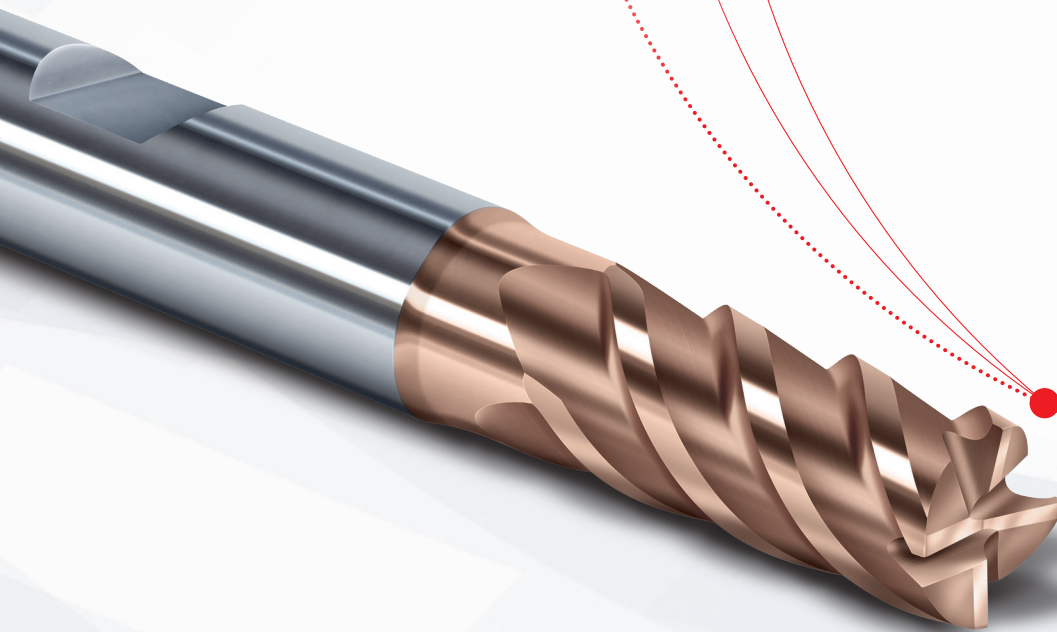


passion  
for precision



**HX: 10 times faster penetration in  
high-hard steels with HPC and HDC machining**



# Rough milling in hard and high-hard materials

You want to machine very hard **steels with a hardness rating higher than 55 HRC**? And to do so quickly, efficiently and safely? Then our new cylindrical **HX** roughing mill is the ideal solution. It's ideally suited to HPC and HDC machining of high-hard steels. These specially developed tools are roughing tools that also have excellent penetration capabilities. Penetration angles of up to 5° are possible, these being 10 times greater than the values of conventional milling cutters used to machine hardened steels. Our smooth-cutting **HX** mill is ideal for machining hard materials for the worlds of mold-making, punching and stamping.

The newly developed geometry of our **HX** mills and the new **Duro-Si coating** combine to faci-

litate high material removal rates and a long tool life when machining steels with a hardness rating in excess of 55 HRC.

