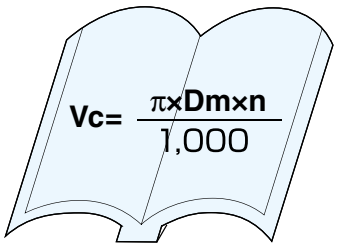


Technical Information

R

R1~R42

SI Derived Units Conversion Chart

(Bold lined units are the ones by SI Derived Unit.)

(Extracted from JIS Handbook "Steel")

● Force

N	kgf	dyn
1	$1.019\ 72\times10^{-1}$	1×10^{5}
9.806 65	1	$9.806\ 65\times10^{5}$
1×10^{-5}	$1.019\ 72\times10^{-6}$	1

● Stress

1Pa=1N/m^2,1MPa=1N/mm^2

Pa or **N/m^2**	**MPa** or **N/mm^2**	kgf/mm^2	kgf/cm^2	kgf/m^2
1	1×10^{-6}	$1.019\ 72\times10^{-7}$	$1.019\ 72\times10^{-5}$	$1.019\ 72\times10^{-1}$
1×10^{6}	1	$1.019\ 72\times10^{-1}$	$1.019\ 72\times10$	$1.019\ 72\times10^{5}$
$9.806\ 65\times10^{6}$	9.806 65	1	1×10^{2}	1×10^{6}
$9.806\ 65\times10^{4}$	$9.806\ 65\times10^{-2}$	1×10^{-2}	1	1×10^{4}
9.806 65	$9.806\ 65\times10^{-6}$	1×10^{-6}	1×10^{-4}	1

● Pressure

1Pa=1N/m^2

Pa	**kPa**	**MPa**	bar	kgf/cm^2
1	1×10^{-3}	1×10^{-6}	1×10^{-5}	$1.019\ 72\times10^{-5}$
1×10^{3}	1	1×10^{-3}	1×10^{-2}	$1.019\ 72\times10^{-2}$
1×10^{6}	1×10^{3}	1	1×10	$1.019\ 72\times10$
1×10^{5}	1×10^{2}	1×10^{-1}	1	1.019 72
$9.806\ 65\times10^{4}$	$9.806\ 65\times10$	$9.806\ 65\times10^{-2}$	$9.806\ 65\times10^{-1}$	1

Symbol of cutting conditions

● Cutting conditions below are indicated by the new symbols listed in 2nd column.

1) Turning

Cutting conditions	**Symbol**	**(Previous Symbol)**	**Unit**
Cutting Speed	Vc	V	m/min
Feed Rate	f	f	mm/rev
Depth of Cut	ap	d	mm
Edge Width	W	W	mm
Workpiece Dia.	Dm	D	mm
Required Power	Pc	Pkw	kW
Specific cutting force	kc	Ks	MPa
Theoretical surface roughness	h	Rz	μm
Corner Radius	rε	R	mm
Revolution	n	N	min^{-1}

Note: 'rε' is read as 'r epsilon'

2) Milling

Cutting conditions	**Symbol**	**(Previous Symbol)**	**Unit**
Cutting Speed	Vc	V	m/min
Feed Speed	Vf	F	mm/min
Feed per tooth	fz	f	mm/t
Feed Rate	f	f	mm/rev
No. of Inserts	Z	Z	teeth
Depth of Cut	ap	d	mm
Width of Cut	ae	w	mm
Pick feed	Pf	Pf	mm
Required Power	Pc	Pkw	kW
Specific cutting force	kc	Ks	MPa
Chip Removal Volume	Q	Q	cm^3/min
Revolution	n	N	min^{-1}

3) Drilling

Cutting conditions	**Symbol**	**(Previous Symbol)**	**Unit**
Cutting Speed	Vc	V	m/min
Feed Speed	Vf	F	mm/min
Feed Rate	f	f	mm/rev
Drill Dia.	Dc	D (Ds)	mm
Required Power	Pc	Pkw	kW
Specific cutting force	kc	Ks	MPa
Depth of hole	H	d	mm
Revolution	n	N	min^{-1}

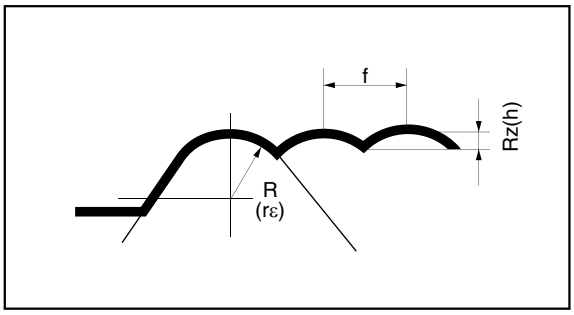
Surface Roughness (JIS B 0601-2001)

Theoretical (Geometrical) Surface Roughness

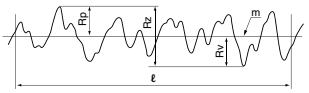
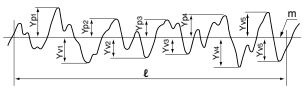
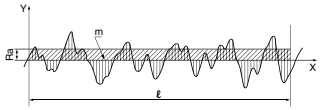
Theoretical Surface Roughness for Turning indicates the minimum roughness value from the cutting conditions and it is shown by the formula as follows.

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

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



How to Obtain Surface Roughness Values

Type	Symbol	How to Obtain	Explanation
Max. Height Roughness	Rz	Rz 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	RzJIS 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". $Rz_{JIS}=\frac{(Yp1+Yp2+Yp3+Yp4+Yp5)+(Yv1+Yv2+Yv3+Yv4+Yv5)}{5}$	 Yp1,Yp2,Yp3,Yp4,Yp5: Distance from the mean line to the highest 5 peaks in the range of sampled reference length "ℓ" Yv1,Yv2,Yv3,Yv4,Yv5: Distance from the mean line to the lowest 5 valleys in the range of sampled reference length "ℓ"
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". $Ra=\frac{1}{\ell}\int_0^{\ell}\{f(x)\}dx$	

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 0.05 0.1 0.2	0.1 0.2 0.4 0.8	0.1 0.2 0.4 0.8	▽▽▽▽
0.4 0.8 1.6	1.6 3.2 6.3	1.6 3.2 6.3	▽▽▽
3.2 6.3	12.5 25	12.5 25	▽▽
12.5 25	50 100	50 100	▽

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

· How to Indicate
(1) When Ra is 1.6μm → 1.6μmRa
(2) When Rz is 6.3μm → 6.3μmRz
(3) When RzJIS is 6.3μm → 6.3μmRzJIS

Indication in JIS Standard

Example of Ra Indication		Example of Rz Indication	
(1) When indicating the upper limit only (when upper limit is 6.3μmRa)	6.3	(1) When indicating the upper limit only indicate surface roughness following the parameter symbol.	Rz6.3
(2) When indicating both lower and upper limit (when upper limit is 6.3μmRa, lower limit is 1.6μmRa)	6.3 1.6	(2) When indicating both lower and upper limit indicate surface roughness as (upper limit ~ lower limit) following the parameter symbol.	Rz6.3~1.6

Note: The indications of Ra and Rz are different.

Caution-Symbols for Surface Roughness

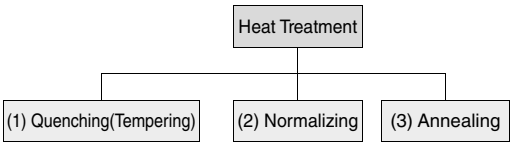
The above information is based on JIS B 0601-2001.
However, some symbols were revised as shown in the right table in accordance with ISO Standard from JIS B 0601-2001 version.
Ten Points Mean Roughness (Rz) was eliminated from 2001 version but it still remains as RzJIS reference, since it was popular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

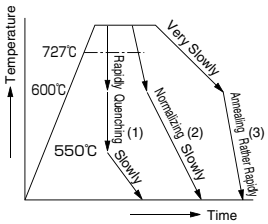
Type	Symbol of JIS B 0601-1994		Symbol of JIS B 0601-2001
Max. Height Roughness	Ry	→	Rz
Ten Points Mean Roughness	Rz	→	(RzJIS)
Arithmetical Mean Roughness	Ra	→	Ra

Heat Treatment and Hardness Expression

Heat Treatment

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



 Heat Treatment Method	· 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)
	· 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.
	· 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: 3,000kgf (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 1.6mm (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
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/mm^2

2) Value in ( ) is not in practical use, but reference only.

Material List (JIS)

Ferrous Materials

Classification		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
Machine Structural Steel		Carbon Steel for Machine Structural Use	SxxC,SxxCK
		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
Special Steel	Tool Steel	Carbon Tool Steel	SK
		Hollow Drill Steel	SKC
		Alloy Tool Steel	SKS,SKD,SKT
		High Speed Tool Steel	SKH
	Special Steel	Free Cutting Carbon Steel	SUM
		High Carbon Chromium Bearing Steel	SUJ
		Spring Steel	SUP
	Stainless Steel	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	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 Metals

Classification	Name of JIS Standard	Symbol
Copper	Copper and Copper Alloy Sheet / Strip	CxxxxP CxxxxPP CxxxxR
	Copper and Copper Alloy Rod and Bar	CxxxxBD CxxxxBDS CxxxxBE
Aluminum Alloys and Aluminum Alloys Expanded Material	Aluminum and Al. Alloy Sheet / Strip	AxxxxP AxxxxPC
	Aluminum and Al. Alloy Rod, Bar, and Wire	AxxxxBE AxxxxBES AxxxxBD AxxxxBDS AxxxxW AxxxxWS
	Aluminum and Al. Alloy Extruded Shape	AxxxxS
	Aluminum and Al. Alloy Forging	AxxxxFD AxxxxFH
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 Table

● **Steel**

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

Material Cross Reference Table

● **Steel**

Classification	Japan	China	USA	UK	Germany	France	Russia
	JIS	GB	AISI/SAE	BS	DIN	NF	ГОСТ
Nickel Chromium Steel	SNC236				36NiCr6		40ХН
	SNC415	12CrNi2			14NiCr10		
	SNC631	30CrNi3			36NiCr10		30ХН3А
	SNC815	12Cr2Ni4		655M13	15NiCr13		
	SNC836	37CrNi3			31NiCr14		
Nickel Chromium Molybdenum Steel	SNCM220	20CrNiMo	8615 8617 8620 8622	805A20 805M20 805A22 805M22	20NiCrMo2 20NiCrMoS2	20NCD 2	
	SNCM240		8637 8640		40NiCrMo2-2		
	SNCM415						
	SNCM420	18CrNiMnMoA	4320		17NiCrMo6-4		20ХН2М (20ХНМ)
	SNCM431				30CrNiMo8		
	SNCM439	40CrNiMoA	4340		40NiCrMo6		
	SNCM447				34CrNiMo6		
	SNCM616						
	SNCM625						
	SNCM630						
	SNCM815						
Chromium Steel	SCr415	15Cr 15CrA			17Cr3 17CrS3		15Х 15ХА
	SCr420	20Cr	5120				20Х
	SCr430	30Cr	5130 5132	34Cr4 34CrS4	34Cr4 34CrS4	34Cr4 34CrS4	30Х
	SCr435	35Cr	5132	37Cr4 37CrS4	37Cr4 37CrS4	37Cr4 37CrS4	35Х
	SCr440	40Cr	5140	530M40 41Cr4 41CrS4	41Cr4 41CrS4	41Cr4 41CrS4	40Х
	SCr445	45Cr 50Cr					45Х
Chromium Molybdenum Steel	SCM415	15CrMo			15CrMo4		
	SCM418	20CrMo			18CrMo4 18CrMoS4		20ХМ
	SCM420			708M20	20CrMo5		20ХМ
	SCM421						
	SCM430	30CrMo 30CrMoA	4130				30ХМ 30ХМА
	SCM432						
	SCM435	35CrMo	4137	34CrMo4 34CrMoS4	34CrMo4 34CrMoS4	34CrMo4 34CrMoS4	35ХМ
	SCM440	42CrMo	4140 4142	708M40 709M40 42CrMo4 42CrMoS4	42CrMo4 42CrMoS4	42CrMo4 42CrMoS4	
	SCM445		4145 4147				
	SCM822						

R

Technical Information

● **Steel**

Classification	Japan	China	USA	UK	Germany	France	Russia
	JIS	GB	AISI/SAE	BS	DIN	NF	ГОСТ
Manganese Steel Manganese Chromium Steel	SMn420	20Mn2	1522	150M19	20Mn5		
	SMn433	30Mn2 35Mn2	1536	150M36	34Mn5		30Г2 35Г2
	SMn438	40Mn2	1541	150M36	36Mn5		35Г2 40Г2
	SMn443	45Mn2	1541				40Г2 45Г2
	SMnC420	15CrMn	5115		16MnCr5		
	SMnC443	40CrMn	5140				
Structural Steel with Specified Hardenability Band (H-Shape Steel)	SMn420H		1522H				
	SMn433H						
	SMn438H		1541H				
	SMn443H		1541H				
	SMnC420H						
	SMnC443H						
	SCr415H	15CrH			17Cr3 17CrS3		15Х
	SCr420H	20Cr1H	5120H		17Cr3		20Х
	SCr430H		5130H 5132H	34Cr4 34CrS4	34Cr4 34CrS3	34Cr4 34CrS4	30Х
	SCr435H		5135H	37Cr4 37CrS4	37Cr4 34CrS4	37Cr4 37CrS4	35Х
	SCr440H	40CrH	5140H	41Cr4 41CrS4	41Cr4 41CrS4	41Cr4 41CrS4	40Х
	SCM415H	15CrMoH	4118H		15CrMo5		
	SCM418H				18CrMo4 18CrMoS4		
	SCM420H	20CrMoH	4118H	708H20	18CrMo4		
	SCM435H		4135H 4137H	34CrMo4 34CrMoS4	34CrMo4 34CrMoS4	34CrMo4 34CrMoS4	
	SCM440H	42CrMoH	4140H 4142H	42CrMo4 42CrMoS4	42CrMo4 42CrMoS4	42CrMo4 42CrMoS4	
	SCM445H		4145H 4147H				
	SCM822H						
	SNC415H						
	SNC631H						
	SNC815H	12Cr2Ni4H		655H13	15NiCr13		
	SNCM220H	20CrNiMoH	8617H 8620H 8622H	805H17 805H20 805H22	21NiCrMo2	20N CD 2	
	SNCM420H	20CrNi2MoH	4320H		20NiCrMoS6-4		

