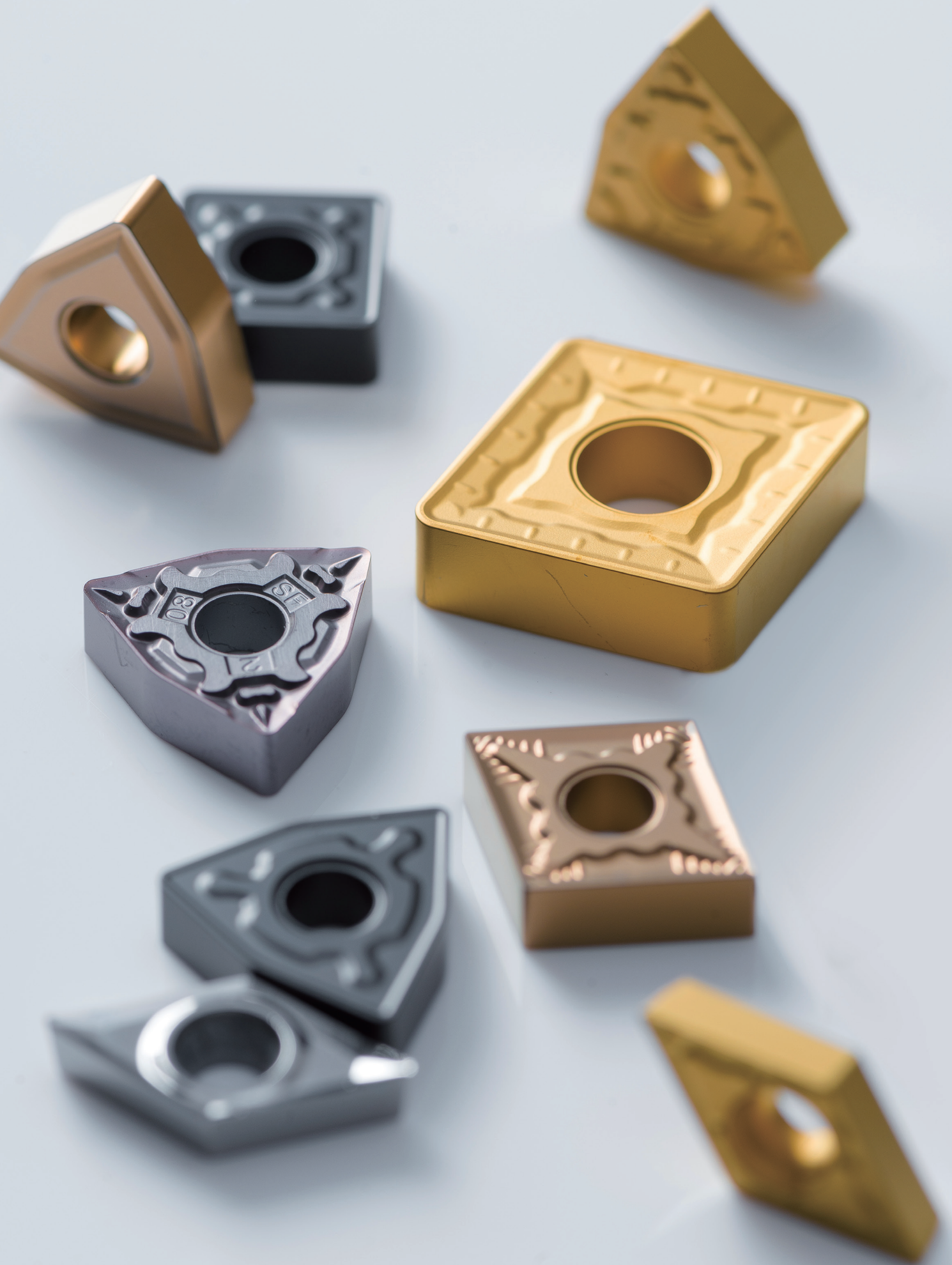


TURNING TOOLS

APPENDIX





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APPENDIX



Workpiece Material Table

ISO Material Group	MC	Workpiece Material	Content	Tensile Strength N/mm ²	Brinell Hardness HB	Rockwell Hardness HRC
P Steels	P1	Low-carbon Steels, Long Chipping	C<0.25%	<530	<125	
	P2	Low-carbon Steels, Short Chipping, Free-cutting Steels	C<0.25%	<530	<125	
	P3	High-carbon Steels, Medium-carbon Steels	C>0.25%	>530	<220	<25
	P4	Alloy Steels, Tool Steels.	C>0.25%	600-850	<330	<35
	P5	Alloy Steels, Tool Steels.	C>0.25%	850-1400	340-450	35-48
	P6	Ferritic Stainless Steels, Martensitic Stainless Steels, PH Stainless Steels	C=(0-0.4)%	600-900	<330	<35
	P7	High-strength Ferritic Stainless Steels, Martensitic Stainless Steels, PH Stainless Steels.	C=(0.1-0.6)%	900-1350	330-450	35-48
M Stainless Steels	M1	Austenitic Stainless Steels	C=(0.05-0.15)%	<600	130-200	
	M2	High-Strength Austenitic Stainless Steels and Cast Stainless Steels	C=(0.05-0.15)%	600-800	150-230	<25
	M3	Duplex Stainless Steels	C=(0.05-0.20)%	<800	135-275	<30
K Cast Iron	K1	Grey Cast Iron		125-500	120-290	< 32
	K2	Moderately Difficult Alloy Cast iron, Nodular Cast Iron.		<600	130-260	< 28
	K3	Difficult High-alloy Cast Iron, Nodular Cast Iron		>600	180-350	< 43
N Non-ferrous Materials	N1	Wrought Aluminium Alloys		<520	60-90	
	N2	Cast Aluminium Alloys	Si<12%	<350	70-100	
	N3	Cast Aluminium Alloys	Si>12%	200-320	60-120	
