

MILLING CUTTERS



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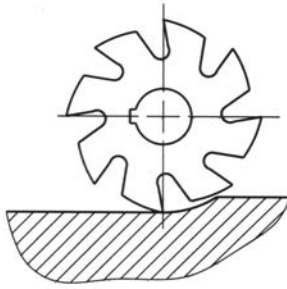
Tool Type	Quality	Standard	Page No
END MILLS - SHORT SERIES - TYPE BN	HSS - E (%8Co)	DIN 844	256
END MILLS - LONG SERIES - TYPE BN	HSS - E (%8Co)	DIN 844	257
END MILLS - SHORT SERIES - TYPE BN - TICN COATED	HSS - E (%8Co)	DIN 844	258
END MILLS - LONG SERIES - TYPE BN - TICN COATED	HSS - E (%8Co)	DIN 844	258
END MILLS - SHORT SERIES - TYPE BW	HSS - E (%8Co)	DIN 844	259
END MILLS - LONG SERIES - TYPE BW	HSS - E (%8Co)	DIN 844	259
END MILLS - SHORT SERIES - TYPE BNF	HSS - E (%8Co)	DIN 844	260
END MILLS - SHORT SERIES - TYPE BNR	HSS - E (%8Co)	DIN 844	260
END MILLS - LONG SERIES - TYPE BNR	HSS - E (%8Co)	DIN 844	261
END MILLS - LONG SERIES - TYPE BNF	HSS - E (%8Co)	DIN 844	261
SLOT CUTTERS	HSS - E (%8Co)	DIN 844	262
BALL NOSED END MILLS - SHORT SERIES	HSS - E (%8Co)	DIN 1889/B	263
BALL NOSED END MILLS - LONG SERIES	HSS - E (%8Co)	DIN 1889/B	263
WOODRUFF KEYSEAT CUTTERS - STAGGERED TEETH	HSS - E	DIN 850/D	264
T- SLOT CUTTERS - STARGGERED TEETH	HSS - E	DIN 851/B	264
DOVETAIL CUTTERS	HSS - E	DIN 1833/C	265
SINGLE FLUTE ALUMINIUM END MILLS	HSS - E (%8Co)	MTE Norm	266
SINGLE FLUTE ALUMINIUM END MILLS	HSS - E (%8Co)	MTE Norm	266
MORSE TAPER END MILLS - SHORT SERIES - TYPE BN	HSS - E	DIN 845	267
MORSE TAPER END MILLS - LONG SERIES - TYPE BN	HSS - E	DIN 845	267
MORSE TAPER END MILLS - SHORT SERIES - TYPE BNR	HSS - E	DIN 845	268
MORSE TAPER END MILLS - SHORT SERIES - TYPE BNF	HSS - E	DIN 845	268
DRILLING - MILLING COMBINED TOOLS	HSS	MTE Norm	269
SHELL END MILLS	HSS	DIN 1880	269
SIDE AND FACE CUTTERS - STRAIGHT TEETH	HSS	DIN 885/B	270
SIDE AND FACE CUTTERS - STAGGERED TEETH	HSS	DIN 885/A	270
ANGULAR CUTTERS	HSS	DIN 842	271
DOUBLE ANGLE MILLING CUTTERS	HSS	DIN 847	271
CONCAVE RADIUS CUTTERS	HSS	DIN 855	272
CONVEX RADIUS CUTTERS	HSS	DIN 856	272



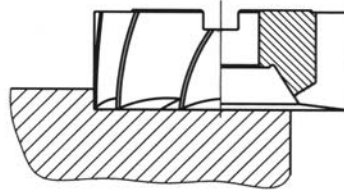
MILLING CUTTERS



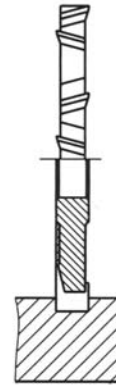
Application Examples of Milling Cutter Types



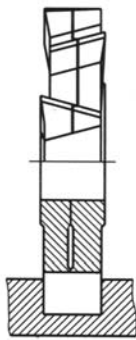
Plain Milling Cutter



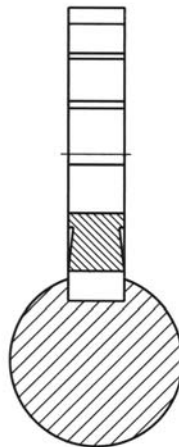
Shell End Mill



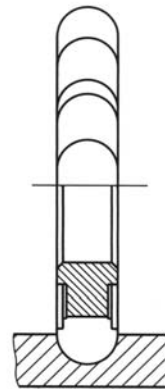
Side and Face Milling Cutter



Adjustable Side and Face Milling Cutter



Side and Face Milling Cutter



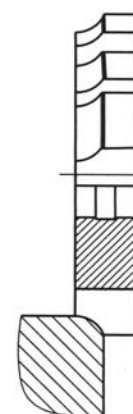
Convex Milling Cutter



Concave Milling Cutter

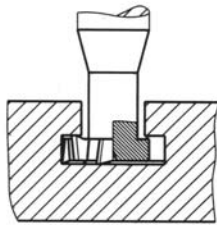


Adjustable Milling Cutter

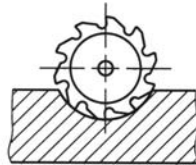


Corner Radius Milling Cutter

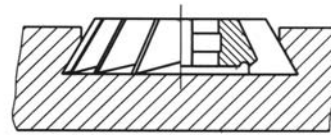
Application Examples of Milling Cutter Types



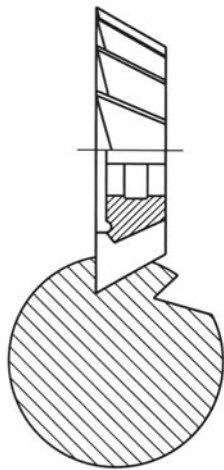
T-Slot Cutter



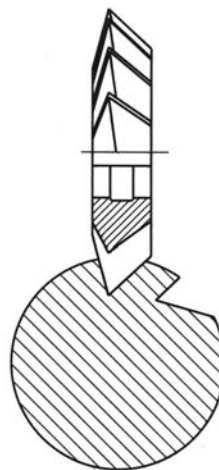
Woodruff Milling Cutter



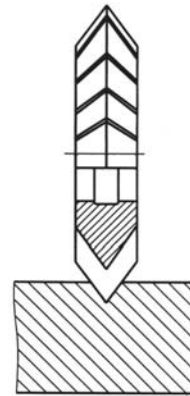
Angular Milling Cutter



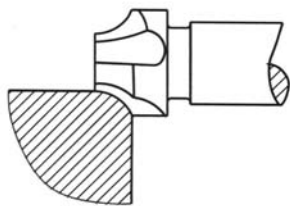
Single - Angled Milling Cutter



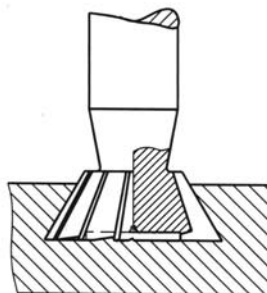
Double - Angled Milling Cutter



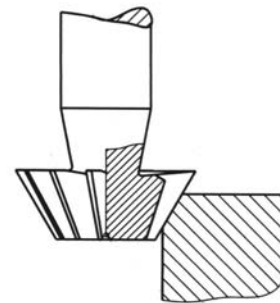
Double - Angled Milling Cutter



Corner Radius Milling Cutter



Dovetail Cutter



Dovetail Cutter



Milling Cutters Types and Materials

The application of milling cutters according to the tool type is show on Table 1 below; the chip breaker form roughing milling cutters Table 2; using area according to the material is shown Table 3.