Material Cross Reference Table

● **Steel**

Classification	Japan	China	USA		UK	Germany	France	Russia
	JIS	GB	UNS	AISI	BS	DIN	NF	ГОСТ
Stainless Steel	SUS 201	1Cr17Mn6Ni5N	S20100	201			Z12CMN17-07Az	
	SUS 202	1Cr18Mn8Ni5N	S20200	202	284S16			12Х17Г9АН4
	SUS 301	1Cr18Mn10Ni5Mo3N 1Cr17Ni7	S30100	301	301S21	X12CrNi17 7	Z11CN17-08	07Х16Н6
	SUS 301L		S30153			X2CrNiN18-7		
	SUS 301J1					X12CrNi17 7		
	SUS 302	1Cr18Ni9	S30200	302	302S25		Z12CN18-09	12Х18Н9
	SUS 302B		S30215	302B				
	SUS 303	Y1Cr18Ni9	S30300	303	303S21	X10CrNiS18 9	Z8CNF18-09	
	SUS 303Se	Y1Cr18Ni9Se	S30323	303Se	303S41			12Х18Н10Е
	SUS 304	0Cr18Ni9	S30400	304	304S31	X5CrNi18 10	Z7CN18-09	08Х18Н10
	SUS 304L	00Cr18Ni10	S30403	304L	304S11	X2CrNi19 11	Z3CN19-11	03Х18Н11
	SUS 304N1	0Cr18Ni9N	S30451	304N			Z6CN19-09Az	
	SUS 304N2	0Cr19Ni10NbN	S30452					
	SUS 304LN	00Cr18Ni10N	S30453	304LN		X2CrNiN18 10	Z3CN18-10Az	
	SUS 304J1							
	SUS 304J2							
	SUS 304J3		S30431	S30431				
	SUS 305	1Cr18Ni12	S30500	305	305S19	X5CrNi18 12	Z8CN18-12	06Х18Н11
	SUS 305J1							
	SUS 309S	0Cr23Ni13	S30908	309S			Z10CN24-13	
	SUS 310S	0Cr25Ni20	S31008	310S	310S31		Z8CN25-20	10Х23Н18
	SUS 316	0Cr17Ni12Mo2	S31600	316	316S31	X5CrNiMo17 12 2	Z7CND17-12-02	
	SUS 316F					X5CrNiMo17 13 3	Z6CND18-12-03	
	SUS 316L	00Cr17Ni14Mo2	S31603	316L	316S11	X2CrNiMo17 13 2	Z3CND17-12-02	
						X2CrNiMo17 14 3	Z3CND17-13-03	03Х17Н14М3
	SUS 316N	0Cr17Ni12Mo2N	S31651	316N				
	SUS 316LN	00Cr17Ni13Mo2N	S31653	316LN		X2CrNiMoN17 12 2	Z3CND17-11Az	
						X2CrNiMoN17 13 3	Z3CND17-12Az	
	SUS 316Ti		S31635			X6CrNiMoTi17 12 2	Z6CNDT17-12	08Х17Н13М2Т
	SUS 316J1	0Cr18Ni12Mo2Cu2						
	SUS 316J1L	00Cr18Ni14Mo2Cu2						
	SUS 317	0Cr19Ni13Mo3	S31700	317	317S16			
	SUS 317L	00Cr19Ni13Mo3	S31703	317L	317S12	X2CrNiMo18 16 4	Z3CND19-15-04	
	SUS 317LN		S31753				Z3CND19-14Az	
	SUS 317J1	0Cr18Ni16Mo5						
	SUS 317J2							
	SUS 317J3L							
	SUS 836L		N08367					
	SUS 890L		N08904	N08904	904S14		Z2NCDU25-20	
	SUS 321	1Cr18Ni9Ti 0Cr18Ni10Ti	S32100	321	321S31	X6CrNiTi18 10	Z6CNT18-10	08Х18Н10Т
	SUS 347	0Cr18Ni11Nb	S34700	347	347S31	X6CrNiNb18 10	Z6CNNb18-10	08Х18Н12Б
	SUS 384		S38400	384			Z6CN18-16	
	SUS XM7	0Cr18Ni9Cu3	S30430	304Cu	394S17		Z2CNU18-10	
	SUS XM15J1	0Cr18Ni13Si4	S38100				Z15CNS20-12	
	SUS 329J1	0Cr26Ni5Mo2	S32900	329				
	SUS 329J3L		S39240	S31803			Z3CNDU22-05Az	08Х21Н6М2Т
	SUS 329J4L		S39275	S31260			Z3CNDU25-07Az	

● Steel

Classification	Japan	China	USA		UK	Germany	France	Russia
	JIS	GB	UNS	AISI	BS	DIN	NF	ГОСТ
Stainless Steel	SUS 405	0Cr13Al 0Cr13	S40500	405	405S17	X6CrAl13	Z8CA12	
	SUS 410L	00Cr12					Z3C14	
	SUS 429		S42900	429				
	SUS 430	1Cr17	S43000	430	430S17	X6Cr17	Z8C17	12Х17
	SUS 430F	Y1Cr17	S43020	430F		X7CrMoS18	Z8CF17	
	SUS 430LX		S43035			X6CrTi17	Z4CT17	
	SUS 430J1L					X6CrNb17	Z4CNb17	
	SUS 434	1Cr17Mo	S43400	434	434S17	X6CrMo17 1	Z8CD17-01	
	SUS 436L		S43600	436				
	SUS 436J1L							
	SUS 444		S44400	444			Z3CDT18-02	
	SUS 447J1	00Cr30Mo2	S44700					
	SUS XM27	00Cr27Mo	S44627				Z1CD26-01	
	SUS 403	1Cr12	S40300	403				
	SUS 410	1Cr13	S41000	410	410S21	X10Cr13	Z13C13	
	SUS 410S		S41008	410S	403S17	X6Cr13	Z8C12	08Х13
	SUS 410F2							
	SUS 410J1	1Cr13Mo 1Cr12Mo	S41025			X12CrS13		
	SUS 416	Y1Cr13	S41600	416	416S21		Z11CF13	
	SUS 420J1	2Cr13	S42000	420	420S29	X20Cr13	Z20C13	20Х13
	SUS 420J2	3Cr13	S42000	420	420S37	X30Cr13	Z33C13	30Х13
	SUS 420F	Y3Cr13	S42020	420F			Z30CF13	
	SUS 420F2							
	SUS 429J1							
	SUS 431	1Cr17Ni2	S43100	431	431S29	X20CrNi17 2	Z15CN16-02	20Х17Н2
	SUS 440A	7Cr17	S44002	440A			Z70C15	
	SUS 440B	8Cr17	S44003	440B				
	SUS 440C	9Cr18 11Cr17 9Cr18Mo	S44004	440C			Z100CD17	95Х18
	SUS 440F	Y11Cr17	S44020	S44020				
	SUS 630	0Cr17Ni4CuNb	S17400	S17400		X5CrNiCuNb16-4	Z6CNU17-04	
	SUS 631	0Cr17Ni7Al	S17700	S17700		X7CrNiAl17 7	Z9CNA17-07	09Х17Н7 Ю
	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 Hardening related)

JIS
SUS630
SUS631

Material Cross Reference Table

● **Steel**

Classification	Japan	China	USA		UK	Germany	France	Russia
	JIS	GB	UNS	AISI	BS	DIN	NF	ГОСТ
Heat Resisting Steel	SUH 31				331S42		Z35CNWS14-14	45Х14Н14В2М
	SUH 35				349S52		Z52CMN21-09Az	
	SUH 36	5Cr21Mn9Ni4N	S63008		349S54	X53CrMnNi21 9	Z55CMN21-09Az	55Х20 Г 9АН4
	SUH 37	2Cr21Ni12N	S63017		381S34			
	SUH 38							
	SUH 309	2Cr23Ni13	S30900	309	309S24		Z15CN24-13	
	SUH 310	2Cr25Ni20	S31000	310	310S24	CrNi2520	Z15CN25-20	20Х25Н20С2
	SUH 330	1Cr16Ni35	N08330	N08330			Z12NCS35-16	
	SUH 660	0Cr15Ni25Ti2MoAlVB	S66286				Z6NCTV25-20	
	SUH 661		R30155					
	SUH 21					CrAl1205		
	SUH 409		S40900	409	409S19	X6CrTi12	Z6CT12	
	SUH 409L						Z3CT12	
	SUH 446	2Cr25N	S44600	446			Z12C25	15Х28
	SUH 1	4Cr9Si2	S65007		401S45	X45CrSi9 3	Z45CS9	
	SUH 3	4Cr10Si2Mo					Z40CSD10	40Х10С2М
	SUH 4	8Cr20Si2Ni			443S65		Z80CSN20-02	
	SUH 11							40Х 9С2
	SUH 600	2Cr12MoVNbN						20Х12ВНМБФР
	SUH 616	2Cr12NiMoWV	S42200					

● **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

● **Steel**

Classification	Japan	China	USA	UK	Germany	France	Russia
	JIS	GB	AISI/ASTM	BS	DIN	NF	ГОСТ
Carbon Tool Steel	SK140 (SK1)	T13				C140E3U	У13
	SK120 (SK2)	T12	W1-11½			C120E3U	У12
	SK105 (SK3)	T11	W1-10		C105W1	C105E2U	У11
	SK95 (SK4)	T10	W1-9			C90E2U	У10
	SK85 (SK5)	T8Mn T9	W1-8		C80W1	C90E2U C80E2U	У8Г У9
	SK75 (SK6)	T8			C80W1	C80E2U C70E2U	У8
	SK65 (SK7)	T7			C70W2	C70E2U	У7
High Speed Tool Steel	SKH2	W18Cr4V	T1	BT1		HS18-0-1	Р18
	SKH3	W18Cr4VCo5	T4	BT4	S18-1-2-5	HS18-1-1-5	Р18К5Ф2
	SKH4	W18Cr4V2Co8	T5	BT5		HS18-0-2-9	Р18К5Ф
	SKH10	W12Cr4V5Co5	T15	BT15	S12-1-4-5	HS12-1-5-5	
	SKH51	W6Mo5Cr4V2	M2	BM2	S6-5-2	HS6-5-2	Р6М5
	SKH52	CW6Mo5Cr4V2 W6Mo5Cr4V3	M3-1				Р6М5Ф3
	SKH53	CW6Mo5Cr4V3	M3-2		S6-5-3	HS6-5-3	Р6М5Ф3
	SKH54		M4	BM4		HS6-5-4	
	SKH55	W6Mo5Cr4V2Co5 W7Mo5Cr4V2Co5	M35 M41	BM35	S6-5-2-5	HS6-5-2-5HC	Р6М5К5
	SKH56		M36				
	SKH57			BT42	S10-4-3-10	HS10-4-3-10	
	SKH58	W2Mo9Cr4V2	M7			HS2-9-2	
	SKH59	W2Mo9Cr4VCo8	M42	BM42	S2-10-1-8	HS2-9-1-8	
Alloy Tool Steel	SKS11		F2				ХВ4
	SKS2				105WCr6	105WCr5	ХВГ
	SKS21	W					
	SKS5						
	SKS51		L6				
	SKS7						
	SKS8	Cr06				C140E3UCr4	13Х
	SKS4	5CrW2Si 6CrW2Si	S1				6ХВ2С 5ХВ2СФ
	SKS41	4CrW2Si	S1				4ХВ2С
	SKS43		W2-9½	BW2		100V2	
	SKS44		W2-8				
	SKS3	9CrWMn					9ХВГ
	SKS31	CrWMn			105WCr6	105WCr5	ХВГ
	SKS93						
	SKS94						
	SKS95	8MnSi					
	SKD1	Cr12	D3	BD3	X210Cr12	X200Cr12	Х12
	SKD10	Cr12Mo1V1	D2		X153CrMoV12		Х12МФ
	SKD11	Cr12MoV	D2	BD2	X153CrMoV12	X160CrMoV12	
	SKD12	Cr5Mo1V	A2	BA2		X100CrMoV5	
	SKD4					X32WCrV3	
	SKD5	3Cr2W8V	H21	BH21	X30WCrV9-3	X30WCrV9	
	SKD6	4Cr5MoSiV	H11	BH11	X38CrMoV51	X38CrMoV5	4Х5МФС
	SKD61	4Cr5MoSiV1	H13	BH13	X40CrMoV51	X40CrMoV5	4Х5МФ1С
	SKD62		H12	BH12		X35CrWMoV5	3Х3М3Ф
	SKD7	4Cr3Mo3SiV	H10	BH10	X32CrMoV33	32CrMoV12-18	
	SKD8		H19	BH19			
	SKT3					55CrNiMoV4	
	SKT4	5CrNiMo		BH224/5	55NiCrMoV6	55NiCrMoV7	5ХНМ

Material Cross Reference Table

● **Steel**

Classification	Japan	China	USA	UK	Germany	France	Russia
	JIS	GB	AISI/ASTM	BS	DIN	NF	ГОСТ
Spring Steel	SUP3		1075 1078				75 80 85
	SUP6	55Si2Mn			56SiCr7	60Si7	60С2
	SUP7	60Si2Mn 60Si2MnA	9260		61SiCr7	60Si7	60С2Г
	SUP9	55CrMnA	5155		55Cr3	55Cr3	
	SUP9A	60CrMnA	5160		55Cr3	60Cr3	
	SUP10	50CrVA	6150	735A51, 735H51	50CrV4	51CrV4	ХФА50ХГФА
	SUP11A	60CrMnBA	51B60		51CrV4		50ХГР
	SUP12		9254	685A57, 685H57	54SiCr6	54SiCr6	
	SUP13	60CrMnMoA	4161	705A60, 705H60	60CrMn3-2	60CrMo4	
Free Cutting Carbon Steel	SUM11		1110				
	SUM12	Y12	1108				
	SUM21		1212				
	SUM22	Y15	1213	(230M07)	9SMn28	S250	
	SUM22L	Y12Pb	12L13		9SMnPb28	S250Pb	
	SUM23		1215				
	SUM23L						
	SUM24L	Y15Pb	12L14		9SMnPb28	S250Pb	
	SUM25				9SMn36	S300	
	SUM31		1117		15S10		
	SUM31L						
	SUM32	Y20		210M15, 210A15		(13MF4)	
	SUM41	Y30 Y35	1137			(35MF6)	
	SUM42	Y40Mn	1141			(45MF6.1)	
	SUM43		1144	(226M44)		(45MF6.3)	
High Carbon Chromium Bearing Steels	SUJ1	GCr4	51100				
	SUJ2	GCr15	52100		100Cr6	100Cr6	ШХ15
	SUJ3	GCr15SiMn	ASTM A 485 Grade 1				
	SUJ4	GCr15SiMo					
	SUJ5	GCr18Mo					

● Cast Iron

Classification	Japan	China	USA	UK	Germany	France	Russia
	JIS	GB	AISI/SAE	BS	DIN	NF	ГОСТ
Gray Cast Iron	FC100	HT100	NO.20	100	GG10		СУ10
	FC150	HT150	NO.30	150	GG15	FGL150	СУ15
	FC200	HT200	NO.35	200	GG20	FGL200	СУ20
	FC250	HT250	NO.45	250	GG25	FGL250	СУ25
	FC300	HT300	NO.50	300	GG30	FGL300	СУ30
	FC350	HT350	NO.60	350	GG35	FGL350	СУ35
					GG40	FGL400	СУ40
Nodular Cast Iron	FCD400	QT400-18	60-40-18	400/17	GGG40	FGS370-17	ВУ40
	FCD450	QT450-10	65-45-12	420/12		FGS400-12	ВУ45
	FCD500	QT500-7	70-50-05	500/7	GGG50	FGS500-7	ВУ50
	FCD600	QT600-3	80-60-03	600/7	GGG60	FGS600-2	ВУ60
	FCD700	QT700-2	100-70-03	700/2	GGG70	FGS700-2	ВУ70
	FCD800	QT800-2	120-90-02	800/2	GGG80	FGS800-2	ВУ80
		QT900-2		900/2			ВУ100

● Non-ferrous Metals

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

Insert Grades Cross Reference Table

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
Classification	Symbol											
P (Steel)	P01	CA510 CA5505	JC110V	HG8010 HC5000 HG3305	UE6105 UE6005 UE6015		GC4005 GC4205	TP0500 TP1000	AC700G AC810P	T9005 T9105	KCP05 KCK05 KC9105	IC8150 IC9150
	P10	CA510 CA515 CA5505 CA5515	JC110V JC215V	GM10 GM20 GM8015 HG8010	UE6105 UE6110 UE6005 UE6010 UE6020	CP2 CP5 CP7	GC4205 GC4015 GC3115 GC4215 GC4315	TP1000 TP1500 TP100	AC700G AC2000 AC810P AC820P	T9005 T9105 T9015 T9115	KCP10 KCM15 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	TP2000 TP2500 TP200	AC2000 AC3000 AC820P AC830P	T9015 T9115 T9025 T9125	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	TP2500 TP2000 TP3500 TP200	AC3000 AC630M AC830P ACP100	T9125 T9035 T9135 T3130	KCP30 KCM25 KC9040 KC9140	IC635 IC8350 IC9350
	P40	CA530 CA5535	JC325V JC450V JC540V	GX30	UE6035 UH6400		GC4235 GC4240	TP40	AC630M AC830P ACP100	T9035 T3130	KCP40 KC9140 KC9240	IC635
M (Stainless Steel)	M10	CA6515	JC110V	GM10	US7020 MC7015	CP2 CP5	GC2015	TP1500 TP100	AC610M	T9015 T9115	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	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	KCP40 KCM35 KC9240	IC6025 IC8350 IC9350 IC4050
	M40		JC525X	GX30	US735			TP40			KC9045 KC9245	IC635
K (Cast Iron)	K01	CA4010 CA4505 CA5505	JC105V JC605X JC605W JC050W	HG3305 HG3315 HX3505 HX3515	MC5005 UC5105 UC5015	CP1	GC3205 GC3210	TK1000 TH1000 TK1001	AC300G AC405K AC410K	T5105 T5010	KC9105 KC9315 KCK05	IC428 IC5010 IC9007 IC9150
	K10	CA4010 CA4115 CA4505 CA4515 CA5505	JC050W JC110V JC605X JC605W JC610	GM8015 HX3515 HG8010 HG3315	UC5015 UC5105 UC5115 UE6010 MC5015	CP1 CP2 CP5	GC3205 GC3210 GC3215 GC3115	TK1000 TK2000 TK2001 MK1500	AC700G AC410K AC415K	T5105 T5115 T5010	KCP10 KC9110 KC9120 KC9315 KCK15	IC418 IC428 IC9015 IC9007
	K20	CA4115 CA4120 CA4515	JC110V JC215V JC605X JC605W JC610	GM8020 HG8025	MC5015 UE6010 UC5115	CP2 CP5	GC4225 GC3215 GC3220	TK2000 TX150 TP200	AC700G AC820P AC420K	T5115 T5125 T5020	KCP25 KC9125 KC9320 KC9325 KCK20	IC418 IC9015
	K30		JC215V JC610	GM25			GC3040	TP2500 TP200		T5125 T9125	KC9320	

