






































































































Tool code	HE 445M	HE 645M	HB 235M	HBL 235M	HBLN 235M	HR 430M	HRLS 430M
Number of teeth	Z=4	Z=6	Z=2	Z=2	Z=2	Z=4	Z=4
Page	14	14	15	16	17	18	19
	VHM K05-K20	VHM K05-K20	VHM K05-K20	VHM K05-K20	VHM K05-K20	VHM K05-K20	VHM K05-K20
	AlSi-X Coating	AlSi-X Coating	AlSi-X Coating	AlSi-X Coating	AlSi-X Coating	AlSi-X Coating	AlSi-X Coating
	HRc 68	HRc 68	HRc 68	HRc 68	HRc 68	HRc 68	HRc 68
							
							
							
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
							
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
							
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
							
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
							
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
							
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
							
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
							
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
							
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
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	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC
	HSC	HSC	HSC	HSC	HSC	HSC	HSC

	<i>New</i> 	<i>New</i> 		<i>New</i> 	<i>New</i> 		
Tool code	HRN 430M	HRLN 230M	HRLN 430M	HRTN2309M	HRTN4309M		
Number of teeth	Z=4	Z=2	Z=4	Z=2	Z=4		
Page	20	21	21	22	22		
	VHM K05-K20	VHM K05-K20	VHM K05-K20	VHM K05-K20	VHM K05-K20		
	AISI-X Coating	AISI-X Coating	AISI-X Coating	AISI-X Coating	AISI-X Coating		
	HRc 68	HRc 68	HRc 68	HRc 68	HRc 68		
	 30°	 30°	 30°	 30°	 30°		
							
							
							
	HSC	HSC	HSC	HSC	HSC		
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
P	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
H	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
M	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
K	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
N	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
S	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

VHM K05-K20	35°	HSC
AlSi-X Coating		
HRc 68		

Ball nose end mills
For HSC of tempered and hardened steels 48 - 68 HRc

Kugelkopfräser
Für die HSC von gehärtetem und vergütetem Stählen mit Härten von 48 - 68 HRc



HB 235M

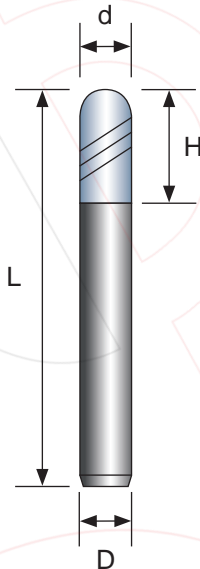
Z=2

Example: Order code HB 235M 010-02004				
d-Code	d	x	H x D	L

P	HRc < 24	
	HRc 24 - 35	○
	HRc > 35	◎
H	HRc 45 - 55	◎
	HRc 56 - 60	◎
	HRc > 60	◎
M	Stainless steel	
K	Cast iron	
N	Copper alloy	
S	Titanium alloy	
	High-temperature alloy	



010-02004	R0.5 x 2.0 x C 4	50	●	
015-03004	R0.75 x 3.0 x C 4	50	●	
020-04004	R1.0 x 4.0 x C 4	50	●	
020-04006	R1.0 x 4.0 x C 6	50	◇	
030-06003	R1.5 x 6.0 x C 3	50	◇	
030-06004	R1.5 x 6.0 x C 4	50	●	
030-06006	R1.5 x 6.0 x C 6	50	●	
040-08004	R2.0 x 8.0 x C 4	50	●	
040-08006	R2.0 x 8.0 x C 6	50	●	
050-10006	R2.5 x 10.0 x C 6	50	◇	
060-12006	R3.0 x 12.0 x C 6	50	●	
080-16008	R4.0 x 16.0 x C 8	60	●	
100-20010	R5.0 x 20.0 x C10	75	●	
120-24012	R6.0 x 24.0 x C12	75	◇	

