,6
20	11,4		18,2		50	38	25	1,6
25	13,8	9,3	23	24,1	56	44	32	1,6
32	15,5	9,9	30	31,2	60	48	35	1,6

## Shank design (for drilling and milling tools) similar to DIN 6535

### Cylindrical shank - Shape HEK

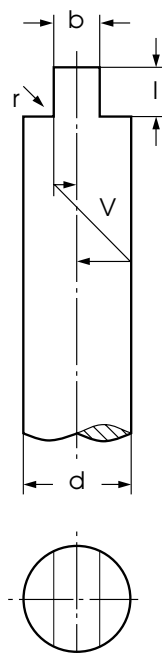
one slope flat - d1 = 6 to 20 mm

one slope flat - d1 = 25 to 32 mm



d <sub>1</sub>	l <sub>1</sub>	l <sub>4</sub>	l <sub>5</sub>	h <sub>1</sub>	r <sub>2</sub>	h <sub>2</sub>
h6	+2/0	0/-1	Nominal size	h11		min.
6	36	25	18	5,3	1,2	1,3
8	36	25	18	7,1	1,2	1,5
10	40	28	20	8,9	1,2	1,8
12	45	33	22,5	10,9	1,2	2
14	45	33	22,5	12,4	1,2	2,5
16	48	36	24	14,5	1,6	2,5
18	48	36	24	16,2	1,6	2,8
20	50	38	25	18,2	1,6	3
25	56	44	32	23	1,6	3,7
32	60	48	35	30	1,6	4,5

### Shank with drive tenon DIN 1809



d		b	l	r	v
from	up to	h12	± IT16 <sup>1</sup>		
3	3,5	1,6	2,2	0,2	0,05
3,5	4	2	2,2	0,2	0,05
4	4,5	2,2	2,5	0,2	0,05
4,5	5,5	2,5	2,5	0,2	0,05
5,5	6,5	3	3	0,2	0,05
6,5	8	3,5	3,5	0,2	0,06
8	9,5	4,5	4,5	0,4	0,06
9,5	11	5	5	0,4	0,06
11	13	6	6	0,4	0,06
13	15	7	7	0,4	0,08
15	18	8	8	0,4	0,08
18	21	10	10	0,4	0,08
21	24	11	11	0,6	0,1
24	27	13	13	0,6	0,1
27	30	14	14	0,6	0,1
30	34	16	16	0,6	0,1
34	38	18	18	0,6	0,1
38	42	20	19	0,6	0,15
42	46	22	20	1	0,15
46	50	24	22	1	0,15

## Formulae of calculation






End mills - Tours cutters - Ball nose cutters		Trace milling	
Revolution per minute	$n = \frac{V_c \times 1000}{D_c \times 3,14}$		
Cutting speed	$V_c = \frac{D_c \times 3,14 \times n}{1000}$		
Feed per tooth	$f_z = \frac{V_f}{Z_n \times n}$	$R_{th}$ Surface roughness $b_r$ Line offset $D_w$ Working diameter	
Feed for revolution	$f = f_z \times Z_n$	Roughness	$R_{th} = \frac{D_c}{2} \sqrt{\frac{D_c^2 - b_r^2}{4}}$
Feed per minute	$V_f = f_z \times Z_n \times n$	Line offset	$b_r = 2\sqrt{R_{th} (D_c - R_{th})}$
Average chip thickness	$h_m = f_z \times \sqrt{\frac{a_e}{D_c}}$	Working diameter	$D_w = 2\sqrt{a_p (D_c - a_p)}$

## Formulae of calculation

### Circular milling - Drill milling - Feed based on movement of the cutter axis VfM (mm/min.)

		Internal profile	$V_{fM} = \frac{V_f \times (D - D_c)}{D}$
		External profile	$V_{fM} = \frac{V_f \times (D + D_c)}{D}$

# Steel Milling

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# Standard Endmills

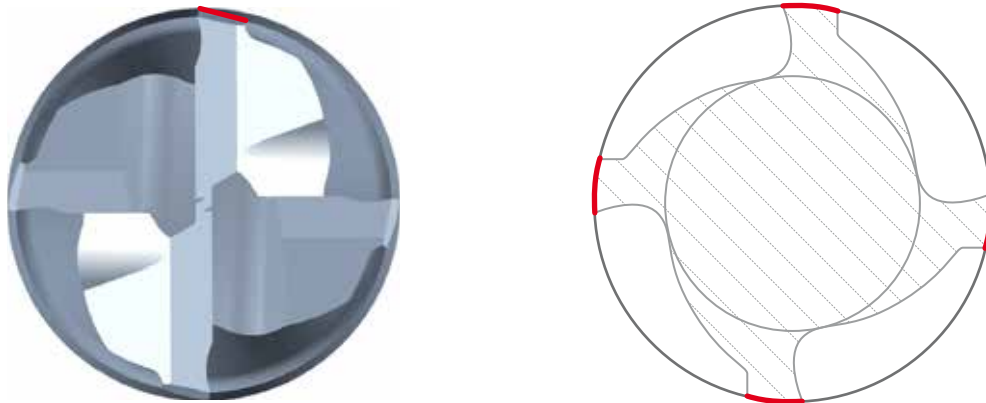


# Tools features

## Radial relief:

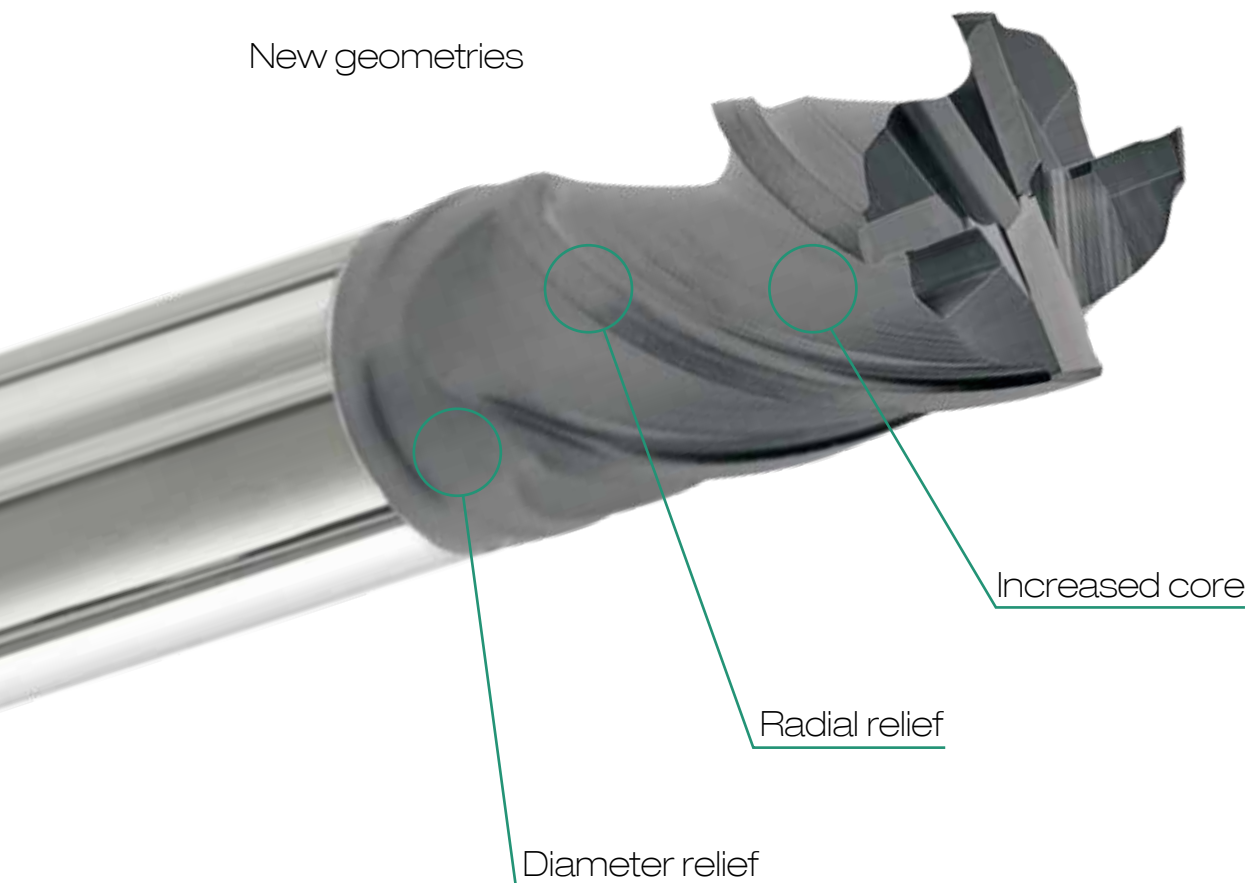
Cutting edge strength suitable for machining medium-hard metals (55 HRC)

Increased core diameter (> 60%) to withstand high bending stresses



## TiAlN based coating

### New geometries



# Test Report

Steel 1.2738

Tool: 64.060061357A

Z=4, Dia. 6, radial relief

Cutting data:

$a_p = 1 \times D$  (6 mm),  $a_e = 0,1 \times D$  (0,6 mm)

$V_c = 200$  m/min

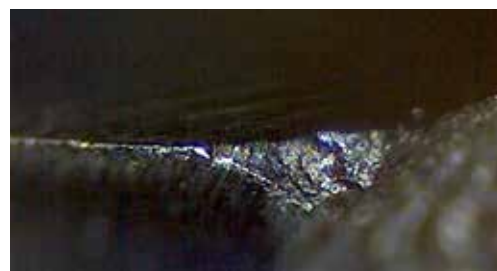
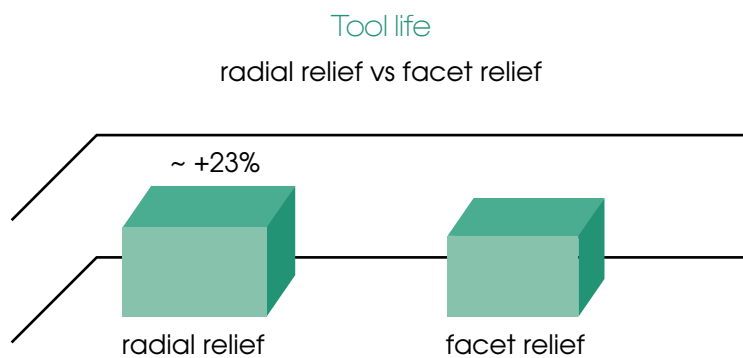
$f_z = 0,1$  mm

Tool life: 340 meters

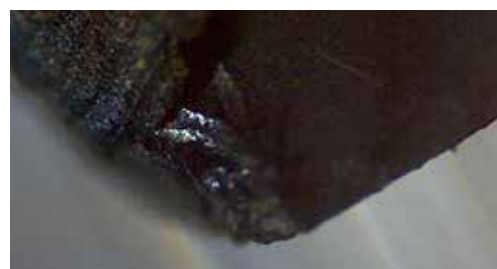


Tempered K110 (1.2379)

Tool: Z=4, radial relief vs facet relief

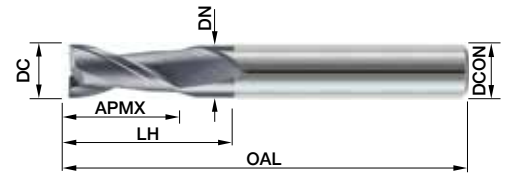


(64.060061357A vs 640W.060061357Y)