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
Classification	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 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
M (Stainless Steel)	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
	M20	PR930 PR1025 PR1125 PR1215 PR1425 PR1225	JC5015 JC5030 JC5040 JC8015	IP100S	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 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
K (Cast Iron)	K01		JC5003						EH10Z	AH110	KC5515	IC910
	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

Insert Grades Cross Reference Table

Cermet (Turning)

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

Classification	Symbol	Kyocera	Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
P (Steel)	P01	TN6010 **PV7010**	LN10 CX50	CH350	**AP25N** **VP25N** NX1010	T3N T15 **Q15**			T110A T1000A	NS520 **GT530** **GT720** **J530**	KT1120 KT125 HTX	IC20N **IC520N**
	P10	TN620 TN60 TN6010 TN6020 **PV7010** **PV720** **PV7020** **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** **PV7020** **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	TN60 TN6010 **PV7005** **PV7010**	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	Symbol	Kyocera	Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
P (Steel)	P10		SRT	WS10	STi10T		S1P		ST10P	TX10S	K2885	IC70
	P20		SRT DX30	EX35	STi20 UTi20T		SMA	S10M	ST20E	TX20 TX25	K125M	IC70 IC50M
	P30		SR30 DX30 DX35	EX35 EX40	UTi20T		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	HTi05T		H1P		H1 H2	TH03 KS05F	K68 K10	IC04
	K10	KW10 GW15	KG10 KT9	WH10	HTi10	KM1	H1P H10 HM	890	EH10 EH510	G1F TH10 H10T	KMI K8735 K313	IC20
	K20	GW25	CR1 KG20	WH20	HTi20T UTi20T	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	GTi30				G5	D40		
	V50	VW50	MH3 MH4 GD174 GD201	WH60	GTi35 GTi40 GTi30S				G6	D50		
	V60		MH5 MH7 MH8 GD206	WB60	GTi40S GTi50S				G7 G8	D60		

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
Classification	Symbol											
P (Steel)	P10	PR830 PR1025 PR1225	JC5003 JC5030 JC8003	JX1020 JP4005			GC1025 GC1010		ACP100		KC715M	
	P20	PR1525 PR830 PR1025 PR1225 PR1230	JC730U JC5015 JC5030 JC8015	JS4045 JP4020 TB6020 JX1015 GX2140	F7030 UP20M	TM1 DT4 DM4	GC1030 GC4220 GC4020 GC4030	MP1500 T250M T25M T20M	ACP200	T313W AH725	KC522M KC525M KCPM20	IC250 IC520M IC950 IC5400
	P30	PR1230	JC5015 JC5040	CY250 CY9020 TB6045 JX1045 JM4060 GX2160	F7030 VP15TF VP30RT	ZM3	GC4040 GC4230	MP2500 T250M T25M F25M F30M	AC230 ACP300	T3130 GH330 AH120 AH330 AH730	KC994M KC725M KC792M KC530M KCPK30	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			GC1025 GC1030		EH10Z		KC522M	
	M20	PR1525 PR1025 PR1225	JC730U JC1341 JC5015 JC5030 JC5040 JC7560	JM4160 JM4060 CY150 TB6020 JX1015 CY250	F7030 UP20M VP15TF VP20RT MP7030 MP7130	DT4 DM4	GC2030	MP2500 T250M T25M F20M F25M F30M	ACP200 EH20Z	GH330 AH330 AH120 AH130 AH725	KC730M KC525M	IC908 IC928
	M30	CA6535 PR1535	JC5015 JC5030 JC5040	TB6045 JX1045 GX2160	F7030 VP30RT MP7140	ZM3	GC1040 GC2040	T350M T250M F40M	ACP300 ACZ350	T3130 AH130	KC994M KC725M KCPK30	IC328 IC330
	M40		JC8050		VP30RT			MM4500	ACZ350	AH140		IC830
K (Cast Iron)	K01		JC8003	TB6005				MH1000		AH110		IC4100
	K10	PR1510 PR905 PR1210	JC600 JC610 JC605W	JP4005 CY10H CY100H CY9020	MP8010 MC5020 VP10RT		GC1010 GC3220 K15W	MK1500 T150M F15M	ACK200 AC211	T1015 T1115 AH110	KCK15 KC915M	IC4010 IC910 DT7150
	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	IC910 IC928
	K30		JC5080				GC3040 GC4040	MK3000 T250M		GH130	KC930M	IC928

Cermet (Milling)

Classification		Kyocera	Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Classification	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							

R

Technical Information

Insert Grades Cross Reference Table

Ceramic

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

Classification	Symbol	Kyocera	Dijet	Nippon Tungsten	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
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** Whiskal 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	WG300 FX105 CX710	KYK35 **KY3400** KY3500	
S (Difficult-to-Cut Material)	S01						CC650				KY2100	
	S10	CF1 KS6030 KS6040	CA200	Whiskal WIN		WA1 WA5 SX9	CC670 CC6060 CC6065		WX120	WG300	**KYS25** KY4300 KY1525 KY1540	
	S20								WX120		KYS30	
H (Hard Materials)	H01	A65 KT66 **A66N** **PT600M**		NPC-A2		HC4 HC7 **ZC7**	CC650 CC670 CC6050		**NB100C**	LX11 LX21	**KY4400**	
	H10	A65 KT66 **A66N** **PT600M**		NPC-A2 Whiskal WIN		**ZC7** WA1 WA5	CC670			WG300	KY4300	

· **Boldface grade** shows PVD Coated Ceramic.

CBN

Classification	Symbol	Kyocera	Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
K (Cast Iron)	K01	KBN475	JBN795		MB710	B20 B22 B30	CB7525 CB50 CB7050	**CBN050C** **CBN300P**	BN500 **BNC500**	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 (Hard Materials)	H01	KBN510 **KBN05M** **KBN10M**			**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**	JBN300 JBN500	BH200	**MBC020** **BC8020** MB8025 MB825	B24 B36 B54 B52	CB7015 CB7050 CB50	CBN150 CBN060K CBN200 **CBN160C**	**BNC160** BNX20 BN2000 **BNC200** **BNC2020**	**BXM10** BXA40 BX330 BX360 **BXC50**	KB1615 KB1625 KB5610 **KB9610**	IB50
	H20	**KBN30M** **KBN35M** **KBN900**	JBN245	BH250	**MBC020** **BC8020** MB8025	B22 B36	CB7025 CB7525	CBN350 **CBN300P** **CBN400C** CBN500	BNX25 BN350 **BNC300**	BX380 **BXC50** **BXM20**	KB1340 **KB5625** **KB9640**	IB55 **IB25HA**
Sintered Steel	-	KBN65B KBN570 **KBN65M** **KBN70M**	JBN795 JBN500		MB4020				BN350 BN7000 BN7500	BX450 BX470 BX480		

· **Boldface grade** shows PVD Coated CBN.

PCD

Classification	Symbol	Kyocera	Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
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		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	

Molded Chipbreaker Cross Reference Table

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

Negative 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	Finishing (With Wiper Edge)	WP	-	-	-	SW	-	WL WF	W-MF2	LUW	AFW	FW	-
	Finishing - Medium (With Wiper Edge)	WQ	-	-	-	MW	-	WM WMX	W-M3 W-M5	GUW	ASW	MW	WG
	Finishing	DP GP PP VF	XF XP XP-T	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	XQ	UA UT	AB B CE CT	SH C SA LP SY	WV WR	LC PF	FF2 MF2	SU EX GU SK SJ SX UJ SE	TS NS CB 11 17 27 ZF	RP FN	NF
	Medium - Roughing	PG GS HS PS	XS	UR UB	AE DE AH	MV MP MA MH	Z5 ZW1	XM QM SM SMC PM	M3 MF3	UA UG GE	NM DM TM ZM	MN	M3P TF
	Medium - Roughing High Feed Rate	PT GT HT	-	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	PR MG	GN
	Roughing One Side High Feed Rate	PX	-	GS RM UC UP	H HX HE TE UE	HV HX HZ HXD	-	QR PR HR	R4 R5 R6 R7 RR6 RP	HG HP MP	TU 57 65	RH RM	TNM
Stainless Steel	Finishing	GU MQ	-	SF	BH MP	FS SH FJ LM	ZF1	MF	-	SU	SF SS	FP	-
	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	EX MU UP EM	HMM SM SA S SH	P MP MS	TF PP M3M
Cast Iron	Medium	C Standard	-	-	AH VA VY	LK MF Standard	-	KF KM	-	UZ UX UJ	Standard 33 CF	FN	-
	Roughing	GC ZS	-	-	-	GH RK	-	KR KRR	-	GZ	CM CH	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 ap	CF	-	-	-	-	-	-	-	-	01	-	-
	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	-	MF MMC	-	LU	PF PSF	FW FP MW	WF
Non-ferrous Metals	Finishing - Medium	AH	-	ALU	-	AZ	-	AL	AL	AG AW	AL	HP	AF AS

Positive Inserts (For Automatic Lathe)

Cutting Range		Kyocera	Dijet	Hitachi	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Carbon Steel / Alloy Steel	Minute ap	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

Milling Insert Description Cross Reference Table

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

Kyocera	Class	Applications	Hitachi	Mitsubishi	Sandvik	Sumitomo	Tungaloy	Iscar
SDMR1203AUER-H **SDKR1203AUEN-S**	M K	Steel	SDKR42TN	(SDNR1203AEEN-JS)		SDMR1203AEEN SDMR1203AETN	SDMR1203AETN-MJ SDKR1203AESR-MJ SDKR1203AETN-MJ SDKR1203AEPN-MS SDKR42ZSR-MJ SDKR42ZPN-MS	SDKR1203AUTR-HS SDKR1203AUN-76
SDCN1203AUTN	C		(SDE42TN-C9)				SDCN1203AETN-12 SDCN42ZTN (SDEN1203AETNCR) (SDEN42ZTNCR)	
SDKN1203AUTN	K		SDK42TN-C9	SDKN1203AEN SDKN1203AETN (SDNN1203AETN1)		SDKN42MT (SDNN1203AETN)	SDKN1203AETN-12 SDKN42ZTN	SDKN1203AETN
SDKN1203AUFN	K	Cast Iron	SDK42FN-C9			SDKN42M (SDNN1203AEEN)	SDKN1203AEFN-12 SDKN42ZFN	
		Non-ferrous Metals				SDKN42M	(SDCN1203AEFN-D) (SDCN42ZFN-DIA)	
SDCN1504AUTN	C	Steel	SDC53TN-C9				SDCN1504AETN SDCN53ZTN	
SDKN1504AUTN	K		SDK53TN-C9	SDKN1504AEN SDKN1504AETN		SDKN53MT	SDKN1504AETN SDKN53ZTN	SDKN1504AETN
SEMR1203AFER-H **SEKR1203AFEN-S**	M K	Steel	SEKR42TN	(SEER1203AFEN-JS)	SEKR1203AZ-WM (SEER1203AZ-WL)	SEMR1203AFEN (SEER1203AFEN)	SEMR1203AFTN-MJ SEKR1203AFSR-MJ SEKR1203AFTN-MJ SEKR1203AFPN-MS	SEKR1203AFTR-HS SEKR1203AFR-HS SEKR1203AFN-76 SEKR1203AFN-42
SEMR1204AFER-H	M				(SEKR1204AZ-WM) (SEER1204AZ-WL)	SEMR1204AFEN (SEER1204AFEN)		(SEKR1204AFTR-HS) (SEKN1204AFTN)
SEEN1203AFTN	E		SEE42TN-C9	SEEN1203AFTN1		SEEN42MT	SEEN1203AFTNCR-14	
SEKN1203AFTN	K		SEK42TN-C9	SEKN1203AFTN1 (SENN1203AFTN1)	SEKN1203AZ (SEMN1203AZ)	SEKN42MT (SENN1203AFTN)	SEKN1203AFTN SEKN1203AFTN-16 SEKN42AFTN SEKN42AFTN16	
SEKN1203AFFN	K	Cast Iron	SEK42FN-C9	(SEEN1203AFFN1)	SEKN1203AZ (SEMN1203AZ)	SEKN42M (SENN1203AFEN)	SEKN1203AFFN SEKN42AFFN	
SEEN1203AFFN	E	Non-ferrous Metals	SEE42FN-C9	(SECN1203AFFR1)				
SEKN1203EFTR	K	Steel	SEK42TR-G3	SEKN1203EFTR1	(SECN1203EER)		SEKN1203EFTR (SECN1203EFTR) (SEEN1203EFTR) (SECN42EFTRCR) (SEEN42EFTRCR)	
SEKN1504AFTN	K	Steel	SEK53TN-C9		SEKN1504AZ	SEKN53MT		SEKN1504AFTN
SPEN1203EESR	E	Cast Iron	(SPK42FR-A3E)	SPEN42EFSR1 SPEN1203EESR1 SPEN1203EEER1 (SPNN1203EEER1)				
SPMR1203EDER-H **SPKR1203EDER-S**	M K	Steel		(SPER1203EDER-JS)	SPKN1203EDR-WH		SPKR1203EDSR-MJ SPKR42SSR-MJ	SPKR1203EDR-76 SPKR1203EDTR-HS
SPCN1203EDTR	C				(SPAN1203EDR)	SPCH42TR-R	SPCN1203EDTR SPCN42STR	
SPKN1203EDTR	K		SPK42TR-A3	SPKN1203EDR	SPKN1203EDR	(SPCH42TR) (SPCH42TR-R)	SPKN1203EDTR SPKN42STR (SPEN1203EDTR) (SPEN42STR)	SPKN1203EDTR SPKN1203EDTR-42
SPKN1203EDFR	K	Cast Iron	SPK42FR-A3		SPKN1203EDR	(SPCH42R)	SPKN1203EDFR SPKN42SFR	SPKN1203EDFR
SPKN1504EDTR	K	Steel	SPK53TR-A3	SPKN1504EDR	SPKN1504EDR	(SPCH53TR-R)	SPKN1504EDTR SPKN53STR (SPCN1504EDTR) (SPCN53STR)	SPKN1504EDTR
SPKN1504EDFR	K	Cast Iron	SPK53FR-A3			(SPCH53R-R) (SPCH53TR-R)	SPKN1504EDFR SPKN53SFR	SPKN1504EDFR

Note 1. Tolerance is different for description in ( ).
2. Since edge shape of Milling insert is slightly different by each maker, please adjust edges (Z axis direction) during operation.

Milling Insert Description Cross Reference Table

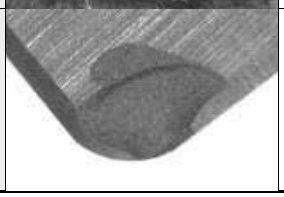
·This table is Kyocera's own estimation based on publications and is not authorized by companies mentioned in it.

