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Inch / Metric Conversion Chart

• Cutting Speed (Vc)

Cutting Speed (Vc)	
SFM	m/min
300	91
600	183
900	274

SFM = (0.262 x rpm) x dia.(inch)
3.28feet/min (SFM) = 1m/min

SFM (Surface Feet per Minute)

• IPR Feed Rate (f)

Feed Rate (f)	
ipr	m/min
0.002	0.05
0.004	0.1
0.008	0.2

1ipr = 25.4mm/rev
0.004ipr = 0.1mm/rev

ipr (Inch per Revolution)
mm/rev (mm per Revolution)

• D.O.C. (ap)

D.O.C. (ap)	
inch	mm
0.02	0.5
0.04	1.0
0.08	2.0

1inch = 25.4mm
0.04inch = 1mm

• IPT Feed Rate (fz)

Feed Rate (fz)	
ipt	mm/t
0.002	0.05
0.004	0.1
0.008	0.2

1ipt = 25.4mm/t
0.004ipt = 0.1mm/t

ipt (Inch per Tooth)
mm/t (mm per Tooth)

• Torque

lbft	Nm
0.738	1

lbft (Pound x Feet)
Nm (Newton x Meter)

SI Derived Units Conversion Chart

(Extracted from JIS Handbook "Iron & Steel")

• Force

N	kgf	dyn
1	1.019 72X10 ⁻¹	1X10 ⁵
9.806 65	1	9.806 65X10 ⁵
1X10 ⁻⁵	1.019 72X10 ⁻⁶	1

• Stress

Pa or N/m ²	MPa or N/mm ²	kgf/mm ²	kgf/cm ²	kgf/m ²
1	1X10 ⁻⁶	1.019 72X10 ⁻⁷	1.019 72X10 ⁻⁵	1.019 72X10 ⁻¹
1X10 ⁶	1	1.019 72X10 ⁻¹	1.019 72X10	1.019 72X10 ⁵
9.806 65X10 ⁶	9.806 65	1	1X10 ⁻²	1X10 ⁻⁶
9.806 65X10 ⁴	9.806 65X10 ⁻²	1X10 ⁻²	1	1X10 ⁻⁴
9.806 65	9.806 65X10 ⁻⁶	1X10 ⁻⁶	1X10 ⁻⁴	1

• Pressure

Pa	kPa	MPa	bar	kgf/cm ²
1	1X10 ⁻³	1X10 ⁻⁶	1X10 ⁻⁵	1.019 72X10 ⁻⁵
1X10 ³	1	1X10 ⁻³	1X10 ⁻²	1.019 72X10 ⁻²
1X10 ⁶	1X10 ³	1	1X10	1.019 72X10
1X10 ⁵	1X10 ²	1X10 ⁻¹	1	1.019 72
9.806 65X10 ⁴	9.806 65X10	9.806 65X10 ⁻²	9.806 65X10 ⁻¹	1

• Power

W	kW	kgf · m/s	PS	kcal/h
1	1X10 ⁻³	1.019 72X10 ⁻¹	1.359 62X10 ⁻³	8.600 00X10 ⁻¹
1X10 ³	1	1.019 72X10 ⁻²	1.359 62	8.600 00X10 ²
9.806 65	9.806 65X10 ⁻³	1	1.333 33X10 ⁻²	8.433 71
7.355X10 ²	7.355X10 ⁻¹	7.5X10	1	6.325 29X10 ²
1.162 79	1.162 79X10 ⁻³	1.185 72X10 ⁻¹	1.580 95X10 ⁻³	1

• Revolution

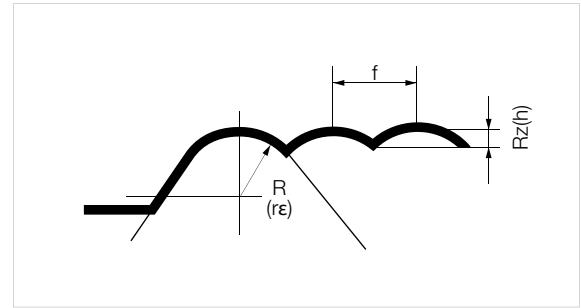
min ⁻¹	s ⁻¹	r.p.m.
1	0.0167	1
60	1	60

Theoretical (Geometrical) Surface Roughness

Theoretical Surface Roughness for Turning indicates the minimum roughness value from the cutting conditions and it is shown by the formula as follows:

$$Rz(h) = \frac{f^2}{8R(r\epsilon)} \times 10^3$$

$Rz(h)$: Theoretical Surface Roughness [μm]
 f : Feed Rate [mm/rev]
 $R(r\epsilon)$: Corner Radius of Insert [mm]



How to Obtain Surface Roughness Values

Type	Symbol	How to Obtain	Explanation
Max. Height Roughness	Rz	Ry is a mean value in micron meter obtained from the distance of the highest peaks and the lowest valleys within the range of sampled reference length (l) in the direction of the center line of the roughness curve. Note) When calculating Rz, extraordinarily high or low threads are considered as damages and excluded from the calculation, and only standard lengths are used. $Rz = Rp + Rv$	
Ten Points Mean Roughness	RzJIS	Rz is a mean value in micron meter obtained from the distance of 5 highest peaks (Yp) and the 5 lowest valleys (Yv) measured from the center line of the roughness curve within the range of sampled reference length "l". $Rz_{JIS} = \frac{(Yp1+Yp2+Yp3+Yp4+Yp5) + (Yv1+Yv2+Yv3+Yv4+Yv5)}{5}$	
Arithmetical Mean Roughness	Ra	Ra is obtained from the following formula in micron meter, the roughness curve is expressed by $y=f(x)$, the X-axis is in the direction of the center line and the Y-axis is the vertical magnification of the roughness curve in the range of sampled reference length "l". $Ra = \frac{1}{l} \int_0^l f(x) dx$	

Relationship with Triangle Symbol

Arithmetical Mean Roughness Ra(μm)	Max. Height Roughness Rz(μm)	Ten Points Mean Roughness RzJIS(μm)	※(Relationship with Triangle)
0.025	0.1	0.1	▽▽▽▽
0.050	0.2	0.2	
0.100	0.4	0.4	
0.200	0.8	0.8	
0.400	1.6	1.6	
0.800	3.2	3.2	▽▽▽
1.600	6.3	6.3	▽▽
3.200	12.5	12.5	
6.300	25.0	25.0	
12.500	50.0	50.0	
25.000	100.0	100.0	

※ Finishing symbol (Triangle ▽ and wave ~) was removed from JIS standard in the 1994 Revision.

• How to Indicate

- ① When Ra is $1.6\mu\text{m} \rightarrow 1.6\mu\text{mRa}$
- ② When Rz is $6.3\mu\text{m} \rightarrow 6.3\mu\text{mRz}$
- ③ When RzJIS is $6.3\mu\text{m} \rightarrow 6.3\mu\text{mRzJIS}$

Indication in JIS Standard

Example of Ra Indication		Example of Ry, (Rz) Indication	
① When indicating the upper limit only (when upper limit is 6.3 mRa)		① When indicating upper limit only Indicate surface roughness following the parameter symbol.	
② When indicating both lower and upper limit (when upper limit is 6.3 mRa, lower limit is 1.6 mRa)		② When indicating both lower and upper limit Indicate surface roughness as (upper limit ~ lower limit) following the parameter symbol.	

Note: The indications of Ra and Rz are different.

Caution-Symbols for Surface Roughness

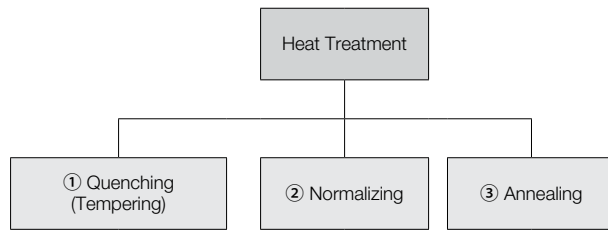
The above information is based on JIS B 0601-2001. However, some symbols were revised as shown in the right table in accordance with ISO Standard from JIS B 0601-2001 version. Ten Points Mean Roughness (Rz) was eliminated from 2001 version but it still remains as RzJIS reference, since it was popular in Japan.

Type	Symbol of JIS B 0601-1994	Symbol of JIS B 0601-2001
Max. Height Roughness	Ry	\rightarrow Rz
Ten Points Mean Roughness	Rz	\rightarrow (RzJIS)
Arithmetical Mean Roughness	Ra	\rightarrow Ra

GRADES A
 LINEUP / INSERTS B
 45° / 70° LEAD C
 75° LEAD D
 90° LEAD E
 HIGH FEED F
 MULTI-FUNCTION G
 SLOT MILLS H
 RADIUS / BALL-NOSE J
 OTHER APPLICATIONS K
 TOOL HOLDING O
 SPARE PARTS P
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Heat Treatment

One of the ways to determine the hardness of steel is the heat treatment and it is classified to 3 types.



<p>Heat Treatment Method</p>	① Quenching (Tempering)	After heating to over 727°C, cool rapidly down to 550°C in water or oil.	Quenching makes steel hard because it cools down red-hot steel very rapidly in water or oil, but it may promote internal stress. In order to remove such internal stress, tempering is used. (After cooled down once, reheat it to 200°C-600°C)
	② Normalizing	After heating to over 727°C, cool down rapidly to 600°C and then to normal temperature.	It miniaturizes the crystals. (Steel is also composed of small cells.) It is used to improve the mechanical character or machinability.
	③ Annealing	After heating to over 727°C, cool down very slowly to 600°C, then to normal temperature.	It miniaturizes the crystals like the process of normalizing, but the crystal size is bigger than that of normalizing. It targets machinability improvement and distortion correction.

Hardness Value

Hardness	Reference Standard	Example	Explanation of Example
Brinell Hardness	JIS Z 2243:1992	250HB	Hardness Value : 250, Hardness Symbol : HB
		200-250HB	When the hardness has the range
Vickers Hardness	JIS Z 2244:1998	640HV	Hardness Value : 640, Hardness Symbol : HV
Rockwell Hardness	JIS Z 2245:1992	60HRC	Hardness Value : 60, Hardness Symbol : HRC
Shore Hardness	JIS Z 2246:1992	50HS	Hardness Value : 50, Hardness Symbol : HS

Vickers Hardness Conversion Chart

Vickers Hardness (HV)	Brinell Hardness 10mm Dia. Ball Load: 3000kgf (HB)		Rockwell Hardness ⁽²⁾			Shore Hardness (HS)	Tensile Strength MPa ⁽¹⁾
	Standard Ball	Tungsten Carbide Ball	A Scale Load: 60kgf Diamond Point (HRA)	B Scale Load: 100kgf 1.60mm (1/16in) Ball (HRB)	C Scale Load: 150kgf Diamond Point (HRC)		
940	-	-	85.6	-	68.0	97	
920	-	-	85.3	-	67.5	96	
900	-	-	85.0	-	67.0	95	
880	-	(767)	84.7	-	66.4	93	
860	-	(757)	84.4	-	65.9	92	
840	-	(745)	84.1	-	65.3	91	
820	-	(733)	83.8	-	64.7	90	
800	-	(722)	83.4	-	64.0	88	
780	-	(710)	83.0	-	63.3	87	
760	-	(698)	82.6	-	62.5	86	
740	-	(684)	82.2	-	61.8	84	
720	-	(670)	81.8	-	61.0	83	
700	-	(656)	81.3	-	60.1	81	
690	-	(647)	81.1	-	59.7	-	
680	-	(638)	80.8	-	59.2	80	
670	-	630	80.6	-	58.8	-	
660	-	620	80.3	-	58.3	79	
650	-	611	80.0	-	57.8	-	
640	-	601	79.8	-	57.3	77	
630	-	591	79.5	-	56.8	-	
620	-	582	79.2	-	56.3	75	
610	-	573	78.9	-	55.7	-	
600	-	564	78.6	-	55.2	74	
590	-	554	78.4	-	54.7	-	2055
580	-	545	78.0	-	54.1	72	2020
570	-	535	77.8	-	53.6	-	1985
560	-	525	77.4	-	53.0	71	1950
550	505	517	77.0	-	52.3	-	1905
540	496	507	76.7	-	51.7	69	1860
530	488	497	76.4	-	51.1	-	1825
520	480	488	76.1	-	50.5	67	1795
510	473	479	75.7	-	49.8	-	1750
500	465	471	75.3	-	49.1	66	1705
490	456	460	74.9	-	48.4	-	1660
480	448	452	74.5	-	47.7	64	1620
470	441	442	74.1	-	46.9	-	1570
460	433	433	73.6	-	46.1	62	1530
450	425	425	73.3	-	45.3	-	1495
440	415	415	72.8	-	44.5	59	1460
430	405	405	72.3	-	43.6	-	1410
420	397	397	71.8	-	42.7	57	1370
410	388	388	71.4	-	41.8	-	1330
400	379	379	70.8	-	40.8	55	1290
390	369	369	70.3	-	39.8	-	1240
380	360	360	69.8	(110.0)	38.8	52	1205
370	350	350	69.2	-	37.7	-	1170
360	341	341	68.7	(109.0)	36.6	50	1130
350	331	331	68.1	-	35.5	-	1095
340	322	322	67.6	(108.0)	34.4	47	1070
330	313	313	67.0	-	33.3	-	1035