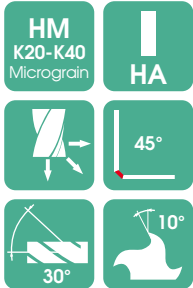


## STANDARD MILLING 2 flutes endmill

PVD TiAlN Cer-T  
Also available without coating



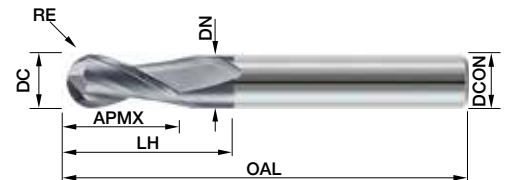
## 62



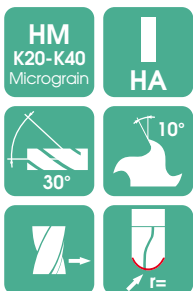
Cod.		DC	APMX	LH	OAL	DCON	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,05
62.020020640A	62.020020640	2	6	10	40	2	1,9
62.020060350A	62.020060350	2	3	6,5	50	6	1,9
62.030030840A	62.030030840	3	8	11	40	3	2,9
62.030060757A	62.030060757	3	7	10,5	57	6	2,9
62.040041040A	62.040041040	4	10	13	40	4	3,9
62.040060857A	62.040060857	4	8	11	57	6	3,9
62.050051250A	62.050051250	5	12	15	50	5	4,9
62.060061057A	62.060061057	6	10	13	57	6	5,9
62.060061450A	62.060061450	6	14	17	50	6	5,9
62.080081663A	62.080081663	8	16	23	63	8	7,9
62.100101972A	62.100101972	10	19	26	72	10	9,8
62.120122283A	62.120122283	12	22	30	83	12	11,8
62.140142283A	62.140142283	14	22	30	83	14	13,8
62.160162692A	62.160162692	16	26	34	92	16	15,8
62.2002032104A	62.2002032104	20	32	45	104	20	19,6
62.2502545120A	62.2502545120	25	45	58	120	25	24,6

## STANDARD MILLING 2 flutes ball nose endmill

PVD TiAlN Cer-T  
Also available without coating



## 62R



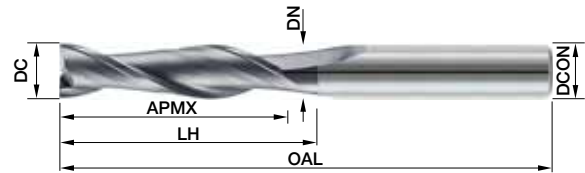
Cod.		DC	APMX	LH	OAL	DCON	RE	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,02	0/-0,05
62R.020020640A	62R.020020640	2	6	10	40	2	1	1,9
62R.030030840A	62R.030030840	3	8	11	40	3	1,5	2,9
62R.030060757A	62R.030060757	3	7	10,5	57	6	1,5	2,9
62R.040041040A	62R.040041040	4	10	13	40	4	2	3,9
62R.040060857A	62R.040060857	4	8	11	57	6	2	3,9
62R.050051250A	62R.050051250	5	12	15	50	5	2,5	4,9
62R.060061057A	62R.060061057	6	10	13	57	6	3	5,9
62R.060061450A	62R.060061450	6	14	17	50	6	3	5,9
62R.080081663A	62R.080081663	8	16	23	63	8	4	7,9
62R.100101972A	62R.100101972	10	19	26	72	10	5	9,8
62R.120122283A	62R.120122283	12	22	30	83	12	6	11,8
62R.140142283A	62R.140142283	14	22	30	83	14	7	13,8
62R.160162692A	62R.160162692	16	26	34	92	16	8	15,8
62R.2002032104A	62R.2002032104	20	32	45	104	20	10	19,6
62R.2502545120A	62R.2502545120	25	45	58	120	25	12,5	24,6

## STANDARD MILLING

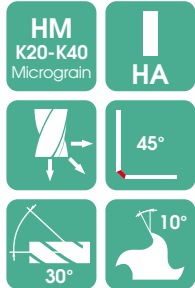
### 2 flutes long endmill

PVD TiAlN Cer-T

Also available without coating



## 62L



Cod.		DC	APMX	LH	OAL	DCON	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,05
62L.030A	62L.030	3	18	23	60	3	2,9
62L.040A	62L.040	4	20	25	60	4	3,9
62L.050A	62L.050	5	25	29	62	5	4,9
62L.060A	62L.060	6	30	34	70	6	5,9
62L.080A	62L.080	8	35	42	79	8	7,9
62L.100A	62L.100	10	40	47	89	10	9,8
62L.120A	62L.120	12	50	55	100	12	11,8
62L.140A	62L.140	14	58	76	125	14	13,8
62L.160A	62L.160	16	58	76	125	16	15,8
62L.200A	62L.200	20	60	73	125	20	19,6

## STANDARD MILLING

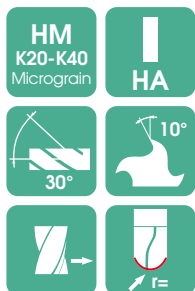
### 2 flutes ball nose long endmill

PVD TiAlN Cer-T

Also available without coating



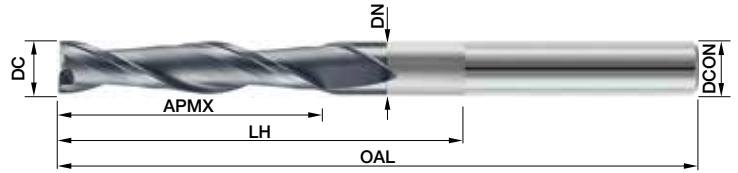
## 62RL



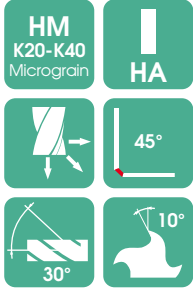
Cod.		DC	APMX	LH	OAL	DCON	RE	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,02	0/-0,05
62RL.030A	62RL.030	3	18	23	60	3	1,5	2,9
62RL.040A	62RL.040	4	20	25	60	4	2	3,9
62RL.050A	62RL.050	5	25	29	62	5	2,5	4,9
62RL.060A	62RL.060	6	30	34	70	6	3	5,9
62RL.080A	62RL.080	8	35	42	79	8	4	7,9
62RL.100A	62RL.100	10	40	47	89	10	5	9,8
62RL.120A	62RL.120	12	50	55	100	12	6	11,8
62RL.140A	62RL.140	14	58	76	125	14	7	13,8
62RL.160A	62RL.160	16	58	76	125	16	8	15,8
62RL.200A	62RL.200	20	60	73	125	20	10	19,6

## STANDARD MILLING 2 flutes extra long endmill

PVD TiAlN Cer-T  
Also available without coating



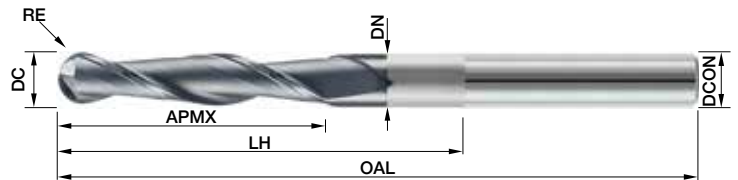
## 62XL



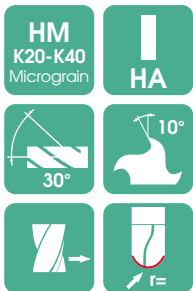
Cod.		DC	APMX	LH	OAL	DCON	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,05
62XL.030A	62XL.030	3	25	37	75	3	2,9
62XL.040A	62XL.040	4	32	39	75	4	3,9
62XL.050A	62XL.050	5	38	58	100	5	4,9
62XL.060A	62XL.060	6	40	60	100	6	5,9
62XL.080A	62XL.080	8	45	63	100	8	7,9
62XL.100A	62XL.100	10	50	75	120	10	9,8
62XL.120A	62XL.120	12	60	100	150	12	11,8
62XL.140A	62XL.140	14	75	103	150	14	13,8
62XL.160A	62XL.160	16	75	100	150	16	15,8
62XL.200A	62XL.200	20	75	98	150	20	19,6

## STANDARD MILLING 2 flutes ball nose extra long endmill

PVD TiAlN Cer-T  
Also available without coating



## 62RXL



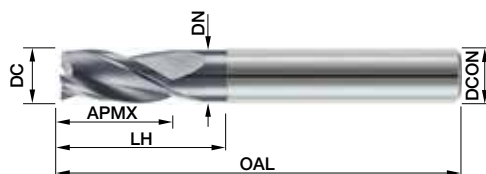
Cod.		DC	APMX	LH	OAL	DCON	RE	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,02	0/-0,05
62RXL.030A	62RXL.030	3	25	37	75	3	1,5	2,9
62RXL.040A	62RXL.040	4	32	39	75	4	2	3,9
62RXL.050A	62RXL.050	5	38	58	100	5	2,5	4,9
62RXL.060A	62RXL.060	6	40	60	100	6	3	5,9
62RXL.080A	62RXL.080	8	45	63	100	8	4	7,9
62RXL.100A	62RXL.100	10	50	75	120	10	5	9,8
62RXL.120A	62RXL.120	12	60	100	150	12	6	11,8
62RXL.140A	62RXL.140	14	75	103	150	14	7	13,8
62RXL.160A	62RXL.160	16	75	100	150	16	8	15,8
62RXL.200A	62RXL.200	20	75	98	150	20	10	19,6

## STANDARD MILLING

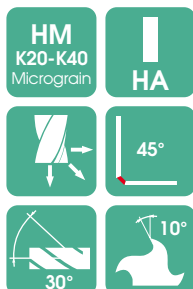
## 3 flutes endmill

PVD TiAlN Cer-T

Also available without coating



## 63



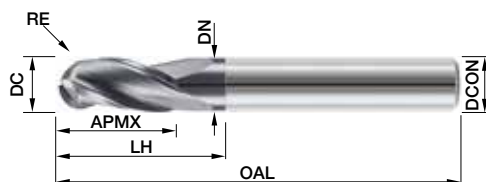
Cod.		DC	APMX	LH	OAL	DCON	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,05
63.020020640A	63.020020640	2	6	10	40	2	1,9
63.020060350A	63.020060350	2	3	6,5	50	6	1,9
63.030031040A	63.030031040	3	10	12	40	3	2,9
63.030060757A	63.030060757	3	7	10,5	57	6	2,9
63.040041140A	63.040041140	4	11	12,5	40	4	3,9
63.040060857A	63.040060857	4	8	11	57	6	3,9
63.050051350A	63.050051350	5	13	19	50	5	4,9
63.060061057A	63.060061057	6	10	19	57	6	5,9
63.060061650A	63.060061650	6	16	16	50	6	5,9
63.080081663A	63.080081663	8	16	23	63	8	7,9
63.100101972A	63.100101972	10	19	26	72	10	9,8
63.120122283A	63.120122283	12	22	34	83	12	11,8
63.140142283A	63.140142283	14	22	36	83	14	13,8
63.160162692A	63.160162692	16	26	42	92	16	15,8
63.2002032104A	63.2002032104	20	32	52	104	20	19,6
63.2502545120A	63.2502545120	25	45	58	120	25	24,6