Kyocera	Class	Applications	Hitachi	Mitsubishi	Sandvik	Sumitomo	Tungaloy	Iscar
SPCN1203XPTR	C	Steel	SPC42TR-A5				SPCN1203ZPTR SPCN42ZTR	
SPKN1203XPTR	K		SPK42TR-A5				SPKN1203ZPTR SPKN42ZTR (SPEN1203ZPTR) (SPEN42ZTR)	
SPKN1203XPFR	K	Cast Iron	SPK42FR-A5				SPKN1203ZPFR SPKN42ZFR	
SPKN1504XETR	K	Steel		SPK53C2SR				
TPMR1603PDER-H	M	Steel		(TPER1603PPER-JS)	(TPKN1603PPR-WH)			(TPKR1603PPTR-HS)
TPKN1603PDTR	K		TPK32TR-E0 TPK32TR-G0	TPKN1603PPR	TPKN1603PPR	TPKN32TR		TPKN1603PPTR
TPKN1603PDFR	K	Cast Iron			TPKN1603PPR	TPKN32R		TPKN1603PPFR
TPMR2204PDER-H **TPKR2204PDER-S**	M K	Steel		(TPER2204PDER-JS)	TPKN2204PDR-WH		TPMR2204PDSR-MJ TPKR2204PDSR-MJ TPKR43ZSR-MJ	TPKR2204PDTR-HS TPKR2204PDR-76
TPKN2204PDTR	K		TPK43TR-E0 TPK43TR-G0	TPKN2204PDR	TPKN2204PDR	(TPCH43TR)	TPKN2204PPTR TPKN43ZTR (TPCN2204PPTR) (TPCN43ZTR)	TPKN2204PDTR TPKN2204PDTR-42
TPKN2204PDFR	K	Cast Iron	TPK43FR-E0		TPKN2204PDR	(TPCH43R)	TPKN2204PPFR TPKN43ZFR (TPCN2204PPFR) (TPCN43ZFR) (TPEN2204PPTR-16) (TPEN43ZTR)	TPKN2204PDFR
TEMR1603PTER-H	M	Steel		(TEER1603PEER-JS)			(TEKR1603PEPR-MS)	
TEKN1603PTTR	K		TEK32TR-G0 (TEE32TR-G0)	(TEEN1603PETR1)		TEKN32TR	(TECN1603PETR) (TEEN1603PETR) (TECN32ZTR) (TEEN32ZTR)	
TEKN1603PTFR	K	Cast Iron	TEK32FR-G0 (TEE32FR-G0)	(TEEN1603PEFR1)		TEKN32R	(TEEN1603PEFR) (TEEN32ZFR)	
TEEN1603PTFR	E	Non-ferrous Metals		(TECN1603PEFR1)		TEEN32R	(TECN1603PEFR-D) (TECN32ZFR-DIA)	
TEMR2204PTER-H **TEKR2204PTER-S**	M K	Steel		(TEER2204PEER-JS)			TEKR2204PEPR-MS	
TEEN2204PTTR	E		(TEK43TR-G0E)	TEEN2204PETR1		TEEN43TR	TEEN2204PETR (TECN2204PETR) TEEN43ZTR (TECN43ZTR)	
TEKN2204PTTR	K		TEK43TR-G0E	TEKN2204PETR1		TEKN43TR	(TEEN2204PETR) (TECN2204PETR) (TEEN43ZTR) (TECN43ZTR)	
TEKN2204PTFR	K	Cast Iron	TEK43FR-G0E	(TEEN2204PEFR1)		TEKN43R	(TEEN2204PEFR) (TEEN43ZFR)	
		Non-ferrous Metals		(TECN2204PEFR1)		(TEEN43R)	(TECN2204PEFR-D) (TECN43ZFR-DIA)	
SNCN1204XNTN	C	Steel	SNC43TN-D5	SNC43B2S		(CSN43MT)	SNCN1204ZNTN SNCN43ZTN	
SNKN1204XNTN	K		SNK43TN-D5	SNK43B2S		(CSN43MT)	SNKN1204ZNTN SNKN43ZTN	
SNCN1204ENTN	C	Steel		(SNKN1204EN)	(SNKN1204ENN)			
SNMF1204XNTN	M	Steel	(SNKF43TN-D5)	(SNKF43B2S)		(CSNB43MT)	(SNKF1204ZNTN) (SNKF43ZFN)	

Note 1. Tolerance is different for description in ( ).

2. Since edge shape of Milling insert is slightly different by each maker, please adjust edges (Z axis direction) during operation.

Cutting Edges Figuration and Countermeasures

Typical Cutting Edge Figuration		Observation	Causes	Countermeasures
Nose wear		· Deterioration of surface roughness and dimensional accuracy	· Too high Vc · End of tool life	· Reduce Vc · Change to higher wear resistant grade
Notching		· Burr formation · Cutting force increase	· Too high f and Vc	· Sharper cutting performance · Reduce Vc · Change to higher heat resistant grade
Crater wear		· Chip control deterioration · Surface finish deterioration (peeled surface)	· Too high Vc	· Reduce Vc · Change to high speed type like Cermet or Al_2O_3 coated insert grade
Plastic Deformation		· Workpiece dimension's change · Crack at nose	· Too high cutting load · Inappropriate tool grade	· Change to harder grade · Reduce f and ap
Crack from Wear		· Surface finish's sudden deterioration · Workpiece dimension changes	· Too high Vc	· Change the tool earlier · Change to higher wear resistant grade
Chipping		· Cutting force increase · Surface roughness deterioration	· Too high f · Chattering · Lack of insert toughness	· Reduce f and ap · Change to more rigid toolholder · Change to tougher grade
Crack from Welding or Built-up Edge		· Surface finish deterioration · Cutting force increase	· Too low Vc	· Increase Vc · Improve sharp cutting performance (rake angle, chamfer)
Mechanical Fracture		· Sudden cracking · Unstable tool life	· Too high f and ap · Chattering	· Change to tougher grade · Enlarge chamfer · Enlarge Corner-R(r_ε) · Change to more rigid toolholder
Fracture from Thermal Crack		· Cracking by heat cycle · Possible in interrupted machining and milling	· Too high Vc and f	· Reduce f · Reduce Vc · Change to dry cutting
Flaking		· Possible in high-hardness material machining · Possible in machining with chattering	· Lack of insert toughness · Lack of toolholder's rigidity	· Change to tougher grade (TiC-base ceramic to CBN.) · Change to more rigid toolholder · Change edge preparation

Turning

Trouble	Trouble Item	Countermeasures	Change to Harder Grade	Change to Tougher Grade	Change to More Thermal Shock Resistant Grade	Change to More Welding Resistant Grade	Vc	f	ap	Tool Path Review	Coolant: Wet	Coolant: Dry	Chipbreaker Review	Rake Angle	Corner-R (rε)	Approach Angle	Edge Strength / Honing	Change to Higher Tolerance (M→G)	Toolholder Rigidity	Workpiece / Tool Installation	Overhang Length	Power, Rigidity
		Check Item	Insert Grades				Cutting Conditions						Tool geometry							Setting		Machine
							Higher (Larger) ↑ Lower (Smaller) ↓						Larger ↑ Smaller ↓									
Unstable Dimension	Unstable Workpiece Dimension	Unsuitable Insert Tolerance																●				
		Tool and Workpiece Evacuation											●	●↑	●↓	●↓			●	●	●	●
	Frequent Offset during Machining	Flank Wear Increase	●												●↑							
		Unsuitable Cutting Conditions					●↓	●↑														
		Built-up Edge				●	●↑															
Surface Roughness	Poor Surface Roughness	Poor Cutting by Tool Wear	●			●	●↓				●		●	●↑	●↑		●↓	●				
		Chipping		●				●↓	●↓				●		●↑		●↑			●	●	●
		Welding, Built-up Edge				●	●↑				●		●	●↑			●↓	●				
		Unsuitable Cutting Conditions					●↑	●↓	●↓		●											
		Unsuitable Insert Grades and Tool Geometry											●		●↑		●↓	●				
		Vibration, Chattering		●			●↓	*1 ●↓	●↓				●	●↑	●↓	●↓	●↓		●	●	●	●
Heat	Deterioration of Accuracy or Tool Life by Cutting Heat	Unsuitable Cutting Conditions					●↓	●↓	●↓		●											
		Unsuitable Tool Geometry	●										●	●↑			●↓					
Burr, Workpiece Chip Off and Scuffing	Burr	Unsuitable Cutting Conditions					●↓	●↑		●	●											
		Unsuitable Insert Grades and Tool Geometry	●										●	●↑	●↓	●↓	●↓					
	Workpiece Chip Off	Unsuitable Cutting Conditions						●↓	●↓	●												
		Unsuitable Insert Grades and Tool Geometry	●										●	●↑	●↑	●↑	●↓		●	●	●	●
	Scuffing	Unsuitable Cutting Conditions					●↑	*2 ●↓			●											
		Unsuitable Insert Grades and Tool Geometry	●			●							●	●↑			●↓					
Edge Damage	Wear Increase at Relief Face, Rake Face	Flank Wear	●				●↓				●		●	●↑	●↑		●↓					
		Rake Face Wear	●				●↓	●↓	●↓		●		●	●↑		●↑						
	Notching	Notching				●	●↓				●											
	Chipping	Vibration, Chattering		●				●↓	●↓				●			●↑	●↑		●	●	●	●
	Crack	Unsuitable Insert Grades and Cutting Conditions		●	●			●↓	●↓				●		●↑	●↑	●↑		●	●	●	●
	Thermal Crack	Work Hardness, Unsuitable Insert Grades and Cutting Conditions			●		●↓	●↓	●↓			●	●	●↑			●↓					
	Edge Nose Deformation	Edge Nose Deformation during Interrupted machining	●				●↓	●↓	●↓				●	●↓	●↑	●↑	●↑					
	Built-up Edge	Work Hardness, Unsuitable Insert Grades and Cutting Conditions				●	●↑	●↑			●		●	●↑			●↓	●				
Chip Control	Long, Tangling Chips	Unsuitable Cutting Conditions					*3 ●↓	●↑	●↑	●		●										
		Unsuitable Tool Geometry											●		●↓	●↓						
	Chips scattering	Unsuitable Cutting Conditions						●↓	●↓			●										
		Unsuitable Tool Geometry											●		●↑	●↑						

*1) To prevent chattering, the higher f may be suitable.

*2) To prevent scuffing, the higher f may be suitable.

*3) When using X-chipbreaker insert for soft steel and low carbon steel, the higher Vc cuts chips short.

Milling

Trouble	Trouble Item	Countermeasures	Change to Harder Grade	Change to Tougher Grade	Change to More Thermal Shock Resistant Grade	Change to More Welding Resistant Grade	Vc (Higher (Larger) ↑ Lower (Smaller) ↓)	fz (Higher (Larger) ↑ Lower (Smaller) ↓)	ap (Higher (Larger) ↑ Lower (Smaller) ↓)	Cutter Dia. Cutting Width Review	Tool Path Review	Coolant: Usage of Mist	Coolant: Dry	Insert with Chipbreaker	Relief Angle (Larger ↑ Smaller ↓)	Corner Angle (Larger ↑ Smaller ↓)	Edge Strength / Honing (Larger ↑ Smaller ↓)	Number of insert (↑ More Less ↓)	Chip pocket (↑ Larger Smaller ↓)	Wiper Edge (Relief Angle) Review	Insert Runout Check	Cutter Rigidity	Workpiece / Tool Installation	Overhang Length	Machine: Power, Rigidity
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 ●			●	●↑	●↓	●↓	●↓				●	●	●	●
	Damaging Chips	Unsuitable Cutting Conditions					●↑	*3 ●↓		●		*6 ●	●												
		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 Endmilling.
*5) If the surface is warped by cutting heat.
*6) Compressed air is recommended.

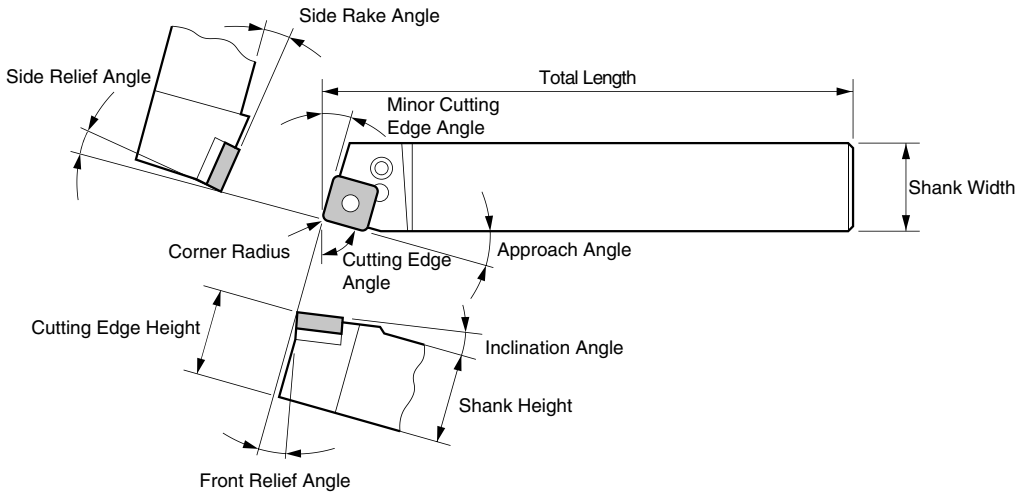
Drilling

Trouble	Trouble Item	Check Item / Countermeasures	Insert Grades: Change to Harder Grade	Insert Grades: Change to Tougher Grade	Cutting Conditions: Vc (Higher (Larger) ↑ Lower (Smaller) ↓)	Cutting Conditions: f (Higher (Larger) ↑ Lower (Smaller) ↓)	Cutting Conditions: Coolant Discharge Condition	Tool geometry: Chipbreaker Review	Tool geometry: Inner Edge's Center Height Check (Core Dia. Check) (Larger ↑ Smaller ↓)	Tool geometry: Tool Rigidity Improvement (Short Type)	Setting: Workpiece / Tool Installation	Setting: Insert Installation	Setting: Offset Check	Setting: Adjustable Sleeve Usage	Machine: Power, Rigidity
Edge Damage	Unusual Wear	Unsuitable Cutting Speed (too high)	●		●↓										
		Unsuitable Cutting Speed (too low)		●	●↑										
		Unsuitable Coolant Discharge					●								
		Poor Rigidity of Machine / Workpiece									●				●
		Small Hole Dia.											*1 ●	●	
		Unsuitable Tool Grade	●												
	Inner Edge Cracking	No core, Too Small Core							●↑						
		Poor Rigidity of Machine / Workpiece								●	●				●
		Unstable Drilling Start				●↓									
		High Hardness Workpiece	●		●↓	●↓									
		Clogged Chips			●↑				●↓						
		Unstable Insert Installation										●			
	Outer Edge Cracking	Poor Rigidity of Machine / Workpiece									●				●
		Unstable Drilling Start				●↓									
		High Hardness Workpiece	●		●↓	●↓									
		Poor Chip Control		●	●↑										
		Unstable Insert Installation										●			
Toolholder, Others	Scratches on Tool Body	Poor Rigidity of Machine / Workpiece									●				●
		Inaccurate Tool Installment											*1 ●	●	
		Clogged Chips			●↑	●↓									
		Unstable Drilling Start				●↓									
	Poor Hole Dia. Accuracy / Surface Finish	Poor Rigidity of Machine / Workpiece									●				●
		Poor Rigidity of Toolholder								●		●			
		Inaccurate Tool Installment											*1 ●	●	
		Clogged Chips			●↑	●↓			●↓						
		Large Core Dia.							●↓						
		Unstable Drilling Start				●↓									
		Unsuitable Coolant Discharge					●								
	Large Vibration / Chattering	Unsuitable Cutting Conditions, Installation			●↑	●↓				●	●				●
	Long Chips	Unsuitable Cutting Conditions			●↑										
		Unsuitable Chipbreaker						●							
	Machine Failure	Lack of Machine Power			●↓	●↓		●							●

*1) For lathe operation

Terms and Angles of Toolholder

Terms and Angles of Turning Toolholder



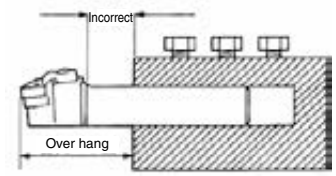
Function of Tool Angle

Tool Angle	Name	Function	Effect
Rake Angle	Side Rake Angle	· Affects cutting force, cutting heat, chip evacuation and tool life.	· If it is positive (+) angle, sharper cutting performance is obtained. (less cutting force, less edge strength) · Positive (+) angle is recommended for easy to machine workpieces or thin workpieces. · Smaller rake angle or negative (-) angle is recommended when a stronger edge is required like scale machining or interrupted machining.
	Inclination Angle		
Relief Angle	Front Relief Angle Side Relief Angle	· Prevents the tool's contact to the workpiece surface, except the cutting edge.	· When it is small, the cutting edge becomes strong, but the wear at relief faces may shorten the tool life.
Cutting Edge Angle	Cutting Edge Angle	· Affects chip control and the direction of cutting force.	· When it is large, chip thickness becomes thick and chip control improves.
	Approach Angle	· Affects chip control and the direction of cutting force.	· When it is large, chip thickness becomes thin and chip control worsens, but cutting force is dispersed and edge strength improves. · When it is small, chip control ability improves.
	Minor Cutting Edge Angle	· Prevents friction between cutting edge and workpiece surface.	· When it is large, edge strength deteriorates.