Table 1

Tool Type		Areas of Usage
DIN	TS	
N	N	Materials with normal resistance and hardness values
H	S	Hard, hard ductile materials with high resistance and short chipping materials
W	Y	Soft, ductile and / or long chipping materials

Table 2

Tool Type	Areas of Usage
NF HF	Roughing & Finishing
NR HR	Roughing

Table 3 A- Steel and steel cast materials

Description of Material		Tensile Resistance (N/mm ²)		Milling Cutter Types				
		from	up to	N	H	W	NF NR	HF HR
Automate Steel		370	600	•		○	•	
		550	1000	•	○		•	○
Construction Steel								
Non-alloyed		-	600	•		○	•	
Alloyed		500	900	•			•	
Stainless steels and stainless steel cast		450	950	•			•	
Nitruration Steel								
Softened		700	900	•			•	
Toughened		800	1250	•	○		•	•
Steel Cast		400	1100	•			•	
Toughened Steel								
Soft or tempered		500	750	•			•	
Non alloyed, toughened		700	1000	•			•	
Alloyed, toughened		700	1000	•			•	
		900	1250	•	○		•	•
Tool Steel								
Alloyed, toughened		900	1250	•	○		•	•
Non-alloyed or alloyed, softened		Hardness 180	(HB) 240	•			•	
High carbon and / or high alloyed softened, finned		Hardness 220	(HB) 300	○	•		○	•
		100	240	•		•	•	
Cast Iron								
Graphite		230	320	○	•	•	○	•
Round		100	240	•		•	○	○
Graphite		230	320	○	•	•		•
Tempered Cast		100	270	•		•	○	○

Table 3 B - Non Ferrous Metals

Description of Material		Tensile Strength (N/mm ²)		Milling Cutter Types				
		from	to	N	H	W	NF NR	HF HR
Aluminium cast alloy with up to 10% Si		-	180	○		•		
Aluminium cast alloy with more than 10 % Si		150	250	•		○	○	
Copper		200	400	○		•		
Copper and Copper alloys								
Low resistance, High copper content		200	550	○		•		
High resistance, low or High copper content		250	850	•		○		○
Chip breaking characteristic (alloyed in Pb1 Ph1Te alloyed)		250	500	○	•			
Magnesium and Mg. alloys		150	300	•		○		
Titanium alloys								
Medium resistance		-	700	•		○	•	•
Low resistance		600	1100	○	•		○	•

Tool Types and Operating Values of Milling Cutters According to the Material

V= Cutting speed (m/min.)
 fz= feed per (mm/thread)
 F = Feed (mm/min)=fz.n.z.
 z = Number of threads of milling cutter
 n = Number of revolution of milling cutter (revolution/minute)

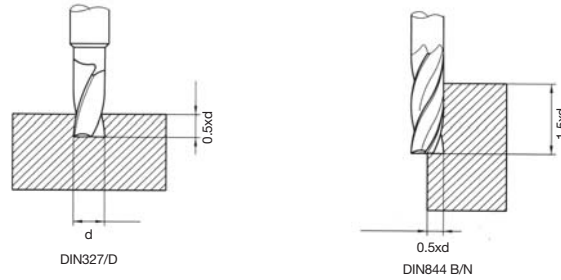
Type of Material	Milling cutter material	Shell End Mills		Side and Face Milling Cutters			
		V	fz	Tip	V	fz	Tip
Non-alloyed steels Up to 500 N/mm ²	HSS	16..20	0.20	N	16..20	0.12	N
	HSS-E	30..40	0.2..0.25		20..25	0.10..1.16	
Non-alloyed and alloyed steels Up to 800 N/mm ²	HSS	14..16	0.16	N	14..16	0.10	N
	HSS-E	27..33	0.2..0.25		16..20	0.10..0.12	
Non-alloyed and alloyed steels Up to 1000 N/mm ²	HSS	11..14	0.12	N-H	11..14	0.08	N-H
	HSS-E	20..26	0.18..0.22		12..16	0.08..0.10	
Non-alloyed and alloyed steels Up to 1300 N/mm ²	HSS	8..11	0.06	H	8..11	0.05	H
	HSS-E	13..15	0.09..0.15		10..12	0.05..0.07	
Aluminium alloys (soft)	HSS	300	0.12	W	280	0.12	W
	HSS-E	300	0.15		300	0.12	
Aluminium alloys (medium, hard)	HSS	220	0.12	N-W	200	0.10	N-W
	HSS-E	240	0.12		220	0.10	
Aluminium alloys (hard)	HSS	180	0.10	N-W	160	0.10	N-W
	HSS-E	200	0.10		180	0.10	
Grey cast iron Up to 200 HB	HSS	12..14	0.25	N	12..14	0.20	N
	HSS-E	22..26	0.2..0.25		14..20	0.20	
Grey cast iron higher than 200 HB	HSS	8..12	0.16	H	8..12	0.10	H
	HSS-E	12..18	0.15..0.20		8..12	0.10	
Tempered Cast Up to 200 HB	HSS	14..18	0.20	N	14..18	0.16	N
	HSS-E	16..20	0.20		16..20	0.20	
Steel Cast Up to 700 N/mm ²	HSS	11..14	0.16	N(H)	11..14	0.16	N(H)
	HSS-E	12..18	0.15..0.20		11..14	0.20	
Brass (soft)	HSS	40	0.20	W	36	0.16	W
	HSS-E	40-60	0.15..0.20		40	0.20	
Brass-Bronze (hard)	HSS	32	0.16	N	32	0.12	N
	HSS-E	30..36	0.16		36	0.20	

The table values above are given as reference values;

- For materials with homogeneous structure,
- For stable machine and stable fixing conditions;
- For proper cooling conditions;
- For perpendicular positioning of the tool to the axis of the work piece.



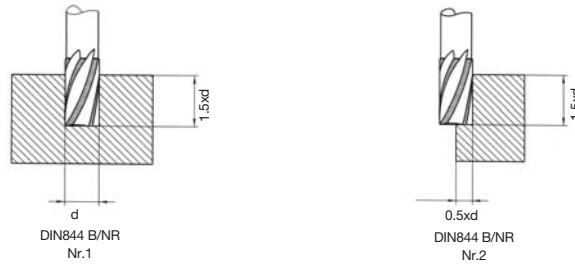
Recommended Operating Conditions for End Mills