Vickers Hardness (HV)	Brinell Hardness 10mm Dia. Ball Load: 3000kgf (HB)		Rockwell Hardness ⁽²⁾			Shore Hardness (HS)	Tensile Strength MPa ⁽¹⁾
	Standard Ball	Tungsten Carbide Ball	A Scale Load: 60kgf Diamond Point (HRA)	B Scale Load: 100kgf 1.60mm (1/16in) Ball (HRB)	C Scale Load: 150kgf Diamond Point (HRC)		
320	303	303	66.4	(107.0)	32.2	45	1005
310	294	294	65.8	-	31.0	-	980
300	284	284	65.2	(105.5)	29.8	42	950
295	280	280	64.8	-	29.2	-	935
290	275	275	64.5	(104.5)	28.5	41	915
285	270	270	64.2	-	27.8	-	905
280	265	265	63.8	(103.5)	27.1	40	890
275	261	261	63.5	-	26.4	-	875
270	256	256	63.1	(102.0)	25.6	38	855
265	252	252	62.7	-	24.8	-	840
260	247	247	62.4	(101.0)	24.0	37	825
255	243	243	62.0	-	23.1	-	805
250	238	238	61.6	99.5	22.2	36	795
245	233	233	61.2	-	21.3	-	780
240	228	228	60.7	98.1	20.3	34	765
230	219	219	-	96.7	(18.0)	33	730
220	209	209	-	95.0	(15.7)	32	695
210	200	200	-	93.4	(13.4)	30	670
200	190	190	-	91.5	(11.0)	29	635
190	181	181	-	89.5	(8.5)	28	605
180	171	171	-	87.1	(6.0)	26	580
170	162	162	-	85.0	(3.0)	25	545
160	152	152	-	81.7	(0.0)	24	515
150	143	143	-	78.7	-	22	490
140	133	133	-	75.0	-	21	455
130	124	124	-	71.2	-	20	425
120	114	114	-	66.7	-	-	390
110	105	105	-	62.3	-	-	-
100	95	95	-	56.2	-	-	-
95	90	90	-	52.0	-	-	-
90	86	86	-	48.0	-	-	-
85	81	81	-	41.0	-	-	-

• Extracted from JIS Handbook "Iron & Steel" (SAE J 417)
 Note 1) 1MPa = 1N/mm²
 2) Value in () is not in practical use, but reference only

GRADES **A**

LINEUP / INSERTS **B**

45° / 70° LEAD **C**

75° LEAD **D**

90° LEAD **E**

HIGH FEED **F**

MULTI-FUNCTION **G**

SLOT MILLS **H**

RADIUS / BALL-NOSE **J**

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TOOL HOLDING **O**

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MATERIAL LIST (JIS)

Metal

Class	Name of JIS Standard	Symbol	
Structural Steel	Rolled Steel for Welded Structure	SM	
	Re-Rolled Steel	SRB	
	Rolled Steel for General Structure	SS	
	Light Gauge Steel for General Structure	SSC	
	Hot-Rolled Steel Plate, Sheet and Strip for Automobile Structural Use	SAPH	
Steel Sheet	Cold-Rolled Steel Plate, Sheet and Strip	SPC	
	Hot-Rolled Soft Steel Plate, Sheet and Strip	SPH	
Steel Pipe	Carbon Steel Pipe for Ordinary Piping	SGP	
	Carbon Steel Pipe for Boiler / Heat Exchanger	STB	
	Seamless Steel Pipe for High Pressure Gas Cylinder	STH	
	Carbon Steel Pipe for General Structural Use	STK	
	Carbon Steel Pipe for Machine Structural Use	STKM	
	Alloy Steel Pipe for Structural Use	STKS	
	Stainless Steel Pipe for Machine Structural Use	SUS-TK	
	Steel Square Pipe for General Structural Use	STKR	
	Alloy Steel Pipe for Ordinary Piping	STPA	
	Carbon Steel Pipe for Pressure Service	STPG	
	Carbon Steel Pipe for High-Temperature Service	STPT	
	Carbon Steel Pipe for High-Pressure Service	STS	
	Stainless Steel Pipe for Ordinary Piping	SUS-TP	
		Carbon Steel for Machine Structural Use	SxxC, SxxCK
Steel for Machine Structural Use	Aluminium Chromium Molybdenum Steel	SACM	
	Chromium Molybdenum Steel	SCM	
	Chromium Steel	SCr	
	Nickel Chromium Steel	SNC	
	Nickel Chromium Molybdenum Steel	SNCM	
	Manganese Steel and Manganese Chromium Steel for Machine Structural Use	SMn, SMnC	
		Carbon Tool Steel	SK
Special Steel	Hollow Drill Steel	SKC	
	Alloy Tool Steel	SKS, SKD, SKT	
	High Speed Tool Steel	SKH	
	Free Cutting Carbon Steel	SUM	
	High Carbon Chromium Bearing Steel	SUJ	
	Spring Steel	SUP	
	Stainless Steel Bar	SUS-B	
	Hot-Rolled Stainless Steel Plate, Sheet and Strip	SUS-HP, SUS-HS	
	Cold-Rolled Stainless Steel Plate, Sheet and Strip	SUS-CP, SUS-CS	
	Heat-Resisting Steel Bar	SUH-B, SUH-CB	
	Heat-Resisting Steel Plate and Sheet	SUH-HP, SUH-CP	
	Super Alloy	Corrosion-Resisting and Heat-Resisting Superalloy Bar	NCF-B
		Corrosion-Resisting and Heat-Resisting Superalloy Plate and Sheet	NCF-P
	Forged Steel	Carbon Steel Forging	SF
Chromium Molybdenum Steel Forging		SFCM	
Nickel Chromium Molybdenum Steel Forging		SFNCM	
Cast Iron	Gray Cast Iron	FC	
	Spheroidal Graphite Cast Iron	FCD	
	Blackheart Malleable Cast Iron	FCMB	
	Whiteheart Malleable Cast Iron	FCMW	
	Pearlitic Malleable Cast Iron	FCMP	
Cast Steel	Carbon Cast Steel	SC	
	High Tensile Strength Carbon Cast Steel & Low Alloy Cast Steel	SCC	
	Stainless Cast Steel	SCS	
	Heat-Resisting Cast Steel	SCH	
	High Manganese Cast Steel	SCMnH	
	Cast Steel for High Temperature and High Pressure Service	SCPH	

Non-Ferrous Metal

Class	Name of JIS Standard	Symbol
Copper	Copper and Copper Alloy Sheet / Strip	CxxxP CxxxPP CxxxR
	Copper and Copper Alloy Rod and Bar	CxxxBD CxxxBDS CxxxBE
Aluminum Alloy and Aluminum Alloy Expanded Material	Aluminum and Al. Alloy Sheet / Strip	AxxxP AxxxPC
	Aluminum and Al. Alloy Rod, Bar, and Wire	AxxxBE AxxxBES AxxxBD AxxxBDS AxxxW AxxxWS
	Aluminum and Al. Alloy Extruded Shape	AxxxS
	Aluminum and Al. Alloy Forging	AxxxFD AxxxFH
Magnesium Alloy Expanded Material	Magnesium Alloy Sheet and Plate	MP
	Magnesium Alloy Rod and Bar	MB
Nickel Alloy	Nickel Copper Alloy Sheet and Plate	NCuP
	Nickel Copper Alloy Rod and Bar	NCuB
Titanium Expanded Material	Titanium Rod and Bar	TB
Casting	Brass Casting	CAC20x
	High Strength Brass Casting	CAC30x
	Bronze Casting	CAC40x
	Phosphoric Bronze Casting	CAC50x
	Aluminum Bronze Casting	CAC70x
	Aluminum Alloy Casting	AC
	Magnesium Alloy Casting	MC
	Zinc Alloy Die Casting	ZDCx
	Aluminum Alloy Die Casting	ADC
	Magnesium Alloy Die Casting	MD
White Metal	WJ	

MATERIAL CROSS REFERENCE CHART

Steel

CLASS	USA AISI / SAE	JAPAN JIS	CHINA GB	UK BS	GERMANY DIN	FRANCE NF	RUSSIA ГОСТ
CARBON STEEL FOR MACHINE STRUCTURAL USE	1010	S10C	08 10	040A10 045A10 045M10	C10E C10R	XC10	
	1012	S12C		040A12		XC12	
	1015	S15C	15	055M15	C15E C15R		
	1017	S17C				XC18	
	1020	S20C	20	070M20 C22 C22E C22R	C22 C22E C22R	C22 C22E C22R	
	1023	S22C					
	1025	S25C	25	C25 C25E C22R	C25 C25E C25R	C25 C25E C25R	
	1029	S28C					25Г
	1030	S30C	30	080A30 080M30 C30 C30E C30R	C30 C30E C30R	C30 C30E C30R	30Г
		S33C					30Г
	1035	S35C	35	C35 C35E C35R	C35 C35E C35R	C35 C35E C35R	35Г
	1038	S38C					35Г
	1039 1040	S40C	40	080M40 C40 C40E C40R	C40 C40E C40R	C40 C40E C40R	40Г
	1042 1043	S43C		080A42			40Г
	1045 1046	S45C	45	C45 C45E C45R	C45 C45E C45R	C45 C45E C45R	45Г
		S48C		080A47			45Г
	1049	S50C	50	080M50 C50 C50E C50R	C50 C50E C50R	C50 C50E C50R	50Г
	1050 1053	S53C					50Г
	1055	S55C	55	070M55 C55 C55E C55R	C55 C55E C55R	C55 C55E C55R	
	1059 1060	S58C	60	C60 C60E C60R	C60 C60E C60R	C60 C60E C60R	60Г
		S09CK		045A10 045M10	C10E	XC10	
	S15CK	15F		C15E	XC12		
	S20CK				XC18		

GRADES	A
LINEUP / INSERTS	B
45° / 70° LEAD	C
75° LEAD	D
90° LEAD	E
HIGH FEED	F
MULTI-FUNCTION	G
SLOT MILLS	H
RADIUS / BALL-NOSE	J
OTHER APPLICATIONS	K
TOOL HOLDING	O
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MATERIAL CROSS REFERENCE CHART

Steel

CLASS	USA AISI / SAE	JAPAN JIS	CHINA GB	UK BS	GERMANY DIN	FRANCE NF	RUSSIA ГОСТ	
NICKEL CHROMIUM STEEL		SNC236			36NiCr6		40XH	
		SNC415	12CrNi2		14NiCr10			
		SNC631	30CrNi3		36NiCr10		30XH3A	
		SNC815	12Cr2Ni4	655M13	15NiCr13			
		SNC836	37CrNi3		31NiCr14			
NICKEL CHROMIUM MOLYBDENUM STEEL	8615 8617 8620 8622	SNCM220	20CrNiMo	805A20 805M20 805A22 805M22	20NiCrMo2 20NiCrMoS2	20NCD 2		
	8637 8640			SNCM240		40NiCrMo2-2		
					SNCM415			
	4320			SNCM420	18CrNiMnMoA		17NiCrMo6-4	
		SNCM431			30CrNiMo8			
	4340	SNCM439	40CrNiMoA		40NiCrMo6			
		SNCM447			34CrNiMo6			
		SNCM616						
		SNCM625						
		SNCM630						
		SNCM815						
	CHROMIUM STEEL		SCr415	15Cr 15CrA		17Cr3 17CrS3		15X 15XA
		5120	SCr420	20Cr				20X
5130 5132		SCr430	30Cr	34Cr4 34CrS4	34Cr4 34CrS4	34Cr4 34CrS4	30X	
5132		SCr435	35Cr	37Cr4 37CrS4	37Cr4 37CrS4	37Cr4 37CrS4	35X	
5140		SCr440	40Cr	530M40 41Cr4 41CrS4	41Cr4 41CrS4	41Cr4 41CrS4	40X	
		SCr445	45Cr 50Cr				45X	
CHROMIUM MOLYBDENUM STEEL		SCM415	15CrMo		15CrMo4			
		SCM418	20CrMo		18CrMo4 18CrMoS4		20XM	
		SCM420		708M20	20CrMo5		20XM	
		SCM421						
	4131	SCM430	30CrMo 30CrMoA				30XM 30XMA	
		SCM432						
	4137	SCM435	35CrMo	34CrMo4 34CrMoS4	34CrMo4 34CrMoS4	34CrMo4 34CrMoS4	35XM	
	4140 4142	SCM440	42CrMo	708M40 709M40 42CrMo4 42CrMoS4	42CrMo4 42CrMoS4	42CrMo4 42CrMoS4		
	4145 4147	SCM445						
		SCM822						