Toolholder Rigidity

1. Flexure of Toolholder

$$\delta = \frac{4 \times F \times L^3}{E \times b \times h^3} = \frac{4 \times k \times ap \times f \times L^3}{E \times b \times h^3}$$



Symbol	Name	Unit
δ(Delta)	Deflection	mm
b	Shank Width	mm
h	Shank Height	mm
E	Young ratio	N/mm^2
ap	Depth of Cut	mm
f	Feed Rate	mm/rev
k	Specific cutting force	N/mm^2
L	Over hang	mm
F	Cutting force	N

(F = k × ap × f)

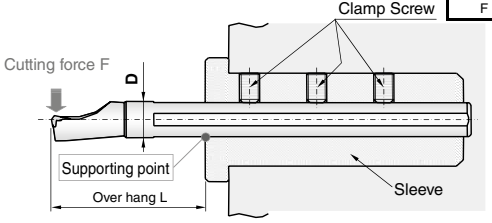
The flexural strength of toolholder will decrease by increasing of shank height by third root and will decrease of reducing over hang by third root. Minimizing toolholder shank over hang as much as possible is important as well as shank's sectional square measure.

2. Flexure of Boring Bar

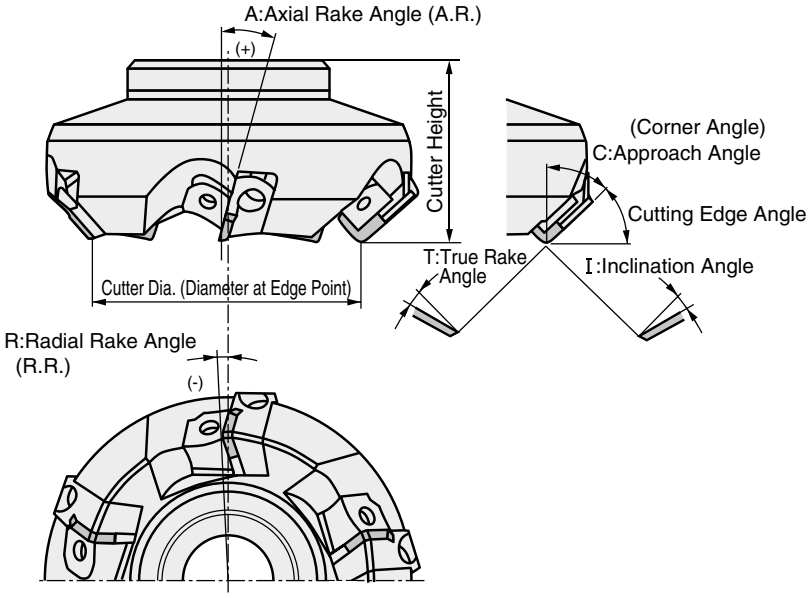
$$\delta = \frac{64 \times F \times L^3}{3 \times E \times \pi \times D^4} = \frac{64 \times k \times ap \times f \times L^3}{3 \times E \times \pi \times D^4}$$

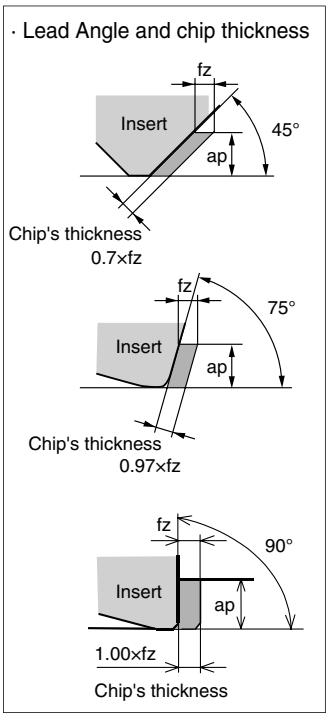
Symbol	Name	Unit
δ(Delta)	Deflection	mm
D	Shank Dia.	mm
E	Young ratio	N/mm^2
ap	Depth of Cut	mm
f	Feed Rate	mm/rev
k	Specific cutting force	N/mm^2
L	Over hang	mm
F	Cutting force	N

(F = k × ap × f)



Terms and Angles of Milling Cutter





Function of Tool Angle

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

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

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

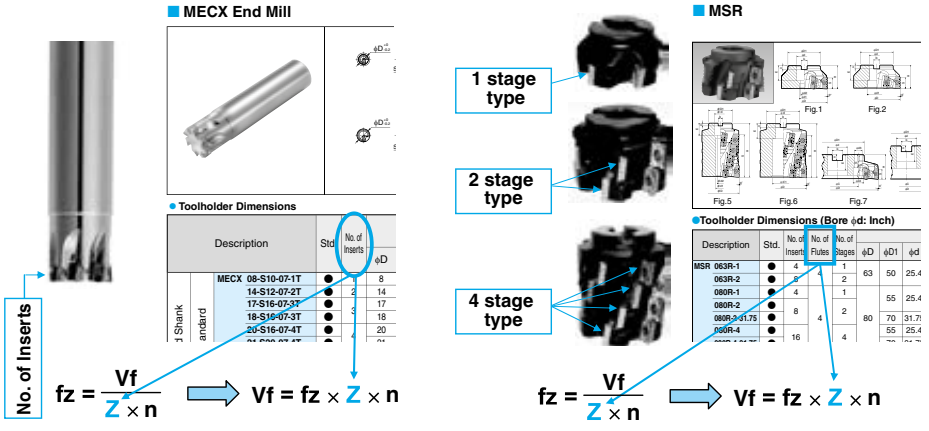
Notes: Number of inserts (Z)

1) If the number of stage is one

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



Turning

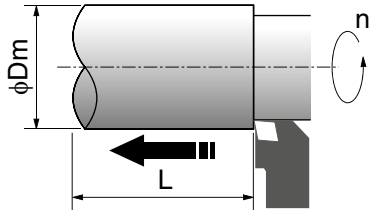
Cutting speed

$$Vc = \frac{\pi \times Dm \times n}{1{,}000}$$

Vc : Cutting speed [m/min]

Dm : Workpiece Dia. [mm]

n : Spindle Revolution [min^{-1}]



Power Requirement

$$Pc = \frac{Ks \times Vc \times ap \times f}{6{,}120 \times \eta}$$

$$P_{HP} = \frac{Ks \times Vc \times ap \times f}{4{,}500 \times \eta}$$

Pc : Power Requirement [kW]

P_{HP} : Power Requirement (Horse Power) [HP]

Vc : Cutting speed [m/min]

ap : Depth of Cut [mm]

f : Feed Rate [mm/rev]

Ks : Specific Cutting Force [kgf/mm^2]

η : Mechanical Efficiency (0.7~0.8)

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

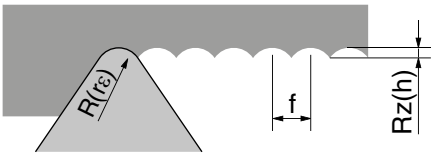
Theoretical Surface Roughness

$$Rz(h) = \frac{f^2}{8 \times R(r\varepsilon)} \times 1{,}000$$

Rz(h): Theoretical Surface Roughness [μm]

f : Feed Rate [mm/rev]

R(rε): Corner Radius of Insert [mm]



Chip Removal Volume

$$Q = Vc \times ap \times f$$

Q : Chip Removal Volume [$cm^3/min=cc/min$]

Vc : Cutting speed [m/min]

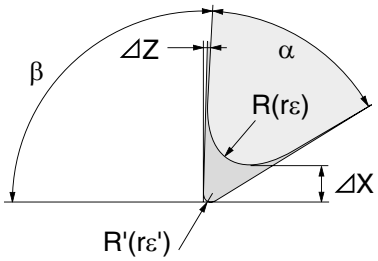
ap : Depth of Cut [mm]

f : Feed Rate [mm/rev]

Edge Position Compensation

$$\Delta X = (R-R') \times \left\{ \frac{\cos\left(\frac{\alpha}{2} + (\beta - 90°)\right)}{\sin\frac{\alpha}{2}} - 1 \right\}$$

$$\Delta Z = (R-R') \times \left\{ \frac{\sin\left(\frac{\alpha}{2} + (\beta - 90°)\right)}{\sin\frac{\alpha}{2}} - 1 \right\}$$



ΔX : X-axis Direction Edge Position Compensation [mm]

ΔZ : Z-axis Direction Edge Position Compensation [mm]

R : Corner-R before Change [mm]

R' : Corner-R after Change [mm]

α : Insert Corner Angle [°]

β : Toolholder's Cutting Edge Angle [°]

Toolholder Type	Insert Corner Angle α	Cutting Edge Angle β	ΔX	ΔZ
DCLN/PCLN	80°	95°	0.100×(R-R')	0.100×(R-R')
DTGN/PTGN	60°	91°	0.714×(R-R')	0.030×(R-R')
DDJN/PDJN	55°	93°	0.866×(R-R')	0.099×(R-R')
DDHN/PDHN	55°	107.5°	0.531×(R-R')	0.531×(R-R')
DVLN/PVLN	35°	95°	2.072×(R-R')	0.273×(R-R')
DVPN/PVPN	35°	117.5°	1.351×(R-R')	1.351×(R-R')
DSBN/PSBN	90°	75°	0.225×(R-R')	-0.293×(R-R')

Example: Compensation when changing corner-R from 0.8 to 0.4, using PCLN type toolholder,
ΔX=0.100×(0.8-0.4)=0.04(mm)
ΔZ=0.100×(0.8-0.4)=0.04(mm)

Turning (Cutting Time)

Cutting Time (External Turning Case 1: 1 Pass machining)

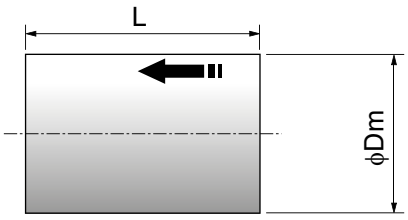
• At Constant Revolution

$$T = \frac{60 \times L}{f \times n}$$

• At Constant Cutting Speed

$$T = \frac{60 \times \pi \times L \times Dm}{1{,}000 \times f \times Vc}$$

T : Cutting Time [second]
L : Cutting Length [mm]
f : Feed Rate [mm/rev]
n : Spindle Revolution [min^{-1}]
Dm : Workpiece Dia. [mm]
Vc : Cutting speed [m/min]



Cutting Time (External Turning Case 2: Multi-Pass machining)

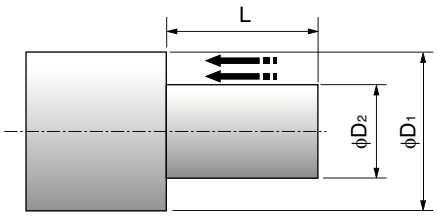
• At Constant Revolution

$$T = \frac{60 \times L}{f \times n} \times N$$

• At Constant Cutting Speed

$$T = \frac{60 \times \pi \times L \times (D_1 + D_2)}{2 \times 1{,}000 \times f \times Vc} \times N$$

T : Cutting Time [second]
L : Cutting Length per Pass [mm]
ap : Depth of Cut per Pass [mm]
f : Feed Rate [mm/rev]
n : Spindle Revolution [min^{-1}]
D_1 : Max. Dia. of Workpiece [mm]
D_2 : Min. Dia. of Workpiece [mm]
Vc : Cutting speed [m/min]
N : Number of Passes = (D1 - D2) / ap / 2
(if it is indivisible, obtain integer by rounding up one place of decimals.)



Cutting Time (Facing)

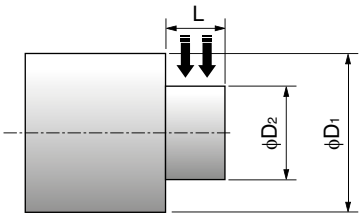
• At Constant Revolution

$$T = \frac{60 \times (D_1 - D_2)}{2 \times f \times n} \times N$$

• At Constant Cutting Speed

$$T_1 = \frac{60 \times \pi \times (D_1 + D_2) \times (D_1 - D_2)}{4{,}000 \times f \times Vc} \times N$$

T : Cutting Time [second]
T_1 : Cutting Time before reaching Max. Spindle Revolution [second]
L : Cutting Length [mm]
ap : Depth of Cut per Pass [mm]
f : Feed Rate [mm/rev]
n : Spindle Revolution [min^{-1}]
D_1 : Max. Dia. of Workpiece [mm]
D_2 : Min. Dia. of Workpiece [mm]
Vc : Cutting speed [m/min]
N : Number of Passes = L / ap
(if it is indivisible, obtain integer by rounding up one place of decimals.)



Cutting Time (Grooving)

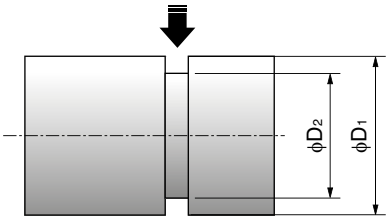
• At Constant Revolution

$$T = \frac{60 \times (D_1 - D_2)}{2 \times f \times n}$$

• At Constant Cutting Speed

$$T_1 = \frac{60 \times \pi \times (D_1 + D_2) \times (D_1 - D_2)}{4{,}000 \times f \times Vc}$$

T : Cutting Time [second]
T_1 : Cutting Time before reaching Max. Spindle Revolution [second]
L : Cutting Length [mm]
f : Feed Rate [mm/rev]
n : Spindle Revolution [min^{-1}]
D_1 : Max. Dia. of Workpiece [mm]
D_2 : Min. Dia. of Workpiece [mm]
Vc : Cutting speed [m/min]



Cutting Time (Cut-Off)

• At Constant Revolution

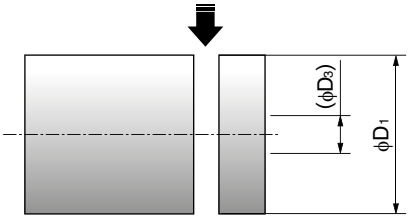
$$T = \frac{60 \times D_1}{2 \times f \times n}$$

• At Constant Cutting Speed

$$T_1 = \frac{60 \times \pi \times (D_1 + D_3) \times (D_1 - D_3)}{4{,}000 \times f \times Vc}$$

$$T_3 = T_1 + \frac{60 \times D_3}{2 \times f \times n_{max}}$$

T : Cutting Time [second]
T_1 : Cutting Time before reaching Max. Spindle Revolution [second]
T_3 : Cutting Time when reaching Max. Spindle Revolution [second]
f : Feed Rate [mm/rev]
n : Spindle Revolution [min^{-1}]
n_{max} : Max. Spindle Revolution [min^{-1}]
D_1 : Max. Dia. of Workpiece [mm]
D_3 : Diameter when reaching Max. Spindle Revolution [mm]
Vc : Cutting speed [m/min]



Basic Formulas

Milling

Cutting speed

$$Vc = \frac{\pi \times Dc \times n}{1{,}000}$$

Vc : Cutting speed [m/min]

Dc : Cutter Dia. [mm]

n : Spindle Revolution [min^{-1}]