Material	Cutting speed (m/min.)	Number of Flutes	Diameter (mm)	DIN 327 / D										DIN 844 B / N									
				2	2	2	2	2	2	2	2	2	2	4	4	4	4	4	4	4	6	6	
I Structural, Nitride Steels, Automate Steels, Tempered Steels > 700 N/mm ² Tool Steels Gray Cast Iron GG<200HB	HSS-E	25-32	fz	.004	.008	.015	.025	.040	.050	.075	.090	.100	.006	.007	.010	.016	.022	.028	.035	.040	.046		
			n	4500	2300	1500	1100	900	750	550	450	300	2300	1500	900	750	550	450	350	300	300	300	
	HSS-E TiN Coated	38-48	fz	.004	.008	.015	.025	.040	.050	.075	.090	.100	.006	.007	.010	.016	.022	.028	.035	.040	.046		
			n	6800	3400	2300	1700	1400	1100	850	700	450	3400	2300	1700	1400	1100	850	700	550	450	450	
II Acid and Heat resistant Steel, Alloyed Steel < 1000N/mm ² Tempered and Tool Steels, Gray Cast Iron GG>200HB	HSS-E	18-25	fz	.004	.008	.015	.023	.035	.045	.070	.085	.090	.005	.006	.009	.014	.019	.025	.031	.034	.037		
			n	3400	1700	1100	900	700	550	450	350	250	1700	1100	900	700	550	450	350	300	250	250	
	HSS-E TiN Coated	27-37	fz	.004	.008	.015	.023	.035	.040	.070	.085	.090	.005	.006	.009	.014	.019	.025	.031	.034	.037		
			n	5100	2500	1700	1300	1000	850	650	500	350	2500	1700	1300	1000	850	650	500	400	350	350	
III Alloyed Steel < 1400 N/mm ² Valve Steel, Cold Work Steels, Speed Steels, Acid Resistant Steels	HSS-E	12-18	fz	.003	.007	.012	.020	.032	.040	.065	.080	.085	.006	.007	.010	.015	.020	.026	.033	.036	.039		
			n	2400	1200	800	600	500	400	300	250	150	1200	800	600	500	400	300	250	200	150	150	
	HSS-E TiN Coated	12-27	fz	.003	.007	.012	.020	.032	.040	.065	.080	.085	.006	.007	.010	.015	.020	.026	.033	.036	.039		
			n	3100	1600	1000	800	600	500	400	300	200	1600	1000	800	600	500	400	300	250	200	200	
IV Difficult Chip Removal Steels, High Temperature Resistant Steels, Ti and Ni Alloyed Steels	HSS-E	3-15	fz	.002	.006	.010	.019	.028	.035	.055	.065	.070	.006	.007	.011	.016	.022	.028	.035	.037	.043		
			n	1400	700	500	350	300	250	180	140	100	700	500	350	300	250	180	140	110	100	100	
	HSS-E TiN Coated	3-20	fz	.002	.006	.010	.019	.028	.035	.055	.065	.070	.006	.007	.011	.016	.022	.028	.035	.037	.043		
			n	1800	900	600	450	350	300	250	180	120	900	600	450	350	300	250	180	150	120	120	
V Aluminium with Non-Hardened Surface, Al - Mg Alloy	HSS-E	200-300	fz	.004	.008	.015	.025	.040	.050	.080	.110	.170	.007	.008	.014	.021	.029	.037	.050	.060	.075		
			n	40000	20000	13300	10000	8000	6600	5000	4000	2700	20000	13300	10000	8000	6600	5000	4000	3200	2700	2700	
	HSS-E TiN Coated	200-450	fz	.004	.008	.015	.025	.040	.050	.080	.110	.170	.007	.008	.014	.021	.029	.037	.050	.060	.075		
			n	51800	26000	17300	13000	10400	8600	7400	5200	3500	26000	17300	13000	10400	8600	7400	5200	4100	3500	3500	
VI Aluminium Cast <= %6 Si Aluminium with Non-Hardened Surface	HSS-E	70-120	fz	.004	.008	.015	.025	.040	.050	.080	.110	.170	.007	.008	.014	.021	.029	.037	.050	.060	.075		
			n	15000	7600	5000	3800	3000	2500	1900	1500	1000	7600	5000	3800	3000	2500	1900	1500	1200	1000	1000	
	HSS-E TiN Coated	70-180	fz	.004	.008	.015	.025	.040	.050	.080	.110	.170	.007	.008	.014	.021	.029	.037	.050	.060	.075		
			n	20000	10000	6600	5000	4000	3300	2500	2000	1300	10000	6600	5000	4000	3300	2500	2000	1600	1300	1300	
VII Aluminium Cast >= %6 Si Copper Brass, Copper Alloys	HSS-E	40-70	fz	.005	.009	.020	.032	.050	.065	.100	.130	.180	.010	.014	.023	.036	.040	.050	.060	.070	.090		
			n	8800	4400	2900	2200	1800	1500	1100	900	600	4400	2900	2200	1800	1500	1100	900	700	600	600	
	HSS-E TiN Coated	40-100	fz	.005	.009	.020	.032	.050	.065	.100	.130	.180	.010	.014	.023	.036	.040	.050	.060	.070	.090		
			n	11000	5600	3700	2800	2200	1900	1400	1100	750	5600	3700	2800	2200	1900	1400	1100	900	750	750	

fz: Feed per thread (mm/thread)
 n: Rev. (rev/min)
 vf: Total feed per minute (m/min)

Recommended Operating Conditions for End Mills



Material	Cutting speed (m/min.)	Number of Flutes	Diameter (mm)	DIN 844 B / NR Nr.1												DIN 844 B / NR Nr.2											
				4	4	4	4	4	4	5	5	6	4	4	4	4	4	4	5	5	6						
I Structural, Nitride Steels, Free Cutting Steels, Tempered Steels > 700 N/mm ² Tool Steels Gray Cast Iron GG<200HB	HSS-E	25-32	fz	.007	.010	.016	.022	.028	.035	.040	.046	.054	.014	.020	.032	.044	.056	.070	.080	.092	.108						
			n	1500	1100	900	750	550	450	350	300	250	1500	1100	900	750	550	450	350	300	250	250					
	HSS-E TiN Coated	38-48	fz	.007	.010	.016	.022	.028	.035	.040	.046	.054	.014	.020	.032	.044	.056	.070	.080	.092	.108						
			n	2300	1700	1400	1100	850	700	550	450	350	2300	1700	1400	1100	850	700	550	450	350	350					
II Acid and Heat resistant Steel, Alloyed Steel < 1000N/mm ² Tempered and Tool Steels, Gray Cast Iron GG>200HB	HSS-E	18-25	fz	.006	.009	.014	.019	.025	.031	.034	.037	.041	.012	.018	.028	.038	.050	.062	.068	.074	.082						
			n	1100	900	700	550	450	350	300	250	170	1100	900	700	550	450	350	300	250	170						
	HSS-E TiN Coated	27-37	fz	.006	.009	.014	.019	.025	.031	.034	.037	.041	.012	.018	.028	.038	.050	.062	.068	.074	.082						
			n	1700	1300	1000	850	650	500	400	350	250	1700	1300	1000	850	650	500	400	350	250						
III Alloyed Steel < 1400 N/mm ² Valve Steel, Cold Work Steels, Speed Steels, Acid Resistant Steels	HSS-E	12-18	fz	.007	.010	.015	.020	.026	.033	.036	.039	.045	.014	.020	.030	.040	.052	.066	.072	.078	.090						
			n	800	600	500	400	300	250	200	150	120	800	600	500	400	300	250	200	150	120						
	HSS-E TiN Coated	12-27	fz	.007	.010	.015	.020	.026	.033	.036	.039	.045	.014	.020	.030	.040	.052	.066	.072	.078	.090						
			n	1000	800	600	500	400	300	250	200	150	1000	800	600	500	400	300	250	200	150						
IV Difficult Chip Removal Steels, High Temperature Resistant Steels, Ti and Ni Alloyed Steels	HSS-E	3-15	fz	.007	.011	.016	.022	.028	.035	.037	.043	.050	.014	.022	.032	.044	.056	.070	.074	.086	.100						
			n	500	350	300	250	180	140	110	100	70	500	350	300	250	180	140	110	100	70						
	HSS-E TiN Coated	3-20	fz	.007	.011	.016	.022	.028	.035	.037	.043	.050	.014	.022	.032	.044	.056	.070	.074	.086	.100						
			n	600	450	350	300	250	180	150	120	90	600	450	350	300	250	180	150	120	90						
V Aluminium with Non-Hardened Surface, Al - Mg Alloy	HSS-E	200-300	fz	.008	.014	.021	.029	.037	.050	.060	.075	.080	.016	.028	.042	.058	.074	.100	.120	.150	.160						
			n	13300	10000	8000	6000	5000	4000	3200	2700	2000	13300	8000	8000	6000	5000	4000	3200	2700	2000						
	HSS-E TiN Coated	200-450	fz	.008	.014	.021	.029	.037	.050	.060	.075	.080	.016	.028	.042	.058	.074	.100	.120	.150	.160						
			n	17300	13000	10400	8600	7400	5200	4100	3500	2600	17300	13000	10400	8600	7400	5200	4100	3500	2600						
VI Aluminium Cast <= %6 Si Aluminium with Hardened Surface	HSS-E	70-120	fz	.008	.014	.021	.029	.037	.050	.060	.075	.080	.016	.028	.042	.058	.074	.100	.120	.150	.160						
			n	5000	3800	3000	2500	1900	1500	1200	1000	750	5000	3800	3000	2500	1900	1500	1200	1000	750						
	HSS-E TiN Coated	70-180	fz	.008	.014	.021	.029	.037	.050	.060	.075	.080	.016	.028	.042	.058	.074	.100	.120	.150	.160						
			n	6600	5000	4000	3300	2500	2000	1600	1300	1000	6600	5000	4000	3300	2500	2000	1600	1300	1000						
VII Aluminium Cast >= %6 Si Copper Brass, Copper Alloys	HSS-E	40-70	fz	.014	.023	.036	.040	.050	.060	.070	.090	.095	.028	.046	.072	.080	.100	.120	.140	.180	.190						
			n	2900	2200	1800	1500	1100	900	700	600	450	2900	2200	1800	1500	1100	900	700	600	450						
	HSS-E TiN Coated	40-100	fz	.014	.023	.036	.040	.050	.060	.070	.090	.095	.028	.046	.072	.080	.100	.120	.140	.180	.190						
			n	3700	2800	2200	1900	1400	1100	900	750	550	3700	2800	2200	1900	1400	1100	900	750	550						