Cutting data, P23



Tolerance / Toleranz

Range	Diameter
1 ≤ d < 8	0 / -0.02
8 ≤ d < 18	0 / -0.03

VHM K05-K20	 35°	HSC
AISI-X Coating		
HRc 68		

Ball nose end mills, long shank
For HSC of tempered and hardened steels 48 - 68 HRc

Kugelkopffräser, langer schaft
Für die HSC von gehärtetem und vergütetem Stählen mit Härten von 48 - 68 HRc



HBSL 235M

Z=2

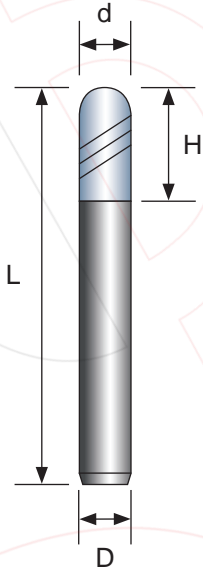
Example: Order code HBSL 235M 020-04104

d-Code d x L x D H

P	HRc < 24	
	HRc 24 - 35	○
	HRc > 35	◎
H	HRc 45 - 55	◎
	HRc 56 - 60	◎
	HRc > 60	◎
M	Stainless steel	
K	Cast iron	
N	Copper alloy	
S	Titanium alloy	
	High-temperature alloy	

020-04104	R1.0 x L 75 x C 4	4.0	◇	
020-04106	R1.0 x L 75 x C 6	4.0	●	
030-06106	R1.5 x L 75 x C 6	6.0	●	
040-08104	R2.0 x L 75 x C 4	8.0	●	
040-08106	R2.0 x L 75 x C 6	8.0	●	
050-10106	R2.5 x L 75 x C 6	10.0	◇	
060-12106	R3.0 x L 75 x C 6	12.0	●	
060-12306	R3.0 x L 100 x C 6	12.0	●	
080-16308	R4.0 x L 100 x C 8	16.0	●	
100-20310	R5.0 x L 100 x C 10	20.0	●	
120-24312	R6.0 x L 100 x C 12	24.0	◇	

Cutting data, P23



Tolerance / Toleranz

Range	Diameter
1 ≤ d < 8	0 / -0.02
8 ≤ d < 18	0 / -0.03

VHM K05-K20	 30°	HSC
AlSi-X Coating		
HRC 68		

Corner radius end mills, long shank
For HSC of tempered and hardened steels 48 - 68 HRC

Eckradiusfräser, langer schaft
Für die HSC von gehärtetem und vergütetem Stählen mit Härten von 48 - 68 HRC



HRLS 430M

Z=4

Example: Order code HRLS 430M 040-05104

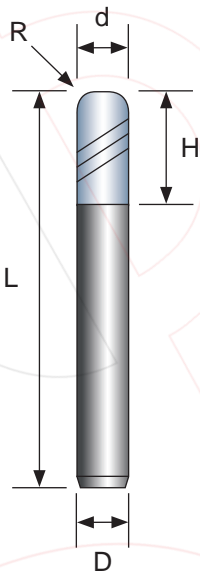
d-Code	d x R x L x D	H
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P	HRc < 24	
	HRc 24 - 35	○
	HRc > 35	⊙
H	HRc 45 - 55	⊙
	HRc 56 - 60	⊙
	HRc > 60	⊙
M	Stainless steel	
K	Cast iron	
N	Copper alloy	
S	Titanium alloy	
	High-temperature alloy	

040-05104	4.0 x R0.5 x L 75 x C 4	8.0
040-10104	4.0 x R1.0 x L 75 x C 4	8.0
060-05106	6.0 x R0.5 x L 75 x C 6	12.0
060-10106	6.0 x R1.0 x L 75 x C 6	12.0
080-05308	8.0 x R0.5 x L 100 x C 8	16.0
080-10308	8.0 x R1.0 x L 100 x C 8	16.0
100-05310	10.0 x R0.5 x L 100 x C 10	20.0
100-10310	10.0 x R1.0 x L 100 x C 10	20.0
120-05312	12.0 x R0.5 x L 100 x C 10	24.0
120-10312	12.0 x R1.0 x L 100 x C 10	24.0