MATERIAL CROSS REFERENCE CHART

Steel

CLASS	USA AISI / SAE	JAPAN JIS	CHINA GB	UK BS	GERMANY DIN	FRANCE NF	RUSSIA ГОСТ	
MANGANESE CHROMIUM STEEL MANGANESE STEEL	1522	SMn420	20Mn2	150M19	20Mn5			
	1534	SMn433	30Mn2 35Mn2	150M36	34Mn5		30Г2 35Г2	
	1541	SMn438	40Mn2	150M36	36Mn5		35Г2 40Г2	
	1541	SMn443	45Mn2				40Г2 45Г2	
	5115	SMnC420	15CrMn		16MnCr5			
	5140	SMnC443	40CrMn					
STRUCTURAL STEEL WITH SPECIFIED HARDENABILITY BAND (H-SHAPE STEEL)	1522H	SMn420H						
		SMn433H						
	1541H	SMn438H						
	1541H	SMn443H						
		SMnC420H						
		SMnC443H						
		SCr415H	15CrH		17Cr3 17CrS3		15X	
	5120H	SCr420H	20Cr1H		17Cr3		20X	
	5130H 5132H	SCr430H		34Cr4 34CrS4	34Cr4 34CrS3	34Cr4 34CrS4	30X	
	5135H	SCr435H		37Cr4 37CrS4	37Cr4 34CrS4	37Cr4 37CrS4	35X	
	5140H	SCr440H	40CrH	41Cr4 41CrS4	41Cr4 41CrS4	41Cr4 41CrS4	40X	
	4118H	SCN415H	15CrMoH		15CrMo5			
		SCM418H			18CrMo4 18CrMoS4			
	4118H	SCM420H	20CrMoH	708H20	18CrMo4			
	4135H 4137H	SCM435H		34CrMo4 34CrMoS4	34CrMo4 34CrMoS4	34CrMo4 34CrMoS4		
	4140H 4142H	SCM440H		42CrMo4 42CrMoS4	42CrMo4 42CrMoS4	42CrMo4 42CrMoS4		
	4145H 4147H	SCM445H						
		SCM822H						
		SNC415H						
		SNC631H						
		SNC815H	12Cr2Ni4H		655H13	15NiCr13		
	8617H 8620H 8622H	SNCM220H	20CrNiMoH		805H17 805H20 805H22	21NiCrMo2	20N CD 2	
	4320H	SNCM420H	20CrNi2MoH			20NiCrMoS6-4		

GRADES	A
LINEUP / INSERTS	B
45° / 70° LEAD	C
75° LEAD	D
90° LEAD	E
HIGH FEED	F
MULTI-FUNCTION	G
SLOT MILLS	H
RADIUS / BALL-NOSE	J
OTHER APPLICATIONS	K
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MATERIAL CROSS REFERENCE CHART

Steel

CLASS	USA		JAPAN JIS	CHINA GB	UK BS	GERMANY DIN	FRANCE NF	RUSSIA ГОСТ
	UNS	AISI						
STAINLESS STEEL	S20100	201	SUS 201	1Cr17Mn6Ni5N			Z12CMN17-07Az	
	S20200	202	SUS 202	1Cr18Mn8Ni5N	284S16			12X17T9AH4
	S30100	301	SUS 301	1Cr18Mn10Ni5Mo3N 1Cr17Ni7	301S21	X12CrNi17 7	Z11CN17-08	07X16H6
			SUS 301L			X2CrNiN18-7		
			SUS 301J1			X12CrNi17 7		
	S30200	302	SUS 302	1Cr18Ni9	302S25		Z12CN18-09	12X18H9
	S30215	302B	SUS 302B					
	S30300	303	SUS 303	Y1Cr18Ni9	303S21	X10CrNiS18 9	Z8CNF18-09	
	S30323	303Se	SUS 303Se	Y1Cr18Ni9Se	303S41			12X18H10E
	S30400	304	SUS 304	0Cr18Ni9	304S31	X5CrNi18 10	Z7CN18-09	08X18H10
	S30403	304L	SUS 304L	00Cr18Ni10	304S11	X2CrNi19 11	Z3CN19-11	03X18H11
	S30451	304N	SUS 304N1	0Cr18Ni9N			Z6CN19-09Az	
	S30452		SUS 304N2	0Cr19Ni10NbN				
	S30453	304LN	SUS 304LN	00Cr18Ni10N		X2CrNiN18 10	Z3CN18-10Az	
			SUS 304J1					
			SUS 304J2					
	S30431	S30431	SUS 304J3					
	S30500	305	SUS 305	1Cr18Ni12	305S19	X5CrNi18 12	Z8CN18-12	06X18H11
			SUS 305J1					
	S30908	309S	SUS 309S	0Cr23Ni13			Z10CN24-13	
	S31008	310S	SUS 310S	0Cr25Ni20	310S31		Z8CN25-20	10X23H18
	S31600	316	SUS 316	0Cr17Ni12Mo2	316S31	X5CrNiMo17 12 2	Z7CND17-12-02	
						X5CrNiMo17 13 3	Z6CND18-12-03	
	S31603	316L	SUS 316L	00Cr17Ni14Mo2	316S11	X2CrNiMo17 13 2	Z3CND17-12-02	
						X2CrNiMo17 14 3	Z3CND17-13-03	03X17H14M3
	S31651	316N	SUS 316N	0Cr17Ni12Mo2N				
	S31653	316LN	SUS 316LN	00Cr17Ni13Mo2N		X2CrNiMoN17 12 2	Z3CND17-11Az	
						X2CrNiMoN17 13 3	Z3CND17-12Az	
	S31635		SUS 316Ti			X6CrNiMoTi17 12 2	Z6CNDT17-12	08X17H13M2T
			SUS 316J1	0Cr18Ni12Mo2Cu2				
			SUS 316J1L	00Cr18Ni14Mo2Cu2				
	S31700	317	SUS 317	0Cr19Ni13Mo3	317S16			
	S31703	317L	SUS 317L	00Cr19Ni13Mo3	317S12	X2CrNiMo18 16 4	Z3CND19-15-04	
	S31753		SUS 317LN				Z3CND19-14Az	
			SUS 317J1	0Cr18Ni16Mo5				
			SUS 317J2					
			SUS 317J3L					
	N08367		SUS 836L					
	N08904	N08904	SUS 890L		904S14		Z2NCDU25-20	
	S32100	321	SUS 321	1Cr18Ni9Ti 0Cr18Ni10Ti	321S31	X6CrNiTi18 10	Z6CNT18-10	08X18H10T
S34700	347	SUS 347	0Cr18Ni11Nb	347S31	X6CrNiNb18 10	Z6CNNb18-10	08X18H12B	
S38400	384	SUS 384				Z6CN18-16		
S30430	304Cu	SUS XM7	0Cr18Ni9Cu3	394S17		Z2CNU18-10		
S38100		SUS XM15J1	0Cr18Ni13Si4			Z15CNS20-12		
S32900	329	SUS 329J1	0Cr26Ni5Mo2					
S39240	S31803	SUS 329J3L				Z3CNDU22-05Az	08X21H6M2T	
S39275	S31260	SUS 329J4L				Z3CNDU25-07Az		

MATERIAL CROSS REFERENCE CHART

Steel

CLASS	USA		JAPAN JIS	CHINA GB	UK BS	GERMANY DIN	FRANCE NF	RUSSIA ГОСТ
	UNS	AISI						
STAINLESS STEEL	S40500	405	SUS 405	0Cr13Al 0Cr13	405S17	X6CrAl13	Z8CA12	
			SUS 410L	00Cr12			Z3C14	
	S42900	429	SUS 429					
	S43000	430	SUS 430	1Cr17	430S17	X6Cr17	Z8C17	12X17
	S43020	430F	SUS 430F	Y1Cr17		X7CrMoS18	Z8CF17	
	S43035		SUS 430LX			X6CrTi17	Z4CT17	
			SUS 430J1L			X6CrNb17	Z4CNb17	
	S43400	434	SUS 434	1Cr17Mo	434S17	X6CrMo17 1	Z8CD17-01	
	S43600	436	SUS 436L					
			SUS 436J1L					
	S44400	444	SUS 444				Z3CDT18-02	
	S44700		SUS 447J1	00Cr30Mo2				
	S44627		SUS XM27	00Cr27Mo			Z1CD26-01	
	S40300	403	SUS 403	1Cr12				
	S41000	410	SUS 410	1Cr13	410S21	X10Cr13	Z13C13	
	S41008	410S	SUS 410S		403S17	X6Cr13	Z8C12	08X13
			SUS 410F2					
	S41025		SUS 410J1	1Cr13Mo 1Cr12Mo		X12CrS13		
	S41600	416	SUS 416	Y1Cr13	416S21		Z11CF13	
	S42000	420	SUS 420J1	2Cr13	420S29	X20Cr13	Z20C13	20X13
	S42000	420	SUS 420J2	3Cr13	420S37	X30Cr13	Z33C13	30X13
	S42020	420F	SUS 420F	Y3Cr13			Z30CF13	
			SUS 420F2					
			SUS 429J1					
S43100	431	SUS 431	1Cr17Ni2	431S29	X20CrNi17 2	Z15CN16-02	20X17H2	
S44002	440A	SUS 440A	7Cr17			Z70C15		
S44003	440B	SUS 440B	8Cr17					
S44004	440C	SUS 440C	9Cr18 11Cr17 9Cr18Mo			Z100CD17	95X18	
S44020	S44020	SUS 440F	Y11Cr17					
S17400	S17400	SUS 630	0Cr17Ni4CuNb		X5CrNiCuNb16-4	Z6CNU17-04		
S17700	S17700	SUS 631	0Cr17Ni7Al		X7CrNiAl17 7	Z9CNA17-07	09X17H7 IO	
		SUS 632J1						

Representative Classification of Stainless Steel

Stainless Steel (Austenitic Related)

JIS	
SUS201	SUS309S
SUS202	SUS310S
SUS301	SUS316
SUS302	SUS316L
SUS302B	SUS316N
SUS303	SUS317
SUS303Se	SUS317L
SUS304	SUS321
SUS304L	SUS347
SUS304N1	SUS384
SUS304N2	SUSXM7
SUS305	SUSXM15J1
SUS308	

Stainless Steel (Ferritic Related)

JIS
SUS405
SUS429
SUS430
SUS430F
SUS434
SUSXM27

Stainless Steel (Martensitic Related)

JIS
SUS403
SUS410
SUS410S
SUS416
SUS420J1
SUS420F
SUS431
SUS440A
SUS440B
SUS440C
SUS440F

Stainless Steel (Precipitation Hardened Related)

JIS
SUS630
SUS631

GRADES A
LINEUP / INSERTS B
45° / 70° LEAD C
75° LEAD D
90° LEAD E
HIGH FEED F
MULTI-FUNCTION G
SLOT MILLS H
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Steel

CLASS	USA		JAPAN JIS	CHINA GB	UK BS	GERMANY DIN	FRANCE NF	RUSSIA ГОСТ
	UNS	AISI						
HEAT RESISTING STEEL			SUH 31		331S42		Z35CNWS14-14	45X14H14B2M
			SUH 35		349S52		Z52CMN21-09Az	
	S63008		SUH 36	5Cr21Mn9Ni4N	349S54	X53CrMnNi21-9	Z55CMN21-09Az	55X20 Г 9AH4
	S63017		SUH 37	2Cr21Ni12N	381S34			
			SUH 38					
	S30900	309	SUH 309	2Cr23Ni13	309S24		Z15CN24-13	
	S31000	310	SUH 310	2Cr25Ni20	310S24	CrNi2520	Z15CN25-20	20X25H20C2
	N08330	N08330	SUH 330	1Cr16Ni35			Z12NCS35-16	
	S66286		SUH 660	0Cr15Ni25Ti2MoAlVB			Z6NCTV25-20	
	R30155		SUH 661					
			SUH 21			CrAl1205		
	S40900	409	SUH 409		409S19	X6CrTi12	Z6CT12	
			SUH 409L				Z3CT12	
	S44600	446	SUH 446	2Cr25N			Z12C25	15X28
	S65007		SUH 1	4Cr9Si2	401S45	X45CrSi9-3	Z45CS9	
			SUH 3	4Cr10Si2Mo			Z40CSD10	40X10C2M
			SUH 4	8Cr20Si2Ni	443S65		Z80CSN20-02	
			SUH 11					40X 9C2
		SUH 600	2Cr12MoVNbN				20X12BHMБФP	
S42200		SUH 616	2Cr12NiMoWV					