## STANDARD MILLING

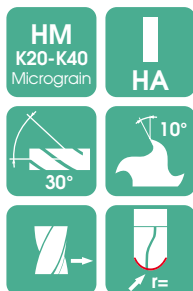
## 3 flutes ball nose endmill

PVD TiAlN Cer-T

Also available without coating



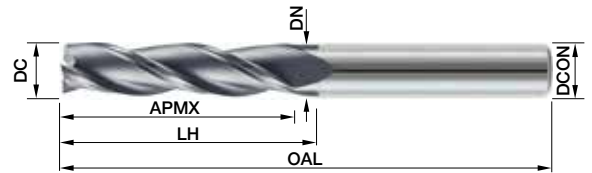
## 63R



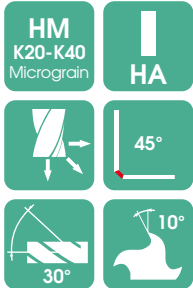
Cod.		DC	APMX	LH	OAL	DCON	RE	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,02	0/-0,05
63R.020020640A	63R.020020640	2	6	10	40	2	1	1,9
63R.030031040A	63R.030031040	3	10	12	40	3	1,5	2,9
63R.030060757A	63R.030060757	3	7	10	57	6	1,5	2,9
63R.040041140A	63R.040041140	4	11	12,5	40	4	2	3,9
63R.040060857A	63R.040060857	4	8	11	57	6	2	3,9
63R.050051350A	63R.050051350	5	13	19	50	5	2,5	4,9
63R.060061057A	63R.060061057	6	10	19	57	6	3	5,9
63R.060061650A	63R.060061650	6	16	16	50	6	3	5,9
63R.080081663A	63R.080081663	8	16	23	63	8	4	7,9
63R.100101972A	63R.100101972	10	19	26	72	10	5	9,8
63R.120122283A	63R.120122283	12	22	34	83	12	6	11,8
63R.140142283A	63R.140142283	14	22	36	83	14	7	13,8
63R.160162692A	63R.160162692	16	26	42	92	16	8	15,8
63R.2002032104A	63R.2002032104	20	32	52	104	20	10	19,6
63R.2502545120A	63R.2502545120	25	45	58	120	25	12,5	24,6

## STANDARD MILLING 3 flutes long endmill

PVD TiAlN Cer-T  
Also available without coating



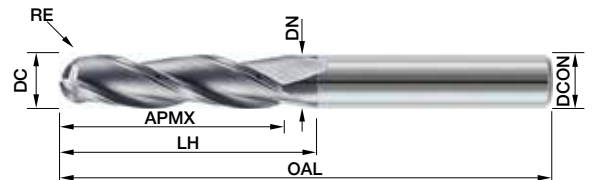
## 63L



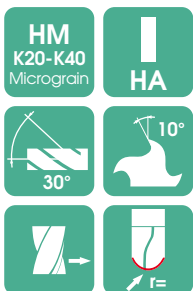
Cod.		DC	APMX	LH	OAL	DCON	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,05
63L.030A	63L.030	3	18	23	60	3	2,9
63L.040A	63L.040	4	20	25	60	4	3,9
63L.050A	63L.050	5	25	29	62	5	4,9
63L.060A	63L.060	6	30	34	70	6	5,9
63L.080A	63L.080	8	35	42	79	8	7,9
63L.100A	63L.100	10	40	47	89	10	9,8
63L.120A	63L.120	12	50	55	100	12	11,8
63L.140A	63L.140	14	58	76	125	14	13,8
63L.160A	63L.160	16	58	76	125	16	15,8
63L.200A	63L.200	20	60	73	125	20	19,6

## STANDARD MILLING 3 flutes ball nose long endmill

PVD TiAlN Cer-T  
Also available without coating



## 63RL



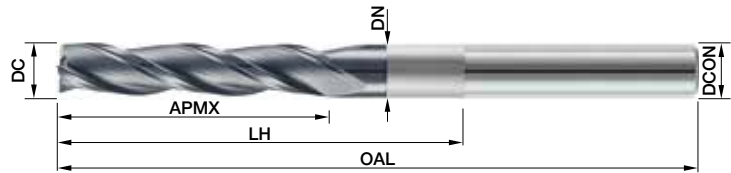
Cod.		DC	APMX	LH	OAL	DCON	RE	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,02	0/-0,05
63RL.030A	63RL.030	3	18	23	60	3	1,5	2,9
63RL.040A	63RL.040	4	20	25	60	4	2	3,9
63RL.050A	63RL.050	5	25	29	62	5	2,5	4,9
63RL.060A	63RL.060	6	30	34	70	6	3	5,9
63RL.080A	63RL.080	8	35	42	79	8	4	7,9
63RL.100A	63RL.100	10	40	47	89	10	5	9,8
63RL.120A	63RL.120	12	50	55	100	12	6	11,8
63RL.140A	63RL.140	14	58	76	125	14	7	13,8
63RL.160A	63RL.160	16	58	76	125	16	8	15,8
63RL.200A	63RL.200	20	60	73	125	20	10	19,6



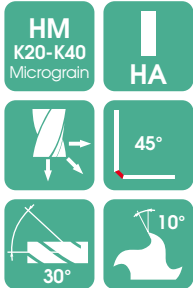
## STANDARD MILLING

### 3 flutes extra long endmill

PVD TiAlN Cer-T  
Also available without coating



## 63XL

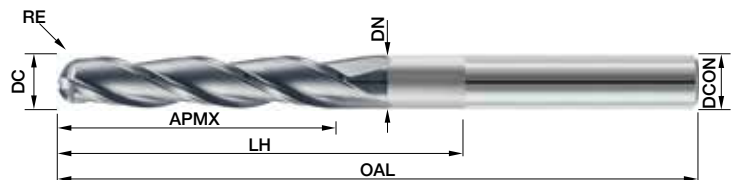


Cod.		DC	APMX	LH	OAL	DCON	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,05
63XL.030A	63XL.030	3	25	37	75	3	2,9
63XL.040A	63XL.040	4	32	39	75	4	3,9
63XL.050A	63XL.050	5	38	58	100	5	4,9
63XL.060A	63XL.060	6	40	60	100	6	5,9
63XL.080A	63XL.080	8	45	63	100	8	7,9
63XL.100A	63XL.100	10	50	75	120	10	9,8
63XL.120A	63XL.120	12	60	100	150	12	11,8
63XL.140A	63XL.140	14	75	103	150	14	13,8
63XL.160A	63XL.160	16	75	100	150	16	15,8
63XL.200A	63XL.200	20	75	98	150	20	19,6

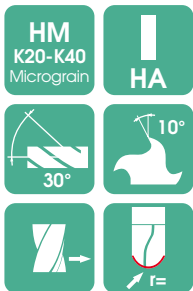
## STANDARD MILLING

### 3 flutes ball nose extra long endmill

PVD TiAlN Cer-T  
Also available without coating



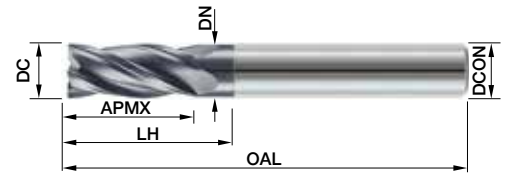
## 63RXL



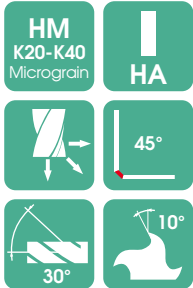
Cod.		DC	APMX	LH	OAL	DCON	RE	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,02	0/-0,05
63RXL.030A	63RXL.030	3	25	37	75	3	1,5	2,9
63RXL.040A	63RXL.040	4	32	39	75	4	2	3,9
63RXL.050A	63RXL.050	5	38	58	100	5	2,5	4,9
63RXL.060A	63RXL.060	6	40	60	100	6	3	5,9
63RXL.080A	63RXL.080	8	45	63	100	8	4	7,9
63RXL.100A	63RXL.100	10	50	75	120	10	5	9,8
63RXL.120A	63RXL.120	12	60	100	150	12	6	11,8
63RXL.140A	63RXL.140	14	75	103	150	14	7	13,8
63RXL.160A	63RXL.160	16	75	100	150	16	8	15,8
63RXL.200A	63RXL.200	20	75	98	150	20	10	19,6

## STANDARD MILLING 4 flutes endmill

PVD TiAlN Cer-T  
Also available without coating



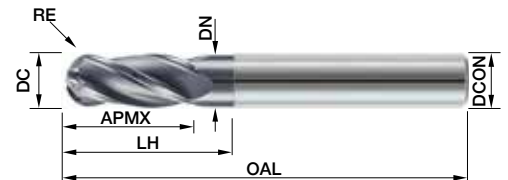
## 64



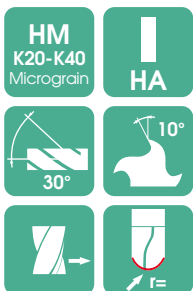
Cod.		DC	APMX	LH	OAL	DCON	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,05
64.020020640A	64.020020640	2	6	10	40	2	1,9
64.020060450A	64.020060450	2	4	7	50	6	1,9
64.030031040A	64.030031040	3	10	12	40	3	2,9
64.030060857A	64.030060857	3	8	11,5	57	6	2,9
64.040041140A	64.040041140	4	11	12,5	40	4	3,9
64.040061157A	64.040061157	4	11	13	57	6	3,9
64.050051350A	64.050051350	5	13	19	50	5	4,9
64.060061357A	64.060061357	6	13	19	57	6	5,9
64.060061650A	64.060061650	6	16	16	50	6	5,9
64.080081963A	64.080081963	8	19	26	63	8	7,9
64.100102272A	64.100102272	10	22	29	72	10	9,8
64.120122683A	64.120122683	12	26	37	83	12	11,8
64.140142683A	64.140142683	14	26	36	83	14	13,8
64.160163292A	64.160163292	16	32	42	92	16	15,8
64.2002038104A	64.2002038104	20	38	52	104	20	19,6
64.2502545120A	64.2502545120	25	45	63	120	25	24,6

## STANDARD MILLING 4 flutes ball nose endmill

PVD TiAlN Cer-T  
Also available without coating



## 64R



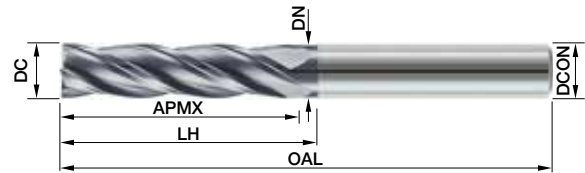
Cod.		DC	APMX	LH	OAL	DCON	RE	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,02	0/-0,05
64R.020020640A	64R.020020640	2	6	6	40	2	1	1,9
64R.030031040A	64R.030031040	3	10	12	40	3	1,5	2,9
64R.030060857A	64R.030060857	3	8	11,5	57	6	2	2,9
64R.040041140A	64R.040041140	4	11	12,5	40	4	2	3,9
64R.040061157A	64R.040061157	4	11	13	57	6	2,5	3,9
64R.050051350A	64R.050051350	5	13	19	50	5	2,5	4,9
64R.060061357A	64R.060061357	6	13	19	57	6	3	5,9
64R.060061650A	64R.060061650	6	16	16	50	6	3	5,9
64R.080081963A	64R.080081963	8	19	26	63	8	4	7,9
64R.100102272A	64R.100102272	10	22	29	72	10	5	9,8
64R.120122683A	64R.120122683	12	26	37	83	12	6	11,8
64R.140142683A	64R.140142683	14	26	36	83	14	7	13,8
64R.160163292A	64R.160163292	16	32	42	92	16	8	15,8
64R.2002038104A	64R.2002038104	20	38	52	104	20	10	19,6
64R.2502545120A	64R.2502545120	25	45	63	120	25	12,5	24,6