●	
●	
●	
●	
●	
●	
●	
◇	
●	

Cutting data, P25



Tolerance

Range	Diameter
1 ≤ d < 8	0 / -0.02
8 ≤ d < 18	0 / -0.03

VHM K05-K20	30°	HSC
AISI-X Coating	R	
HRc 68		

Corner radius end mills, with working depth
For HSC of tempered and hardened steels 48 - 68 HRc

Eckradiusfräser, mit Arbeitstiefen
Für die HSC von gehärtetem und vergütetem Stählen mit
Härten von 48 - 68 HRc

New



HRN 430M

Z=4

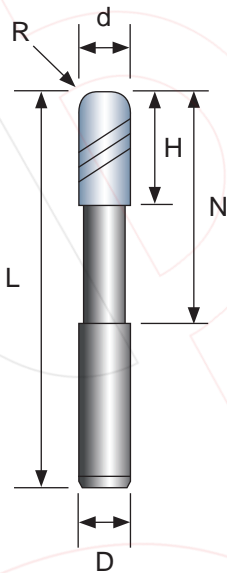
Example: Order code HRN 430M 060-05301

d-Code	d x R x N x D	H L
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P	HRc < 24	
	HRc 24 - 35	○
	HRc > 35	◎
H	HRc 45 - 55	◎
	HRc 56 - 60	◎
	HRc > 60	◎
M	Stainless steel	
K	Cast iron	
N	Copper alloy	
S	Titanium alloy	
	High-temperature alloy	

060-05301	6.0 x R0.5 x N 30 x C 6	9.0 75	●	
060-10301	6.0 x R1.0 x N 30 x C 6	9.0 75	●	
080-05403	8.0 x R0.5 x N 40 x C 8	12.0 100	●	
080-10403	8.0 x R1.0 x N 40 x C 8	12.0 100	●	
100-05503	10.0 x R0.5 x N 50 x C10	15.0 100	●	
100-10503	10.0 x R1.0 x N 50 x C10	15.0 100	●	
120-05603	12.0 x R0.5 x N 60 x C12	18.0 100	◇	
120-10603	12.0 x R1.0 x N 60 x C12	18.0 100	●	

Cutting data, P25



Tolerance / Toleranz

Range	Diameter
1 ≤ d < 8	0 / -0.02
8 ≤ d < 18	0 / -0.03

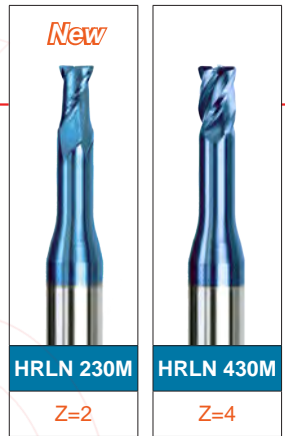
VHM K05-K20	30°	HSC
AISI-X Coating		
HRc 68		

Corner radius end mills, long neck
For HSC of tempered and hardened steels 48 - 68 HRc

Eckradiusfräser, überlaufhals
Für die HSC von gehärtetem und vergütetem Stählen mit Härten von 48 - 68 HRc

Example: Order code HRLN 230M 010-01044

d-Code	d x R x N x D	H L
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Hard-max

P	HRc < 24	
	HRc 24 - 35	○
	HRc > 35	◎
H	HRc 45 - 55	◎
	HRc 56 - 60	◎
	HRc > 60	◎
M	Stainless steel	○
K	Cast iron	
N	Copper alloy	
S	Titanium alloy	○
	High-temperature alloy	

010-01044	1.0 x R0.1 x N 4 x C 4	1.2 50
010-01064	1.0 x R0.1 x N 6 x C 4	1.2 50
010-01084	1.0 x R0.1 x N 8 x C 4	1.2 50
010-02044	1.0 x R0.2 x N 4 x C 4	1.2 50
010-02064	1.0 x R0.2 x N 6 x C 4	1.2 50
010-02084	1.0 x R0.2 x N 8 x C 4	1.2 50
010-02104	1.0 x R0.2 x N 10 x C 4	1.2 50
010-02124	1.0 x R0.2 x N 12 x C 4	1.2 50