Representative Classification of Heat Resisting Steel

Heat Resisting Steel (Austenitic Related)

JIS
SUH31
SUH35
SUH36
SUH37
SUH38
SUH309
SUH310
SUH330
SUH660
SUH661

Heat Resisting Steel (Ferritic Related)

JIS
SUH21
SUH409
SUH446

Heat Resisting Steel (Martensitic Related)

JIS
SUH1
SUH3
SUH4
SUH11
SUH600
SUH616

MATERIAL CROSS REFERENCE CHART

Steel

CLASS	USA AISI / SAE	JAPAN JIS	CHINA GB	UK BS	GERMANY DIN	FRANCE NF	RUSSIA ГОСТ
CARBON TOOL STEEL		SK140 (SK1)	T13			C140E3U	Y13
	W1-11½	SK120 (SK2)	T12			C120E3U	Y12
	W1-10	SK105 (SK3)	T11		C105W1	C105E2U	Y11
	W1-9	SK95 (SK4)	T10			C90E2U	Y10
	W1-8	SK85 (SK5)	T8Mn T9		C80W1	C90E2U C80E2U	Y8Г Y9
		SK75 (SK6)	T8		C80W1	C80E2U C70E2U	Y8
		SK65 (SK7)	T7		C70W2	C70E2U	Y7
HIGH SPEED TOOL STEEL	T1	SKH2	W18Cr4V	BT1		HS18-0-1	P18
	T4	SKH3	W18Cr4VCo5	BT4	S18-1-2-5	HS18-1-1-5	P18K5Φ2
	T5	SKH4	W18Cr4V2Co8	BT5		HS18-0-2-9	P18K5Φ
	T15	SKH10	W12Cr4V5Co5	BT15	S12-1-4-5	HS12-1-5-5	
	M2	SKH51	W6Mo5Cr4V2	BM2	S6-5-2	HS6-5-2	P6M5
	M3-1	SKH52	CW6Mo5Cr4V2 W6Mo5Cr4V3				P6M5Φ3
	M3-2	SKH53	CW6Mo5Cr4V3		S6-5-3	HS6-5-3	P6M5Φ3
	M4	SKH54		BM4		HS6-5-4	
	M35 M41	SKH55	W6Mo5Cr4V2Co5 W7Mo5Cr4V2Co5	BM35	S6-5-2-5	HS6-5-2-5HC	P6M5K5
	M36	SKH56					
		SKH57		BT42	S10-4-3-10	HS10-4-3-10	
	M7	SKH58	W2Mo9Cr4V2			HS2-9-2	
	M42	SKH59	W2Mo9Cr4VCo8	BM42	S2-10-1-8	HS2-9-1-8	
ALLOY TOOL STEEL	F2	SKS11					XB4
		SKS2			105WCr6	105WCr5	XBГ
		SKS21	W				
		SKS5					
	L6	SKS51					
		SKS7					
		SKS8	Cr06			C140E3UCr4	13X
	S1	SKS4	5CrW2Si 6CrW2Si				6XB2C 5XB2CΦ
	S1	SKS41	4CrW2Si				4XB2C
	W2-9½	SKS43		BW2		100V2	
	W2-8	SKS44					
		SKS3	9CrWMn				9XBГ
		SKS31	CrWMn		105WCr6	105WCr5	XBГ
		SKS93					
		SKS94					
		SKS95	8MnSi				
	D3	SKD1	Cr12	BD3	X210Cr12	X200Cr12	X12
	D2	SKD10	Cr12Mo1V1		X153CrMoV12		X12MΦ
	D2	SKD11	Cr12MoV	BD2	X153CrMoV12	X160CrMoV12	
	A2	SKD12	Cr5Mo1V	BA2		X100CrMoV5	
		SKD4				X32WCrV3	
H21	SKD5	3Cr2W8V	BH21	X30WCrV9-3	X30WCrV9		
H11	SKD6	4Cr5MoSiV	BH11	X38CrMoV51	X38CrMoV5	4X5MΦC	
H13	SKD61	4Cr5MoSiV1	BH13	X40CrMoV51	X40CrMoV5	4X5MΦ1C	
H12	SKD62		BH12		X35CrWMoV5	3X3M3Φ	
H10	SKD7	4Cr3Mo3SiV	BH10	X32CrMoV33	32CrMoV12-18		
H19	SKD8		BH19				
	SKT3				55CrNiMoV4		
	SKT4	5CrNiMo	BH224 / 5	55NiCrMoV6	55NiCrMoV7	5XHM	

GRADES	A
LINEUP / INSERTS	B
45° / 70° LEAD	C
75° LEAD	D
90° LEAD	E
HIGH FEED	F
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MATERIAL CROSS REFERENCE CHART

Steel

CLASS	USA AISI / SAE	JAPAN JIS	CHINA GB	UK BS	GERMANY DIN	FRANCE NF	RUSSIA ГОСТ
SPRING STEEL	1075 1078	SUP3					75 80 85
		SUP6	55Si2Mn		56SiCr7	60Si7	60C2
	9260	SUP7	60Si2Mn 60Si2MnA		61SiCr7	60Si7	60C2Г
	5155	SUP9	55CrMnA		55Cr3	55Cr3	
	5160	SUP9A	60CrMnA		55Cr3	60Cr3	
	6150	SUP10	50CrVA	735A51, 735H51	50CrV4	51CrV4	XΦA50XΓΦA
	51B60	SUP11A	60CrMnBA		51CrV4		50XΓP
	9254	SUP12		685A57, 685H57	54SiCr6	54SiCr6	
4161	SUP13	60CrMnMoA	705A60, 705H60	60CrMn3-2	60CrMo4		
FREE CUTTING CARBON STEEL	1110	SUM11					
	1108	SUM12	Y12				
	1212	SUM21					
	1213	SUM22	Y15	(230M07)	9SMn28	S250	
	12L13	SUM22L	Y12Pb		9SMnPb28	S250Pb	
	1215	SUM23					
		SUM23L					
	12L14	SUM24L	Y15Pb		9SMnPb28	S250Pb	
		SUM25			9SMn36	S300	
	1117	SUM31			15S10		
		SUM31L					
		SUM32	Y20	210M15, 210A15		(13MF4)	
	1137	SUM41	Y30 Y35			(35MF6)	
	1141	SUM42	Y40Mn			(45MF6.1)	
1144	SUM43		(226M44)		(45MF6.3)		
CARBON CHROMIUM BEARING STEEL	51100	SUJ1	GCr4				
	52100	SUJ2	GCr5		100Cr6	100Cr6	ШХ15
	ASTM A 485 Grade 1	SUJ3	GCr15SiMn				
		SUJ4	GCr15SiMo				
		SUJ5	GCr18Mo				

MATERIAL CROSS REFERENCE CHART

Cast Iron

CLASS	USA AISI / SAE	JAPAN JIS	CHINA GB	UK BS	GERMANY DIN	FRANCE NF	RUSSIA ГОСТ
GRAY CAST IRON	NO.20	FC100	HT100	100			CY10
	NO.30	FC150	HT150	150	GG15	FGL150	CY15
	NO.35	FC200	HT200	200	GG20	FGL200	CY20
	NO.45	FC250	HT250	250	GG25	FGL250	CY25
	NO.50	FC300	HT300	300	GG30	FGL300	CY30
	NO.60	FC350	HT350	350	GG35	FGL350	CY35
					GG40	FGL400	CY40
NODULAR CAST IRON	60-40-18	FCD400	QT400-18	400/17	GGG40	FGS370-17	BY40
	65-45-12	FCD450	QT450-10	420/12		FGS400-12	BY45
	70-50-05	FCD500	QT500-7	500/7	GGG50	FGS500-7	BY50
	80-60-03	FCD600	QT600-3	600/7	GGG60	FGS600-2	BY60
	100-70-03	FCD700	QT700-2	700/2	GGG70	FGS700-2	BY70
	120-90-02	FCD800	QT800-2	800/2	GGG80	FGS800-2	BY80
			QT900-2	900/2			BY100

Non-Ferrous Metal

CLASS	USA AISI / SAE	JAPAN JIS	CHINA GB	UK BS	GERMANY DIN	FRANCE NF	RUSSIA ГОСТ
ALUMINUM ALLOY	1199		1A99		A199.99R		A99
			1A97		A199.98R		A97
			1A95				A95
		A1080	1A80	1080(1A)	A199.90	1080A	A8
	1050	A1050	1A50	1050(1B)	A199.50	1050A	A5
	5052	A5052	5A02	NS4	AlMg2.5	5052	Amg
			5A03	NS5			AMg3
	5056	A5056	5A05	NB6	AlMg5		AMg5V
	5456	A5556	5A30	NG61		5957	
	2036	A2117	2A01		AlCu2.5Mg0.5	2117	D18
		A2017	2A11	HF15	AlCuMg1	2017S	D1
	2124	A2024	2A12		AlCuMg2	2024	D16AVTV
	2319		2B16				
		A2N01	2A80				AK4
	2218	A2018	2A90				AK2
	2014	A2014	2A14		AlCuSiMn	2014	AK8
	6061	A6061		6061		6061	
7175	A7075	7A09		AlZnMgCu1.5	7075	V95P	
ALUMINUM ALLOY CASTING	356.2	AC4C	ZAlSi7Mn	LM25	G-AlSi7Mg		
	413.2	AC3A	ZAlSi12	LM6	G-Al12	A-S12-Y4	AL2
	355.2		ZAlSi5Cu1Mg				AL5
	413.0	AC8A	ZAlSi2Cu2Mg1		G-Al12(Cu)		
			ZAlCu5Mn				AL19
	201.0		ZAlCu5MnCdVA				
	520.2		ZAlMg10	LM10	G-AlMg10	AG11	AL8
		ZAlMg5Si		G-AlMg5Si		AL13	

GRADES
LINEUP / INSERTS
45° / 70° LEAD
75° LEAD
90° LEAD
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INSERT GRADES CROSS REFERENCE

Coated Carbide (Milling)

• This table is Kyocera's own estimation based on publications and is not authorized by companies mentioned in it.