	N4	Copper, Copper Alloys		200-650	60-200	
	N5	Graphite, CFK, CFRP Graphite, Composite Materials		600-1500		
	N6	GFK, CFK Aluminium-based Composite Materials (MMCs)		<700	<210	
S Heat-resistant SuperAlloys, Titanium Alloys	S1	Iron-based Heat-resistant Alloys		500-1200	160-260	25-48
	S2	Cobalt-based Heat-resistant Alloys		1000-1450	250-450	25-48
	S3	Nickel-based Heat-resistant Alloys		600-1700	160-450	<48
	S4	Titanium and Titanium Alloys		900-1600	300-400	33-48
H Hardened Materials	H1	Hardened Steels				45-55
	H2	Hardened Steels				55-60
	H3	Hardened Steels				60-65
	H4	Hardened Steels				>65

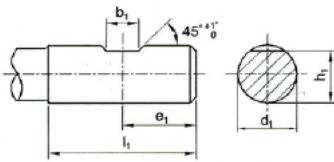
The Structure of Shank-DIN Standard

DIN 6535-HA

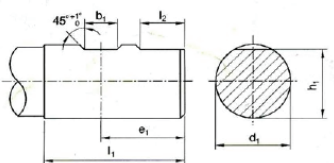


d · h ₀	2	3	4	5	6	8	10	12	14	16	18	20	25	32
$l_1 \begin{smallmatrix} +2 \\ 0 \end{smallmatrix}$	28				36		40	45		48		50	56	60

DIN 6535-HB



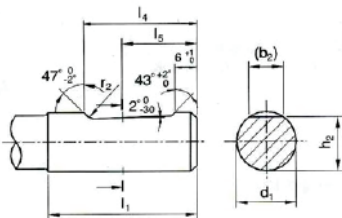
d₁=6~20mm



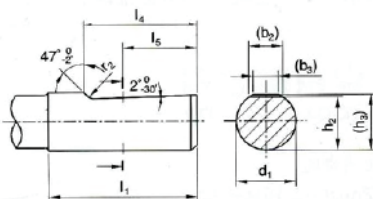
d₁=25~32mm

d ₁ h ₀	b ₁ $\begin{smallmatrix} +0.05 \\ 0 \end{smallmatrix}$	e ₁ $\begin{smallmatrix} 0 \\ -1 \end{smallmatrix}$	h ₁ h ₁₁	l ₁ $\begin{smallmatrix} +2 \\ 0 \end{smallmatrix}$	l ₂ $\begin{smallmatrix} +1 \\ 0 \end{smallmatrix}$
6.0	4.2	18.0	5.1	36.0	
8.0	5.5		6.9		
10	7.0	20.0	8.5	40.0	
12	8.0	22.5	10.4	45.0	
14			12.7		
16	10.0	24.0	14.2	48.0	
18			16.2		
20	11.0	25.0	18.2	50.0	
25	12.0	32.0	23.0	56.0	17.0
32	14.0	36.0	30.0	60.0	19.0