fz: Feed per thread (mm/thread)
 n: Rev. (rev/min)
 vf: Total feed per minute (m/min)



MILLING CUTTERS



END MILLS - SHORT SERIES - TYPE BN

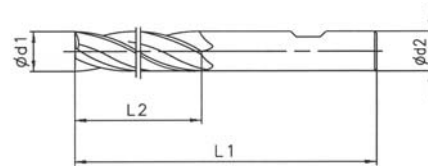


Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes	Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes
B00276180200	2,0	6	51	7	3	B00276181500	15,0	12	83	26	4
B00276180250	2,5	6	52	8	3	B00276181600	16,0	16	92	32	4
B00276180300	3,0	6	52	8	3	B00276181700	17,0	16	92	32	4
B00276180350	3,5	6	54	10	3	B00276181800	18,0	16	92	32	4
B00276180400	4,0	6	55	11	4	B00276181900	19,0	16	92	32	4
B00276180450	4,5	6	55	11	4	B00276182000	20,0	20	104	38	4
B00276180500	5,0	6	57	13	4	B00257182100	21,0	20	104	38	5
B00276180550	5,5	6	57	13	4	B00257182200	22,0	20	104	38	5
B00276180600	6,0	6	57	13	4	B00257182300	23,0	20	104	38	5
B00276180650	6,5	10	66	16	4	B00257182400	24,0	25	121	45	5
B00276180700	7,0	10	66	16	4	B00257182500	25,0	25	121	45	5
B00276180750	7,5	10	66	16	4	B00257182600	26,0	25	121	45	5
B00276180800	8,0	10	69	19	4	B00257182700	27,0	25	121	45	5
B00276180850	8,5	10	69	19	4	B00257182800	28,0	25	121	45	5
B00276180900	9,0	10	69	19	4	B00257182900	29,0	25	121	45	5
B00276180950	9,5	10	69	19	4	B00257183000	30,0	25	121	45	5
B00276181000	10,0	10	72	22	4	B00257183200	32,0	32	133	53	6
B00276181050	10,5	12	79	22	4	B00257183300	33,0	32	133	53	6
B00276181100	11,0	12	79	22	4	B00257183400	34,0	32	133	53	6
B00276181150	11,5	12	79	22	4	B00257183500	35,0	32	133	53	6
B00276181200	12,0	12	83	26	4	B00257183600	36,0	32	133	53	6
B00276181250	12,5	12	83	26	4	B00257183800	38,0	40	155	63	6
B00276181300	13,0	12	83	26	4	B00257184000	40,0	40	155	63	6
B00276181400	14,0	12	83	26	4						

* Over \varnothing 20 mm Producing from HSS-E (%5Co)



END MILLS - LONG SERIES - TYPE BN



Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes	Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes
B00276220200	2	6	54	10	3	B00276221700	17	16	123	63	4
B00276220250	2,5	6	56	12	3	B00276221800	18	16	123	63	4
B00276220300	3	6	56	12	3	B00276221900	19	16	123	63	4
B00276220400	4	6	63	19	4	B00276222000	20	20	141	75	4
B00276220500	5	6	68	24	4	B00257222200	22	20	141	75	5
B00276220600	6	6	68	24	4	B00257222400	24	25	166	90	5
B00276220700	7	10	80	30	4	B00257222500	25	25	166	90	5
B00276220800	8	10	88	38	4	B00257222600	26	25	166	90	5
B00276220900	9	10	88	38	4	B00257222800	28	25	166	90	5
B00276221000	10	10	95	45	4	B00257223000	30	25	166	90	5
B00276221100	11	12	102	45	4	B00257223200	32	32	186	106	6
B00276221200	12	12	110	53	4	B00257223400	34	32	186	106	6
B00276221300	13	12	110	53	4	B00257223600	36	32	186	106	6
B00276221400	14	12	110	53	4	B00257223800	38	40	217	125	6
B00276221500	15	12	110	53	4	B00257224000	40	40	217	125	6
B00276221600	16	16	123	63	4						





END MILLS - SHORT SERIES - TYPE BN - TICN COATED



Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes
B11276180200	2,0	6	51	7	3
B11276180300	3,0	6	52	8	3
B11276180400	4,0	6	55	11	4
B11276180500	5,0	6	57	13	4
B11276180600	6,0	6	57	13	4
B11276180800	8,0	10	69	19	4

Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes
B11276181000	10,0	10	72	22	4
B11276181200	12,0	12	83	26	4
B11276181400	14,0	12	83	26	4
B11276181600	16,0	16	92	32	4
B11276181800	18,0	16	92	32	4
B11276182000	20,0	20	104	38	4



END MILLS - LONG SERIES - TYPE BN - TICN COATED



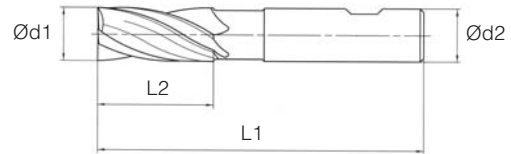
Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes
B11276220400	4,0	6	63	19	4
B11276220500	5,0	6	68	24	4
B11276220600	6,0	6	68	24	4
B11276220800	8,0	10	88	38	4

Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes
B11276221000	10,0	10	95	45	4
B11276221200	12,0	12	110	53	4
B11276221600	16,0	16	123	63	4
B11276222000	20,0	20	141	75	4

* Over \varnothing 20 mm Producing from HSS-E (%5Co)