Classification		Kyocera	Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
P (Steel)	P10	PR830 PR1025 PR1225	JC5003 JC5030 JC8003	JP4105 JX1020 JP4005	F7010	-	GC1025 GC1010	-	ACP100	-	KC715M	-
	P20	PR1525 PR830 PR1025 PR1225 PR1230	JC730U JC5015 JC5030 JC8015	JP4120 JS4045 JP4020 TB6020 JX1015 GX2140	MP6120 F7030 UP20M	TM1 DT4 DM4	GC1130 GC1030 GC4220 GC4020 GC4030	MP1500 T250M T25M T20M	ACP200	T313W AH725	KC522M KC525M KCPM20	IC330 IC250 IC520M IC950 IC5400
	P30	PR1230	JC5015 JC5040	CY250 CY9020 TB6045 JX1045 JM4060 GX2160	MP6130 F7030 VP15TF VP30RT	ZM3	GC1130 GC4040 GC4230	MP2500 T250M T25M F25M F30M	AC230 ACP300	T3130 GH330 AH120 AH330 AH730	KC994M KC725M KC792M KC530M KCPK30	IC330 IC328 IC635 IC830 IC908 IC928
	P40	-	JC5040	CY250 HC844 TB6060 JX1060	VP30RT	-	GC4040 GC4240	MP3000 T350M T60M T25M	AC230 ACZ330 ACZ350	AH140	KC735M	IC635 IC928 IC4050
M (Stainless Steel)	M10	PR1025 PR1225		CY9020 JX1020 JP4020	F7010	-	GC1025 GC1030	-	ACM100 ACM200 EH10Z	-	KC522M	-
	M20	PR1525 PR1025 PR1225	JC730U JC1341 JC5015 JC5030 JC5040 JC7560	CY150 TB6020 JX1015 CY250	F7030 UP20M VP15TF VP20RT MP7030 MP7130	DT4 DM4	GC2030	MP2500 T250M T25M F20M F25M F30M	ACM100 ACP200 EH20Z	GH330 AH330 AH120 AH130 AH725	KC730M KC525M	IC380 IC908 IC928
	M30	CA6535 PR1535	JC5015 JC5030 JC5040	JM4160 JM4060 TB6045 JX1045 GX2160	F7030 VP30RT MP7140	ZM3	GC1040 GC2040	T350M T250M F40M	AMC300 ACP300 ACZ350	T3130 AH130	KC994M KC725M KCPK30	IC380 IC328 IC330
	M40	-	JC8050	-	VP30RT	-	-	MM4500	ACZ350	AH140	-	IC830
K (Cast Iron)	K01	-	JC8003	TB6005	-	-	-	MH1000	-	AH110	-	IC5100 IC4100
	K10	PR1510 PR905 PR1210	JC800 JC610 JC605W	JP4005 CY10H CY100H CY9020	MP8010 MC5020 VP10RT	-	GC1010 GC3220 K15W	MK1500 T150M F15M	ACK200 AC211	T1015 T1115 AH110	KCK15 KC915M	IC5100 IC4010 IC910 DT7150 IC810
	K20	CA420M PR905 PR1210	JC605X JC610 JC5015 JC8015	CY150 TB6020 JX1015	VP15TF VP20RT	-	GC1020 GC3020 K20W/K20D GC3330	MP1500 T150M T250M MK2000 MK2050	EH20Z ACZ310 ACK300	AH120 AH725	KC520M KC920M KC925M KC992M	IC810 IC910 IC928
	K30	-	JC5080	-	-	-	GC3040 GC4040	MK3000 T250M	-	GH130	KC930M	IC928
S (Heat-resistant Alloy)	S10	CA6535 PR1535 PR1210	IC8015 IC5015	PCS08M PTH13S JS1025	MP9120 VP15TF	-	GC1030 GC1025	MS2050	ACM100 ACM200 ACM300	-	KC510M	IC903 IC807 IC808 IC908
	S20	CA6535 PR1535 PR1210	IC8015 IC5015 JC8050 JC7560	CY100H CY10H	MP9120 VP15TF MP9130 MP9030	-	GC1030 GC2030 S30T	-	ACM200	-	KC525M	IC903 IC807 IC808 IC908 IC830 IC928
	S30	PR1535	JC8050 JC7560	-	-	-	GC2040 S40T	F40M	ACM300	-	KC725M	IC328 IC330

INSERT GRADES CROSS REFERENCE

Cermet (Milling)

• This table is Kyocera's own estimation based on publications and is not authorized by companies mentioned in it.

Classification		Kyocera	Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
P (Steel)	P10	TN60	NIT CX75	CH550	NX2525	-	-	C15M	-	NS530 NS730	KT530M KT195M	-
	P20	TN60 TN100M	NAT CX75 CX90	CH570 CH7030 MZ1000	NX2525	C7X C7Z	CT530	C15M MP1020	T250A T1500A	NS530 NS730 NS740	HT7 KT530M KT605M	IC30N
	P30	-	CX90 CX99 SC30	CH7035	NX4545	-	-	-	T4500A	NS540	-	IC30N
M (Stainless Steel)	M10	TN60	-	-	NX2525	-	-	C15M	-	-	-	-
	M20	TN60 TN100M	NIT CX75 NAT	CH550 CH570 CH7030	NX2525	-	CT530	C15M	T250A	NS530	KT7 KT530M KT605M	IC30N
	M30	-	CX75 CX90 CX99 SC30	-	NX4545	-	-	-	T4500A	NS740 N308	-	-
K (Cast Iron)	K01	-	LN10	-	-	-	-	-	-	-	-	-
	K10	-	LN10 CX75	CH550	NX2525	-	-	-	-	-	-	IC30N
	K20	-	NIT	CH7030 CH7035	NX2525	-	-	-	-	-	-	-

GRADES	A
LINEUP / INSERTS	B
45° / 70° LEAD	C
75° LEAD	D
90° LEAD	E
HIGH FEED	F
MULTI-FUNCTION	G
SLOT MILLS	H
RADIUS / BALL-NOSE	J
OTHER APPLICATIONS	K
TOOL HOLDING	O
SPARE PARTS	P
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INSERT GRADES CROSS REFERENCE

CVD Coated Carbide (Turning)

• This table is Kyocera's own estimation based on publications and is not authorized by companies mentioned in it.

Classification		Kyocera	Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
P (Steel)	P01	CA510 CA5505	JC110V	HG8010 HC5000 HG3305	UE6105 UE6005 UE6015	-	GC4305 GC4005 GC4205	TP0501 TP0500 TP1000	AC700G AC810P	T9005 T9105	KCP05B KCP05 KC9105	IC8150 IC9150
	P10	CA510 CA515 CA5505 CA5515	JC110V JC215V	GM10 GM20 GM8015 HG8010	MC6015 UE6105 UE6110 UE6005 UE6010 UE6020	CP2 CP5 CP7	GC4205 GC4015 GC3115 GC4215 GC4315	TP1501 TP1000 TP1500 TP100	AC700G AC2000 AC810P AC820P	T9005 T9105 T9015 T9115	KCP10B KCP10 KC9010 KC9110	IC8150 IC9150 IC9250
	P20	CA525 CA5515 CA5525 CR9025	JC110V JC215V	GM20 GM8020 HG8025	MC6025 UC6010 UE6110 UE6020	CP2 CP5 CP7	GC4025 GC4215 GC4220 GC4225 GC4325	TP2501 TP2000 TP2500 TP200	AC2000 AC3000 AC820P AC830P	T9015 T9115 T9025 T9125	KCP25B KCP25 KC9125 KC9225 KC9325	IC8250 IC9125 IC9250 IC9350
	P30	CA525 CA5525 CA530 CA5535 CR9025	JC215V JC325V	GM25 GM8035 HG8025	MC6025 UE6020 UE6035 UH6400	-	GC4225 GC4230 GC4235 GC2135	TP2501 TP2500 TP2000 TP3500 TP200	AC3000 AC630M AC830P ACP100	T9125 T9035 T9135 T3130	KCP30B KCP30 KC9040 KC9140	IC635 IC8350 IC9350
	P40	CA530 CA5535	JC325V JC450V JC540V	GX30	UE6035 UH6400	-	GC4035 GC4235 GC4240	TP40	AC630M AC830P ACP100	T9035 T3130	KCP40B KCP40 KC9140 KC9240	IC635
M (Stainless Steel)	M10	CA6515	JC110V	GM10	MC7015 US7020	CP2 CP5	GC2015	TP1500 TP100	AC610M	T9015 T9115	KCM15B KCM15 KC9010 KC9110 KC9210	IC8250 IC9250 IC9350
	M20	CA6525	JC110V JC215V	GM8020 HG8025	US7020 MC7025	CP2 CP5	GC1515 GC2015 GC2025	TM2000 TP200	AC6030M AC610M AC630M AC830P	T6020 T6120 T9115 T9125	KCM25B KCM25 KC9025 KC9125 KC9225	IC6015 IC8350 IC9250 IC9350
	M30	-	JC215V JC325V JC525X	GM25 GM8035	MC7025 US735	-	GC2040 GC235	TM4000 TP300	AC6030M AC630M AC830P	T6030 T6130 T9125	KCM35B KCM35 KC9240	IC6025 IC8350 IC9350 IC4050
	M40	-	JC525X	GX30	US735	-	-	TP40	-	-	KC9045 KC9245	IC635
K (Cast Iron)	K01	CA310 CA5505	JC105V JC605X JC605W JC050W	HG3305 HG3315 HX3505 HX3515	MC5005 UC5105 UC5015	CP1	GC3205 GC3210	TK1000 TH1000 TK1001	AC405K AC410K AC300G	T5105 T5010	KC9105 KC9315 KCK05B KCK05	IC5005 IC428 IC9007 IC9150
	K10	CA310 CA315 CA5505	JC050W JC110V JC605X JC605W JC108W	GM8015 HX3515 HG8010 HG3315	UC5015 UC5105 UC5115 UE6010 MC5015	CP1 CP2 CP5	GC3205 GC3210 GC3215 GC3115	TK1000 TK2000 TK2001 MK1500	AC410K AC415K AC700G	T515 T5105 T5115 T5010	KC9110 KC9120 KC9315 KCK15B KCK15	IC5010 IC418 IC428 IC9015 IC9007
	K20	CA315 CA320	JC110V JC215V JC605X JC605W	GM8020 HG8025	MC5015 MY5015 UE6010 UC5115 UE6110	CP2 CP5	GC4225 GC3215 GC3220 GC3225	TK2000 TX150 TP200	AC420K AC700G AC820P	T5115 T5125 T5020	KC9125 KC9320 KC9325 KCK20B KCK20	IC418 IC9015
	K30	-	JC215V	GM25	UE6110	-	GC3040	TP2500 TP200	-	T5125 T9125	KCP25B KC9320	-



INSERT GRADES CROSS REFERENCE

PVD Coated Carbide (Turning)

• This table is Kyocera's own estimation based on publications and is not authorized by companies mentioned in it.

Classification		Kyocera	Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
P (Steel)	P01	PR1005	JC5003	-	-	-	-	-	ACZ150	-	KC5510	-
	P10	PR930 PR1005 PR1025 PR1115 PR1215 PR1425 PR1225	JC5003 JC5030	CY15 CY150 IP2000	VP10MF	VM1 TM1 TA1 TAS DT4 DM4	GC1025	CP200	ACZ150 ACZ310 AC520U	AH710	KC5010 KC5510 KU10T	IC507 IC807 IC907
	P20	PR930 PR1025 PR1115 PR1215 PR1425 PR1225	JC5015 JC5030 JC5040	CY150 IP2000	VP10RT VP15TF VP20MF UP20M VP20RT	QM1 VM1 TA1 TAS	GC1020 GC1025 GC4125 GC1125	CP250	ACZ310 ACZ330 AC520U	AH710 AH725 AH730 SH725 SH730	KC5025 KC5525 KC7215 KC7315 KU25T	IC507 IC907 IC908
	P30	PR1025 PR1225	JC5015 JC5040	CY250 CY9020 HC844 IP3000	VP10RT VP15TF VP20MF UP20M	ZM3 QM3 TAS	GC1125 GC1145 GC1115 GC1105	CP500	ACZ330 ACZ350 AC530U	GH330 AH120 AH740	KC7015 KC7020 KC7235 KU25T	IC328 IC928 IC3028
	P40	-	JC5040	CY250 HC844		ZM3 QM3 TAS	GC1145 GC2145	CP500	ACZ350	AH140 AH740 J740	KC7030 KC7040 KC7140	IC328 IC3028
	M10	PR1025 PR1215 PR1225	JC5003	IP050S	VP10MF VP10RT	VM1 TM1 TA1	GC1005 GC1025 GC1105 GC15	TS2000 CP200 CP250	EH510Z ACZ150 AC510U	AH710	KC5010 KC5510 KC6005 KCU10	IC507 IC520 IC807 IC907
M (Stainless Steel)	M20	PR930 PR1025 PR1125 PR1215 PR1425 PR1225	JC5015 JC5030 JC5040 JC8015	IP100S GX30	VP10RT VP15TF VP20MF UP20M VP20RT	QM1 VM1 TA1 TAS DT4 DM4	GC1025 GC1115 GC4125 GC1125 GC30	TS2500 CP200 CP250 CP500	EH520Z ACZ150 ACZ310 AC520U	AH630 AH725 AH730 GH330 GH730 SH725 SH730	KC5025 KC5525 KC7020 KC7025 KCU25	IC308 IC507 IC907 IC908 IC3028
	M30	PR1125 PR1535	JC5015 JC5030 JC5040	CY250 CY9020	VP15TF VP20MF UP20M MP7035	ZM3 QM3 TAS	GC1020 GC2035 GC2030	CP500	ACZ330 ACZ350 AC530U AC6040M	AH120 AH725	KC7030 KC7225	IC908 IC1008 IC1028 IC3028
	M40	-	-	-	MP7035	ZM3 QM3 TAS	GC2145 GC1145	-	AC6040M ACZ350	J740 AH140 AH645	-	IC228 IC928 IC328
	K01	-	JC5003	-	-	-	-	-	EH10Z	AH110	KC5515	IC910
K (Cast Iron)	K10	PR905 PR1215	JC5003 JC5015	CY100H CY10H	VP05RT	TA1 TM1	GC1010	TS2000 CP200	EH10Z EH510Z AC510U	GH110 AH110	KC5010 KC7210	IC807 IC910 IC507 IC908
	K20	PR905 PR1215	JC5015	IP2000 CY9020	VP10RT VP15TF VP20RT	QM1 TA1	GC1020 GC1120	TS2500 CP200 CP250	EH20Z ACZ310 AC520U AC530U	AH120 AH725	KC5025 KC5525 KC7015 KC7215 KC7315	IC508 IC908
	K30	-	-	-	VP15TF VP20RT	QM3 TA3	GC1030	CP500	ACZ310	-	KC7225	IC508 IC908
	S01	PR1305	JC5003	-	MP9005 VP05RT	-	-	-	-	AH8005 AH905	-	-
S (Difficult-to-cut Materials)	S10	PR1305 PR1310	JC5015 JC8015	JP9105	MP9005 MP9015 VP10RT	-	GC1105 GC1005 GC1025	CP200 TS2000	AC510U	AH8015 AH905 SH730 AH110	KC5010 KC5510	IC807 IC808 IC907 IC908
	S20	PR1310 PR1325 PR1535	JC5015 JC8015	JP9115	MP9015 MT9015 VP20RT	-	GC1025 GC1125	CP250 TS2500	AC510U AC520U	AH8015 AH120 AH725	KC5025 KC5525	IC806 IC808 IC908
	S30	PR1535	-	-	VP15TF	-	GC1125	-	AC520U	AH725	-	IC328

GRADES
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75° LEAD
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INSERT GRADES CROSS REFERENCE

Cermet (Turning)

• This table is Kyocera's own estimation based on publications and is not authorized by companies mentioned in it.