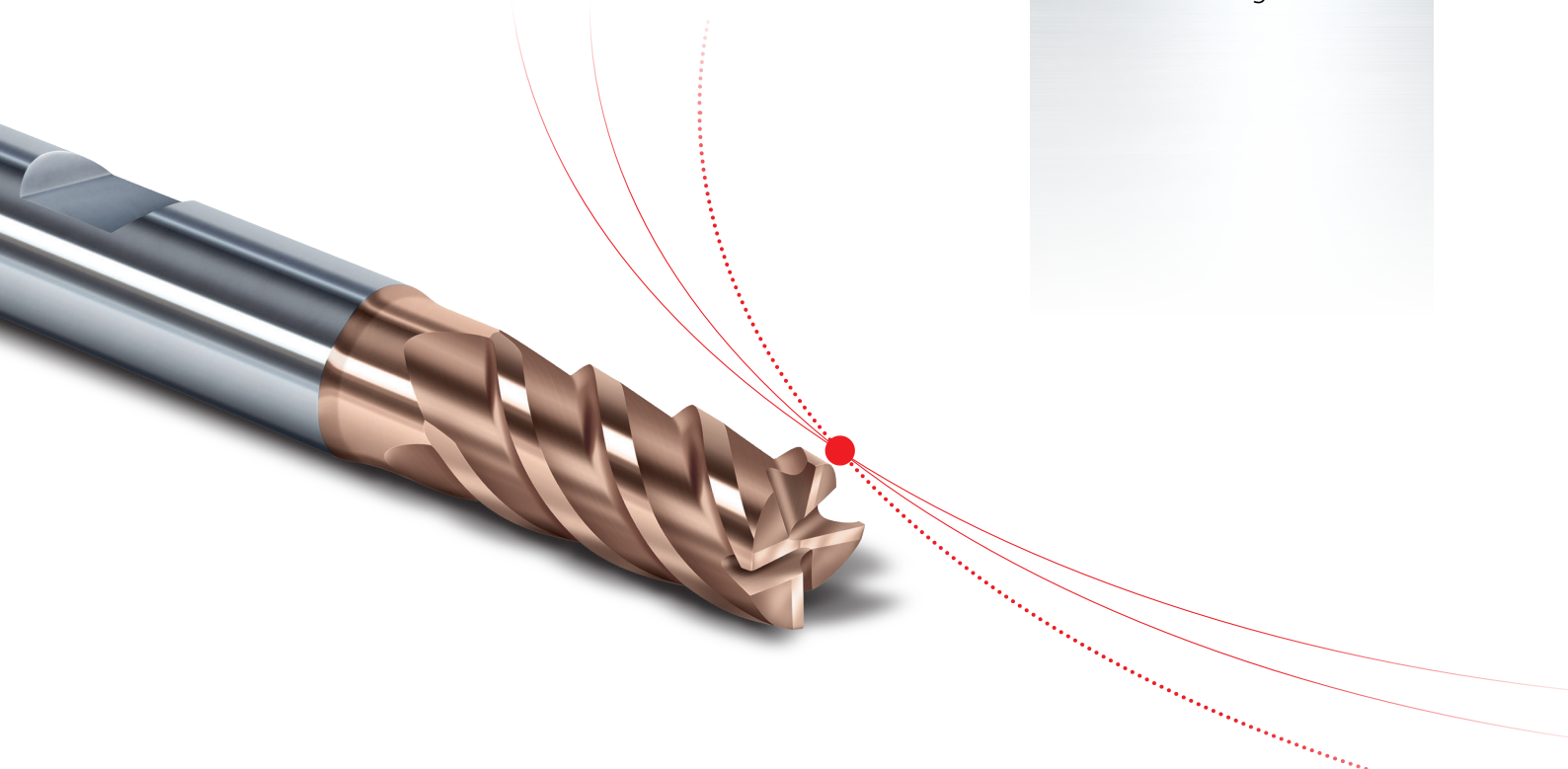
Thanks to the perfect combination of robust, penetration-capable edge geometries and high-hard and highly wear-resistant coating systems, these tools offer significant advantages over conventional rivals.

When the demands for **rapid roughing of grooves, inner and outer pockets and complex two-dimensional contours** are high, **HX** mills reveal their true potential – resulting in greater productivity gains and lower tool costs compared with conventional tools.

## The benefits:

- **Greater productivity** thanks to an improved penetration capability with penetration angles of up to 5°
- **Greater flexibility** thanks to high infeed rates in the axial and radial directions
- **High rigidity** also facilitates HPC applications
- **Shorter machining times** thanks to the ability to perform HDC applications
- **Low tool costs** thanks to a long tool life

[ 2 ]

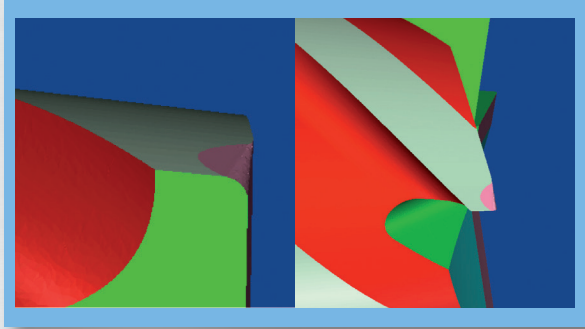


**Product innovations for greater efficiency and lower costs:**

**Newly developed cutting edge geometry**

The **HX** tool concept differs from that of conventional milling tools primarily with regard to the new cutting edge geometry that has been specially developed with high-hard steels in mind. In combination with the new **Duro-Si** coating, this tool concept is an outstanding solution for roughing steels with hardness ratings greater than 55 HRC.