●
●
◇
●
●
◇
◇

015-02064	1.5 x R0.2 x N 6 x C 4	1.8 50
015-02124	1.5 x R0.2 x N 12 x C 4	1.8 50
015-02184	1.5 x R0.2 x N 18 x C 4	1.8 60
015-03064	1.5 x R0.3 x N 6 x C 4	1.8 50
015-03124	1.5 x R0.3 x N 12 x C 4	1.8 50
015-03184	1.5 x R0.3 x N 18 x C 4	1.8 60

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Cutting data, P26

Tolerance / Toleranz	
Range	Diameter
1 ≤ d < 8	0 / -0.02

020-02084	2.0 x R0.2 x N 8 x C 4	2.4 50
020-02124	2.0 x R0.2 x N 12 x C 4	2.4 50
020-02164	2.0 x R0.2 x N 16 x C 4	2.4 60
020-02204	2.0 x R0.2 x N 20 x C 4	2.4 60
020-05084	2.0 x R0.5 x N 8 x C 4	2.4 50
020-05124	2.0 x R0.5 x N 12 x C 4	2.4 50
020-05164	2.0 x R0.5 x N 16 x C 4	2.4 60
020-05204	2.0 x R0.5 x N 20 x C 4	2.4 60

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030-02126	3.0 x R0.2 x N 12 x C 6	3.6 60
030-02186	3.0 x R0.2 x N 18 x C 6	3.6 60
030-02246	3.0 x R0.2 x N 24 x C 6	3.6 75
030-03126	3.0 x R0.3 x N 12 x C 6	3.6 60
030-03186	3.0 x R0.3 x N 18 x C 6	3.6 60
030-03246	3.0 x R0.3 x N 24 x C 6	3.6 75
030-05126	3.0 x R0.5 x N 12 x C 6	3.6 60
030-05186	3.0 x R0.5 x N 18 x C 6	3.6 60
030-05246	3.0 x R0.5 x N 24 x C 6	3.6 75

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040-02166	4.0 x R0.2 x N 16 x C 6	4.8 60
040-02246	4.0 x R0.2 x N 24 x C 6	4.8 75
040-02326	4.0 x R0.2 x N 32 x C 6	4.8 75
040-03166	4.0 x R0.3 x N 16 x C 6	4.8 60
040-03246	4.0 x R0.3 x N 24 x C 6	4.8 75
040-03326	4.0 x R0.3 x N 32 x C 6	4.8 75
040-05166	4.0 x R0.5 x N 16 x C 6	4.8 60
040-05246	4.0 x R0.5 x N 24 x C 6	4.8 75
040-05326	4.0 x R0.5 x N 32 x C 6	4.8 75

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VHM K05-K20		HSC
AISI-X Coating		
HRc 68		

Corner radius end mills, conic neck 0.9°
For HSC of hardened and tempered steels 48 - 68 HRc

Eckradiusfräser, 0.9° konisch zum Schaft
Für die HSC von gehärtetem und vergütetem Stählen mit
Härten von 48 - 68 HRc

Example: Order code HRTN 2309M 010-02104

<i>New</i>		<i>New</i>	
HRTN2309M		HRTN4309M	
Z=2		Z=4	

P	HRc < 24	
	HRc 24 - 35	○
	HRc > 35	◎
H	HRc 45 - 55	◎
	HRc 56 - 60	◎
	HRc > 60	◎
M	Stainless steel	○
K	Cast iron	
N	Copper alloy	
S	Titanium alloy	○
	High-temperature alloy	