Classification		Kyocera	Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
P (Steel)	P01	TN610 TN6010 PV710 PV7010	LN10 CX50	CH350	AP25N VP25N NX1010	T3N T15 Q15	-	-	T110A T1000A	NS520 GT530 GT720 J530	KT1120 KT125 HTX	IC20N IC520N
	P10	TN610 TN6010 TN620 TN6020 PV710 PV7010 PV720 PV7025	LN10 CX50 CX75 NIT PX75	CH350 CZ25	NX2525 AP25N VP25N	T15 C7Z Z15	CT5015 CT525	TP1020 CM CMP	T1500Z T2000Z T1200A T1500A	NS9530 NS520 GT9530 GT530 GT730	KT315 KT175 HT2	IC20N IC520N IC530N IC75T
	P20	TN620 TN90 TN6020 PV720 PV7025	CX50 CX75 CX90 NAT PX90	CH550 CH7030 CZ1025 CZ25	MP3025 NX2525 NX3035 AP25N VP45N	T15 C7X C7Z	CT525 CT530 GC1525	TP1020 C15M TP1030	T1200A T1500A T1500Z T2000Z T3000Z	NS9530 NS530/730 GT9530 GT530/730	PS5 KT5020	IC20N IC520N IC530N IC75T IC30N
	P30	-	CX90 CX99 SUZ	-	NX4545 VP45N	N40 C7X	CT530 GC1525	TP1030	T3000Z T250A	NS740	-	IC75T IC30N
M (Stainless Steel)	M10	TN620 TN60 TN6020 PV720 PV7020 PV7025	LN10	CH350	NX2525 AP25N VP25N	T15 C7X C7Z Z15	CT5015 CT525	CM CMP	T110A T1000A T2000Z	NS520 J530	KT1120 KT315 KT125	IC20N IC520N
	M20	TN620 TN90 TN6020 PV720 PV7020 PV7025	CX50 CX75 PX75 NIT NAT	CH550 CH7030 CZ1025	NX2525 NX3025 AP25N VP25N	C7X C7Z Q15	CT530 GC1525	TP1020 C15M	T1500A T2000Z	NS530 NS730 GT530 GT730	KT175 HT2 PS5 KT5020	IC30N IC530N
	M30	-	CX75 CX90 PX90 CX99 SUZ	CZ25	NX4545	C7X	-	TP1030	T3000Z T250A	NS740	-	-
K (Cast Iron)	K01	PV7005	LN10	-	AP25N VP25N	T3N T15 Q15	-	-	T110A T1000A	NS520	KT1120	-
	K10	TN610 TN6010 PV710 PV7010 PV7005	LN10	CH350	NX2525 AP25N VP25N	T15 C7X C7Z Z15	CT5015	-	T1200A T1500A T2000Z	NS530 NS730 GT530 GT730	KT315 HTX	-
	K20	-	NIT	CZ25	NX2525 AP25N VP25N	-	-	-	T3000Z	-	KT5020	-

• Boldface grade shows PVD Coated Cermet.

Carbide

Classification		Kyocera	Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
P (Steel)	P10	-	SRT	WS10	ST110T	-	S1P	-	ST10P	TX10S	K2885	IC70
	P20	-	SRT DX30	EX35	ST120 UT120T	-	SMA	S10M	ST20E	TX20 TX25	K125M	IC70 IC50M
	P30	-	SR30 DX30 DX35	EX35 EX40	UT120T	-	SM30	S25M	A30N A30 ST30E	TX30 UX30	KMF	IC50M IC54
	P40	-	SR30 DX35	EX45	-	-	S6	S60M	ST40E	TX40	PVA	IC54
K (Cast Iron)	K01	-	KG03	WH02 WH05	HT105T	-	H1P	-	H1 H2	TH03 KS05F	K68 K10	IC04
	K10	KW10 GW15	KG10 KT9	WH10	HT110	KM1	H1P H10 HM	890	EH10 EH510	G1F TH10 H10T	KMI K8735 K313	IC20
	K20	GW25	CR1 KG20	WH20	HT120T UT120T	KM3	H13A	883 890 HX	G10E EH20 EH520	G2F KS15F KS20	KMF	IC20 IC10
	K30	-	KG30	-	-	-	-	883	G3 G10E	G3 UX30	THR	IC10 IC28
V (Wear and Shock Resistant Tool)	V40	-	G5 GD195	WH50	GT130	-	-	-	G5	D40	-	-
	V50	VW50	MH3 MH4 GD174 GD201	WH60	GT135 GT140 GT130S	-	-	-	G6	D50	-	-
	V60	-	MH5 MH7 MH8 GD206	WB60	GT140S GT150S	-	-	-	G7 G8	D60	-	-

INSERT GRADES CROSS REFERENCE

Ceramic

• This table is Kyocera's own estimation based on publications and is not authorized by companies mentioned in it.

Classification		Kyocera	Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
K (Cast Iron)	K01	KA30 A65 KT66 PT600M CS7050	-	NPC-H2 NPC-A2	-	SE1 HC1 HC2 HC5 HC6 HW2	CC620 CC650	-	NB90S NB90M WX120	-	KW80 KY1615 AC5	-
	K10	A65 KT66 A66N PT600M CS7050 KS6050	-	NX NXA Whisker WIN	-	WA1 HC2 HC6 HC7	CC6090 CC6190 GC1690	-	WX120 NS260C	LX11 LX21	KYK10 KYK25 KB90 KY1320 KY3000 KY3400	-
	K20	KS6050	-	-	-	SX6 SX9 SP9	CC6090 CC6190 GC1690	-	WX120	KS20 FX105 CX710	KYK35 KY3400 KY3500	-
S (Difficult-to-cut Material)	S01	-	-	-	-	-	CC650	-	-	-	KY2100	-
	S10	CF1 KS6030 KS6040	CA200	Whisker WIN	-	WA1 WA5 SX9	CC670 CC6060 CC6065	-	WX120	TH10	KYS25 KY4300 KY1525 KY1540	-
	S20	-	-	-	-	-	-	-	WX120	KS20	KYS30	-
H (Hardened Material)	H01	A65 KT66 A66N PT600M	-	NPC-A2	-	HC4 HC7 ZC7	CC650 CC670 CC6050	-	NB100C	LX11 LX21	KY4400	-
	H10	A65 KT66 A66N PT600M	-	NPC-A2 Whisker WIN	-	ZC7 WA1 WA5	CC670	-	-	TH10	KY4300	-

• Boldface grade shows Coated Ceramic.

CBN

Classification		Kyocera	Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
K (Cast Iron)	K01	KBN475	JBN795	-	MB710	B20 B22 B30	CB7525 CB50 CB7050	CBN050C CBN300P	BN500 BN500	BX910 BX930 BX950	-	IB50 IB85
	K10	KBN60M KBN900	JBN330	BH200	MB710 MB5015 MB4020	B22 B23	CB50 CB7050	CBN20 CBN200 CBN300	BN600 BN700 BN7000	BX950 BXC90 BX470	KB1630 KB9610	IB55 IB90
	K20	KBN900	-	BH250	MB730 MBS140 BC5030	B16 B40	-	CBN350 CBN500 CBN600	BN7000 BNS800	BX950 BXC90 BX90S	KB9640	-
H (Hardened Material)	H01	KBN510 KBN05M KBN10M	DH102	-	BC8110 MBC010 MB810	B24 B52	CB20	CBN050C CBN010 CBN10 CBN100	BN1000 BNX10 BNC100 BNC160 BNC2010	BXA30 BX310 BXC30 BXM10	KB1610	IB20H IB25HC IB50
	H10	KBN525 KBN05M KBN25M	JC6102 JC8003 JBN500	BH200	BC8120 MBC020 BC8020 MB8025 MB825	B24 B36 B54 B52	CB7015 CB7050 CB50	CBN150 CBN060K CBN200 CBN160C	BNC160 BNX20 BN2000 BNC200 BNC2020	BXA40 BX330 BX360 BXC50	KB1615 KB1625 KB5610 KB9610	IB50
	H20	KBN30M KBN35M KBN900	JC8003 JC5015 JBN245	BH250	BC8120 MBC020 BC8020 MB8025	B22 B36	CB7025 CB7525	CBN350 CBN300P CNB400C CBN500	BNX25 BN350 BNC300	BX380 BXC50 BXM20	KB1340 KB5625 KB9640	IB55 IB25HA
Stainless Steel	-	KBN65B KBN570 KBN65M KBN70M	JBN795 JBN500	-	MB4020	-	-	CBN200	BN350 BN7000 BN7500	BX450 BX470 BX480	-	-

• Boldface grade shows PVD Coated CBN.

PCD (Diamond)

Classification		Kyocera	Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
N (Non-ferrous Metals)	N01	KPD001	JDA30 JDA735	-	MD205	PD1	CD05 CD10	PCD05 PCD10	DA90 DA1000 DA2200	DX180 DX160	PD100 KD1400 KD1405	-
	N10	KPD001 KPD010 KPD230 KPD250	JDA40 JDA745	-	MD220	PD2	CD10	PCD10 PCD20	DA150 DA1000 DA2200	DX140	KD100 KD1400 KD1415	ID5
	N20	KPD001 KPD010 KPD230 KPD250	JDA10 JDA715	-	MD230	-	-	PCD30 PCD30M	DA1000 DA2200	DX110 DX120	KD1425	-

GRADES
LINEUP / INSERTS
45° / 70° LEAD
75° LEAD
90° LEAD
HIGH FEED
MULTI-FUNCTION
SLOT MILLS
RADIUS / BALL-NOSE
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CHIPBREAKER CROSS REFERENCE

Molded Chipbreaker Cross Reference Table

Negative Inserts

• This table is Kyocera's own estimation based on publications and is not authorized by companies mentioned in it.