**Comparison of tooth widths**



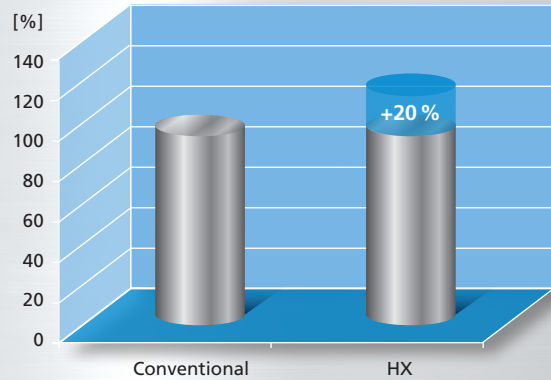
Robust, polished tooth edge enables high tooth loads and consequently high feed rates

The concave 8° profile is suitable for penetration operations with angles of up to 5°

**Up to 20% higher material removal rates**

The polished tooth edge – precisely matched to the load profile – and the solid tooth stabilize the cutting edge and help prevent break-outs from occurring during the chip formation process. This stabilizing effect is reinforced by the new, extremely hard **Duro-Si** coating. This can increase the material removal rate by up to 20% compared with a conventional tool. Thanks to the enlarged concave profile, the mills can be used for penetration operations with angles of up to 5°. This also enables inner pockets to be milled out cost-efficiently.

**Comparative productivity increase (material removal rates)**

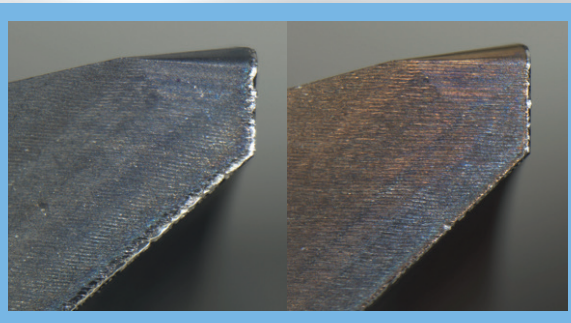


[ 3 ]

**Longer tool life**

By combining a conditioned cutting edge and **Duro-Si** coating with a very fine-grained carbide that offers very good edge stability, tool life can be increased considerably. What's more, the cutting edges suffer from very little wear and retain extremely good cutting performance even after a long time in use.

**Comparative wear: in 1.2379 material (60 HRC)**

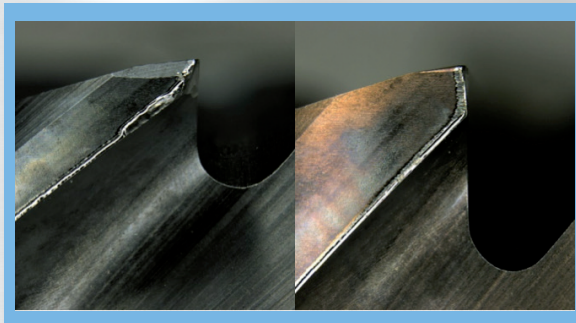


Conventional

HX Duro-Si

Material: 1.2379 (60 HRC), Vc = 100 m/min, n = 3000 rpm, vf = 2000 mm/min, ap = 9 mm, ae = 0.3 mm, tool dia. = 10 mm, t = 85 min