## STANDARD MILLING

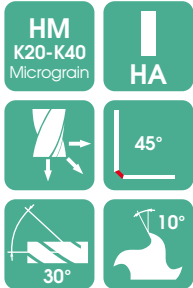
4 flutes long endmill

PVD TiAlN Cer-T

Also available without coating



## 64L



Cod.		DC	APMX	LH	OAL	DCON	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,05
64L.030A	64L.030	3	18	23	60	3	2,9
64L.040A	64L.040	4	20	25	60	4	3,9
64L.050A	64L.050	5	25	27,5	62	5	4,9
64L.060A	64L.060	6	30	34	70	6	5,9
64L.080A	64L.080	8	35	42	79	8	7,9
64L.100A	64L.100	10	40	47	89	10	9,8
64L.120A	64L.120	12	50	55	100	12	11,8
64L.140A	64L.140	14	58	76	125	14	13,8
64L.160A	64L.160	16	58	76	125	16	15,8
64L.200A	64L.200	20	60	73	125	20	19,6

## STANDARD MILLING

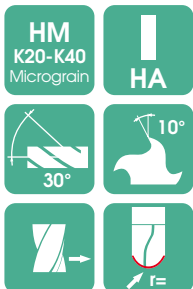
4 flutes ball nose long endmill

PVD TiAlN Cer-T

Also available without coating



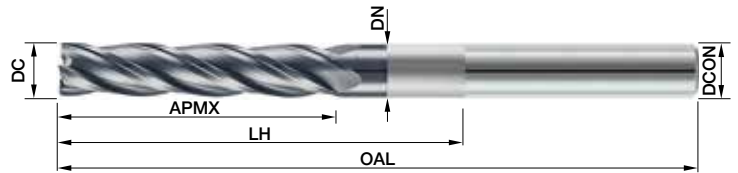
## 64RL



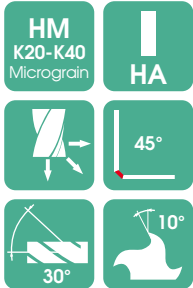
Cod.		DC	APMX	LH	OAL	DCON	RE	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,02	0/-0,05
64RL.030A	64RL.030	3	18	23	60	3	1,5	2,9
64RL.040A	64RL.040	4	20	25	60	4	2	3,9
64RL.050A	64RL.050	5	25	27,5	62	5	2,5	4,9
64RL.060A	64RL.060	6	30	34	70	6	3	5,9
64RL.080A	64RL.080	8	35	42	79	8	4	7,9
64RL.100A	64RL.100	10	40	47	89	10	5	9,8
64RL.120A	64RL.120	12	50	55	100	12	6	11,8
64RL.140A	64RL.140	14	58	76	125	14	7	13,8
64RL.160A	64RL.160	16	58	76	125	16	8	15,8
64RL.200A	64RL.200	20	60	73	125	20	10	19,6

## STANDARD MILLING 4 flutes extra long endmill

PVD TiAlN Cer-T  
Also available without coating



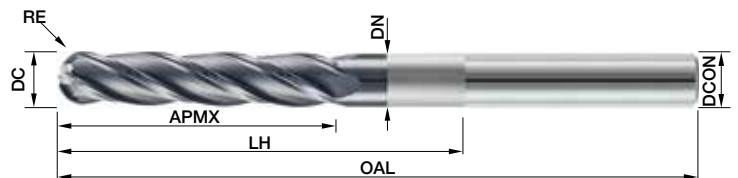
## 64XL



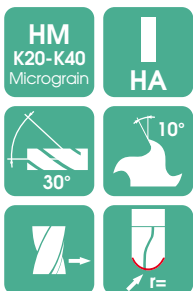
Cod.		DC	APMX	LH	OAL	DCON	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,05
64XL.030A	64XL.030	3	25	37	75	3	2,9
64XL.040A	64XL.040	4	32	39	75	4	3,9
64XL.050A	64XL.050	5	38	58	100	5	4,9
64XL.060A	64XL.060	6	40	60	100	6	5,9
64XL.080A	64XL.080	8	45	63	100	8	7,9
64XL.100A	64XL.100	10	50	75	120	10	9,8
64XL.120A	64XL.120	12	60	100	150	12	11,8
64XL.140A	64XL.140	14	75	103	150	14	13,8
64XL.160A	64XL.160	16	75	100	150	16	15,8
64XL.200A	64XL.200	20	75	98	150	20	19,6

## STANDARD MILLING 4 flutes ball nose extra long endmill

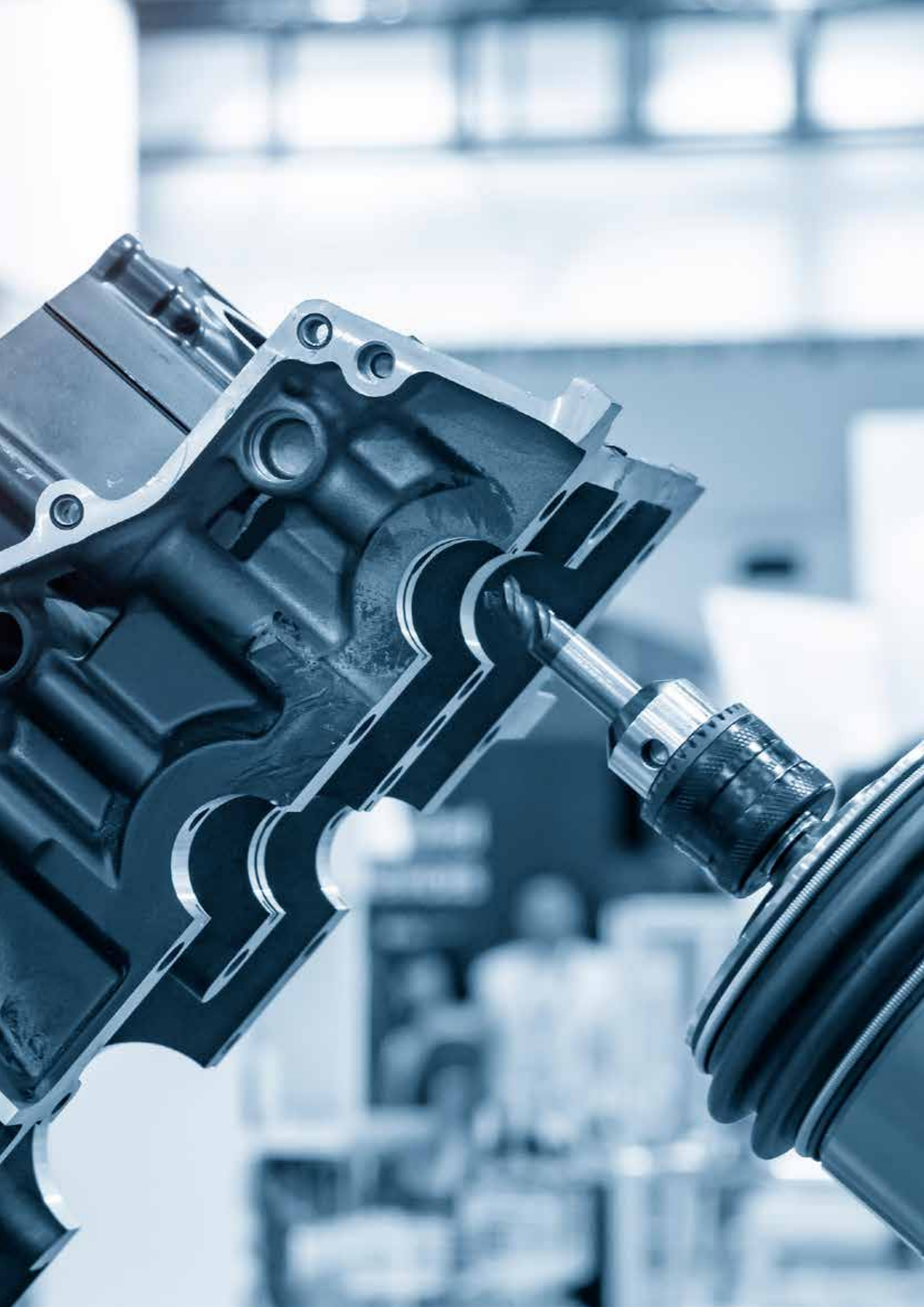
PVD TiAlN Cer-T  
Also available without coating



## 64RXL



Cod.		DC	APMX	LH	OAL	DCON	RE	DN
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,02	0/-0,05
64RXL.030A	64RXL.030	3	25	37	75	3	1,5	2,9
64RXL.040A	64RXL.040	4	32	39	75	4	2	3,9
64RXL.050A	64RXL.050	5	38	58	100	5	2,5	4,9
64RXL.060A	64RXL.060	6	40	60	100	6	3	5,9
64RXL.080A	64RXL.080	8	45	63	100	8	4	7,9
64RXL.100A	64RXL.100	10	50	75	120	10	5	9,8
64RXL.120A	64RXL.120	12	60	100	150	12	6	11,8
64RXL.140A	64RXL.140	14	75	103	150	14	7	13,8
64RXL.160A	64RXL.160	16	75	100	150	16	8	15,8
64RXL.200A	64RXL.200	20	75	98	150	20	10	19,6



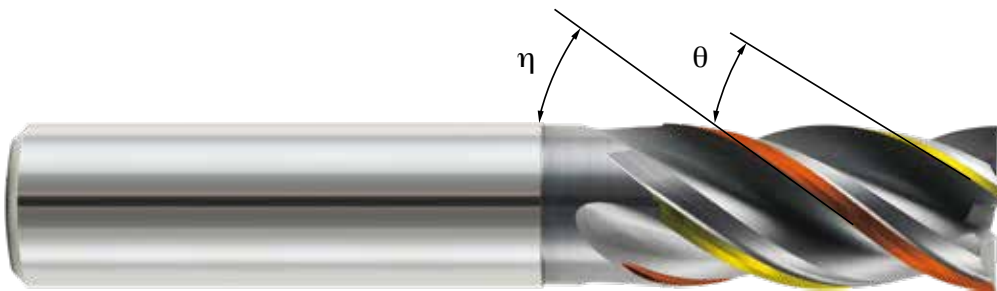
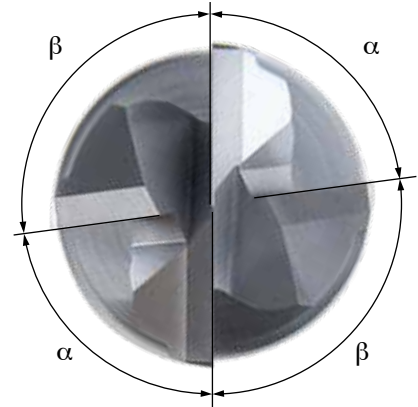


# HPC Endmills



# Tools features

- ▶ Irregular division and uneven helix;
- ▶ Suitable for high feed and high Material Removal Rate;
- ▶ Vibration free;
- ▶ Roughing and finishing with the same tool;
- ▶ Excellent chips evacuation thanks to flute geometry.