Cutting Range	Kyocera		Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar	
	General Chipbreaker	Chipbreaker for Sticky Material / Soft Steel											
Carbon Steel / Alloy Steel	Finishing (with Wiper Edge)	WP	-	-	SW	-	WL WF	W-MF2	SEW LUW	AFW FW	FW	-	
	Finishing - Medium (with Wiper Edge)	WQ	-	-	MW	-	WM WMX	W-M3 W-M5	GUW	ASW SW	MW	WG	
	Finishing	DP GP PP	XF XP	F1 FA FT PF	BE BH FE	F FH FS FY PK	UL WM ZF1	XF QF	FF1	FP SP FA FL LU	TF 01 AS TSF	FF UF FS	F3P SF
	Finishing - Medium	HQ PQ CQ CJ VC VF	XQ	UA UT	AB B CE CT	SH C SA LP SY	WV WR	LC PF	FF2 MF2	SU EX SJ SX UJ SE	TS NS CB 11 17 27 ZF	RP FN	NF
	Medium - Roughing	PG GS PS	XS	UR UB	AE DE AH	MV MP MA MH	Z5 ZW1	XM QM SM SMC PM	M3 MF3	UA UG GE GU	AM DM NM TM ZM	MN	M3P TF
	Medium - Roughing High Feed Rate	PT GT	-	GC PQ	AR AY	GH RP	GS	MR XMR	M5 MR5 MR6	MU UX ME	TH 32Y 32 37	RP RN	R3P NR
	Roughing	Standard PH	-	GG LG GQ	RE	MT Standard	G	Standard 23	MR7	MC MU MX UZ	31 33 F-K THS	PR MG	GN
	Roughing One Side High Feed Rate	PX	-	GS RM UC UP	H HX HE TE UE	HV HR HX HZ HL HM	-	QR PR HR	R4 R5 R6 R7 RR6 RP	HG HP MP	TU 57 65 TUS	RH RM	TNM
Stainless Steel	Finishing	GU MQ	-	SF	BH MP	FS SH FJ LM	ZF1	MF	-	SU EF	SF SS	FP	F3M
	Medium - Roughing	MS MU TK	-	GP SZ	DE SE PV	MS MA GM MJ MM ES MH GH GJ RM	ZP WS	MM MMC MR XMR SMR	MF1 MF3 A3 A5 M5 56 R8 RR9	EG EX MU UP EM	HMM SM SA S SH	P MP MS	TF PP M3M R3M
Cast Iron	Medium	C Standard	-	-	AH VA VY	LK MF Standard	-	KF KM	-	UZ UX UJ	Standard 33 CF	FN	-
	Roughing	K GC ZS	-	-	-	GH RK	-	KR KRR	-	GZ	CM OH	RP UN	-
Non-ferrous Metals	Medium - Roughing	AH	-	-	-	-	-	AL	95	AG	P	GP MS	PP

Positive Inserts

Cutting Range	Kyocera		Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar	
	General Chipbreaker	Chipbreaker for Sticky Material / Soft Steel											
Carbon Steel / Alloy Steel	Minute D.O.C.	CF	-	-	-	-	-	-	-	01	-	-	
	Finishing (with Wiper Edge)	WP	-	-	SW	-	WF WK	W-F1	LUW SDW	-	FW	WF	
	Finishing	DP GP PP VF	XP	ASF	-	FV SQ FP SMG	AZ3 AMX AZ7	PF UF XF	FF1	FB FC FK FP LU	PF PSF 23	11 GF UF FP	PF SM
	Finishing - Medium ①	HQ	XQ	ACB FT	JE	MQ MV LP	AF1	PM UM SMC	F1	LB SF SU	PS PSS 24	LF	14
	Finishing - Medium ②	GK	-	BM	JQ	No Indication	QD CL	PF PM XM	MF2	-	-	-	-
	Medium	Standard	-	-	J	MP Standard	AM3	PR UR KM XR	F2	MU SC	PM	GM MP MR	Standard
Stainless Steel	Finishing	MQ	-	-	MP	FM FV SV LM	-	MF MMC	-	LU	JS PF PSF	FW FP MW	WF
Non-ferrous Metals	Finishing - Medium	AH	-	ALU	-	AZ	-	AL	AL	AG AW	AL	HP	AF AS

CHIPBREAKER CROSS REFERENCE

● Positive Inserts (For Small Parts Machining)

Cutting Range		Kyocera	Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Carbon Steel / Alloy Steel	Minute D.O.C.	CF	-	-	-	-	-	-	-	01	-	-
	Finishing	CK GF	ASF	JQ	FP FV SMG	AZ7 AMX ZR	PF XF	FF1	SI FC	PF	11 UF FP	PF SM
	Finishing - Medium	GQ SK	ACB FT	JE	LP AM MV	AM3 YL	PM XM	F1 MF2	SU	PS	LF	14
	Medium	GK	-	J	MP Standard	QD CL	PR	F2	SC	PM	MF MP	Standard
Stainless Steel	Finishing	MQ	-	MP	FM FV SV	-	MF	-	LU	PF PSF	FW FP MW	WF
Non-ferrous Metals	Finishing - Medium	AH	ALU	-	AZ	-	AL	AL	AG AW	AL	HP	AF AS






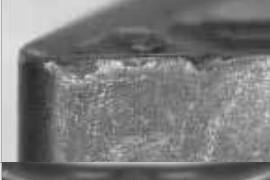




■ Cera-Notch Conversion Chart

Insert Style	Kyocera	Horizon	Tool-Flo	Kennametal	RTW	Valenite	Sandvik	Mitsubishi
Notch Style Grooving Insert								
Face Grooving	KCFP	HF	FLF	NF	-	-	TLF*	EF
ID/OD Grooving	KCG/KCGP	HG	FLG	NG	PG	VLG	TLG*	EG
ID/OD with Chipbreaker	KCGP MY	HG RK-LK	FLG CB	NG RK-LK	PG RK-LK	-	-	EG RK-LK
ID/OD with Positive Rake	KCGP	HGP	FLGP	NGP	-	VLGP	TLGP*	EGP
ID/OD Deep Grooving	KCGDP	HGD	FLGD	NGD	PGD	-	-	EGD
Full Nose Radius	KCRP	HR	FLR	NR	PR	VLR	TLR*	EGR
Full Nose Radius with Postive Rake	KCRP	HRP	FLRP	NRP	PRP	VLRP	TLRP*	-
Notch Style Threading Insert								
60° V Partial Profile	KCT	HT	FLT	NT	PT	VLT	TLT*	ET
60° V Fine Pitch Positive	KCTK	HTK	FLTK	NTK	PTK	VLTk	TLTK*	-
60° V Postive	KCTP	HTP	FLTP	NTP	PTP	VLTp	TLTP*	-

* Sandvik inserts require a Kyocera or industrial standard clamp due to different clamping system.

GRADES	A
LINEUP / INSERTS	B
45° / 70° LEAD	C
75° LEAD	D
90° LEAD	E
HIGH FEED	F
MULTI-FUNCTION	G
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Cutting Edges Figuration and Countermeasures

Typical Cutting Edge Figuration	Observation	Causes	Countermeasures
Nose Wear	 <ul style="list-style-type: none"> Deterioration of surface roughness and dimensional accuracy 	<ul style="list-style-type: none"> Too high Vc End of tool life 	<ul style="list-style-type: none"> Reduce Vc Change to higher wear resistant grade
Notching	 <ul style="list-style-type: none"> Burr formation Cutting force increase 	<ul style="list-style-type: none"> Too high f and Vc 	<ul style="list-style-type: none"> Sharper cutting performance Reduce Vc Change to higher heat resistant grade
Crater Wear	 <ul style="list-style-type: none"> Chip control deterioration Surface finish deterioration (peeled surface) 	<ul style="list-style-type: none"> Too high Vc 	<ul style="list-style-type: none"> Reduce Vc Change to high speed type like Cermet or Al2O3 coated insert
Plastic Deformation	 <ul style="list-style-type: none"> Workpiece dimension's change Crack at nose 	<ul style="list-style-type: none"> Too high cutting load Inappropriate tool grade 	<ul style="list-style-type: none"> Change to harder grade Reduce f and ap
Crack from Wear	 <ul style="list-style-type: none"> Surface finish's sudden deterioration Workpiece dimension changes 	<ul style="list-style-type: none"> Too high Vc 	<ul style="list-style-type: none"> Reduce the pre-set tool life Change to higher wear resistant grade
Chipping	 <ul style="list-style-type: none"> Cutting force increase Surface roughness deterioration 	<ul style="list-style-type: none"> Too high f Chattering Lack of insert toughness 	<ul style="list-style-type: none"> Reduce f and ap Change to more rigid toolholder Change to tougher grade
Crack from Welding or Built-up Edge	 <ul style="list-style-type: none"> Surface finish deterioration Cutting force increase 	<ul style="list-style-type: none"> Too low Vc 	<ul style="list-style-type: none"> Increase Vc Improve sharp cutting performance (rake angle, chamfer)
Mechanical Fracture	 <ul style="list-style-type: none"> Sudden cracking Unstable tool life 	<ul style="list-style-type: none"> Too high f and ap Chattering 	<ul style="list-style-type: none"> Change to tougher grade Enlarge chamfer Enlarge Corner-R(r) Change to more rigid toolholder
Fracture from Thermal Crack	 <ul style="list-style-type: none"> Cracking by heat cycle Possible in interrupted cutting and milling 	<ul style="list-style-type: none"> Too high Vc and f 	<ul style="list-style-type: none"> Reduce f Reduce Vc Change to dry cutting
Flaking	 <ul style="list-style-type: none"> Possible in high-hardness material cutting Possible in machining with chattering 	<ul style="list-style-type: none"> Lack of insert toughness Lack of toolholder's rigidity 	<ul style="list-style-type: none"> Change to harder grade (TiC-base ceramic to CBN.) Change to more rigid toolholder Change edge preparation

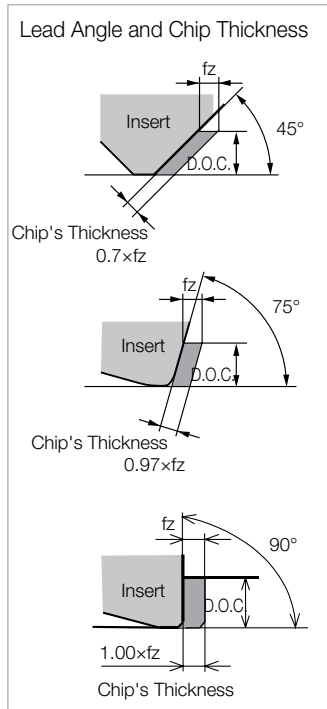
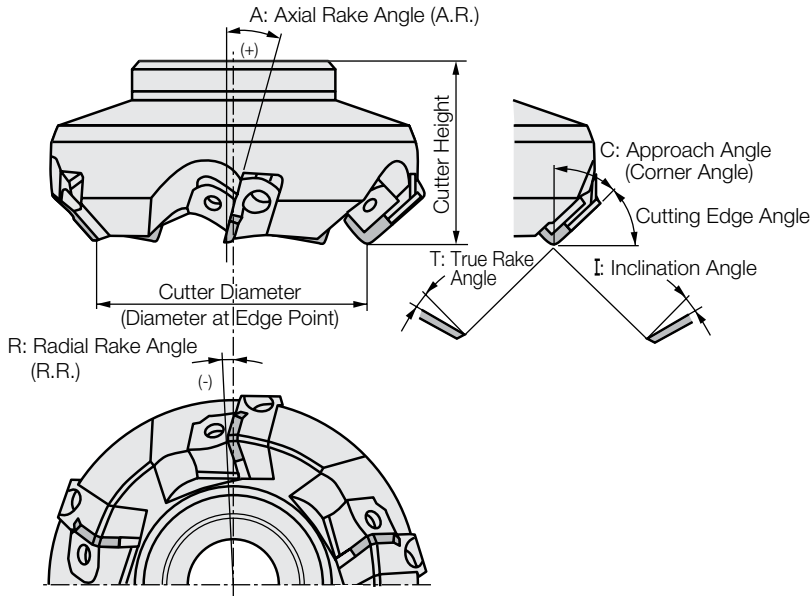
Milling

Problem	Problem Item	Countermeasures	Check Item		Insert Grade		Cutting Conditions				Tool Geometry					Setting		Machine								
			Change to Harder Grade	Change to Tougher Grade	Change to More Thermal Shock Resistant Grade	Change to More Welding Resistant Grade	Vc	fz	D.O.C.	Tool Path Review	Coolant		Relief Angle	Corner Angle	Approach Angle	Edge Strength / Honing	Number of Inserts		Chip Pocket	Wiper Edge (Relief Angle) Review	Insert Runout Check	Cutter Rigidity	Workpiece / Tool Installation	Overhang Length	Power, Rigidity	
											Usage of Mist	Dry														Insert with Chipbreaker
Edge Damage	Flank Wear Increase	Unsuitable Cutting Conditions				● ↓					●															
		Unsuitable Tool Geometry	●										● ↑		● ↓			●								
	Rake Face Wear Increase	Unsuitable Cutting Conditions				● ↓	● ↓	● ↓			●															
		Unsuitable Tool Geometry	●										● ↑	● ↑	● ↓											
	Chipping, Cracking	Unsuitable Cutting Conditions					● ↓	● ↓	●	●																
		Unsuitable Tool Geometry	●										● ↓	● ↑	● ↑			●	●	●	●	●	●	●	●	●
Edge Breakage by Thermal Shock	Unsuitable Cutting Conditions				● ↓	● ↓	● ↓			●																
	Unsuitable Tool Geometry		●									● ↑		● ↓												
Built-up Edge	Unsuitable Cutting Conditions				● ↑	● ↑				●																
	Unsuitable Tool Geometry			●								● ↑		● ↓												
Cutting Accuracy	Poor Surface Finish	Unsuitable Cutting Conditions				● ↑	● ↓	● ↓	●	●																
		Unsuitable Tool Geometry	●		●										● ↓	● ↓		●	●		●	●	●	●	●	
	Burr Formation	Unsuitable Cutting Conditions				● ↓	● ↓	● ↓	●	●																
		Unsuitable Tool Geometry											● ↑	● ↓	● ↓			●								
	Workpiece Chip Off	Unsuitable Cutting Conditions					● ↓	● ↓			●															
		Unsuitable Tool Geometry											● ↑	● ↑	● ↓	● ↑		●								
Poor Planeness / Parallelness	Tool and Workpiece Evacuation					● ↓	● ↓			● ^{*5}		●	● ↑	● ↓	● ↓	● ↓	●	●	●	●	●	●	●	●		
Others	Heavy Chattering, Vibration	Unsuitable Cutting Conditions, Installation				● ↓	● ↓ ^{*1}	● ↓ ^{*2}	● ↓ ^{*4}	●	●		●	● ↑	● ↓	● ↓	● ↓				●	●	●	●	●	
		Unsuitable Cutting Conditions				● ↑	● ↓ ^{*3}		●	●	● ^{*6}	●														
	Damaging Chips	Unsuitable Tool Geometry										●	● ↑		● ↓	● ↑										

- *1) To prevent chattering, the higher fz may be suitable.
- *2) To prevent chattering, the larger ap may be suitable.
- *3) Higher fz may be suitable.
- *4) Down-cut method is recommended for helical end milling.
- *5) If the surface is warped by cutting heat.
- *6) Compressed air is recommended.