**Comparative wear: in HSS material (65 HRC)**

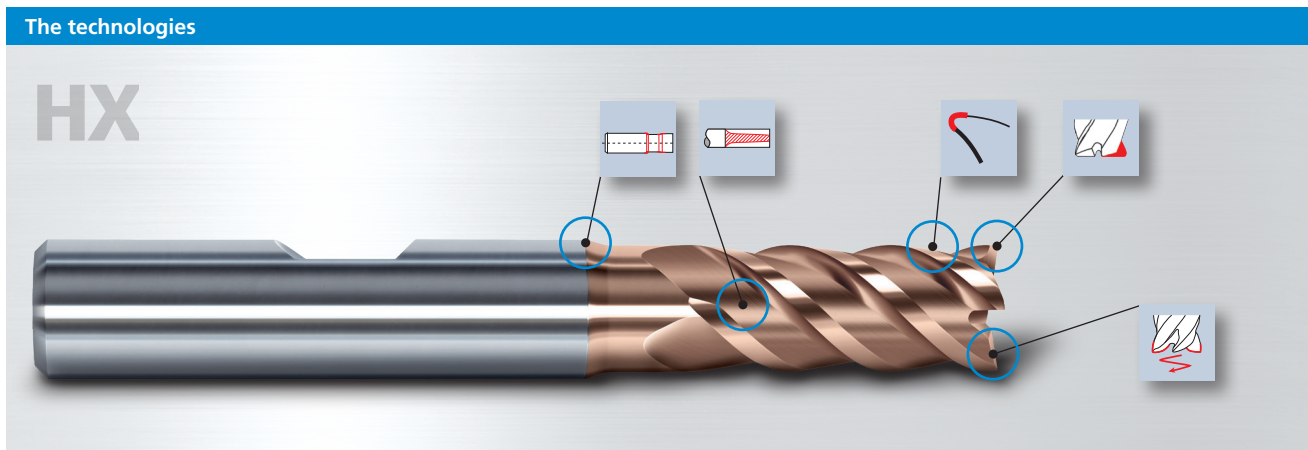


Conventional

HX Duro-Si

Material: HSS (65 HRC), Vc = 80 m/min, n = 2600 rpm, vf = 900 mm/min, ap = 9 mm, ae = 0.2 mm, tool dia. 10 mm, t = 45 min

# The advantages of our HX over conventional milling cutters are compelling on all fronts



[ 4 ]



## Milling tool with increasing core diameter

- Improved tool rigidity and less deflection of the tool
- Superior performance for infeeds  $a_p$ ,  $a_e$  and the feed rate  $f_z$
- Better workpiece accuracy thanks to less tool deflection



## Smooth transitions

- The transitions between the shaft, neck and cutting edge have smooth gradients and radii
- Improved tool rigidity and therefore less radial deflection
- Minimal "stepping" when working with multiple infeed depths
- Higher mechanical resistance for better performance



## Tools with polished teeth

- Reinforcement of the exposed cutting edge
- Absorption of higher cutting forces



## Milling tools with special edge reconditioning

- Reconditioning of the main cutting edge for greater cutting-edge stability
- Increased mechanical and thermal loading of the cutting edge
- Overall lengthening of tool life



## Tools with an edge designed for machining hardened materials

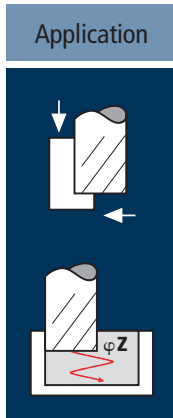
- The special, polished edge facilitates penetration operations with angles of up to  $5^\circ$  in all hardened steels

## Greater flexibility

Thanks to their high rigidity, the **HX** tools are excellent for HPC strategies: High axial and radial infeed rates when machining high-hard materials such as cold work steels and HSS are among the strengths of these tools.

The Tri-Layer **Duro-Si** hard coating features extraordinary resistance to abrasive wear. Combined with a very fine-grained hardened metal with outstanding edge strength, this allows

the tools to be deployed in demanding HDC milling strategies. With these tools, it's possible to obtain not only high material removal rates but also excellent surface qualities.



Material
Hardened tool steel 52 - 56 HRC
Hardened tool steel 56 - 60 HRC
Hardened tool steel 60 - 64 HRC
Hardened tool steel 64 - 70 HRC