END MILLS - SHORT SERIES - TYPE BW

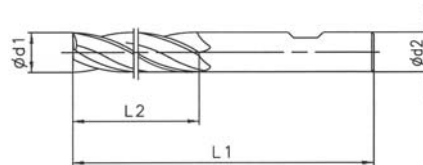


Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes
B00276190200	2,0	6	51	7	3
B00276190300	3,0	6	52	8	3
B00276190400	4,0	6	55	11	3
B00276190500	5,0	6	57	13	3
B00276190600	6,0	6	57	13	3
B00276190800	8,0	10	69	19	3
B00276191000	10,0	10	72	22	3
B00276191200	12,0	12	83	26	4
B00276191400	14,0	12	83	26	4
B00276191600	16,0	16	92	32	4

Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes
B00276191800	18,0	16	92	32	4
B00276192000	20,0	20	104	38	4
B00257192200	22,0	20	104	38	4
B00257192400	24,0	25	121	45	4
B00257192500	25,0	25	121	45	4
B00257192600	26,0	25	121	45	4
B00257192800	28,0	25	121	45	4
B00257193000	30,0	25	121	45	4
B00257193200	32,0	32	133	53	4



END MILLS - LONG SERIES - TYPE BW



Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes
B00276230300	3	6	56	12	3
B00276230400	4	6	63	19	4
B00276230500	5	6	68	24	4
B00276230600	6	6	68	24	4
B00276230800	8	10	88	38	4
B00276231000	10	10	95	45	4
B00276231200	12	12	110	53	4
B00276231400	14	12	110	53	4
B00276231600	16	16	123	63	4

Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes
B00276231800	18	16	123	63	4
B00276232000	20	20	141	75	4
B00257232200	22	20	141	75	5
B00257232400	24	25	166	90	5
B00257232500	25	25	166	90	5
B00257232600	26	25	166	90	5
B00257232800	28	25	166	90	5
B00257233000	30	25	166	90	5
B00257233200	32	32	186	106	6

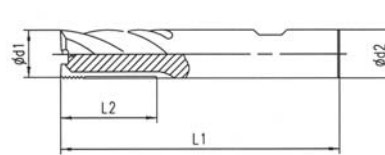
* Over ø 20 mm Producing from HSS-E (%5Co)



MILLING CUTTERS



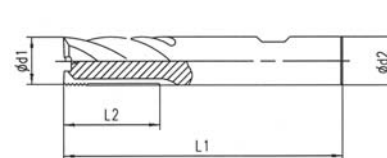
END MILLS - SHORT SERIES - TYPE BNF



Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes	Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes
B00279330800	8,0	10	69	19	4	B00274332200	22,0	20	104	38	5
B00279331000	10,0	10	72	22	4	B00274332400	24,0	25	121	45	5
B00279331200	12,0	12	83	26	4	B00274332500	25,0	25	121	45	5
B00279331400	14,0	12	83	26	4	B00274332600	26,0	25	121	45	5
B00279331600	16,0	16	92	32	4	B00274332800	28,0	25	121	45	5
B00279331800	18,0	16	92	32	4	B00274333000	30,0	25	121	45	5
B00279332000	20,0	20	104	38	4	B00274333200	32,0	32	133	53	6



END MILLS - SHORT SERIES - TYPE BNR

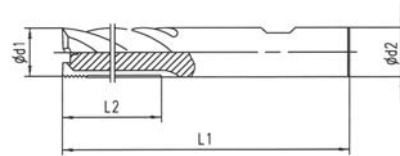


Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes	Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes
B00277330800	8,0	10	69	19	4	B00273332200	22,0	20	104	38	5
B00277331000	10,0	10	72	22	4	B00273332400	24,0	25	121	45	5
B00277331200	12,0	12	83	26	4	B00273332500	25,0	25	121	45	5
B00277331400	14,0	12	83	26	4	B00273332600	26,0	25	121	45	5
B00277331600	16,0	16	92	32	4	B00273332800	28,0	25	121	45	5
B00277331800	18,0	16	92	32	4	B00273333000	30,0	25	121	45	5
B00277332000	20,0	20	104	38	4	B00273333200	32,0	32	133	53	6

* Over \varnothing 20 mm Producing from HSS-E (%5Co)

HSS-E (%8 Co)
DIN 844
BNR
js14

END MILLS - LONG SERIES - TYPE BNR

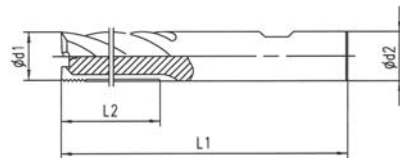


Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes
B00277390800	8	10	88	38	4
B00277391000	10	10	95	45	4
B00277391200	12	12	110	53	4
B00277391400	14	12	110	53	4
B00277391600	16	16	123	63	4
B00277391800	18	16	123	63	4
B00277392000	20	20	141	75	4

Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes
B00273392200	22	20	141	75	5
B00273392400	24	25	166	90	5
B00273392500	25	25	166	90	5
B00273392600	26	25	166	90	5
B00273392800	28	25	166	90	5
B00273393000	30	25	166	90	5
B00273393200	32	32	186	106	6

HSS-E (%8 Co)
DIN 844
BNF
js14

END MILLS - LONG SERIES - TYPE BNF



Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes
B00279391000	10	10	95	45	4
B00279391200	12	12	110	53	4
B00279391400	14	12	110	53	4
B00279391600	16	16	123	63	4
B00279391800	18	16	123	63	4
B00279392000	20	20	141	75	4
B00274392200	22	20	141	75	5

Product code	d1 mm	d2 mm	L1 mm	L2 mm	Z Nr of Flutes
B00274392400	24	25	166	90	5
B00274392500	25	25	166	90	5
B00274392600	26	25	166	90	5
B00274392800	28	25	166	90	5
B00274393000	30	25	166	90	5
B00274393200	32	32	186	106	6

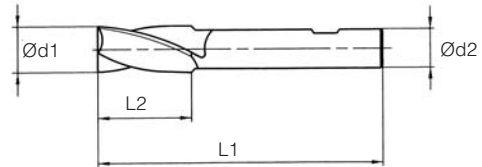


MILLING CUTTERS

* Over ø 20 mm Producing from HSS-E (%5Co)



SLOT CUTTERS



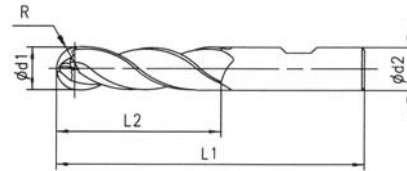
Product code	d1 mm	d2 mm	L1 mm	L2 mm	z Nr of Flutes
B00278140200	2	6	48	4	2
B00278140250	2,5	6	49	5	2
B00278140300	3	6	49	5	2
B00278140400	4	6	51	7	2
B00278140500	5	6	52	8	2
B00278140600	6	6	52	8	2
B00278140700	7	10	60	10	2
B00278140800	8	10	61	11	2
B00278140900	9	10	61	11	2
B00278141000	10	10	63	13	2

Product code	d1 mm	d2 mm	L1 mm	L2 mm	z Nr of Flutes
B00278141100	11	12	70	13	2
B00278141200	12	12	73	16	2
B00278141300	13	12	73	16	2
B00278141400	14	12	73	16	2
B00278141500	15	12	73	16	2
B00278141600	16	16	79	19	2
B00278141700	17	16	79	19	2
B00278141800	18	16	79	19	2
B00278141900	19	16	79	19	2
B00278142000	20	20	88	22	2

* Over \varnothing 20 mm Producing from HSS-E (%5Co)