## Multilayer AlTiN based coating

Geometries, base material, coatings are specifically developed for a wide range of ferrous materials.





# Test Report

AISI 304 stainless steel

Tool: 640.080081963Y

Z=4, Dia. 8, facet relief

Cutting data:

$a_p = 1 \times D$  (8 mm),  $a_e = 0,6 \times D$  (4,8 mm)

$V_c = 70$  m/min

$f_z = 0,03$  (up to 0,04)

Tool life: 46 meters

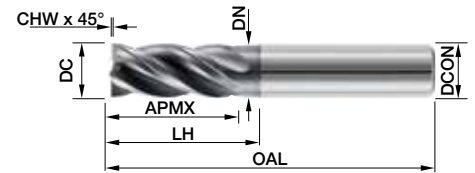
Facet relief sharpness reduces  
typical chip sticking



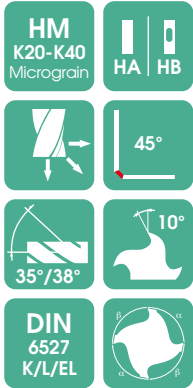
# 640

## HPC STEEL MILLING HPC 4 flutes endmill

PVD TiAlCrN Cer-Y



## 640

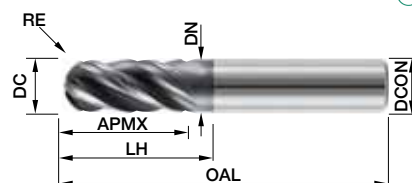


Cod.		DC	APMX	LH	OAL	DCON	DN	CHW
HA shank	HB shank	h10	0/+2	0/+2	0/+2	h6	0/-0,05	+/-0,05
640.030060550Y	640W.030060550Y	3	5		50	6		0,15
640.030060857Y	640W.030060857Y	3	8	12	57	6	2,8	0,15
640.030060870Y	640W.030060870Y	3	8	15	70	6	2,8	0,15
640.040060854Y	640W.040060854Y	4	8		54	6		0,15
640.040061157Y	640W.040061157Y	4	11	15	57	6	3,8	0,15
640.040061170Y	640W.040061170Y	4	11	20	70	6	3,8	0,15
640.050060954Y	640W.050060954Y	5	9		54	6		0,15
640.050061357Y	640W.050061357Y	5	13	17	57	6	4,8	0,15
640.050061370Y	640W.050061370Y	5	13	25	70	6	4,8	0,15
640.060061054Y	640W.060061054Y	6	10		54	6		0,15
640.060061357Y	640W.060061357Y	6	13	21	57	6	5,8	0,15
640.060061370Y	640W.060061370Y	6	13	30	70	6	5,8	0,15
640.080081258Y	640W.080081258Y	8	12		58	8		0,25
640.080081963Y	640W.080081963Y	8	19	27	63	8	7,7	0,25
640.080081980Y	640W.080081980Y	8	19	40	80	8	7,7	0,25
640.100101466Y	640W.100101466Y	10	14		66	10		0,25
640.100102272Y	640W.100102272Y	10	22	32	72	10	9,7	0,25
640.100102294Y	640W.100102294Y	10	22	50	94	10	9,7	0,25
640.120121673Y	640W.120121673Y	12	16		73	12		0,35
640.120122683Y	640W.120122683Y	12	26	38	83	12	11,6	0,35
640.1201226109Y	640W.1201226109Y	12	26	64	109	12	11,6	0,35
640.160162282Y	640W.160162282Y	16	22		82	16		0,35
640.160163292Y	640W.160163292Y	16	32	44	92	16	15,5	0,35
640.1601632132Y	640W.1601632132Y	16	32	80	132	16	15,5	0,35
640.200202692Y	640W.200202692Y	20	26		92	20		0,35
640.2002038104Y	640W.2002038104Y	20	38	54	104	20	19,5	0,35
640.2002038154Y	640W.2002038154Y	20	38	100	154	20	19,5	0,35

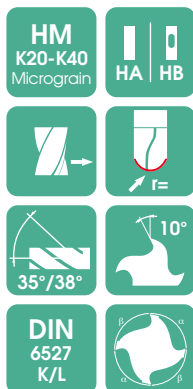
## HPC STEEL MILLING

HPC 4 flutes ball nose endmill

PVD TiAlCrN Cer-Y



## 640R



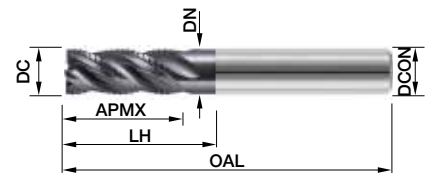
Cod.		DC	APMX	LH	OAL	DCON	DN	RE
HA shank	HB shank	h10	0/+2	0/+2	0/+2	h6	0/-0,05	+/-0,05
640R.030060550Y	640WR.030060550Y	3	5		50	6		1,5
640R.030060857Y	640WR.030060857Y	3	8	12	57	6	2,8	1,5
640R.040060854Y	640WR.040060854Y	4	8		54	6		2
640R.040061157Y	640WR.040061157Y	4	11	15	57	6	3,8	2
640R.050060954Y	640WR.050060954Y	5	9		54	6		2,5
640R.050061357Y	640WR.050061357Y	5	13	17	57	6	4,8	2,5
640R.060061054Y	640WR.060061054Y	6	10		54	6		3
640R.060061357Y	640WR.060061357Y	6	13	21	57	6	5,8	3
640R.080081258Y	640WR.080081258Y	8	12		58	8		4
640R.080081963Y	640WR.080081963Y	8	19	27	63	8	7,7	4
640R.100101466Y	640WR.100101466Y	10	14		66	10		5
640R.100102272Y	640WR.100102272Y	10	22	32	72	10	9,7	5
640R.120121673Y	640WR.120121673Y	12	16		73	12		6
640R.120122683Y	640WR.120122683Y	12	26	38	83	12	11,6	6
640R.160162282Y	640WR.160162282Y	16	22		82	16		8
640R.160163292Y	640WR.160163292Y	16	32	44	92	16	15,5	8
640R.200202692Y	640WR.200202692Y	20	26		92	20		10
640R.2002038104Y	640WR.2002038104Y	20	38	54	104	20	19,5	10



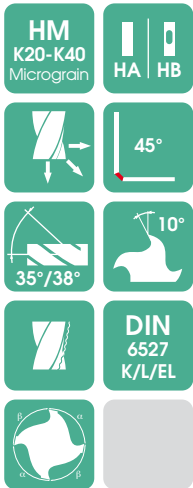
# 640

HPC STEEL MILLING  
HPC 4 flutes roughing endmill

PVD TiAlCrN Cer-Y



## 640SP



Cod.		DC	APMX	LH	OAL	DCON	DN
HA shank	HB shank	h10	0/+2	0/+2	0/+2	h6	0/-0,05
640SP.030060550Y	640WSP.030060550Y	3	5		50	6	
640SP.030060857Y	640WSP.030060857Y	3	8	12	57	6	2,8
640SP.030060870Y	640WSP.030060870Y	3	8	15	70	6	2,8
640SP.040060854Y	640WSP.040060854Y	4	8		54	6	
640SP.040061157Y	640WSP.040061157Y	4	11	15	57	6	3,8
640SP.040061170Y	640WSP.040061170Y	4	11	20	70	6	3,8
640SP.050060954Y	640WSP.050060954Y	5	9		54	6	
640SP.050061357Y	640WSP.050061357Y	5	13	17	57	6	4,8
640SP.050061370Y	640WSP.050061370Y	5	13	25	70	6	4,8
640SP.060061054Y	640WSP.060061054Y	6	10		54	6	
640SP.060061357Y	640WSP.060061357Y	6	13	21	57	6	5,8
640SP.060061370Y	640WSP.060061370Y	6	13	30	70	6	5,8
640SP.080081258Y	640WSP.080081258Y	8	12		58	8	
640SP.080081963Y	640WSP.080081963Y	8	19	27	63	8	7,7
640SP.080081980Y	640WSP.080081980Y	8	19	40	80	8	7,7
640SP.100101466Y	640WSP.100101466Y	10	14		66	10	
640SP.100102272Y	640WSP.100102272Y	10	22	32	72	10	9,7
640SP.100102294Y	640WSP.100102294Y	10	22	50	94	10	9,7
640SP.120121673Y	640WSP.120121673Y	12	16		73	12	
640SP.120122683Y	640WSP.120122683Y	12	26	38	83	12	11,6
640SP.1201226109Y	640WSP.1201226109Y	12	26	64	109	12	11,6
640SP.160162282Y	640WSP.160162282Y	16	22		82	16	
640SP.160163292Y	640WSP.160163292Y	16	32	44	92	16	15,5
640SP.1601632132Y	640WSP.1601632132Y	16	32	80	132	16	15,5
640SP.200202692Y	640WSP.200202692Y	20	26		92	20	
640SP.2002038104Y	640WSP.2002038104Y	20	38	54	104	20	19,5
640SP.2002038154Y	640WSP.2002038154Y	20	38	100	154	20	19,5







# Endmill for tempered steel



## Tools features

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- ▶ Ultrafine micrograin carbide;
- ▶ Coating highly resistant to abrasive wear;
- ▶ h5 shank tolerance to assure tool-spindle precise coupling;
- ▶ Negative cutting angle;
- ▶ Core up to 80% of the diameter to assure stability and vibrations reduction.