d1 [mm]	z	v <sub>c</sub> [m/min]	f <sub>z</sub> [mm]	a <sub>p</sub> [mm]	a <sub>e</sub> [mm]	n [min <sup>-1</sup> ]	v <sub>f</sub> /v <sub>fZ</sub> [mm/min]	Q [cm <sup>3</sup> /min]	φZ [°]
3	4	60	0.015	4.5	1.2	6365	380	2.0	5°
4	4	60	0.020	6.0	1.6	4775	380	3.5	5°
5	4	60	0.030	7.5	2.0	3820	460	7.0	5°
6	4	60	0.035	9.0	2.4	3185	445	9.5	5°
8	4	60	0.045	12.0	3.2	2385	430	16.5	5°
10	4	60	0.055	15.0	4.0	1910	420	25.0	5°
12	4	60	0.065	18.0	4.8	1590	415	36.0	5°
16	4	60	0.090	24.0	5.6	1195	430	58.0	5°
20	4	60	0.110	30.0	7.0	955	420	88.0	5°
3	4	30	0.015	4.5	1.2	3185	190	1.0	5°
4	4	30	0.020	6.0	1.6	2385	190	2.0	5°
5	4	30	0.025	7.5	2.0	1910	190	3.0	5°
6	4	30	0.025	9.0	2.4	1590	160	3.5	5°
8	4	30	0.035	12.0	3.2	1195	165	6.5	5°
10	4	30	0.045	15.0	4.0	955	170	10.0	5°
12	4	30	0.055	18.0	4.8	795	175	15.0	5°
16	4	30	0.075	24.0	5.6	595	180	24.0	5°
20	4	30	0.090	30.0	7.0	475	170	35.5	5°
3	4	25	0.010	4.5	1.2	2655	106	0.5	5°
4	4	25	0.010	6.0	1.6	1990	80	1.0	5°
5	4	25	0.015	7.5	2.0	1590	95	1.5	5°
6	4	25	0.015	9.0	2.4	1325	80	1.5	5°
8	4	25	0.025	12.0	3.2	995	100	4.0	5°
10	4	25	0.030	15.0	4.0	795	95	5.5	5°
12	4	25	0.035	18.0	4.8	665	93	8.0	5°
16	4	25	0.045	24.0	5.6	495	89	12.0	5°
20	4	25	0.055	30.0	7.0	400	88	18.5	5°
3	4	20	0.010	4.5	0.8	2120	85	0.5	5°
4	4	20	0.010	6.0	1.0	1590	64	0.5	5°
5	4	20	0.015	7.5	1.3	1275	77	0.5	5°
6	4	20	0.015	9.0	1.5	1060	64	1.0	5°
8	4	20	0.025	12.0	2.0	795	80	2.0	5°
10	4	20	0.030	15.0	2.5	635	76	3.0	5°
12	4	20	0.035	18.0	3.0	530	74	4.0	5°
16	4	20	0.045	24.0	3.2	400	72	5.5	5°
20	4	20	0.055	30.0	4.0	320	70	8.5	5°



Material
Hardened tool steel 52 - 56 HRC
Hardened tool steel 56 - 60 HRC
Hardened tool steel 60 - 64 HRC
Hardened tool steel 64 - 70 HRC

d1 [mm]	z	v <sub>c</sub> [m/min]	f <sub>z</sub> [mm]	a <sub>p</sub> [mm]	a <sub>e</sub> [mm]	n [min <sup>-1</sup> ]	v <sub>f</sub> [mm/min]	Q [cm <sup>3</sup> /min]	
3	4	50	0.015	3.0	3	5305	320	3.0	
4	4	50	0.020	4.0	4	3980	320	5.0	
5	4	50	0.025	5.0	5	3185	320	8.0	
6	4	50	0.025	6.0	6	2655	265	9.5	
8	4	50	0.035	8.0	8	1990	280	18.0	
10	4	50	0.045	10.0	10	1590	285	28.5	
12	4	50	0.055	12.0	12	1325	290	42.0	
16	4	50	0.075	8.0	16	995	300	38.5	
20	4	50	0.090	10.0	20	795	285	57.0	
3	4	30	0.010	3.0	3	3185	125	1.0	
4	4	30	0.013	4.0	4	2385	125	2.0	
5	4	30	0.017	5.0	5	1910	130	3.5	
6	4	30	0.020	6.0	6	1590	125	4.5	
8	4	30	0.027	8.0	8	1195	130	8.5	
10	4	30	0.033	10.0	10	955	125	12.5	
12	4	30	0.040	12.0	12	795	125	18.0	
16	4	30	0.053	8.0	16	595	125	16.0	
20	4	30	0.067	10.0	20	475	125	25.0	
3	4	20	0.008	3.0	3	2120	68	0.5	
4	4	20	0.011	4.0	4	1590	70	1.0	
5	4	20	0.013	5.0	5	1275	66	1.5	
6	4	20	0.016	6.0	6	1060	68	2.5	
8	4	20	0.021	8.0	8	795	67	4.5	
10	4	20	0.026	10.0	10	635	66	6.5	
12	4	20	0.032	12.0	12	530	68	10.0	
16	4	20	0.042	8.0	16	400	67	8.5	
20	4	20	0.053	10.0	20	320	68	13.5	
3	4	15	0.008	1.8	3	1590	51	0.5	
4	4	15	0.011	2.4	4	1195	53	0.5	
5	4	15	0.013	3.0	5	955	50	1.0	
6	4	15	0.016	3.6	6	795	51	1.0	
8	4	15	0.021	4.8	8	595	50	2.0	
10	4	15	0.026	6.0	10	475	49	3.0	
12	4	15	0.032	7.2	12	400	51	4.5	
16	4	15	0.042	4.8	16	300	50	4.0	
20	4	15	0.053	6.0	20	240	51	6.0	