DIN 6535-HE



d₁=6~20mm



d₁=25~32mm

d ₁	(b ₂)	(b ₂)	(h ₂)	(h ₂)	l ₁	l ₄	l ₅	r ₂
6.0	4.3		5.1		36.0	25.0	18.0	1.2
8.0	5.5		6.9					
10	7.1		8.5		40.0	28.0	20.0	
12	8.2		10.4		45.0	33.0	22.5	
14	8.1		12.7					
16	10.1		14.2		48.0	36.0	24.0	
18	10.8	16.2						
20	11.4	18.2	50.0	38.0	25.0	1.6		
25	13.6	9.3	23.0	24.1	56.0		44.0	32.0
32	15.5	9.9	30.0	31.2	60.0		48.0	35.0

Cutting Calculations and Definitions

Parameter and Unit		
D Diameter	(mm)	F_n Feed per Revolution (mm/rev)
a_p Cutting Depth	(mm)	f_z Feeding per Teeth (mm/tooth)
a_e Cutting Width	(mm)	Z Number of Teeth
V_f Feed Rate	(mm/min)	n Spindle Speed (rev/min)
V_c Cutting Speed	(m/min)	L Length (mm)
Q Rate of Metal Removal	(cm^3/min)	T_c Processing Time (min)

General Formula	
n Spindle Speed	$n = \frac{V_c \cdot 1000}{\pi \cdot D}$ (rev/min)
V_c Cutting Speed	$V_c = \frac{\pi \cdot D \cdot n}{1000}$ (m/min)
V_f Feed Rate	$V_f = f_z \cdot z \cdot n$ (mm/min)
f_z Feed per Teeth	$f_z = \frac{V_f}{z \cdot n}$ (mm)
Q Rate of Metal Removal	$Q = \frac{a_e \cdot a_p \cdot V_f}{1000}$ (cm^3/min)
T_c Processing Time	$T_c = \frac{L}{V_f}$ (min)

Comparison Table for Tensile Strength , Brinell Hardness and Rockwell Hardness

N/mm2	HV10	HB	HRC
240	75	71	
255	80	76	
270	85	81	
285	90	86	
305	95	90	
320	100	95	
335	105	100	
350	110	105	
370	115	109	
385	120	114	
400	125	119	
415	130	124	
430	135	128	
450	140	133	
465	145	138	
480	150	143	
495	155	147	
510	160	152	
530	165	157	
545	170	162	
560	175	166	
575	180	171	
595	185	176	
610	190	181	
625	195	185	
640	200	190	
660	205	195	
675	210	199	
690	215	204	
705	220	209	
720	225	214	
740	230	219	
755	235	223	
770	240	228	
785	245	233	
800	250	238	22
820	255	242	23
835	260	247	24
860	268	255	25
870	272	258	26
900	280	266	27

N/mm2	HV10	HB	HRC
920	287	273	28
940	293	278	29
970	302	287	30
995	310	295	31
1020	317	301	32
1050	327	311	33
1080	336	319	34
1110	345	328	35
1140	355	337	36
1170	364	346	37
1200	373	354	38
1230	382	363	39
1260	392	372	40
1260	403	383	41
1330	413	393	42
1360	423	402	43
1400	434	413	44
1440	446	424	45
1480	458	435	46
1530	473	449	47
1570	484	460	48
1620	497	472	49
1680	514	488	50
1730	527	501	51
1790	544	517	52
1845	560	632	53
1910	578	549	54
1980	596	567	55
2050	615	584	56
2140	639	607	57
	655	622	58
	675		59
	698		60
	720		61
	745		62
	773		63
	800		64
	829		65
	864		66
	900		67
	940		68