BALL NOSED END MILLS - SHORT SERIES

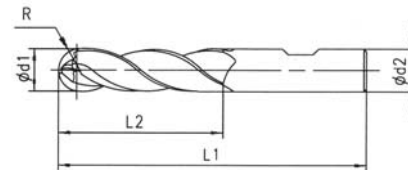


Product code	d1 mm	d2 mm	L1 mm	L2 mm	R
B00272300600	6	6	57	13	3
B00272300800	8	10	69	19	4
B00272301000	10	10	72	22	5
B00272301200	12	12	83	26	6

Product code	d1 mm	d2 mm	L1 mm	L2 mm	R
B00272301400	14	12	83	26	7
B00272301600	16	16	92	32	8
B00272301800	18	16	92	32	9
B00272302000	20	20	104	38	10



BALL NOSED END MILLS - LONG SERIES



Product code	d1 mm	d2 mm	L1 mm	L2 mm	R
B00272500600	6	6	68	24	3
B00272500800	8	10	88	38	4
B00272501000	10	10	95	45	5
B00272501200	12	12	110	53	6
B00272501400	14	12	110	53	7

Product code	d1 mm	d2 mm	L1 mm	L2 mm	R
B00272501600	16	16	123	63	8
B00272501800	18	16	123	63	9
B00272502000	20	20	141	75	10
B00272502500	25	25	166	90	12,5
B00272503200	32	32	186	106	16

* Over ø 20 mm Producing from HSS-E (%5Co)





WOODRUFF KEYSEAT CUTTERS - STAGGERED TEETH



Product code	d1 mm	b (e8) mm	d2 mm	L mm	Product code	d1 mm	b (e8) mm	d2 mm	L mm
B00261220600	13,5	3	10	56	B00261221500	22,5	6	10	63
B00261220700	13,5	4	10	56	B00261221600	22,5	8	10	63
B00261220800	16,5	3	10	56	B00261221700	25,5	6	10	63
B00261220900	16,5	4	10	56	B00261221800	28,5	6	10	63
B00261221000	16,5	5	10	56	B00261221900	28,5	8	10	63
B00261221100	19,5	4	10	63	B00261222000	28,5	10	12	71
B00261221200	19,5	5	10	63	B00261222300	32,5	8	12	71
B00261221300	19,5	6	10	63	B00261222400	32,5	10	12	71
B00261221400	22,5	5	10	63	B00261222600	45,5	10	12	71



T- SLOT CUTTERS - STARGGERED TEETH

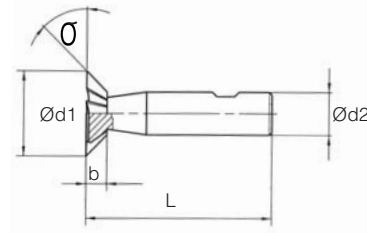


Product code	d1 mm	b (e8) mm	d2 mm	d3 mm	L1 mm	Product code	d1 mm	b (e8) mm	d2 mm	d3 mm	L1 mm
B00262111100	11,0	4,0	10	4	53,5	B00262112800	28,0	12,0	16	13	85,0
B00262111250	12,5	6,0	10	5	57,0	B00262113200	32,0	14,0	16	15	90,0
B00262111600	16,0	8,0	10	7	62,0	B00262113600	36,0	16,0	25	17	103,0
B00262111800	18,0	8,0	12	8	70,0	B00262114000	40,0	18,0	25	19	108,0
B00262112100	21,0	9,0	12	10	74,0	B00262114500	45,0	20,0	25	21	113,0
B00262112500	25,0	11,0	16	12	82,0						

* Over ø 20 mm Producing from HSS-E (%5Co)



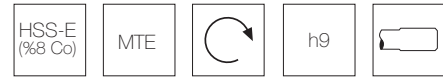
DOVETAIL CUTTERS



Product code	d1 mm	b mm	L mm	d2 mm
B00263201600	16 x 45°	4,0	60	12
B00263202000	20 x 45°	5,0	63	12
B00263202500	25 x 45°	6,3	67	12
B00263203200	32 x 45°	8,0	71	16

Product code	d1 mm	b mm	L mm	d2 mm
B00263231600	16 x 60°	6,3	60	12
B00263232000	20 x 60°	8,0	63	12
B00263232500	25 x 60°	10,0	67	12
B00263233200	32 x 60°	12,5	71	16



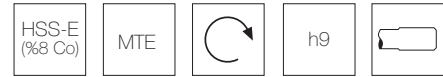


SINGLE FLUTE ALUMINIUM END MILLS



Product code	d1 mm	d2 (h8) mm	L1 mm	L2 mm
B00276500300	3	8	60	12
B00276500400	4	8	60	12
B00276510400	4	8	100	23
B00276500500	5	8	60	14
B00276510500	5	8	100	23

Product code	d1 mm	d2 (h8) mm	L1 mm	L2 mm
B00276500600	6	8	60	14
B00276510600	6	8	100	25
B00276500800	8	8	80	14
B00276510800	8	8	120	25
B00276511000	10	10	120	25



SINGLE FLUTE ALUMINIUM END MILLS



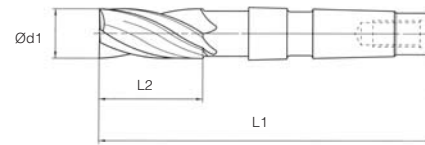
Product code	d1 mm	d2 (h8) mm	L1 mm	L2 mm
B00257520400	4	8	20x45	80
B00257520500	5	8	20x45	80

Product code	d1 mm	d2 (h8) mm	L1 mm	L2 mm
B00257520600	6	8	20x45	80

* Over ø 20 mm Producing from HSS-E (%5Co)



MORSE TAPER END MILLS - SHORT SERIES - TYPE BN

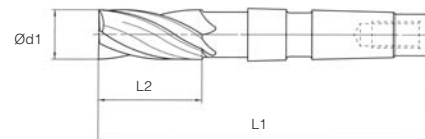


Product code	d1 mm	L1 mm	L2 mm	Z Nr of Flutes
B00258141600	16	117	32	2
B00258141800	18	117	32	2
B00258142000	20	123	38	2
B00258142200	22	123	38	2
B00258142500	25	147	45	3
B00258142600	26	147	45	3
B00258142800	28	147	45	3

Product code	d1 mm	L1 mm	L2 mm	Z Nr of Flutes
B00258143000	30	147	45	3
B00258143200	32	178	53	4
B00258143600	36	178	53	4
B00258144000	40	188	63	4
B00258144500	45	188	63	4
B00258145000	50	233	75	5



MORSE TAPER END MILLS - LONG SERIES - TYPE BN



Product code	d1 mm	L1 mm	L2 mm	Z Nr of Flutes
B00258261600	16	148	63	2
B00258261800	18	148	63	2
B00258262000	20	160	75	2
B00258262200	22	160	75	2
B00258262500	25	192	90	3
B00258262600	26	192	90	3

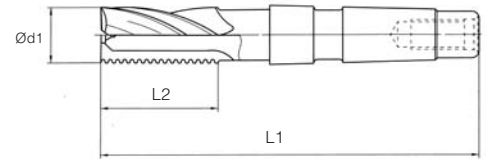
Product code	d1 mm	L1 mm	L2 mm	Z Nr of Flutes
B00258262800	28	192	90	3
B00258263000	30	192	90	3
B00258263200	32	231	106	4
B00258263600	36	231	106	4
B00258264000	40	250	125	4

* Over \varnothing 20 mm Producing from HSS-E (%5Co)