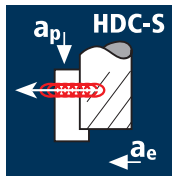
If you have any question, please send an email to [mail.ch@fraisa.com](mailto:mail.ch@fraisa.com). You may also directly contact our local customer consultant.

The FRAISA application engineers will be happy to advise you.

Where is it possible to ask questions concerning the product?

For further information, please refer to [fraisa.com](http://fraisa.com)

Application



Material

Hardened tool steel  
52 - 56 HRC



Hardened tool steel  
56 - 60 HRC



Hardened tool steel  
60 - 64 HRC

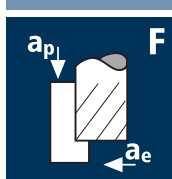


Hardened tool steel  
64 - 70 HRC



d1 [mm]	z	v <sub>c</sub> [m/min]	f <sub>z</sub> [mm]	a <sub>p</sub> [mm]	a <sub>e</sub> [mm]	n [min <sup>-1</sup> ]	v <sub>f</sub> [mm/min]	Q [cm <sup>3</sup> /min]
3	4	122	0.062	8	0.15	12945	3215	4.0
4	4	122	0.080	11	0.20	9710	3120	7.0
5	4	122	0.102	13	0.25	7765	3175	10.5
6	4	122	0.120	13	0.30	6470	3120	12.0
8	4	122	0.161	19	0.40	4855	3120	23.5
10	4	122	0.204	22	0.50	3885	3175	35.0
12	4	122	0.193	26	0.60	3235	2500	39.0
16	4	122	0.257	32	0.80	2425	2490	63.5
20	4	122	0.320	38	1.00	1940	2485	94.5
3	4	110	0.058	8	0.09	11670	2720	2.0
4	4	110	0.075	11	0.12	8755	2625	3.5
5	4	110	0.096	13	0.15	7005	2680	5.0
6	4	110	0.112	13	0.18	5835	2625	6.0
8	4	110	0.150	19	0.24	4375	2620	12.0
10	4	110	0.187	22	0.30	3500	2620	17.5
12	4	110	0.181	26	0.36	2920	2115	20.0
16	4	110	0.240	32	0.48	2190	2105	32.5
20	4	110	0.299	38	0.60	1750	2095	48.0
3	4	103	0.050	8	0.08	10930	2170	1.5
4	4	103	0.061	11	0.10	8195	1985	2.0
5	4	103	0.077	13	0.13	6555	2020	3.5
6	4	103	0.094	13	0.15	5465	2045	4.0
8	4	103	0.127	19	0.20	4100	2080	8.0
10	4	103	0.160	22	0.25	3280	2095	11.5
12	4	103	0.148	26	0.30	2730	1615	12.5
16	4	103	0.200	32	0.40	2050	1645	21.0
20	4	103	0.248	38	0.50	1640	1630	31.0
3	4	88	0.025	8	0.06	9335	925	0.5
4	4	88	0.030	11	0.08	7005	850	0.5
5	4	88	0.039	13	0.10	5600	865	1.0
6	4	88	0.047	13	0.12	4670	875	1.5
8	4	88	0.063	19	0.16	3500	885	2.5
10	4	88	0.080	22	0.20	2800	895	4.0
12	4	88	0.074	26	0.24	2335	690	4.5
16	4	88	0.100	32	0.32	1750	700	7.0
20	4	88	0.124	38	0.40	1400	695	10.5