d-Code	d x R x N x D	H	L
010-02104	1.0 x R0.2 x N 10 x C 4	1.2	50
010-02124	1.0 x R0.2 x N 12 x C 4	1.2	50
010-02154	1.0 x R0.2 x N 15 x C 4	1.2	50
015-02154	1.5 x R0.2 x N 15 x C 4	1.8	75
015-02204	1.5 x R0.2 x N 20 x C 4	1.8	75
015-02254	1.5 x R0.2 x N 25 x C 4	1.8	75
020-02204	2.0 x R0.2 x N 20 x C 4	2.4	75
020-02254	2.0 x R0.2 x N 25 x C 4	2.4	75
020-02304	2.0 x R0.2 x N 30 x C 4	2.4	75
020-05204	2.0 x R0.5 x N 20 x C 4	2.4	75
020-05254	2.0 x R0.5 x N 25 x C 4	2.4	75
020-05304	2.0 x R0.5 x N 30 x C 4	2.4	75
030-02306	3.0 x R0.2 x N 30 x C 6	3.6	75
030-02406	3.0 x R0.2 x N 40 x C 6	3.6	75
030-02506	3.0 x R0.2 x N 50 x C 6	3.6	100
030-05306	3.0 x R0.5 x N 30 x C 6	3.6	75
030-05406	3.0 x R0.5 x N 40 x C 6	3.6	75
030-05506	3.0 x R0.5 x N 50 x C 6	3.6	100

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Tolerance / Toleranz	
Range	Diameter
1 ≤ d < 8	0 / -0.02

Cutting data / Hard-max (Square end mills, Ball nose end mills)

Hard-max		Side milling / Finishing (HSC)									
		$A_p = 1.0 \times d$ $A_e = 0.02 \times d$		HE 445M, HE 645M							
		V_c [m / min]		f_z feed [mm / tooth] by diameter							
P	HRc > 35	145 - 185	0.018	0.022	0.031	0.050	0.059	0.078	0.093	0.013	0.017
H	HRc < 52	125 - 165	0.016	0.020	0.028	0.045	0.054	0.070	0.084	0.011	0.015
	HRc 52 - 55	105 - 135	0.014	0.017	0.025	0.039	0.046	0.061	0.073	0.010	0.014
	HRc 56 - 60	70 - 95	0.012	0.015	0.021	0.033	0.039	0.052	0.061	0.008	0.011

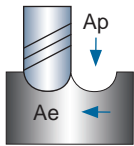
Hard-max		Copy milling / Finishing (HSC)									
		HB 235M, HBL5 235M(#1)									
		P HRc > 35		H							
		HRc < 52	HRc 52 - 55		HRc 56 - 60		HRc < 65				
A_p [mm]		0.02 x d		0.02 x d		0.02 x d		0.02 x d		0.02 x d	
A_e [mm]		0.015 x d		0.015 x d		0.015 x d		0.015 x d		0.015 x d	
d [mm]	n [min ⁻¹]	V_f [mm/min]	n [min ⁻¹]	V_f [mm/min]	n [min ⁻¹]	V_f [mm/min]	n [min ⁻¹]	V_f [mm/min]	n [min ⁻¹]	V_f [mm/min]	
R0.2	30000	360	30000	360	30000	360	30000	360	30000	360	
R0.25	30000	450	30000	450	30000	450	30000	450	30000	450	
R0.3	30000	540	30000	540	30000	540	30000	540	30000	540	
R0.4	30000	720	30000	720	30000	720	27700	670	21800	520	
R0.5	30000	900	30000	900	26700	801	22300	669	17500	525	
R0.75	30000	1350	30000	1350	25600	1152	21400	963	17500	788	
R1.0	30000	1800	27400	1644	22400	1344	18700	1122	17500	1050	
R1.5	29700	2673	24400	2196	20100	1809	14800	1332	11600	1044	
R2.0	22200	2664	18300	2196	15100	1812	11100	1332	8700	1044	
R2.5	17800	2670	14600	2190	12100	1815	8900	1335	7000	1050	
R3.0	14800	2664	12200	2196	10000	1800	7400	1332	5800	1044	
R4.0	11100	2664	9100	2184	7500	1800	5500	1320	4300	1032	
R5.0	8900	2670	7300	2190	6000	1800	4400	1320	3500	1050	
R6.0	7400	2664	6100	2196	5000	1800	3700	1332	2900	1044	