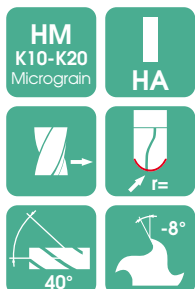
# 62RHR

TEMPERED STEEL MILLING  
2 flutes ball nose endmill

PVD TiAlN/TiSiN Cer-SA



## 62RHR



Cod.	DC	APMX	OAL	LH	DCON	DN	RE
	0/-0,02	0/+2	0/+2	0/+2	h5	0/-0,05	+/- 0.01
62RHR.010060257SA	1	2	57	4	6	0,9	0,5
62RHR.010060280SA	1	2	80	7	6	0,9	0,5
62RHR.015062557SA	1,5	2,5	57	5,5	6	1,4	0,75
62RHR.015062580SA	1,5	2,5	80	10	6	1,4	0,75
62RHR.020060357SA	2	3	57	7	6	1,9	1
62RHR.020060380SA	2	3	80	13	6	1,9	1
62RHR.030060457SA	3	4	57	10	6	2,8	1,5
62RHR.030060480SA	3	4	80	19	6	2,8	1,5
62RHR.040060557SA	4	5	57	13	6	3,7	2
62RHR.040060580SA	4	5	80	25	6	3,7	2
62RHR.050060657SA	5	6	57	16	6	4,6	2,5
62RHR.050060680SA	5	6	80	31	6	4,6	2,5
62RHR.060060757SA	6	7	57	19	6	5,5	3
62RHR.060060780SA	6	7	80	37	6	5,5	3
62RHR.080080963SA	8	9	63	25	8	7,4	4
62RHR.0800809100SA	8	9	100	49	8	7,4	4
62RHR.100101172SA	10	11	72	31	10	9,2	5
62RHR.1001011100SA	10	11	100	61	10	9,2	5
62RHR.120121383SA	12	13	83	37	12	11	6
62RHR.1201213120SA	12	13	120	73	12	11	6

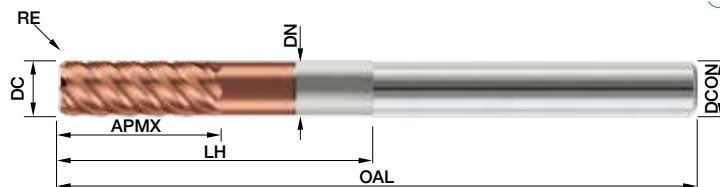




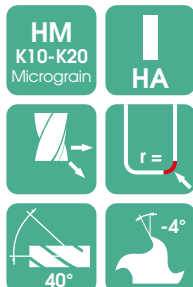
## TEMPERED STEEL MILLING

Multiflute torus radius endmill

PVD TiAlN/TiSiN Cer-SA



## 66THR



Cod.	DC	APMX	OAL	LH	DCON	DN	RE	ZEFP
	+/-0,02	0/+2	0/+2	0/+2	h5	0/-0,05	0/+0,015	
66THR.02006035705SA	2	3	57	7	6	1,9	0,2	4
66THR.02006035710SA	2	3	57	7	6	1,9	0,4	4
66THR.02006038005SA	2	3	80	13	6	1,9	0,2	4
66THR.02006038010SA	2	3	80	13	6	1,9	0,4	4
66THR.03006045705SA	3	4	57	10	6	2,8	0,3	4
66THR.03006045710SA	3	4	57	10	6	2,8	0,6	4
66THR.03006048005SA	3	4	80	19	6	2,8	0,3	4
66THR.03006048010SA	3	4	80	19	6	2,8	0,6	4
66THR.04006055705SA	4	5	57	13	6	3,7	0,4	4
66THR.04006055710SA	4	5	57	13	6	3,7	0,8	4
66THR.04006058005SA	4	5	80	25	6	3,7	0,4	4
66THR.04006058010SA	4	5	80	25	6	3,7	0,8	4
66THR.05006065705SA	5	6	57	16	6	4,6	0,5	4
66THR.05006075710SA	5	6	57	16	6	4,6	1	4
66THR.05006068005SA	5	6	80	31	6	4,6	0,5	4
66THR.05006078010SA	5	6	80	31	6	4,6	1	4
66THR.06006075705SA	6	7	57	19	6	5,5	0,5	6
66THR.06006075710SA	6	7	57	19	6	5,5	1	6
66THR.06006078005SA	6	7	80	37	6	5,5	0,5	6
66THR.06006078010SA	6	7	80	37	6	5,5	1	6
66THR.08008096305SA	8	9	63	25	8	7,4	0,5	6
66THR.08008096310SA	8	9	63	25	8	7,4	1	6
66THR.080080910005SA	8	9	100	49	8	7,4	0,5	6
66THR.080080910010SA	8	9	100	49	8	7,4	1	6
66THR.10010117205SA	10	11	72	31	10	9,2	0,5	6
66THR.10010117210SA	10	11	72	31	10	9,2	1	6
66THR.100101110005SA	10	11	100	61	10	9,2	0,5	6
66THR.100101110010SA	10	11	100	61	10	9,2	1	6
66THR.12012138305SA	12	13	83	37	12	11	0,5	6
66THR.12012138310SA	12	13	83	37	12	11	1	6
66THR.120121312005SA	12	13	120	73	12	11	0,5	6
66THR.120121312010SA	12	13	120	73	12	11	1	6



# Deburring Endmills



## Tools features

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- ▶ CNC deburring tool;
- ▶ Negative rake to strengthen cutting edge;
- ▶ Crossed cut to dissipate machining heat;
- ▶ Also available with TiAlN based coating.



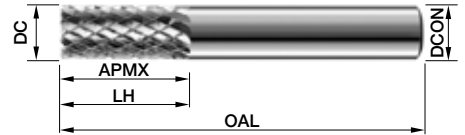
# 66M

## DEBURRING ENDMILLS

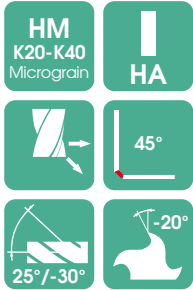
Double cut endmill

PVD TiAlN Cer-T

Also available without coating



## 66M



Cod.		DC	APMX	LH	OAL	DCON
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6
66M.030A	66M.030	3	10	10	40	3
66M.040A	66M.040	4	11	11	40	4
66M.050A	66M.050	5	13	13	50	5
66M.060A	66M.060	6	16	16	50	6
66M.080A	66M.080	8	19	19	63	8
66M.100A	66M.100	10	22	22	72	10
66M.120A	66M.120	12	26	26	83	12
66M.160A	66M.160	16	32	32	92	16
66M.180A	66M.180	18	32	32	92	18
66M.200A	66M.200	20	38	38	104	20

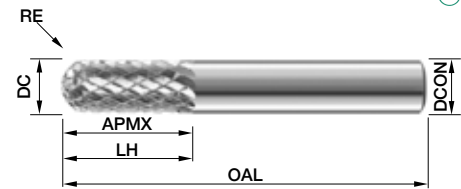


# 66MR

Steel Milling

DEBURRING ENDMILLS  
Ball nose double cut endmill

PVD TiAlN Cer-T  
Also available without coating



## 66MR



Cod.		DC	APMX	LH	OAL	DCON	RE
Coated	Uncoated	h10	0/+2	0/+2	0/+2	h6	0/-0,04
66MR.030A	66MR.030	3	10	10	40	3	1,5
66MR.040A	66MR.040	4	11	11	40	4	2
66MR.050A	66MR.050	5	13	13	50	5	2,5
66MR.060A	66MR.060	6	16	16	50	6	3
66MR.080A	66MR.080	8	19	19	63	8	4
66MR.100A	66MR.100	10	22	22	72	10	5
66MR.120A	66MR.120	12	26	26	83	12	6
66MR.160A	66MR.160	16	32	32	92	16	8
66MR.180A	66MR.180	18	32	32	92	18	9
66MR.200A	66MR.200	20	38	38	104	20	10





**PATENT PENDING**

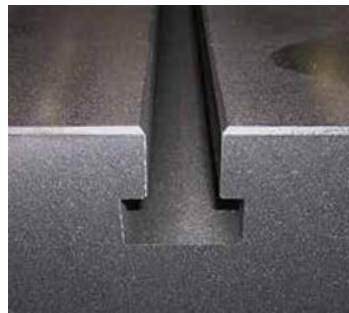
# T-slot cutters

## Tools features

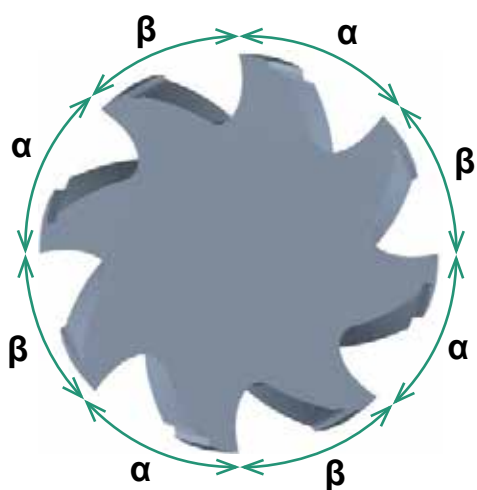
Endmill according to DIN 650 standard



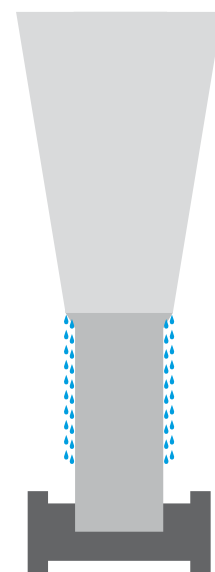
Multilayer AlTiN based coating



Solid carbide head brazing and steel shank allow a combination of performance and tool's economy



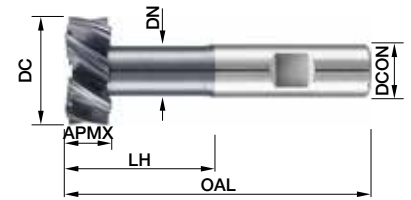
- ▶ Irregular division and uneven helix;
- ▶ Vibration free;
- ▶ Roughing and finishing with the same tool;
- ▶ Excellent chips evacuation thanks to flute geometry.



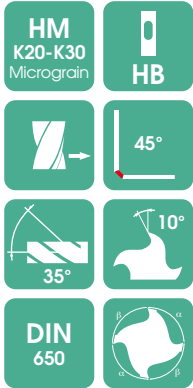
Collects or bushings with slots for improved intake of cooling lubricant are highly recommended

## T-SLOT CUTTER Z6/Z10 right helix endmill

PVD TiAlCrN Cer-Y



# 78



Cod.	DC	APMX	APMX TOL.	LH	OAL	DCON	DN	ZEFP
	e8			0/+2	0/+2	h6	0/+0,05	
78.110100453,5Y	11	4	-0,105/-0,030	10,5	53,5	10	4	6
78.125100657Y	12,5	6	-0,105/-0,030	13	57	10	5	6
78.160100862Y	16	8	-0,130/-0,040	18	62	10	7	6
78.180120870Y	18	8	-0,130/-0,040	21	70	12	8	6
78.190120971Y	19	9	-0,130/-0,040	22	71	12	8	6
78.210120974Y	21	9	-0,130/-0,040	25	74	12	10	6
78.220121075Y	22	10	-0,130/-0,040	26	75	12	10	6
78.250161182Y	25	11	-0,160/-0,050	28	82	16	12	8
78.280161285Y	28	12	-0,160/-0,050	32	85	16	13	8
78.320161490Y	32	14	-0,160/-0,050	36	90	25	15	8
78.3602516103Y	36	16	-0,160/-0,050	42	103	25	17	8
78.4002518108Y	40	18	-0,160/-0,050	49	108	25	19	10