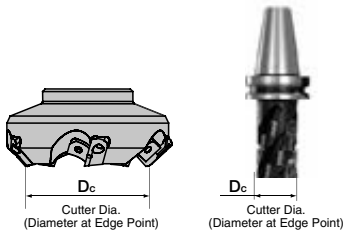


Table Feed & Feed per Tooth

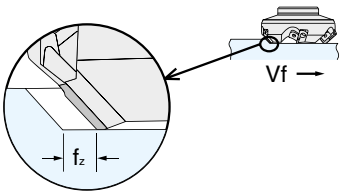
$$f_z = \frac{Vf}{Z \times n}$$

f_z : Feed per Tooth [mm/t]

Vf : Table Feed [mm/min]

Z : Number of Inserts

n : Spindle Revolution [min^{-1}]



Power Requirement

$$Pc = \frac{Ks \times Q}{6{,}120 \times \eta} = \frac{Ks \times ae \times Vf \times ap}{6{,}120{,}000 \times \eta}$$

$$= \frac{Ks \times ae \times f_z \times Z \times n \times ap}{6{,}120{,}000 \times \eta}$$

$$P_{HP} = \frac{6{,}120}{4{,}500} \times Pc$$

Pc : Power Requirement [kW]

P_{HP} : Power Requirement (Horse Power) [HP]

ae : Width of Cut [mm]

Vf : Table Feed [mm/min]

f_z : Feed per Tooth [mm/t]

Z : Number of Inserts

n : Spindle Revolution [min^{-1}]

ap : Depth of Cut [mm]

Ks : Specific Cutting Force [kgf/mm^2]

η : Mechanical Efficiency (0.7~0.8)

Q : Chip Removal Volume [cm^3/min=cc/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

$$Q = \frac{ae \times Vf \times ap}{1{,}000} = \frac{ae \times f_z \times Z \times n \times ap}{1{,}000}$$

Q : Chip Removal Volume [cm^3/min=cc/min]

ae : Width of Cut [mm]

Vf : Table Feed [mm/min]

f_z : Feed per Tooth [mm/t]

Z : Number of Inserts

n : Spindle Revolution [min^{-1}]

ap : Depth of Cut [mm]

Cutting Time

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

T : Cutting Time [second]

L' : Total Table Transfer Length [mm]
(=L+Ds+2α)

L : Workpiece Length [mm]

Ds : Cutter Dia. [mm]

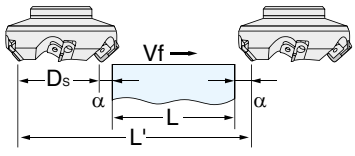
α : Idling Distance [mm]

Vf : Table Feed [mm/min]

f_z : Feed per Tooth [mm/t]

Z : Number of Inserts

n : Spindle Revolution [min^{-1}]



● True Rake Angle

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

● Inclination Angle

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

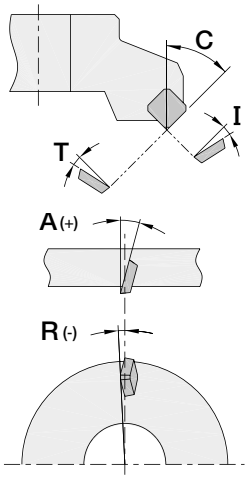
A : Axial Rake Angle (A.R.) [°] (-90°<A<90°)

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°)



● Ball-Nose End Mill Cutting Speed & Revolution

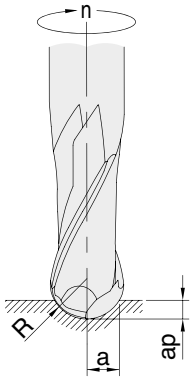
$$n = \frac{1{,}000 \times V_a}{2 \times \pi \times \sqrt{a(2R-ap)}}$$

n : Revolution [min^{-1}]

R : Radius of Ball-Nose End Mill (Ball Part's radius [mm])

ap : Depth of Cut [mm]

V_a : Cutting Speed at Point "a" [m/min]



■ Drilling

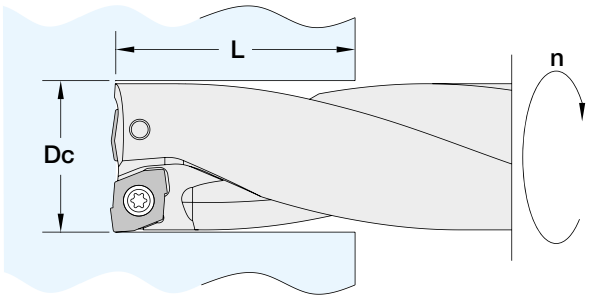
● Cutting speed

$$Vc = \frac{\pi \times Dc \times n}{1{,}000}$$

Vc : Cutting speed [m/min]

Dc : Drill Dia. [mm]

n : Spindle Revolution [min^{-1}]



● Feed Rate (Milling)

$$Vf = fz \times Z \times n$$

Vf : Table Feed [mm/min]

fz : Feed per Tooth [mm/t]

Z : No. of Inserts (Number of Insert = 1)

n : Spindle Revolution [min^{-1}]

● Cutting Time

$$T = \frac{60 \times L}{f \times n} = \frac{60 \times \pi \times Dc \times L}{1{,}000 \times Vc \times f}$$

T : Cutting Time [second]

L : Drilling Depth [mm]

f : Feed Rate [mm/rev]

n : Spindle Revolution [min^{-1}]

Dc : Drill Dia. [mm]

Vc : Cutting speed [m/min]

● Power Requirement (Reference Value)

$$Pc = \frac{Dc}{20} \times \frac{Vc}{100} \times \left(1 + \left(\frac{2.5 \times f}{0.1}\right)\right)$$

Pc : Power Requirement [kW]

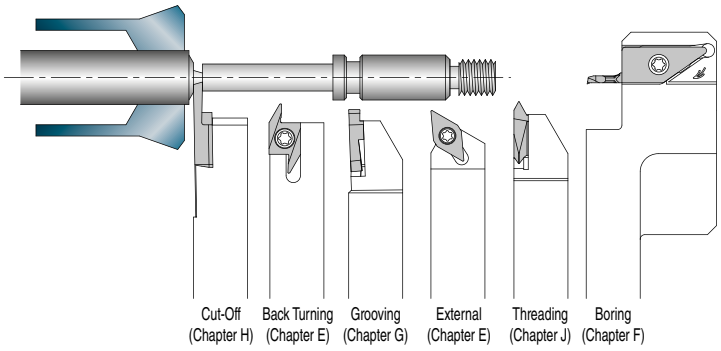
Dc : Drill Dia. [mm]

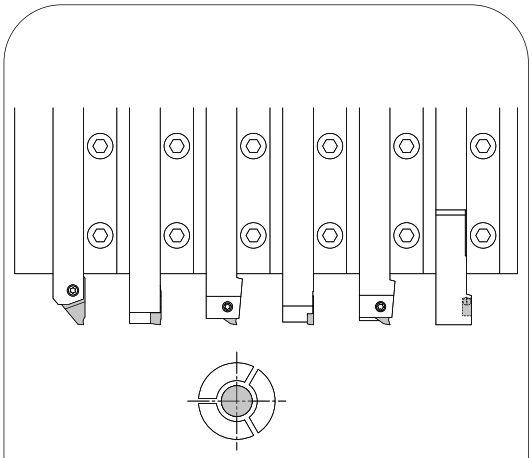
Vc : Cutting speed [m/min]

f : Feed Rate [mm/rev]

Tooling Examples of Small Tools

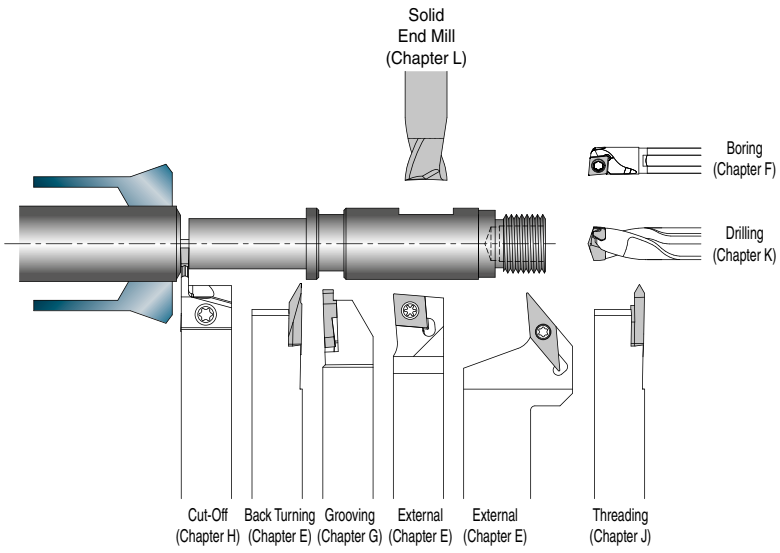
Tooling example (1) CNC Automatic lathe (Gang Type)

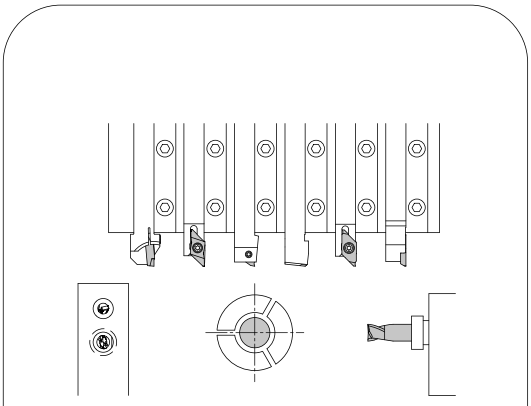




Tools installed on Gang Type Automatic Lathe

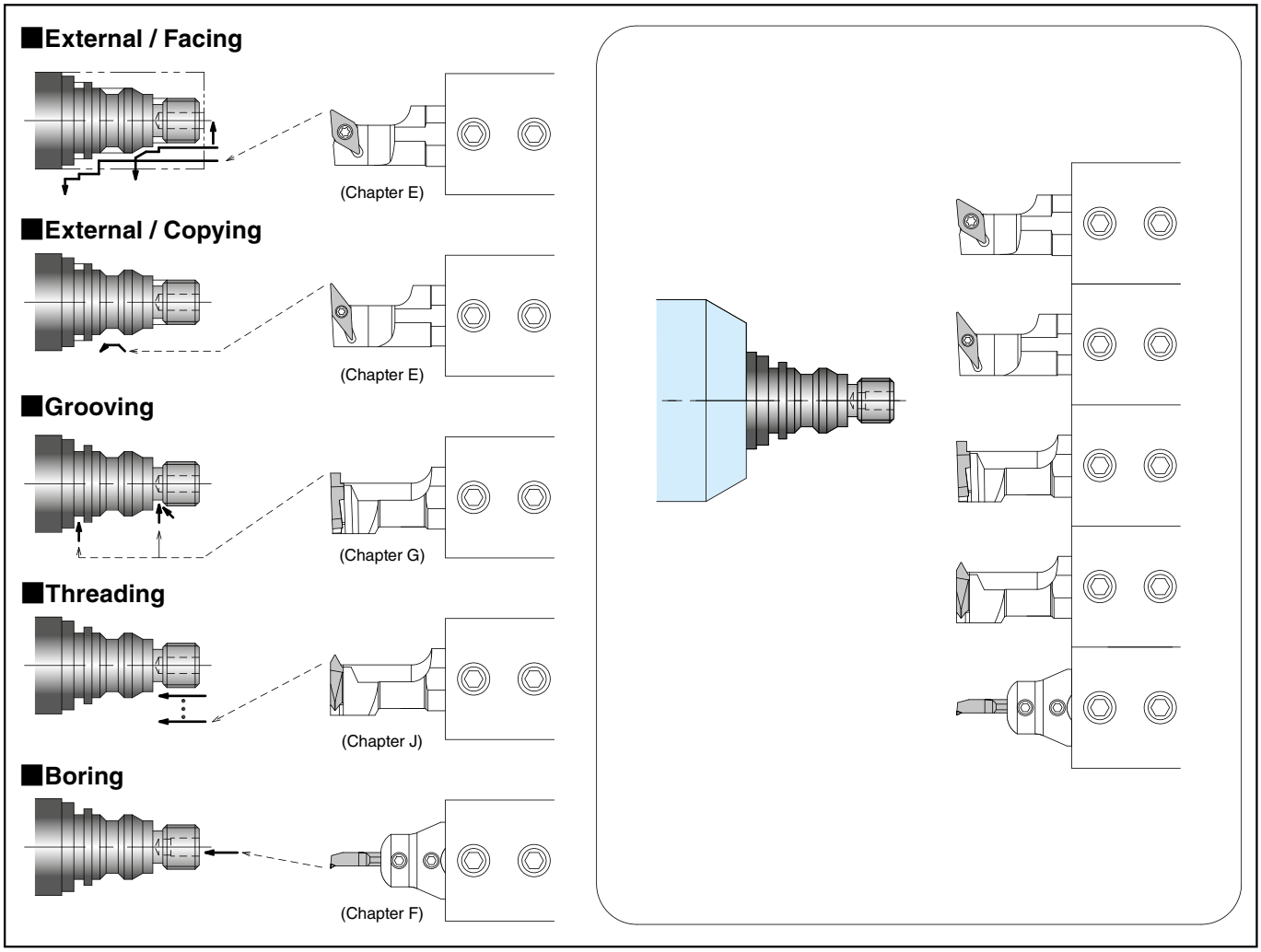
Tooling Example (2) CNC Automatic Lathe (Gang Type)



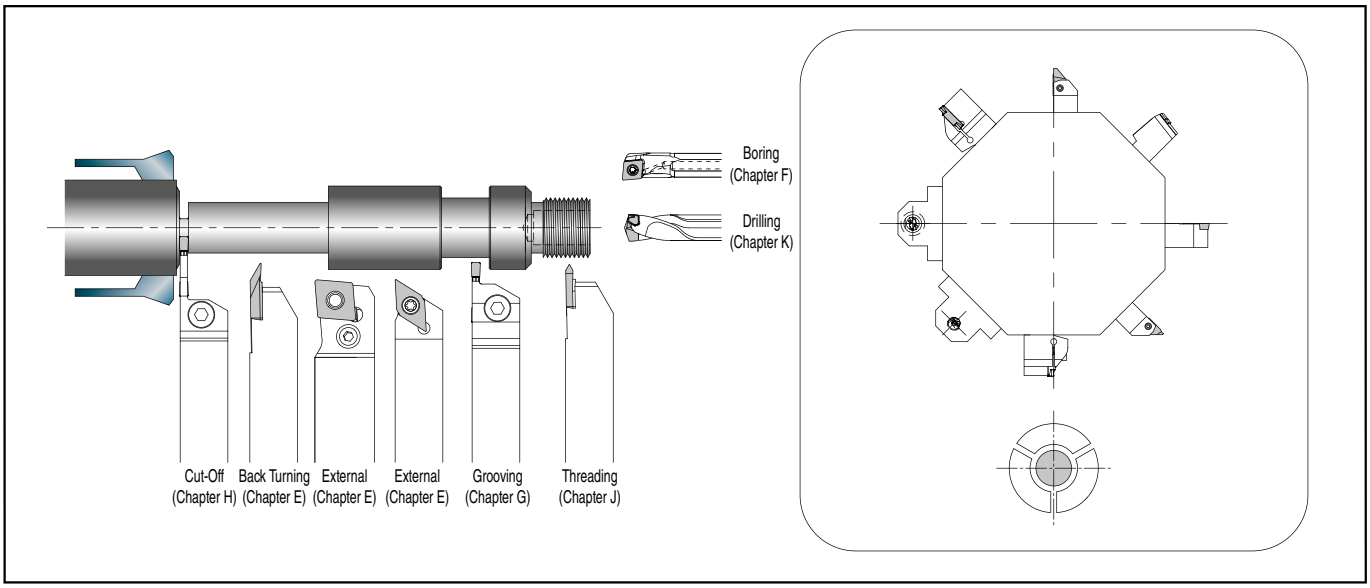


Tools installed on gang tool post + milling toolholder

Tooling Example (3) CNC Automatic Lathe (Opposed Gang Type)



Tooling Example (4) CNC Automatic lathe (Turret Type)



Ref. to Page ➡ **R34~R41** for Tooling Layout and Automatic Lathe List by Manufacturer.