GRADES	A
LINEUP / INSERTS	B
45° / 70° LEAD	C
75° LEAD	D
90° LEAD	E
HIGH FEED	F
MULTI-FUNCTION	G
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Terms and Angles of Milling Cutters



Function of Tool Angles

Symbol	Name	Function	Effect
A	Axial Rake Angle (A.R.)	Controls chip flow direction and cutting force	When it is positive ... Good cutting performance and less chip welding
R	Radial Rake Angle (R.R.)	Controls chip flow direction and cutting force	When it is negative ... Good chip evacuation
C	Approach Angle	Controls chip thickness and chip flow direction	When it is large ... Thinner chip thickness Lower cutting load
T	True Rake Angle	Actual rake angle	When it is positive ... Good cutting performance and less chip welding, but lower edge strength When it is negative ... Higher edge strength but easier to weld
I	Inclination Angle	Controls chip flow direction	When it is positive ... Good chip evacuation Less cutting force Lower edge stability of the corner part

True Rake Calculation Formula : $\tan T = \tan R \times \cos C + \tan A \times \sin C$

Cutting Edge Inclination Angle Formula : $\tan I = \tan A \times \cos C - \tan R \times \sin C$

Number of Inserts (Z)

1) If there is one stage

If the number of stage is one, it is not indicated on the catalog. Please use "No. of inserts" of the catalogue for "Z" of the formula to calculate cutting conditions.

2) If the number of stages is more than two

If the number of stages is more than two, it is indicated on the catalog. Please use "No. of Flutes" of the catalogue for "Z" of the formula to calculate cutting conditions.

MECX End Mill

Toolholder Dimensions

Description	Std.	No. of Inserts	φD
MECX 08-S10-07-1T	●	8	
14-S12-07-2T	●	14	
17-S16-07-3T	●	17	
18-S19-07-3T	●	18	
20-S16-07-4T	●	20	

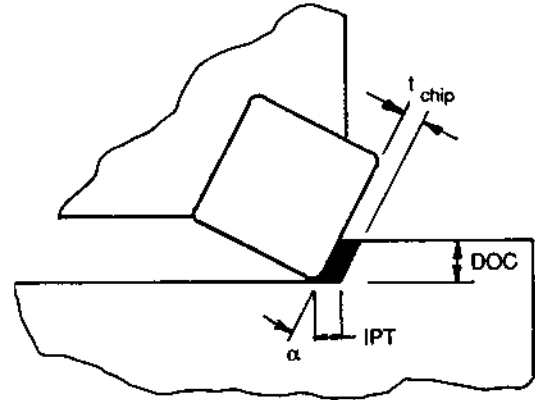
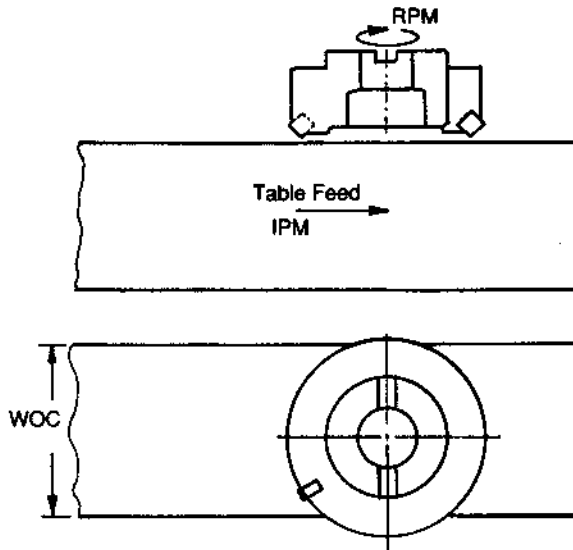
$fz = \frac{V_f}{Z \times n}$ → $V_f = fz \times Z \times n$

MSR

Toolholder Dimensions (Bore ø: Inch)

Description	Std.	No. of Inserts	No. of Flutes	φD	φD1	φd
MSR 063R-1	●	1	1	63	50	25.4
063R-2	●	2	2	63	50	25.4
080R-1	●	1	1	80	63	25.4
080R-2	●	2	2	80	63	25.4
080R-3-1.75	●	4	4	80	70	25.4
080R-4	●	4	4	80	70	25.4

$fz = \frac{V_f}{Z \times n}$ → $V_f = fz \times Z \times n$



Surface Speed per Minute

$$SFM = 0.262 \times DIA \times RPM$$

Revolutions per Minute

$$RPM = \frac{3.820 \times SFM}{DIA}$$

Feedrate (inches/minute)

$$IPM = IPT \times N \times RPM$$

Feedrate (inches/tooth)

$$\text{Programmed IPT} = \frac{t_{\text{chip Max}}}{\cos \alpha}$$

Radial Chip Thinning for 90° Cutters

$$f_1 = \frac{1/2 \left(\frac{DIA}{Ae} \right)}{\sqrt{\left(\frac{DIA}{Ae} \right) - 1}}$$

Table Feed with f_1 Compensation (inches/minute)
 $= IPT \times N \times RPM \times f_1$

Metal Removal Rate

$$Q = WOC \times DOC \times IPM \text{ (in}^3\text{/min)}$$

Horsepower Required at the Spindle

$$HPS = Q \times UHP$$

Horsepower Required at the Motor

$$HPM =$$

Time in Cut (Seconds)

$$T = \frac{15.7 \times DIA \times LOC}{SFM \times IPR \times N}$$

or

$$T = \frac{60 \times LOC}{IPM}$$

Definition of Terms

DIA = Diameter of the Workpiece (Inches)

D.O.C. = Axial Depth of Cut (Inches)

EFF = Machine Efficiency

f = Feedrate (See IPM, IPR, and IPT)

HPM = Horsepower Required at the Motor (HP)

HPS = Horsepower Required at the Spindle (HP)

IPM = Feedrate (Inches per Minute)

IPR = Feedrate (Inches per Revolution)

IPT = Feedrate (Inches per Tooth)

f_1 = Cutter Compensation Factor

WOC = Width of Cut (Inches)

LOC = Length of Cut (Inches)

N = Number of Effective Teeth in Cutter

Q = Metal Removal Rate (Cubic Inches per Minute)

RPM = Revolutions per Minute

SFM = Surface Speed (Feet per Minute)

T = Time (in Seconds)

$t_{\text{chip Max}}$ = Maximum Recommended Chip Thickness (Inches)

UHP = Unit Horsepower Factor

α = Lead Angle

GRADES	A
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Milling

Cutting Speed

$$V_c = \frac{\pi \times D_c \times n}{1,000}$$

V_c : Cutting Speed [m/min]
 D_c : Cutter Diameter [mm]
 n : Spindle Revolution [min^{-1}]

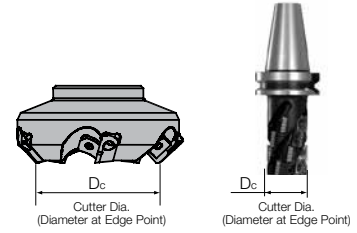
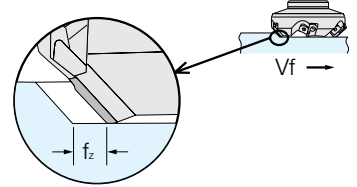


Table Feed & Feed per Tooth

$$V_c = \frac{V_f}{Z \times n}$$

f_z : Feed per Tooth [mm/t]
 V_f : Table Feed [mm/min]
 Z : Number of Inserts
 n : Spindle Revolution [min^{-1}]



Power Requirement

$$P_c = \frac{K_s \times Q}{6,120 \times \eta} = \frac{K_s \times a_e \times V_f \times a_p}{6,120,000 \times \eta}$$

$$= \frac{K_s \times a_e \times f_z \times Z \times n \times a_p}{6,120,000 \times \eta}$$

P_c : Power Requirement [kW]
 V_f : Power Requirement (Horse Power) [HP]
 a_e : Width of Cut [mm]
 V_f : Table Feed [mm/min]
 f_z : Feed per Tooth [mm/t]
 Z : Number of Inserts
 n : Spindle Revolution [min^{-1}]
 a_p : Depth of Cut [mm]
 K_s : Specific Cutting Force [kgf/mm^2]
 η : Mechanical Efficiency (0.7~0.8)
 Q : Chip Removal Volume [$\text{cm}^3/\text{min} = \text{cc}/\text{min}$]

Ks Figure	
Low Carbon Steel	190
Medium Carbon Steel	210
High Carbon Steel	240
Low Alloy Steel	190
High Alloy Steel	245
Cast Iron	93
Malleable Cast Iron	120
Bronze, Brass	70

Chip Removal Volume

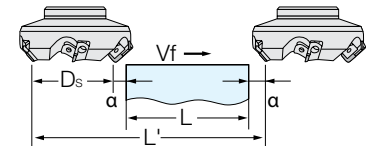
$$Q = \frac{a_e \times V_f \times a_p}{1,000} = \frac{a_e \times f_z \times Z \times n \times a_p}{1,000}$$

Q : Chip Removal Volume [$\text{cm}^3/\text{min} = \text{cc}/\text{min}$]
 a_e : Width of Cut [mm]
 V_f : Table Feed [mm/min]
 f_z : Feed per Tooth [mm/t]
 Z : Number of Inserts
 n : Spindle Revolution [min^{-1}]
 a_p : Depth of Cut [mm]

Cutting Time

$$T = \frac{60 \times L'}{V_f} = \frac{60 \times L'}{f_z \times Z \times n}$$

T : Cutting Time [seconds]
 L' : Total Table Transfer Length [mm]
 (= $L + D_s + 2\alpha$)
 L : Workpiece Length [mm]
 D_s : Cutter Diameter [mm]
 α : Idling Distance [mm]
 V_f : Table Feed [mm/min]
 f_z : Feed per Tooth [mm/t]
 Z : Number of Inserts
 n : Spindle Revolution [min^{-1}]



Milling

True Rake Angle

$$\tan T = \tan R \times \cos C + \tan A \times \sin C$$

True Rake Angle

$$\tan I = \tan A \times \cos C - \tan R \times \sin C$$

- A : Axial Rake Angle (A.R.) [°] (-90° < A < 90°)
- R : Radial Rake Angle (R.R.) [°] (-90° < R < 90°)
- C : Approach Angle [°] (0° < C < 90°)
- T : True Rake Angle [°] (-90° < T < 90°)
- I : Inclination Angle [°] (-90° < I < 90°)

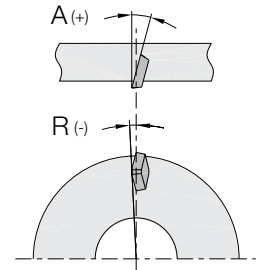
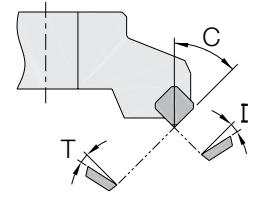
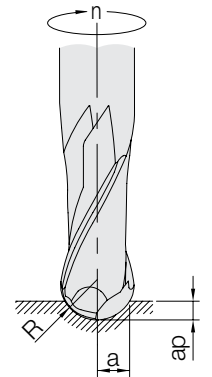


Table Feed & Feed per Tooth

$$n = \frac{1,000 \times Va}{2 \times \pi \times \sqrt{a(2R-ap)}}$$

- n : Revolution [min⁻¹]
- R : Radius of Ball-Nose End Mill (Ball Part's Radius [mm])



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