MORSE TAPER END MILLS - SHORT SERIES - TYPE BNR

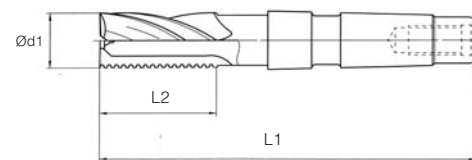


Product code	d1 mm	L1 mm	L2 mm	Z Nr of Flutes
B00273441600	16	117	32	2
B00273441800	18	117	32	2
B00273442000	20	123	38	2
B00273442200	22	123	38	2
B00273442500	25	147	45	3
B00273442600	26	147	45	3

Product code	d1 mm	L1 mm	L2 mm	Z Nr of Flutes
B00273442800	28	147	45	3
B00273443000	30	147	45	3
B00273443200	32	178	53	4
B00273443600	36	178	53	4
B00273444000	40	188	63	4



MORSE TAPER END MILLS - SHORT SERIES - TYPE BNF



Product code	d1 mm	L1 mm	L2 mm	Mors Taper Nr
B00274441600	16	117	32	2
B00274441800	18	117	32	2
B00274442000	20	123	38	2
B00274442200	22	123	38	2
B00274442500	25	147	45	3
B00274442600	26	147	45	3

Product code	d1 mm	L1 mm	L2 mm	Mors Taper Nr
B00274442800	28	147	45	3
B00274443000	30	147	45	3
B00274443200	32	178	53	4
B00274443600	36	178	53	4
B00274444000	40	188	63	4

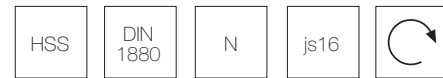
* Over \varnothing 20 mm Producing from HSS-E (%5Co)



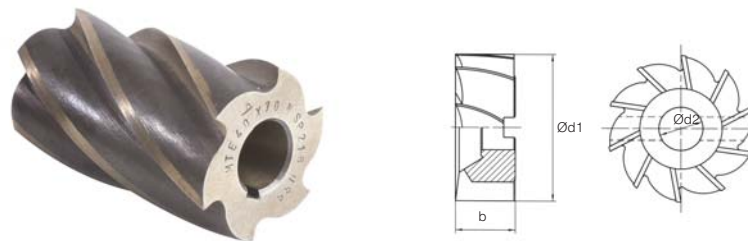
DRILLING - MILLING COMBINED TOOLS



Product code	d1 mm	d1 mm	L1 mm	L2 mm
B00902000686	6	6	90	18
B00902000688	8	8	90	18



SHELL END MILLS



Product code	d1 mm	d2 (H7) mm	b (k16) mm	Product code	d1 mm	d2 (H7) mm	b (k16) mm
B00201000040	40	16	32	B00201000080	80	27	45
B00201000050	50	22	36	B00201000100	100	32	50
B00201000063	63	27	40				

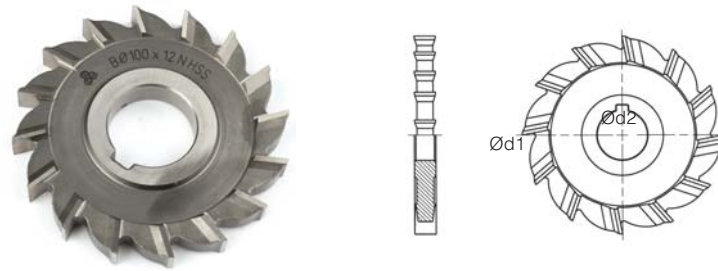


MILLING CUTTERS

* HSS-E Available upon request

HSS	DIN 885/B	N	js16	
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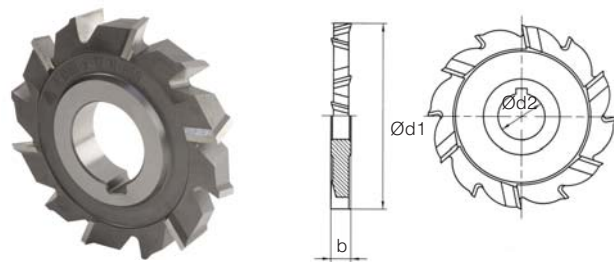
SIDE AND FACE CUTTERS - STRAIGHT TEETH



Product code	d1 mm	d2 (H7) mm	b (k11) mm	Product code	d1 mm	d2 (H7) mm	b (k11) mm
B00252030800	63	22	8	B00252033900	80	27	20
B00252030900	63	22	10	B00252036000	100	32	10
B00252031000	63	22	12	B00252036100	100	32	12
B00252031100	63	22	14	B00252036200	100	32	14
B00252033300	80	27	8	B00252036300	100	32	16
B00252033400	80	27	10	B00252036400	100	32	18
B00252033500	80	27	12	B00252036500	100	32	20
B00252033600	80	27	14	B00252036600	100	32	22
B00252033700	80	27	16	B00252036700	100	32	25
B00252033800	80	27	18				

HSS	DIN 885/A	N	js16	
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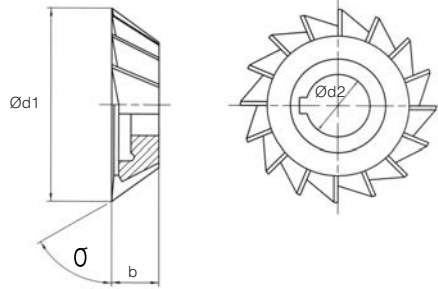
SIDE AND FACE CUTTERS - STAGGERED TEETH



Product code	d1 mm	d2 (H7) mm	b (k11) mm	Product code	d1 mm	d2 (H7) mm	b (k11) mm
B00252000400	50	16	10	B00252003800	80	27	18
B00252000800	63	22	8	B00252003900	80	27	20
B00252000900	63	22	10	B00252006000	100	32	10
B00252001000	63	22	12	B00252006100	100	32	12
B00252001100	63	22	14	B00252006200	100	32	14
B00252003300	80	27	8	B00252006300	100	32	16
B00252003400	80	27	10	B00252006400	100	32	18
B00252003500	80	27	12	B00252006500	100	32	20
B00252003600	80	27	14	B00252006600	100	32	22
B00252003700	80	27	16	B00252006700	100	32	25

HSS DIN 842 H js16

ANGULAR CUTTERS

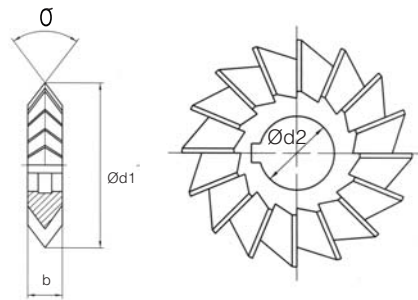


Product code	d1 mm	d2 (H7) mm	b (js14) mm	α
B00203020040	40	10	10	45
B00203020050	50	13	13	45
B00203020063	63	16	18	45
B00203020080	80	22	22	45
B00203020100	100	27	28	45
B00203040040	40	10	13	60
B00203040050	50	13	16	60
B00203040063	63	16	20	60

Product code	d1 mm	d2 (H7) mm	b (js14) mm	α
B00203040080	80	25	22	60
B00203040100	100	32	27	60
B00203060040	40	13	10	50
B00203060050	50	16	13	50
B00203060063	63	20	16	50
B00203060080	80	25	22	50
B00203060100	100	32	27	50

HSS DIN 847 H js16

DOUBLE ANGLE MILLING CUTTERS



Product code	d1 mm	d2 (H7) mm	b (js16) mm	α
B00206100050	50	16	8	45
B00206100063	63	22	10	45
B00206100080	80	27	12	45
B00206100100	100	32	18	45
B00206110050	50	16	10	60
B00206110063	63	22	14	60