Application



Material

Hardened tool steel  
52 - 56 HRC



Hardened tool steel  
56 - 60 HRC



Hardened tool steel  
60 - 64 HRC



Hardened tool steel  
64 - 70 HRC



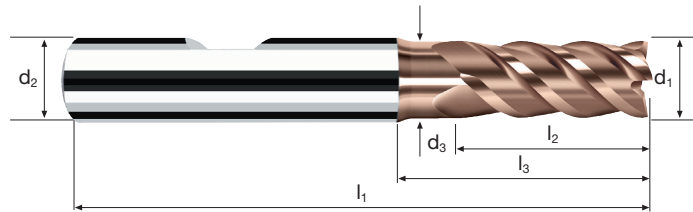
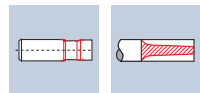
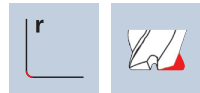
d1 [mm]	z	v <sub>c</sub> [m/min]	f <sub>z</sub> [mm]	a <sub>p</sub> [mm]	a <sub>e</sub> [mm]	n [min <sup>-1</sup> ]	v <sub>f</sub> [mm/min]	Q [cm <sup>3</sup> /min]
3	4	120	0.008	4.5	0.1	12735	410	
4	4	120	0.010	6.0	0.1	9550	380	
5	4	120	0.014	7.5	0.1	7640	430	
6	4	120	0.016	9.0	0.1	6365	405	
8	4	120	0.022	12.0	0.1	4775	420	
10	4	120	0.028	15.0	0.1	3820	430	
12	4	120	0.032	18.0	0.1	3185	410	
16	4	120	0.044	24.0	0.2	2385	420	
20	4	120	0.054	30.0	0.2	1910	415	
3	4	100	0.008	4.5	0.1	10610	340	
4	4	100	0.010	6.0	0.1	7960	320	
5	4	100	0.014	7.5	0.1	6365	355	
6	4	100	0.016	9.0	0.1	5305	340	
8	4	100	0.022	12.0	0.1	3980	350	
10	4	100	0.028	15.0	0.1	3185	355	
12	4	100	0.032	18.0	0.1	2655	340	
16	4	100	0.044	24.0	0.2	1990	350	
20	4	100	0.054	30.0	0.2	1590	345	
3	4	80	0.008	4.5	0.1	8490	270	
4	4	80	0.010	6.0	0.1	6365	255	
5	4	80	0.012	7.5	0.1	5095	245	
6	4	80	0.016	9.0	0.1	4245	270	
8	4	80	0.020	12.0	0.1	3185	255	
10	4	80	0.026	15.0	0.1	2545	265	
12	4	80	0.030	18.0	0.1	2120	255	
16	4	80	0.040	24.0	0.2	1590	255	
20	4	80	0.050	30.0	0.2	1275	255	
3	4	50	0.008	4.5	0.1	5305	170	
4	4	50	0.010	6.0	0.1	3980	160	
5	4	50	0.012	7.5	0.1	3185	155	
6	4	50	0.016	9.0	0.1	2655	170	
8	4	50	0.020	12.0	0.1	1990	160	
10	4	50	0.026	15.0	0.1	1590	165	
12	4	50	0.030	18.0	0.1	1325	160	
16	4	50	0.040	24.0	0.2	995	160	
20	4	50	0.050	30.0	0.2	795	160	

# Cylindrical end mills HX

Smooth-edged, normal version with short neck  
High-performance penetration edge



**HM**  
**XA**     $\lambda$  45°  
           $\gamma$ -10°



Roughing HPC



Roughing HDC



Finishing



				<b>HRC</b> 48-56	<b>HRC</b> 56-60	<b>HRC</b> > 60			<b>HSS</b>
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Ø Code	d1 e8	d2 h6	d3	l1	l2	l3	r	α	z	DURO-Si	
										H8604	H8504
<b>180</b>	3	6	2.8	57	8	14	0.10	4.5°	4		●
<b>220</b>	4	6	3.7	57	11	16	0.10	3.0°	4		●
<b>260</b>	5	6	4.6	57	13	18	0.10	1.5°	4		●
<b>300</b>	6	6	5.5	57	13	20	0.15	0.0°	4		●
<b>391</b>	8	8	7.4	63	19	26	0.15	0.0°	4		●
<b>450</b>	10	10	9.2	72	22	31	0.20	0.0°	4		●
<b>501</b>	12	12	11.0	83	26	37	0.20	0.0°	4		●
<b>610</b>	16	16	15.0	92	32	43	0.20	0.0°	4		●
<b>682</b>	20	20	19.0	104	38	53	0.20	0.0°	4		●



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