Notes	<p>#1 For HBL5 235M: Adjust feed rate (V_f) and spindle speed (n) 10% - 50% lower according to the ratio of overhang length / cutting diameter.</p> <ul style="list-style-type: none"> ▶ All cutting data are target values. Please adjust conditions based on machining shape and machining path. ▶ Use a rigid and precise machine and holder. ▶ Recommend to use MQL (Minimum Quantity Lubrication / mist coolant) or air blow for machining hardened steel. ▶ Recommend to apply helical or ramping for approaching into axial direction. ▶ When the available RPM are insufficient, please reduce the RPM and feed rates in proportion.
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Cutting data / Hard-max (Ball nose end mills)

Hard-max

Contour line / Roughing (HSC)



HBLN 235M

H

HRc < 52

HRc 52 - 55

HRc 56 - 60

R [mm]	N [mm]	n [min ⁻¹]	Vf [mm/min]	Ap [mm]	Ae [mm]	n [min ⁻¹]	Vf [mm/min]	Ap [mm]	Ae [mm]	n [min ⁻¹]	Vf [mm/min]	Ap [mm]	Ae [mm]
R0.5	4	28000	1460	0.035	0.105	24600	1180	0.032	0.096	19700	750	0.025	0.075
	6	25200	1310	0.020	0.060	22100	1060	0.018	0.054	17700	670	0.014	0.042
	8	25200	1310	0.015	0.045	22100	1060	0.014	0.042	17700	670	0.011	0.033
	10	22400	1030	0.012	0.036	19700	830	0.011	0.033	15800	540	0.009	0.027
	12	20100	840	0.010	0.030	17700	670	0.009	0.027	14200	430	0.007	0.021
R0.75	6	21000	1510	0.053	0.159	18500	1220	0.048	0.144	14800	800	0.038	0.114
	8	18900	1360	0.030	0.090	16700	1100	0.027	0.081	13300	720	0.022	0.066
	12	18900	1360	0.023	0.069	16700	1100	0.021	0.063	13300	720	0.017	0.051
	16	15100	880	0.015	0.045	13300	720	0.014	0.042	10600	470	0.011	0.033
	20	14500	750	0.014	0.042	12700	610	0.012	0.036	10200	390	0.010	0.030
R1.0	6	17600	1690	0.120	0.360	15500	1360	0.100	0.300	12400	890	0.072	0.216
	8	17600	1690	0.085	0.255	15500	1360	0.071	0.213	12400	890	0.051	0.153
	12	15800	1520	0.048	0.144	14000	1230	0.040	0.120	11200	810	0.029	0.087
	16	15800	1520	0.037	0.111	14000	1230	0.031	0.093	11200	810	0.022	0.066
	20	14100	1210	0.030	0.090	12400	970	0.025	0.075	9900	630	0.018	0.054
R1.5	12	15400	2220	0.149	0.447	13600	1800	0.117	0.351	10800	1170	0.085	0.255
	16	13900	2000	0.084	0.252	12200	1610	0.066	0.198	9700	1050	0.048	0.144
	20	13900	2000	0.065	0.195	12200	1610	0.051	0.153	9700	1050	0.037	0.111
	25	12300	1570	0.052	0.156	10900	1290	0.041	0.123	8600	830	0.030	0.090
	30	12300	1249	0.052	0.156	10900	1030	0.041	0.123	8600	660	0.030	0.090
R2.0	16	12000	2300	0.198	0.594	10600	1870	0.170	0.510	8400	1210	0.127	0.381
	20	10800	2070	0.112	0.336	9500	1670	0.096	0.288	7600	1090	0.072	0.216
	30	10800	2070	0.086	0.258	9500	1670	0.074	0.222	7600	1090	0.055	0.165

Notes

- ▶ These recommended cutting conditions indicate just reference. It should be adjusted according to milling shape and machine type.
- ▶ Recommend to use MQL (Minimum Quantity Lubrication / mist coolant) or air blow for machining hardened steel.
- ▶ Recommend to apply herical or ramping for approaching into axial direction.
- ▶ Reduce both spindle speed and feed at same rate for chattering and also for insufficient spindle speed of a machine.