# Milling - Working parameters

Tool	ISO	Material	Streght [MPa]	N.	Designation	Vc [m/min]	ap max x DC	Short/long version	Extralong version	DC = 2 mm			DC = 3 mm			
										0,10x DC	0,30x DC	0,6-1,0 x DC	0,10x DC	0,30x DC	0,6-1,0 x DC	
																ae
640(W) 640(W)R* 640(W)SP	P	General construction steel	< 800	1,0037	S137-2	200	160	1,0	0,5				0,024	0,019	0,014	0,029
		Automatic steel	< 800	1,0719	9SMnPb28	210	170	1,0	0,5				0,024	0,019	0,014	0,029
		Unalloyed case hardened steel	< 800	1,0401	C15	180	140	1,0	0,5				0,017	0,013	0,010	0,029
		Alloyed case hardened steel	< 1000	1,7331	16MnCr5 (EC80)	160	130	1,0	0,5				0,012	0,009	0,007	0,029
		Unalloyed annealed steel	< 850	1,0503	C45	170	135	1,0	0,5				0,017	0,013	0,010	0,029
		Unalloyed annealed steel	< 1000	1,0601	C60	160	130	1,0	0,5				0,018	0,014	0,010	0,029
		Alloyed annealed steel	< 800	1,5131	50MnS14	160	130	1,0	0,5				0,018	0,014	0,010	0,029
		Alloyed annealed steel	< 1300	1,5755	31NiCr14	140	115	1,0	0,5				0,012	0,009	0,007	0,029
		Cast steel	< 850	0,9650	G-X260Cr27	140	110	1,0	0,5				0,018	0,014	0,010	0,029
		Nitriding steel	< 1000	1,8504	34CrA16	160	130	1,0	0,5				0,018	0,014	0,010	0,029
		Nitriding steel	< 1200	1,8515	31CrMo12	140	115	1,0	0,5				0,012	0,009	0,007	0,022
		Bearing steel	< 1200	1,3505	100Cr6 (W3)	160	130	1,0	0,5				0,018	0,014	0,010	0,029
	Tool steel (cold working)	< 1300	1,2312	40CrMnMoS8 6	150	120	1,0	0,5				0,017	0,013	0,010	0,029	
	Tool steel (hot working)	< 1300	1,2343	X38CrMoV 51	130	100	1,0	0,5				0,017	0,013	0,010	0,029	
	M	Sulphured stainless steel	< 850	1,4305	X8CrNiS18-9	110	90	1,0	0,5				0,012	0,009	0,007	0,018
		Ferritic stainless steel	< 750	1,4510	X3CrTi17	100	80	1,0	0,5				0,012	0,009	0,007	0,018
		Martensitic stainless steel	< 900	1,4034	X46Cr13	85	70	1,0	0,5				0,012	0,009	0,007	0,018
		Ferritic/martensitic stainless steel	< 1100	1,4313	X3CrNi113.4	100	80	1,0	0,5				0,012	0,009	0,007	0,018
		Austenitic/ferritic martensitic stainless steel	< 850	1,4460	X8CrNiMo27 5	100	80	1,0	0,5				0,012	0,009	0,007	0,018
		Austenitic stainless steel	< 750	1,4301	X5CrNi18-10	100	80	1,0	0,5				0,012	0,009	0,007	0,018
	K	Lamellar graphite cast iron	100-350	0,6010	GG10	170	135	1,0	0,5				0,024	0,019	0,014	0,036
		Grey graphite cast iron	300-1000	0,6030	GG30	140	110	1,0	0,5				0,018	0,014	0,010	0,036
		Spheroidal cast iron	300-500	0,7040	GGG40	160	130	1,0	0,5				0,018	0,014	0,010	0,029
		Spheroidal cast iron	550-800	0,7060	GGG60	130	100	1,0	0,5				0,018	0,014	0,010	0,029
		Tempered white cast iron	350-450	0,8035	GTW35	150	120	1,0	0,5				0,018	0,014	0,010	0,029
		Tempered white cast iron	500-650	0,8055	GTW55	140	110	1,0	0,5				0,018	0,014	0,010	0,029
		Tempered black cast iron	350-450	0,8135	GTS35	150	120	1,0	0,5				0,018	0,014	0,010	0,029
		Tempered black cast iron	500-700	0,8155	GTS55	135	110	1,0	0,5				0,018	0,014	0,010	0,029
64(R)*	P	General construction steel	< 800	1,0037	S137-2	200	160	1,0	0,5	0,012	0,009	0,007	0,020	0,015	0,011	0,023
		Automatic steel	< 800	1,0719	9SMnPb28	210	170	1,0	0,5	0,012	0,009	0,007	0,020	0,015	0,011	0,023
		Unalloyed case hardened steel	< 800	1,0401	C15	180	140	1,0	0,5	0,010	0,008	0,006	0,014	0,011	0,008	0,023
		Alloyed case hardened steel	< 1000	1,7331	16MnCr5 (EC80)	160	130	1,0	0,5	0,009	0,007	0,005	0,010	0,008	0,005	0,023
		Unalloyed annealed steel	< 850	1,0503	C45	170	135	1,0	0,5	0,010	0,008	0,006	0,014	0,011	0,008	0,023
		Unalloyed annealed steel	< 1000	1,0601	C60	160	130	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023
		Alloyed annealed steel	< 800	1,5131	50MnS14	160	130	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023
		Alloyed annealed steel	< 1300	1,5755	31 NiCr14	140	115	1,0	0,5	0,009	0,007	0,005	0,010	0,008	0,005	0,023
		Nitriding steel	< 1000	1,8504	34CrA16	160	130	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023
		Nitriding steel	< 1200	1,8515	31CrV1o12	140	115	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023
		Cast steel	< 850	0,9650	G-X260Cr27	140	110	1,0	0,5	0,008	0,006	0,004	0,010	0,008	0,005	0,017
		Bearing steel	< 1200	1,3505	100Cr6 (W3)	160	130	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023
	Tool steel (cold working)	< 1300	1,2312	40CrMnMoS8 6	150	120	1,0	0,5	0,010	0,008	0,006	0,014	0,011	0,008	0,023	
	Tool steel (hot working)	< 1300	1,2343	X38CrMoV 51	130	100	1,0	0,5	0,010	0,008	0,006	0,014	0,011	0,008	0,023	
	M	Sulphured stainless steel	< 850	1,4305	X8CrNiS18 9	110	90	1,0	0,5	0,007	0,005	0,004	0,010	0,008	0,005	0,015
		Ferritic stainless steel	< 750	1,4510	X3CrTi17	100	80	1,0	0,5	0,007	0,005	0,004	0,010	0,008	0,005	0,015
		Martensitic stainless steel	< 900	1,4034	X46Cr13	85	70	1,0	0,5	0,007	0,005	0,004	0,010	0,008	0,005	0,015
		Ferritic/Martensitic stainless steel	< 1100	1,4313	X3CrNi113.4	100	80	1,0	0,5	0,007	0,005	0,004	0,010	0,008	0,005	0,015
		Ferritic/Martensitic stainless steel	< 850	1,4460	X8CrNiMo27 5	100	80	1,0	0,5	0,007	0,005	0,004	0,010	0,008	0,005	0,015
		Austenitic stainless steel	< 750	1,4301	X5CrNi18-10	100	80	1,0	0,5	0,007	0,005	0,004	0,010	0,008	0,005	0,015
	K	Lamellar graphite cast iron	100-350	0,6010	GG10	170	135	1,0	0,5	0,014	0,011	0,008	0,020	0,015	0,011	0,029
		Grey graphite cast iron	300-1000	0,6030	GG30	140	110	1,0	0,5	0,012	0,009	0,007	0,015	0,011	0,008	0,029
		Spheroidal cast iron	300-500	0,7040	GGG40	160	130	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023
		Spheroidal cast iron	550-800	0,7060	GGG60	130	100	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023
		Tempered white cast iron	350-450	0,8035	GTW35	150	120	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023
		Tempered white cast iron	500-650	0,8055	GTW55	140	110	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023
		Tempered black cast iron	350-450	0,8135	GTS35	150	120	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023
		Tempered black cast iron	500-700	0,8155	GTS55	135	110	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023

\* Ball nose end mills: calculate n[rpm] as per Tab.K pag. 46



# Milling - Working parameters

Tool	ISO	Material	Streght [MPa]	N.	Designation	Vc [m/min]	ap max x DC	Short/long version			DC = 2 mm			DC = 3 mm			
								Short/long version	Extralong version	Short/long version	Extralong version	ap	fz	fz	ap	fz	fz
62(R)* 63(R)*	P	General construction steel	< 800	1,0037	S137-2	200	160	1,0	0,5	0,012	0,009	0,007	0,020	0,015	0,011	0,023	
		Automatic steel	< 800	1,0719	9SMnPb28	210	170	1,0	0,5	0,012	0,009	0,007	0,020	0,015	0,011	0,023	
		Unalloyed case hardened steel	< 800	1,0401	C15	180	140	1,0	0,5	0,010	0,008	0,006	0,014	0,011	0,008	0,023	
		Alloyed case hardened steel	< 1000	1,7331	16MnCr5 (EC80)	160	130	1,0	0,5	0,009	0,007	0,005	0,010	0,008	0,005	0,023	
		Unalloyed annealed steel	< 850	1,0503	C45	150	135	1,0	0,5	0,010	0,008	0,006	0,014	0,011	0,008	0,023	
		Unalloyed annealed steel	< 1000	1,0601	C60	160	130	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023	
		Alloyed annealed steel	< 800	1,5131	50MnS14	160	130	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023	
		Alloyed annealed steel	< 1300	1,5755	31NiCr14	140	115	1,0	0,5	0,009	0,007	0,005	0,010	0,008	0,005	0,023	
		Cast steel	< 850	0,9650	G-X260Cr27	140	110	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023	
		Nitriding steel	< 1000	1,8504	34CrA16	160	130	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023	
		Nitriding steel	< 1200	1,8515	31CrMo12	140	115	1,0	0,5	0,008	0,006	0,004	0,010	0,008	0,005	0,017	
		Bearing steel	< 1200	1,3505	100Cr6 (W3)	160	130	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023	
	Tool steel (cold working)	< 1300	1,2312	40CrMnMoS8 6	150	120	1,0	0,5	0,010	0,008	0,006	0,014	0,011	0,008	0,023		
	Tool steel (hot working)	< 1300	1,2343	X38CrMoV 51	130	100	1,0	0,5	0,010	0,008	0,006	0,014	0,011	0,008	0,023		
	M	Sulphured stainless steel	< 850	1,4305	X8CrNiS18-9	110	90	1,0	0,5	0,007	0,005	0,004	0,010	0,008	0,005	0,015	
		Ferritic stainless steel	< 750	1,4510	X3CrTi17	100	80	1,0	0,5	0,007	0,005	0,004	0,010	0,008	0,005	0,015	
		Martensitic stainless steel	< 900	1,4034	X46Cr13	85	70	1,0	0,5	0,007	0,005	0,004	0,010	0,008	0,005	0,015	
		Ferritic martensitic stainless steel	< 1100	1,4313	X3CrN113.4	100	80	1,0	0,5	0,007	0,005	0,004	0,010	0,008	0,005	0,015	
		Austenitic/ferritic martensitic stainless steel	< 850	1,4460	X8CrNiMo27 5	100	80	1,0	0,5	0,007	0,005	0,004	0,010	0,008	0,005	0,015	
	Austenitic stainless steel	< 750	1,4301	X5CrNi18-10	100	80	1,0	0,5	0,007	0,005	0,004	0,010	0,008	0,005	0,015		
	K	Lamellar graphite cast iron	100-350	0,6010	GG10	170	135	1,0	0,5	0,014	0,011	0,008	0,020	0,015	0,011	0,029	
		Grey graphite cast iron	300-1000	0,6030	GG30	140	110	1,0	0,5	0,012	0,009	0,007	0,015	0,011	0,008	0,029	
		Spheroidal cast iron	300-500	0,7040	GGG40	160	130	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023	
		Spheroidal cast iron	550-800	0,7060	GGG60	130	100	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023	
		Tempered white cast iron	350-450	0,8035	GTW35	150	120	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023	
		Tempered white cast iron	500-650	0,8055	GTW55	140	110	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023	
		Tempered black cast iron	350-450	0,8135	GTS35	150	120	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023	
	Tempered black cast iron	500-700	0,8155	GTS55	135	110	1,0	0,5	0,011	0,008	0,006	0,015	0,011	0,008	0,023		