Citizen Machinery (Cincom Products)

Model	Toolholder Dimensions (Gang-Type)	Number of tools	Toolholder Dimensions (Turret-Type)	Number of tools	Sleeve Dia. (Horizontal/ Opposed)	Number of tools	Max. Cutting Dia.	Remarks
A12/16	10×10×100	5			ϕ19.05 / ϕ20		ϕ12 / ϕ16	
A20	12(13)×12(13)×120 Cut-off toolholder : □16mm	6			ϕ25.4		ϕ20	
A20Ⅶ	12(13)×12(13)×120 Cut-off toolholder : □16mm	6			ϕ25.4		ϕ20	
A32	16×16×150	6			ϕ25.4		ϕ32	
B12	10×10×100	5			ϕ19.05 / ϕ20		ϕ12	
B12E/B16E	10×10×120(60)	5			ϕ19.05(ϕ20^{OP})		ϕ12 / ϕ16	
B20	12(13)×12(13)×120	6			ϕ19.05 / ϕ20		ϕ20	
BL12	10×10×60~120	5			ϕ20(ϕ19.05)		ϕ12	
BL20/25	12(13)×12(13)×120	4~7			ϕ20(ϕ19.05)		ϕ20 / ϕ25	
C12/16	10×10×120	6			ϕ19.05		ϕ12 / ϕ16	
C32	16×16×130	5			ϕ25.4		ϕ32	
E16			10×10×60	20	ϕ19.05		ϕ16	
E20			16×16×90	20	ϕ25.4		ϕ20	
E25			16×16×90	20	ϕ25.4		ϕ25	
E32			16(19)×16(13)×90	20	ϕ25.4		ϕ32	
F10			10×10×60	10	ϕ19.05		ϕ10	
F12			10×10×60	10	ϕ19.05		ϕ12	
F16			10×10×60	10	ϕ19.05		ϕ16	
F20			16(19)×16(13)×90	10	ϕ25.4		ϕ20	
F25			16(19)×16(13)×90	10	ϕ25.4		ϕ25	
FL25			16×16×90	12	ϕ16		ϕ25	
FL42			16×16×90	12	ϕ16		ϕ42	
G32			16(19)×16(19)×90	10	-		ϕ32	
K12/16	12(10)×12(10)×100	6(7)			ϕ19.05 / ϕ20		ϕ12 / ϕ16	
K12E/K16E	12×12×120	6			ϕ19.05 / ϕ20		ϕ12 / ϕ16	
L10	8×8×100~130	5			ϕ15.875		ϕ10	
L12	10×10×100	6			ϕ19.05		ϕ12	
L16	12(10)×12(10)×130	5			ϕ19.05		ϕ16	
L20,L20E	12×12×130 Cut-off toolholder : □16mm	5			ϕ19.05		ϕ20	
L20X,L220	12(13,16)×12(13,16)×120 Cut-off toolholder : □16mm	5~7			ϕ19.05 / ϕ25		ϕ20	
L25	16×16×130	5			ϕ25.4		ϕ25	
L32	16×16×130	5			ϕ25.4		ϕ32	
M$_2$12, M$_3$12	10×10×120	5	10×10×60	10+α	ϕ19.05		ϕ12	
M$_2$16, M$_3$16	10×10×120	5	10×10×60	10+α	ϕ19.05		ϕ16	
M$_2$20, M$_3$20	16×16×130	5	16×16×90	10+α	ϕ25.4		ϕ20	
M$_2$32, M$_3$32, M$_4$32	16×16×130	5	16×16×90	10+α	ϕ25.4		ϕ32	
M$_4$16	10×10×100	5	10×10×60	10+α	ϕ19.05		ϕ16	
M20	13(12)×13(12)×130	5	10×10×60	10+α	ϕ19.05		ϕ20	
MC20	12×12×120, 13×13×120	2+2+2			ϕ19.05 / ϕ31.0		ϕ20.0	
MSL12	10×10×120				-		ϕ12	
R04	8×8×120	5			ϕ15.875		ϕ4	
R07	8×8×120	5			ϕ15.875		ϕ7	
RL01	10(8)×10(8)×90				ϕ16(ϕ20)		ϕ10	
RL02	16×16×90				ϕ20		ϕ20	
RL21	10(12)×10(12)×90				ϕ19.05		ϕ35	

· Manufacturers are in no particular order.

Citizen Machinery (Miyano Products)

Model	Toolholder Dimensions (Gang-Type)	Number of tools	Toolholder Dimensions (Turret-Type)	*Number of tools	Sleeve Dia. (Horizontal/ Opposed)	Number of tools	Max. Cutting Dia.	Remarks
ABX-51SY2			20×20×125(100)	24	ϕ25	48	ϕ51	
ABX-51SYY2			20×20×125(100)	24	ϕ25	48	ϕ51	
ABX-51TH5			20×20×125(100)	36	ϕ25	72	ϕ51	
ABX-51THY2			20×20×125(100)	36	ϕ25	72	ϕ51	
ABX-64SY2			20×20×125(100)	24	ϕ25	48	ϕ64	
ABX-64SYY2			20×20×125(100)	24	ϕ25	48	ϕ64	
ABX-64TH5			20×20×125(100)	36	ϕ25	72	ϕ64	
ABX-64THY2			20×20×125(100)	36	ϕ25	72	ϕ64	
BNA-34C			20×20×125(100)	8(16)	ϕ25	24	ϕ34	
BNA-34C2			20×20×125(100)	8(16)	ϕ25	24	ϕ34	
BNA-34DHY			20×20×125(100)	14(22)	ϕ25	27	ϕ34	
BNA-34DHY2			20×20×125(100)	14(22)	ϕ25	27	ϕ34	
BNA-34S			20×20×125(100)	8(16)	ϕ25	24	ϕ34	
BNA-34S2			20×20×125(100)	8(16)	ϕ25	24	ϕ34	
BNA-42C			20×20×125(100)	8(16)	ϕ25	24	ϕ42	
BNA-42C2			20×20×125(100)	8(16)	ϕ25	24	ϕ42	
BNA-42DHY			20×20×125(100)	14(22)	ϕ25	27	ϕ42	
BNA-42DHY2			20×20×125(100)	14(22)	ϕ25	27	ϕ42	
BNA-42GTY	20×20×125(100)	3	20×20×125(100)	8(16)	ϕ25	24(7)	ϕ42	
BNA-42MSY2			20×20×125(100)	8(16)	ϕ25	24	ϕ42	
BNA-42S			20×20×125(100)	8(16)	ϕ25	24	ϕ42	
BNA-42S2			20×20×125(100)	8(16)	ϕ25	24	ϕ42	
BNC-42C7			20×20×125(100)	8(16)	ϕ25	24	ϕ42	
BND-51C2			20×20×125(100)	12	ϕ25	24	ϕ51	
BND-51S2			20×20×125(100)	12	ϕ25	24	ϕ51	
BND-51SY2			20×20×125(100)	12	ϕ25	24	ϕ51	
BNE-34S6			20×20×125(100)	24	ϕ25	48	ϕ34	
BNE-34SY6			20×20×125(100)	24	ϕ25	48	ϕ34	
BNE-42S6			20×20×125(100)	24	ϕ25	48	ϕ42	
BNE-42SY6			20×20×125(100)	24	ϕ25	48	ϕ42	
BNE-51S6			20×20×125(100)	24	ϕ25	48	ϕ51	
BNE-51SY6			20×20×125(100)	24	ϕ25	48	ϕ51	
BNJ-34S3			20×20×125(100)	18	ϕ25	30	ϕ34	
BNJ-34S5			20×20×125(100)	18	ϕ25	30	ϕ34	
BNJ-34SY3			20×20×125(100)	18	ϕ25	30	ϕ34	
BNJ-34SY5			20×20×125(100)	18	ϕ25	30	ϕ34	
BNJ-42S3			20×20×125(100)	18	ϕ25	30	ϕ42	
BNJ-42S5			20×20×125(100)	18	ϕ25	30	ϕ34	
BNJ-42SY3			20×20×125(100)	18	ϕ25	30	ϕ42	
BNJ-42SY5			20×20×125(100)	18	ϕ25	30	ϕ42	
BNJ-51S3			20×20×125(100)	18	ϕ25	30	ϕ51	
BNJ-51S5			20×20×125(100)	18	ϕ25	30	ϕ51	
BNJ-51SY3			20×20×125(100)	18	ϕ25	30	ϕ51	
BNJ-51SY5			20×20×125(100)	18	ϕ25	30	ϕ51	
GN-3200	12(16)×12(16)×70~120	4~5			ϕ20	4~5	ϕ40	
GN-3200W	12(16)×12(16)×70~120	4~5			ϕ20	4~5	ϕ40	
GN-4200	12(16)×12(16)×70~120	7~8			ϕ20	7~8	ϕ40	
LX-06E2			20×20×125(100)	8	ϕ32	8	ϕ31	
LX-08C			25×25×150	10	ϕ40	10	ϕ51	
LX-08E2			25×25×150	8	ϕ40	8	ϕ51	
LX-08R			20×20×125(100)	10	ϕ25	20	ϕ51	
LZ-01R2			20×20×125(100)	12	ϕ25	24	ϕ31	
LZ-01RY2			20×20×125(100)	12	ϕ25	24	ϕ31	
LZ-02R2			20×20×125(100)	10	ϕ25	20	ϕ51	
LZ-02RY2			20×20×125(100)	10	ϕ25	20	ϕ51	
RL01Ⅲ	10×10×70~120	2~3			ϕ16	2~3	ϕ10	
RL01Ⅴ	10×10×70~120	2~3			ϕ16	2~3	ϕ10	
RL03	12(16)×12(16)×70~120	4~5			ϕ20	4~5	ϕ40	

* Number of tools shown in parentheses is the maximum number of toolholder mountable including ϕ25 sleeves.

· Manufacturers are in no particular order.

Star Micronics

Model	Toolholder Dimensions (Gang-Type)	Number of tools	Toolholder Dimensions (Turret-Type)	Number of tools	Sleeve Dia. (Horizontal/ Opposed)	Number of tools	Max. Cutting Dia.	Remarks
ECAS-12	10×10×95~150	6			ϕ22		ϕ13	
ECAS-20	12×12×80~150 16×16×80~144	6			ϕ22		ϕ20	
ECAS-20T			16×16×60~78 16×16×80~88		ϕ22 / ϕ32		ϕ20	
ECAS-32T			16×16×60~78 16×16×80~88	10 10	ϕ22 / ϕ32		ϕ32	
JNC-10			8×8×65	6			ϕ10	
JNC-16			10×10×80	6			ϕ16	
JNC-25/32			10×10×78~120	10	ϕ22		ϕ25 / 32	
KJR-16B/25B			16×16×78	12/16	ϕ22 / ϕ32			
KNC-16/20			16×16×68	16	ϕ22			
KNC-25Ⅱ/32Ⅱ			16×16×78	20	ϕ22 / ϕ32			
RNC-10	10×10×80~120	5			ϕ22			
RNC-16	10×10×80~120	5			ϕ22			
SA-16R	10×10×95~120	6			ϕ22			
SB-16 (A/C/D/E)	12×12×95~130	5			ϕ22(Front & Rear) / (ϕ22)	4/4		Only D/E for back clamp sleeves
	12×12×95~130	6				4/4		
	10×10×95~130	6				4/4		
SB-12Ⅱ (C/E)	12×12×95~130	6				4/4		Only E for back clamp sleeves
SB-16Ⅱ (C/E)	12×12×95~130	6				4/4		
	10×10×95~130	6				4/4		
SB-20 A/C/E	12×12×95~130	6				4/4		
SB-12R typeG	12×12×95~130	6				4/4	ϕ13	
	10×10×95~130	7				4/4		
SB-16R/20R typeN	12×12×95~130	6				4/4	ϕ16 / ϕ23	
	10×10×95~130	7				4/4		
SB-16R/20R typeG	12×12×95~130	6				4/4	ϕ16 / ϕ23	
	10×10×95~130	7				4/4		
SC20	12×12×95~130	5			ϕ22 / -	4		
	10×10×95~130	6				4/4		
SE-12B/16B	10×10×95~120	5			ϕ22		ϕ13 / 16	
SG-42			16×16×84~88 16×16×71~82 20×20×84~88		ϕ22 / ϕ32		ϕ42	
SH-7	8×8×95~120	5			ϕ22		ϕ7	
SH-12/16	10×10×95~120	5			ϕ22		ϕ13 / 16	
SI-12/12C	10×10×80~130	6			ϕ22		ϕ13	
SR-10J	8×8×67~110 (Spacer is needed)	6			ϕ16	4		
SR-20RⅡ	12×12×100~135	6		4	ϕ22	6/8	ϕ23	Toolpost for 2 toolholders (deep boring) on the front side
SR-20Ⅲ	12×12×95~135	6			ϕ22	6/8	ϕ23	
SR-20ⅣtypeA	12×12×100~130	7			ϕ22(Front & Rear) / ϕ22	6/8	ϕ23	
SR-20ⅣtypeB	12×12×100~130	7			ϕ22(Front & Rear) / ϕ22	6/8	ϕ23	
SR-25J/32J	16×16×95~155	6		4	ϕ22+ϕ32(Front & Rear) / ϕ22		ϕ32	
SW-12RⅡ	10×10×95~115	7			ϕ16(Front & Rear) / ϕ22	4/8	ϕ13	
ST-20			12×12×73~79 12×12×65~73(Cut-Off) 16×16×64~73 16×16×65~73(Cut-Off)		ϕ22 / ϕ32		ϕ20	
ST-38			16×16×83~88 16×16×71~82 16×16×84~88(Cut-Off) 20×20×84~88 20×20×84~88(Cut-Off)		ϕ22 / ϕ32		ϕ32 / ϕ38	
SV-38R	16×16×105~135 20×20×115~135(Cut-Off)	4 1	16×16×84~88 16×16×71~82 20×20×84~88		ϕ22 / ϕ32	- / 8	ϕ32 / ϕ38	
SV-12/20	12×12×95~135 16×16×95~135	5 4	12×12×70~78 16×16×65~70		ϕ22 / 32			
SV-32	16×16×95~135	4	16×16×60~78 16×16×80~88		ϕ22 / 32			
SW-7	8×8×80~120	6					ϕ7	

· Manufacturers are in no particular order.