Cutting data / Hard-max (Corner radius end mills)

Hard-max		Contour line / Roughing (HSC)											
		HR 430M, HRLS 430M (#1), HRN 430M (#1)											
		H											
		HRc < 52				HRc 52 - 55				HRc 56 - 62			
d [mm]	R [mm]	n [min ⁻¹]	Vf [mm/min]	Ap [mm]	Ae [mm]	n [min ⁻¹]	Vf [mm/min]	Ap [mm]	Ae [mm]	n [min ⁻¹]	Vf [mm/min]	Ap [mm]	Ae [mm]
1	0.2	26500	1780	0.04	0.13	23300	1420	0.04	0.12	18600	900	0.03	0.09
1.5	0.2	19800	1810	0.06	0.2	17400	1420	0.06	0.18	14000	940	0.04	0.14
2	0.2,0.5	16600	1860	0.09	0.27	14600	1580	0.08	0.25	11700	980	0.06	0.19
2.5	0.2,0.5	15300	2080	0.11	0.34	13700	1740	0.1	0.31	10900	1090	0.08	0.24
3	0.2,0.5	13900	2130	0.13	0.41	12200	1760	0.12	0.37	9800	1130	0.09	0.28
4	0.2,0.5	10800	1940	0.18	0.54	9500	1580	0.16	0.49	7600	970	0.12	0.38
5	0.5,1.0	8640	1940	0.23	0.68	7600	1580	0.2	0.62	6080	970	0.16	0.48
6	0.5,1.0	7200	1940	0.27	0.81	6330	1580	0.24	0.74	5060	970	0.19	0.58
8	0.5,1.0	5400	1940	0.36	1.08	4740	1580	0.33	0.98	3800	970	0.26	0.76
10	1.0,2.0	4320	1940	0.45	1.35	3800	1580	0.41	1.23	3040	970	0.32	0.96
12	1.0,2.0	3450	1940	0.54	1.62	3160	1580	0.49	1.47	2530	970	0.38	1.15

Hard-max		Inclined surface milling / Finishing (HSC)											
		HR 430M, HRLS 430M (#1), HRN 430M (#1)											
		H											
		HRc < 52				HRc 52 - 55				HRc 56 - 62			
d [mm]	R [mm]	n [min ⁻¹]	Vf [mm/min]	Ap [mm]	Ae [mm]	n [min ⁻¹]	Vf [mm/min]	Ap [mm]	Ae [mm]	n [min ⁻¹]	Vf [mm/min]	Ap [mm]	Ae [mm]
1	0.2	27000	1810	0.03	0.03	23800	1450	0.02	0.03	18900	920	0.02	0.03
1.5	0.2	27000	2460	0.04	0.04	23800	1940	0.03	0.04	18900	1270	0.03	0.04
2	0.2,0.5	27000	3100	0.06	0.06	23800	2590	0.04	0.06	17400	1360	0.04	0.06
2.5	0.2,0.5	26000	3540	0.07	0.07	20800	2660	0.05	0.07	13900	1400	0.05	0.07
3	0.2,0.5	25100	3860	0.09	0.09	20100	2900	0.06	0.09	13500	1550	0.06	0.09
4	0.2,0.5	18700	3340	0.12	0.12	15100	2510	0.08	0.12	10100	1300	0.08	0.12
5	0.5,1.0	15100	3380	0.15	0.15	12100	2510	0.10	0.15	8100	1300	0.10	0.15
6	0.5,1.0	12500	3360	0.18	0.18	10100	2530	0.12	0.18	6700	1280	0.12	0.18
8	0.5,1.0	9400	3380	0.24	0.24	7600	2530	0.16	0.24	5100	1310	0.16	0.24
10	1.0,2.0	7500	3360	0.30	0.30	6100	2540	0.20	0.30	4000	1280	0.20	0.30
12	1.0,2.0	6200	3330	0.36	0.36	5100	2540	0.24	0.36	3300	1260	0.24	0.36