\* Ball nose end mills: calculate n[rpm] as per Tab.K pag. 46



# Milling - Working parameters

								DC = 1 mm
								ae max = 0,1 x DC
Tool	ISO	Material	Hardness [HRC]	N.	Designation	Vc [m/min]	ap max x DC	fz [mm]
62RHR*	P	Unalloyed annealed steel		1,0503	C45	120	0,1	0,002
		Annealed tool steel	59-61	1.2080 (K100)	X210Cr12	70	0,1	0,002
		Annealed tool steel	60-62	1.2379 (K110)	X155CrVMo121	70	0,1	0,002
		Anneal steel	58-60	1.2842	90MnVCr8	70	0,1	0,003
		Annealed stainless steel	52-54	12083	X40Cr14	100	0,1	0,002

\* Ball nose end mills: calculate  $n$ [rpm] as per Tab.K pag. 46

								DC = 2 mm
								ae max = 0,1 x DC
Tool	ISO	Material	Hardness [HRC]	N.	Designation	Vc [m/min]	ap max x DC	fz [mm]
66THR	P	Unalloyed annealed steel		1,0503	C45	120	0,1	0,004
		Annealed tool steel	59-61	1.2080 (K100)	X210Cr12	70	0,1	0,005
		Annealed tool steel	60-62	1.2379 (K110)	X155CrVMo121	70	0,1	0,005
		Anneal steel	58-60	1.2842	90MnVCr8	70	0,1	0,006
		Annealed stainless steel	52-54	12083	X40Cr14	100	0,1	0,004

							DC = 3 mm			DC = 4 mm				
							ae 0,1-0,2 x DC	ae 0,3-0,4 x DC	ae 0,6-1,0 x DC	ae 0,1-0,2 x DC	ae 0,3-0,4 x DC	ae 0,6-1,0 x DC		
Tool	ISO	Material	Streght [MPa]	N.	Designation	Vc [m/min]	ap max x DC	fz [mm]			fz [mm]			
66M(R)*	P	General construction steel	< 800	1,0037	S137-2	200	1,0	0,014	0,011	0,008	0,016	0,013	0,009	0,025
		Automatic steel	< 800	1,0719	9SMnPb28	210	1,0	0,014	0,011	0,008	0,016	0,013	0,009	0,025
		Unalloyed case hardened steel	< 800	1,0401	C15	180	1,0	0,010	0,008	0,005	0,016	0,013	0,009	0,025
		Alloyed case hardened steel	< 1000	1,7331	16MnCr5 (EC80)	160	1,0	0,007	0,005	0,004	0,016	0,013	0,009	0,025
		Unalloyed annealed steel	< 850	1,0503	C45	170	1,0	0,010	0,008	0,005	0,016	0,013	0,009	0,025
		Unalloyed annealed steel	< 1000	1,0601	C60	160	1,0	0,010	0,008	0,006	0,016	0,013	0,009	0,025
		Alloyed annealed steel	< 800	1,5131	50MnS14	160	1,0	0,010	0,008	0,006	0,016	0,013	0,009	0,025
		Alloyed annealed steel	< 1300	1,5755	31NiCr14	140	1,0	0,007	0,005	0,004	0,016	0,013	0,009	0,025
		Cast steel	< 850	0,9650	G-X260Cr27	140	1,0	0,010	0,008	0,006	0,016	0,013	0,009	0,025
		Nitriding steel	< 1000	1,8504	34CrA16	160	1,0	0,010	0,008	0,006	0,016	0,013	0,009	0,025
		Nitriding steel	< 1200	1,8515	31CrMo12	140	1,0	0,007	0,005	0,004	0,012	0,009	0,007	0,018
		Bearing steel	< 1200	1,3505	100Cr6 (W3)	160	1,0	0,010	0,008	0,006	0,016	0,013	0,009	0,025
	Tool steel (cold working)	< 1300	1,2312	40CrMnMoS8 6	150	1,0	0,010	0,008	0,005	0,016	0,013	0,009	0,025	
	Tool steel (hot working)	< 1300	1,2343	X38CrMoV 51	130	1,0	0,010	0,008	0,005	0,016	0,013	0,009	0,025	
	M	Sulphured stainless steel	< 850	1,4305	X8CrNiS18-9	110	1,0	0,007	0,005	0,004	0,010	0,008	0,006	0,015
		Ferritic stainless steel	< 750	1,4510	X3CrTi17	100	1,0	0,007	0,005	0,004	0,010	0,008	0,006	0,015
		Martensitic stainless steel	< 900	1,4034	X46Cr13	85	1,0	0,007	0,005	0,004	0,010	0,008	0,006	0,015
		Ferritic martensitic stainless steel	< 1100	1,4313	X3CrNi113.4	100	1,0	0,007	0,005	0,004	0,010	0,008	0,006	0,015
		Austenitic/ferritic martensitic stainless steel	< 850	1,4460	X8CrNiMo27 5	100	1,0	0,007	0,005	0,004	0,010	0,008	0,006	0,015
		Austenitic stainless steel	< 750	1,4301	X5CrNi18-10	100	1,0	0,007	0,005	0,004	0,010	0,008	0,006	0,015
	K	Lamellar graphite cast iron	100-350	0,6010	GG10	170	1,0	0,014	0,011	0,008	0,020	0,016	0,011	0,029
		Grey graphite cast iron	300-1000	0,6030	GG30	140	1,0	0,010	0,008	0,006	0,020	0,016	0,011	0,029
		Spheroidal cast iron	300-500	0,7040	GGG40	160	1,0	0,010	0,008	0,006	0,016	0,013	0,009	0,025
		Spheroidal cast iron	550-800	0,7060	GGG60	130	1,0	0,010	0,008	0,006	0,016	0,013	0,009	0,025
Tempered white cast iron		350-450	0,8035	GTW35	150	1,0	0,010	0,008	0,006	0,016	0,013	0,009	0,025	
Tempered white cast iron		500-650	0,8055	GTW55	140	1,0	0,010	0,008	0,006	0,016	0,013	0,009	0,025	
Tempered black cast iron		350-450	0,8135	GTS35	150	1,0	0,010	0,008	0,006	0,016	0,013	0,009	0,025	
Tempered black cast iron		500-700	0,8155	GTS55	135	1,0	0,010	0,008	0,006	0,016	0,013	0,009	0,025	

\* Ball nose end mills: calculate  $n$ [rpm] as per Tab.K pag. 46



# Milling - Working parameters

Tool	ISO	Material	Streght [MPa]	N.	Designation	Vc [m/min]	DC = 11 mm	DC = 12,5 mm	DC = 16 mm
							fz [mm]	fz [mm]	fz [mm]
78°	P	General construction steel	< 800	1,0037	Sf37-2	80	0,015	0,018	0,021
		Automatic steel	< 800	1,0719	9SMnPb28	84	0,015	0,018	0,021
		Unalloyed case hardened steel	< 800	1,0401	C15	72	0,015	0,018	0,021
		Alloyed case hardened steel	< 1000	1,7331	16MnCr5 (EC80)	64	0,015	0,018	0,021
		Unalloyed annealed steel	< 850	1,0503	C45	68	0,015	0,018	0,021
		Unalloyed annealed steel	< 1000	1,0601	C60	64	0,015	0,018	0,021
		Alloyed annealed steel	< 800	1,5131	50MnS14	64	0,015	0,018	0,021
		Alloyed annealed steel	< 1300	1,5755	31NiCr14	56	0,015	0,018	0,021
		Cast steel	< 850	0,9650	G-X260Cr27	56	0,015	0,018	0,021
		Nitriding steel	< 1000	1,8504	34CrA16	64	0,015	0,018	0,021
		Nitriding steel	< 1200	1,8515	31CrMo12	56	0,011	0,014	0,016
		Bearing steel	< 1200	1,3505	100Cr6 (W3)	64	0,015	0,018	0,021
	Tool steel (cold working)	< 1300	1,2312	40CrMnMoS8 6	60	0,015	0,018	0,021	
	Tool steel (hot working)	< 1300	1,2343	X38CrMoV 51	60	0,015	0,018	0,021	
	M	Sulphured stainless steel	< 850	1,4305	X8CrNiS18-9	44	0,010	0,012	0,014
		Ferritic stainless steel	< 750	1,451	X3CrTi17	40	0,010	0,012	0,014
		Martensitic stainless steel	< 900	1,4034	X46Cr13	34	0,015	0,018	0,021
		Ferritic martensitic stainless steel	< 1100	1,4313	X3CrNi13.4	40	0,015	0,018	0,021
		Austenitic/ferritic martensitic stainless steel	< 850	1,446	X8CrNiMo27 5	40	0,015	0,018	0,021
		Austenitic stainless steel	< 750	1,4301	X5CrNi18-10	40	0,015	0,018	0,021
	K	Lamellar graphite cast iron	100-350	0,601	GG10	68	0,028	0,034	0,040
		Grey graphite cast iron	300-1000	0,603	GG30	56	0,028	0,034	0,040
		Spheroidal cast iron	300-500	0,704	GGG40	64	0,012	0,014	0,017
		Spheroidal cast iron	550-800	0,706	GGG60	52	0,012	0,014	0,017
		Tempered white cast iron	350-450	0,8035	GTW35	60	0,015	0,018	0,021
		Tempered white cast iron	500-650	0,8055	GTW55	56	0,015	0,018	0,021
		Tempered black cast iron	350-450	0,8135	GTS35	60	0,015	0,018	0,021
		Tempered black cast iron	500-700	0,8155	GTS55	54	0,015	0,018	0,021

\* Reduce fz by 50% while approaching the workpiece

## Tab. K

Tab. K								
ap	DC x 0,05	DC x 0,1	DC x 0,15	DC x 0,2	DC x 0,25	DC x 0,3	DC x 0,4	DC x 0,5
K	2,3	1,7	1,4	1,3	1,2	1,1	1,0	1,0

$$n[\text{rpm}] = K \times Vc[\text{m/min}] \times 1000 / (Dc[\text{mm}] \times 3,14)$$



DC = 18 mm	DC = 19 mm	DC = 21 mm	DC = 22 mm	DC = 25 mm	DC = 28 mm	DC = 32 mm	DC = 36 mm	DC = 40 mm
fz [mm]	fz [mm]	fz [mm]	fz [mm]	fz [mm]	fz [mm]	fz [mm]	fz [mm]	fz [mm]
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,019	0,021	0,023	0,023	0,023	0,026	0,030	0,034	0,034
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,017	0,019	0,020	0,020	0,020	0,023	0,027	0,030	0,030
0,017	0,019	0,020	0,020	0,020	0,023	0,027	0,030	0,030
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,047	0,053	0,056	0,056	0,056	0,066	0,075	0,085	0,085
0,047	0,053	0,056	0,056	0,056	0,066	0,075	0,085	0,085
0,020	0,022	0,024	0,024	0,024	0,028	0,032	0,036	0,036
0,020	0,022	0,024	0,024	0,024	0,028	0,032	0,036	0,036
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045
0,025	0,028	0,030	0,030	0,030	0,035	0,040	0,045	0,045





# Steel Milling



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