Tsugami

Model	Toolholder Dimensions (Gang-Type)	Number of tools	Toolholder Dimensions (Turret-Type)	Number of tools	Sleeve Dia. (Horizontal/ Opposed)	Number of tools	Max. Cutting Dia.	Remarks
B0123-Ⅲ	12×12×85	9	-	-	ϕ20 / -	4 / -	ϕ12	
B0124/125/126-Ⅲ	12×12×85	9	-	-	ϕ20 / ϕ20	4 / 4	ϕ12	
B0203-Ⅲ	12×12×85	9	-	-	ϕ20 / ϕ20	4 / 4	ϕ20	
B0204/205/206-Ⅲ	12×12×85	9	-	-	ϕ20 / ϕ20	4 / 4	ϕ20	
B020M-Ⅱ	-	-	-	-	- / ϕ20	- / 1	ϕ20	
B0265/265B/266-Ⅱ	16×16×100	12	-	-	ϕ25 / ϕ25	5 / 4	ϕ26	
B0325/325B/326-Ⅱ	16×16×100	12	-	-	ϕ25 / ϕ25	5 / 4	ϕ32	
B0385/385L	20×20×125	8	-	-	ϕ32 / ϕ32	3 / 5	ϕ38	
B038T	-	-	20×20×125	St.8	ϕ32 / ϕ25		ϕ38	
B073/074-Ⅱ	8×8×85	9			ϕ20	4	ϕ7	
BH20/BH20Z	12×12×85	4	12×12×85	St.12	ϕ25 / ϕ32		ϕ20	
BH38	16×16×125	5	20×20×125	St.12	ϕ25 / ϕ32		ϕ38.1	
BM163-Ⅲ	12×12×85	9	-	-	ϕ20 / -	4 / -	ϕ16	
BM164/165-Ⅲ	12×12×85	9	-	-	ϕ20 / ϕ20	4 / 4	ϕ16	
C150/CH154	12×12×60~100	4~6	-	-	-		ϕ80	
C180	12×12×60~100	4~6	-	-	-		ϕ120	
C220/220T	12×12×60~100	6~8	-	-	-		ϕ120	
C300-Ⅳ	16×16×100~130	6~10	-	-	-		ϕ165	
C300H	16×16×100~130	6~10	-	-	-		ϕ165	
P013	8×8×100~120	6	-	-	ϕ16 / -	3 / -	ϕ1	
P013-Ⅱ	8×8×100~120	6	-	-	ϕ16 / -	3 / -	ϕ1	
P014	8×8×100~120	6	-	-	ϕ16 / ϕ16	3 / 3	ϕ1	
P014-Ⅱ	8×8×100~120	6	-	-	ϕ16 / ϕ16	3 / 3	ϕ1	
P033	8×8×100~120	6	-	-	ϕ16 / -	3 / -	ϕ3	
P033-Ⅱ	8×8×100~120	6	-	-	ϕ16 / -	3 / -	ϕ3	
P034	8×8×100~120	6	-	-	ϕ16 / ϕ16	3 / 3	ϕ3	
P034-Ⅱ	8×8×100~120	6	-	-	ϕ16 / ϕ16	3 / 3	ϕ3	
S205/206/SS207	12×12×100	8	-	-	ϕ22 / ϕ20	5 / 4	ϕ20	
SS26	16×16×100	7	-	-	ϕ22 / ϕ20	5 / 4	ϕ26	
SS32/32L	16×16×100	7	-	-	ϕ22 / ϕ20	5 / 4	ϕ32	
SS20M	-	-	-	-	- / ϕ20	- / 1	ϕ20	
SS267	16×16×100	7	-	-	ϕ22 / ϕ20	5 / 4	ϕ26	
SS327	16×16×100	7	-	-	ϕ22 / ϕ20	5 / 4	ϕ32	
MB25	-	-	20×20×90	2×St.8	ϕ20 / ϕ32	5 / 4	ϕ25	
M42J/M42SD	-	-	20×20×125	St.12	ϕ25 / ϕ32		ϕ42	
M50J/M50SY-Ⅲ	-	-	20×20×100	St.12	ϕ20 / ϕ32		ϕ51	
M06JC		-	20×20×125	St.8	ϕ25		ϕ220 / ϕ42	
M06J		-	25×25×150	St.8	ϕ32 / ϕ40		ϕ260 / ϕ51	
M08J		-	25×25×150	St.8	ϕ32 / ϕ40		ϕ280 / ϕ65	
M06D		-	25×25×150	St.12	ϕ40		ϕ260 / ϕ51	
M08D		-	25×25×150	St.12	ϕ40		ϕ280 / ϕ65	
M06SD		-	25×25×150	St.12	ϕ40		ϕ260 / ϕ51	
M08SD		-	25×25×150	St.12	ϕ40		ϕ280 / ϕ65	
M06SY		-	25×25×150	St.12	ϕ40		ϕ260 / ϕ51	
M08SY		-	25×25×150	St.12	ϕ40		ϕ280 / ϕ65	
TMU1	20×20×100~125	1	20×20×125	St.16	ϕ32 / ϕ32		ϕ38	
TMB2	20×20×100~125	1	20×20×125	St.16	ϕ32 / ϕ32		ϕ51	
TMA8-Ⅳ	20×20×100~125	1			ϕ32 / ϕ32		ϕ65	
TMA8J	20×20×100~125	1			ϕ32 / ϕ32		ϕ65	
TMA8H	20×20×100~125	1			ϕ32 / ϕ32		ϕ65	

· Manufacturers are in no particular order.

Amada Machine Tools

Model	Toolholder Dimensions (Gang-Type)	Number of tools	Toolholder Dimensions (Turret-Type)	Number of tools	Sleeve Dia. (Horizontal/ Opposed)	Number of tools	Max. Cutting Dia.	Remarks
G05	16×16				ϕ20		ϕ50×40	
G06	16×16				ϕ20		ϕ60×60	
G07	16×16				ϕ20		ϕ100×100	
G07M	20×20				ϕ20		ϕ100×100	
G07F	16×16				ϕ20		ϕ120×120	
GG5	16×16				ϕ20		ϕ50×40	
GS04	16×16				ϕ20		ϕ30×20	
J1			20×20	8	ϕ25		ϕ120×120	
J3			25×25	8	ϕ32		ϕ170	
J5			25×25	8	ϕ32		ϕ240	
JJ1			20×20	8	ϕ32		ϕ50×50	
JJ3			25×25	8	ϕ32		ϕ100×100	
JJ3M			25×25	12	ϕ32		ϕ100×100	
Ai8			20×20	8	ϕ25		ϕ50×50	
A12			16×16	12	ϕ25		ϕ80×50	
A18S			20×20	18	ϕ25		ϕ80×50	
AD12			16×16	9	ϕ25		ϕ80×50	
AD18S			20×20	15	ϕ25		ϕ80×50	
AA1			20×20	8	ϕ25		ϕ50×50	
Mi8			16×16	5	ϕ20		ϕ70×70	
S10			20×20	12	ϕ25		ϕ250×150	
V8G			20×20	15	ϕ32		ϕ220×450	
V10T			20×20	30(15×2)	ϕ32		ϕ250×450	

Nomura DS

Model	Toolholder Dimensions (Gang-Type)	Number of tools	Toolholder Dimensions (Turret-Type)	Number of tools	Sleeve Dia. (Horizontal/ Opposed)	Number of tools	Max. Cutting Dia.	Remarks
NN-10C	10×10×130	6			ϕ17		ϕ10	
NN-10CS	10×10×130	5			ϕ17	4	ϕ10	
NN-10SII	10×10×130	5			ϕ23		ϕ10	
NN-10SB5	10×10×130	5			ϕ23		ϕ13	
NN-10T	10×10×130	7			ϕ23		ϕ10	
NN-16HIII	12×12×130	6			ϕ23		ϕ16	
NN-16J	12.7×12.7×130	6			ϕ23		ϕ16	
NN-16SB5	10×10×130	5			ϕ23		ϕ16	
NN-16SB6 Type1	12.7×12.7×130	7			ϕ17(ϕ22)	4	ϕ16	
NN-16SB6 Type2	12.7×12.7×130	5			ϕ17(ϕ22)	4	ϕ16	
NN-16SB6 Type2.5	12.7×12.7×130	6			ϕ17(ϕ22)	5	ϕ16	
NN-16SB6 Type3	12.7×12.7×130	5			ϕ17(ϕ22)	4	ϕ16	
NN-16SB7	12.7×12.7×130	5			ϕ16	4	ϕ16	
NN-16UIII	12×12×130	5			ϕ23		ϕ16	
NN-16UB5	12×12×130	5			ϕ23		ϕ16	
NN-20CS	12.7×12.7×130	5(6)			ϕ22	4	ϕ20(ϕ25)	
NN-20HIII	12×12×130	6			ϕ23		ϕ20	
NN-20J	12.7×12.7×130	6			ϕ23		ϕ20	
NN-20J2	12.7×12.7×130	6			ϕ22	4	ϕ20	
NN-20UIII	12×12×130	5			ϕ23		ϕ20	
NN-20U5	12.7×12.7×150	5(6)			ϕ22	4	ϕ20(ϕ25)	
NN-20UB5	12×12×130	5			ϕ23		ϕ20	
NN-20UB7	12×12×130	6			ϕ23		ϕ20	
NN-20UB8	12.7×12.7×150	5(6)			ϕ22	4	ϕ20(ϕ25)	
NN-20YB	12×12×130	8			ϕ23		ϕ20	
NN-25YB/32YB	16×16×130	8			ϕ23 / ϕ32		ϕ25 / ϕ32	
NN-32YB2	16×16×130	5			ϕ22 / ϕ32	4	ϕ32	

· Manufacturers are in no particular order.

Eguro

Model	Toolholder Dimensions (Gang-Type)	Number of tools	Toolholder Dimensions (Turret-Type)	Number of tools	Sleeve Dia. (Horizontal/ Opposed)	Number of tools	Max. Cutting Dia.	Remarks
SANAX-6	12×12	5(Max.)		5	ϕ16		ϕ15	
SANAX-8	16×16	5(Max.)		5	ϕ25 / ϕ30		ϕ20	
	12×12	7(Max.)		5	ϕ25 / ϕ30		ϕ20	
SANAX-10	16×16	5(Max.)		5	ϕ25 / ϕ30		ϕ25.5	
EBN-10EX	12×12	6(Max.)			ϕ20		ϕ25.5	
NUCBOY-8EX	12×12	6(Max.)			ϕ20		ϕ20	
NUCLET-10EX	16×16	10(Max.)			ϕ20		ϕ25.5	
NUCPAL-10EX	16×16	10(Max.)			ϕ20		ϕ25.5	

· Manufacturers are in no particular order.

List of Instruments and Applicable Small Tools and Toolholders

List of Instruments and Applicable Small Tools and Toolholders

Models of major machine tool manufacturers				Corresponding Toolholder No.
Manufacturer	Model (Automatic Lathe)	Toolholder Size	Total Length of Attached Toolholder (MAX.)	
Citizen Machinery	A12,A16,B12,L12,M$_4$16,RL01,RL21	10×10	100	…1010F-··
	K12,K16	12×12		…1212F-··
	RL02	16×16		…1616H-··
	B12E,B16E,BL12,C12,C16,M$_2$12,M$_2$16 M$_3$12,M$_3$16,MSL12	10×10	120	…1010JX-··
	A20,A20Ⅶ,B20,BL20,BL25,K12E,K16E L20X,L220	12×12		…1212JX-··
	L16,L20,L20E	12×12	130	…1212JX-··
	C32,L25,L32,M20,M$_2$20,M$_2$32 M$_3$20,M$_3$32,M$_4$32	16×16		…1616JX-··
Star Micronics	RNC-10,RNC-16,SA-16R,SE-12B/16B SH-12/16	10×10	120	…1010JX-··
	SI-12,SI-12C	10×10	130	…1010JX-··
	SB-16A,SB-16C,SB-16D,SC20	12×12	130	…1212JX-··
	SR20RⅡ,SR20ⅢⅡ,SV12,SV20	12×12	135	…1212JX-··
	SV32,SV32J,SV32JⅡ	16×16		…1616JX-··
	ECAS-12	10×10	150	…1010JX-··
	ECAS-20	12×12		…1212JX-··
	SR25J,SR32J	16×16		…1616JX-··
Tsugami	B007	10×10	85	…1010F-··
	B0,BA,BC,BH20,BM,BU12,BU20 BS12,BS18,BS20	12×12		…1212F-··
	C004,C150,C180,C220	12×12	100	…1212F-··
	BH38,BS26,BS32,BU26,BU38	16×16		…1616H-··
Nomura DS	NN-10C,NN-10CS,NN-10SⅡ NN-10SB5,NN-10SⅡ,NN-10T,NN-16SB5	10×10	130	…1010JX-··
	NN-16HⅢ,NN-16UB5,NN-16UⅢ,NN-16J NN-20HⅢ,NN-20UⅢ,NN-20UB5,NN-20YB	12×12		…1212JX-··
	NN-25YB	16×16		…1616JX-··

· Manufacturers are in no particular order.

Parts Compatibility of Lever Lock Toolholders

1) For better usability of lever lock toolholders, some levers, lock screws and shims are modified.
2) It is highly recommended to use only new parts. However, they are compatible with conventional parts and can be used together with them.
3) It is possible to use new parts only with a toolholder which has been in use.
4) When purchasing replacements, order them stating the new numbers.
5) Some of the shims remain unmodified.

Classification	Ref. to Page	Toolholder Description			Spare Parts					
					Lever		Lock Screw		Shim	
					New No.	Conventional	New No.	Conventional	New No.	Conventional
External Toolholder	D8	PCLNR/L	·····-09		LL-1N	LL-1	LS-1N	LS-1	LC-32N	LC-32
			·····-12		LL-2N	LL-2	LS-2N	LS-2	LC-42N	LC-42
			·····-16		LL-5N	LL-5	LS-4N	LS-4	LC-53N	LC-53
	D11	PDJNR/L	·····-11		LL-1DN	LL-1D	LS-1N	LS-1	LD-32N	LD-32
			·····-15		LL-3N	LL-3	LS-2N	LS-2	LD-42	
	D12	PSBNR/L	·····-09		LL-1N	LL-1	LS-1N	LS-1	LS-32	
			·····-12		LL-2N	LL-2	LS-2N	LS-2	LS-42	
		PSKNR/L	·····-09		LL-1N	LL-1	LS-1N	LS-1	LS-32	
			·····-12		LL-2N	LL-2	LS-2N	LS-2	LS-42	
	D13	PSSNR/L	·····-09		LL-1N	LL-1	LS-1N	LS-1	LS-32	
			·····-12		LL-2N	LL-2	LS-2N	LS-2	LS-42	
		PSDNN	·····-09		LL-1N	LL-1	LS-1N	LS-1	LS-32	
			·····-12		LL-2N	LL-2	LS-2N	LS-2	LS-42	
	D14	PTGNR/L	1212F-11		LL-03N	LL-03	LS-03N	LS-03	-	
			·····-11		LL-03TN	LL-03T	LS-03SN	LS-03S	-	
			·····-16		LL-1N	LL-1	LS-1N	LS-1	LT-32N	LT-32
			·····-22		LL-2N	LL-2	LS-2N	LS-2	LT-42N	LT-42
		PTFNR/L	1212F-11		LL-03N	LL-03	LS-03N	LS-03	-	
			·····-11		LL-03TN	LL-03T	LS-03SN	LS-03S	-	
			·····-16		LL-1N	LL-1	LS-1N	LS-1	LT-32N	LT-32
			·····-22		LL-2N	LL-2	LS-2N	LS-2	LT-42N	LT-42
	D19	PRGCR/L	·····-12		LL-1CN	LL-1C	LS-1N	LS-1	LR-12C	
		PRXCR/L	·····-12							
		PRGNR/L	·····-09		LL-1N	LL-1	LS-1N	LS-1	LR-80	
			·····-12		LL-2N	LL-2	LS-2N	LS-2	LR-81	
	D20	PWLNR/L	·····-06		LL-1N	LL-1	LS-1N	LS-1	LW-32N	LW-32
			·····-08		LL-2N	LL-2	LS-2N	LS-2	LW-42N	LW-42
Boring Bars	F66	□16M-	PCLNR/L	09-20	LL-03SN	LL-03S	LS-03SN	LS-03S	-	
		□20Q-		09-27	LL-1N	LL-1	LS-1SN	LS-1S	LC-32N	LC-32
		□25R-		09-32						
		·····-	PCLNR/L	12-··	LL-2N	LL-2	LS-2N	LS-2	LC-42NR/L	LC-42R/L
	F67	·····-	PDUNR/L	11-··	LL-1DN	LL-1D	LS-1SN	LS-1S	LD-32N	LD-32
	F73	·····-	PTUNR/L	11-··	LL-03TN	LL-03T	LS-03SN	LS-03S	-	
		S25R-	PTUNR/L	16-30	LL-03SN	LL-03S	LS-03SN	LS-03S	-	
		S32S-		16-40	LL-1N	LL-1	LS-1N	LS-1	LT-32N	LT-32
		S40T-		16-50						
	F74	□16M-	PWLNR/L	06-20	LL-03SN	LL-03S	LS-03SN	LS-03S	-	
		□20Q-		06-27	LL-1N	LL-1	LS-1SN	LS-1S	LW-32N	LW-32
		□25R-		06-32						
	F76	·····-	PWLNR/L	08-··	LL-2N	LL-2	LS-2N	LS-2	LW-42NR/L	LW-42R/L
Turning Mill	N5	T63H-	PCLNR/L	-DX12	LL-2N	LL-2	LS-2N	LS-2	LC-42N	LC-42
		T63H-	PCMNN	-□12						
		T63H-	PDJNR/L	-DX15	LL-3N	LL-3	LS-2N	LS-2	LD-42	
	N6	T63H-	PDNNN	-□15						
		T63H-	PTGNR/L	-DX16	LL-1N	LL-1	LS-1N	LS-1	LT-32N	LT-32
	N7	T63H-	PWLNR/L	-DX08	LL-2N	LL-2	LS-2N	LS-2	LW-42N	LW-42