Notes

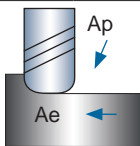
#1 For HRLS 430M and HRN 430M : Adjust feed rate (Vf) and spindle speed (n) 10% - 50% lower according to the ratio of overhang length / cutting diameter.

- ▶ Recommend to use MQL (Minimum Quantity Lubrication / mist coolant) or air blow for machining hardened steel.
- ▶ Recommend to apply herical or ramping for approaching into axial direction.
- ▶ Reduce both spindle speed and feed at same rate for chattering and also for insufficient spindle speed of a machine.

Cutting data / Hard-max (Corner radius end mills)

Hard-max

Contour line / Semi-roughing (HSC)



HRLN 230M, HRLN 430M (※ 1)

H

HRc < 52

HRc 52 - 55

HRc 56 - 60

d, R [mm]	N [mm]	n [min ⁻¹]	Vf [mm/min]	Ap [mm]	Ae [mm]	n [min ⁻¹]	Vf [mm/min]	Ap [mm]	Ae [mm]	n [min ⁻¹]	Vf [mm/min]	Ap [mm]	Ae [mm]
1.0 R0.2	6	20200	850	0.018	0.054	17800	680	0.016	0.048	14200	430	0.013	0.039
	8	18100	760	0.012	0.036	16000	610	0.011	0.033	12700	380	0.009	0.027
	10	15900	600	0.011	0.033	14000	480	0.010	0.030	11200	290	0.008	0.024
	12	14200	480	0.009	0.027	12500	380	0.008	0.024	10000	240	0.006	0.018
1.5 R0.2	6	17000	990	0.048	0.144	14900	770	0.044	0.132	12000	500	0.034	0.102
	12	13600	790	0.019	0.057	11900	620	0.017	0.051	9600	400	0.013	0.039
	18	10600	490	0.014	0.042	9300	390	0.012	0.036	7500	260	0.010	0.030
2.0 R0.2 R0.5	8	14200	1020	0.064	0.192	12500	850	0.058	0.174	10000	520	0.045	0.135
	12	12600	910	0.036	0.108	11100	750	0.033	0.099	8900	460	0.026	0.078
	16	11400	820	0.025	0.075	10000	680	0.023	0.069	8000	420	0.018	0.054
	20	10000	640	0.022	0.066	8800	530	0.020	0.060	7000	320	0.016	0.048
D3 R0.2 R0.5	12	11100	1070	0.096	0.288	9800	880	0.087	0.261	7800	560	0.068	0.204
	18	10000	960	0.054	0.162	8800	790	0.049	0.147	7000	500	0.038	0.114
	24	8800	840	0.037	0.111	7700	690	0.034	0.102	6200	450	0.027	0.081
D4 R0.2 R0.5	16	8600	960	0.127	0.381	7600	790	0.116	0.348	6100	490	0.091	0.273
	24	7800	870	0.072	0.216	6800	710	0.066	0.198	5500	440	0.051	0.153
	32	6800	760	0.050	0.150	6000	620	0.045	0.135	4800	380	0.035	0.105

Notes

#1 For HRLN 430M : Adjust feed rate (Vf) 60% higher.

- ▶ These recommended cutting conditions indicate just reference. It should be adjusted according to milling shape and machine type.
- ▶ Recommend to use oil mist coolant for machining hardened steel.
- ▶ Recommend to apply herical or ramping for approaching into axial direction.
- ▶ Reduce both spindle speed and feed at same rate for chattering and also for insufficient spindle speed of a machine.