Product code	d1 mm	d2 (H7) mm	b (js16) mm	α
B00206110080	80	27	18	60
B00206110100	100	32	25	60
B00206120050	50	16	14	90
B00206120063	63	22	20	90
B00206120080	80	27	22	90
B00206120100	100	32	32	90



MILLING CUTTERS

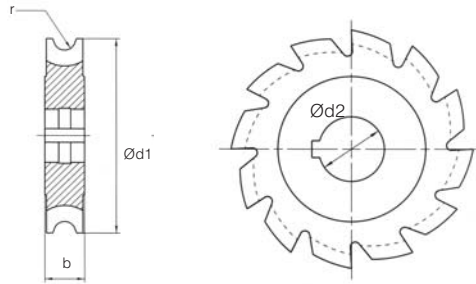
* HSS-E Available upon request

HSS

DIN
855

js16

CONCAVE RADIUS CUTTERS



Product code	d1 mm	d2 (H7) mm	b (js16) mm	r (H11)
B00216320100	50	16	6,0	1,00
B00216320125	50	16	6,0	1,25
B00216320160	50	16	8,0	1,60
B00216320200	50	16	9,0	2,00
B00216320250	63	22	10,0	2,50
B00216320300	63	22	12,0	3,00

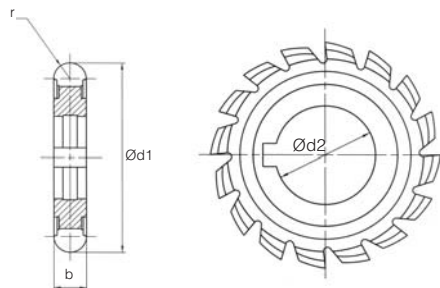
Product code	d1 mm	d2 (H7) mm	b (js16) mm	r (H11)
B00216320315	63	22	12,0	3,15
B00216320400	63	22	16,0	4,00
B00216320500	63	22	20,0	5,00
B00216320600	80	27	24,0	6,00
B00216320630	80	27	24,0	6,30
B00216320800	80	27	32,0	8,00

HSS

DIN
856

js16

CONVEX RADIUS CUTTERS



Product code	d1 mm	d2 (H7) mm	b (js16) mm	r (H11)
B00216400100	50	16	2,0	1,00
B00216400125	50	16	2,5	1,25
B00216400160	50	16	3,2	1,60
B00216400200	50	16	4,0	2,00
B00216400250	63	22	5,0	2,50
B00216400300	63	22	6,0	3,00

Product code	d1 mm	d2 (H7) mm	b (js16) mm	r (H11)
B00216400315	63	22	6,3	3,15
B00216400400	63	22	8,0	4,00
B00216400500	63	22	10,0	5,00
B00216400600	80	27	12,0	6,00
B00216400630	80	27	12,6	6,30
B00216400800	80	27	16,0	8,00

* HSS-E Available upon request

Ali Usta says;

Milling cutters are tools which are subject to the highest level of mechanic forces in machining.

Milling cutters are cutting tools for threading surfaces, holes and channels also used for special forms and threads for machining on metal, plastic, etc materials.

Milling cutters are divided into two classes:

- Drilling milling cutters; used by connecting from holes to the chuck.
- Cylindrical and Morse taper shank milling cutters; used by connecting to tool holders MK shells.

Ali Usta recommends:

Use different types of milling cutters for each material to be processed.

- Use TYPE N for ductile, long chipping materials with medium hardness and normal resistance (non-alloyed or low-alloyed steels, grey cast iron, tempered cast and brass materials)
- Use TYPE H (or S) for hard and brittle materials which medium and short chipping (alloyed steel, cast steel, hard gray cast iron and brass materials)
- Use TYPE W (or Y) for soft, long chipping materials with low resistance (Aluminium and soft aluminium alloys, soft brass, MS 63, copper and copper alloys)

Ali Usta;

In choosing milling cutters we must pay attention to the following:

Milling cutters are chosen depending on the connection positions of milling cutters, type of the material and the side or face cutting position of the milling cutter. In choosing the correct type of milling cutters we must pay attention to the type of steel made from.

Milling cutters manufactured

Type N: Number of cutting edges, chip and helical length normal

Type H: Number of cutting edges, more chip and helical angle less than normal

Type W: Number of cutting edges, more chip and helical angle more than normal

Materials of Milling Cutters

- Cobalt alloyed high speed steel (HSS-E)
- Solid carbide metals

In addition:

- TITANIUM NITRIDE (TiN) AND
- TITANIUM CARBON-NITRIDE (TiCN) surface coatings can be used.



Ali Usta reminds to keep the following principles always in mind:

- When proceed from soft materials to hard materials, in other words, from low resistant to high resistant materials, cutting speed and progress gradually decreases.
- The chips are the biggest enemy of the cutting tools; therefore chips must be immediately removed away from the work piece and tool. If necessary, better use rough machining cutters.
- TiN coated tools must be operated with higher revolutions than uncoated tools.
- The work piece and the end mills must be connected to the machine as close as possible.
- Do not use milling cutters with blunt and worn cutting edges.
- Must be preferred a down milling (in concurrent direction) as far as possible.
- Chuck must be ensured the clean, without burr and oil-free spindle, the tool's axis and the shaft's axis must match each other.



Ali Usta presents the problems encountered in milling, their causes and solutions.



1- Breaking of the cutting edges

CAUSE

- 1.1. Too much feed
- 1.2. Work piece is not rigid
- 1.3. Cutting tool is not fixed tightly
- 1.4. The stability of cutting tool is inadequate
- 1.5. Threads are too sharp

SOLUTION

Feed must be decreased
 More rigid machine or connection devices is required
 Connecting nut must be assembled
 Must be used short type tool or short connection holder.
 Change the rake angle or chamfer the sharp edges

2- Too much wearing

CAUSE

- 2.1. Cutting speed is too high
- 2.2. Work piece is too hard
- 2.3. Formation of tempered chips
- 2.4. Unsuitable feed speed (too high)
- 2.5. Unsuitable cutting angle
- 2.6. Back of the cutting edge scuffs

SOLUTION

Reduce speed and use coolant
 Use TiN coated end mill
 Reduce the cutting speed
 Reduce feed rate
 Choose cutting angle as per material
 Increase the clearance angle

3- Vibration

CAUSE

- 3.1. Feed rate and cutting speed are too high
- 3.2. Cutting tool and connecting system are not suitable
- 3.3. Clearance angle is too large
- 3.4. Work piece is improperly connected
- 3.5. Cutting depth too large
- 3.6. Cutting tool is too long or total length is too long

SOLUTION

Suitable cutting values must be used
 More rigid tool and connection must be used
 Adjust the margin
 Work piece must be connected properly
 Cutting depth must be reduced
 Cutting tool must be connected shorter or
 short milling cutter must be chosen

4- Difficulty in chip removal

CAUSE

- 4.1. Chip volume is too much
- 4.2. The chip flute is narrow in milling at the bottom of thread
- 4.3. Insufficient cooling

SOLUTION

Reduce the feed and cutting speed's rates
 Use an end mill with less threads and wide fluted
 Increase cooling pressure

5- Bad surface quality

CAUSE

- 5.1. The chosen feed rate may be too large
- 5.2. Cutting speed is too low
- 5.3. Wear out in cutting tool may be high
- 5.4. Formation of blue chips

SOLUTION

Reduce the feed rate
 Increase the speed
 Make point sharpening in short period
 Reduce the cutting speed

