

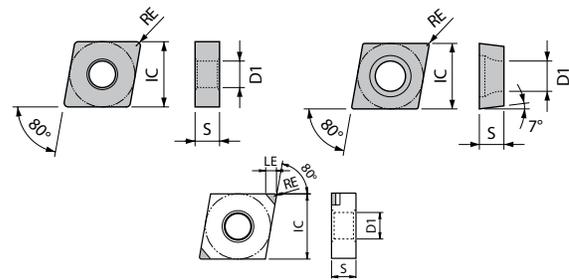
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Turning Dimensions

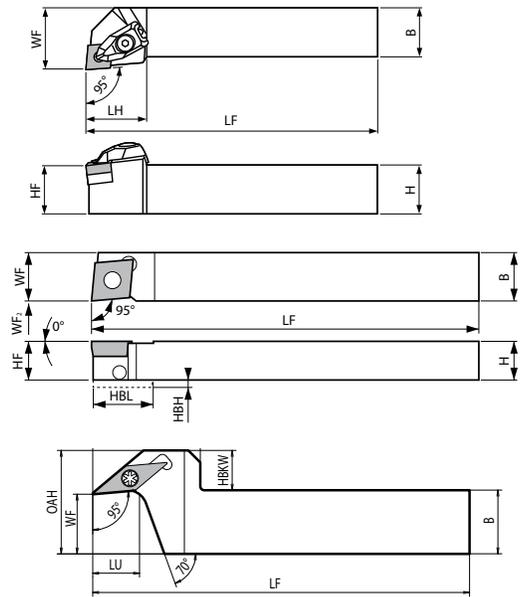
Turning Inserts

Symbol	Description	Previous Symbol
AN	Relief Angle	α
D1	Hole Diameter	$\varnothing d$
IC	Inscribed Circle Diameter	A
RE	Corner Radius	$r\epsilon$
S	Insert Thickness	T
LE	Edge Length (PCD / CBN Tip)	S



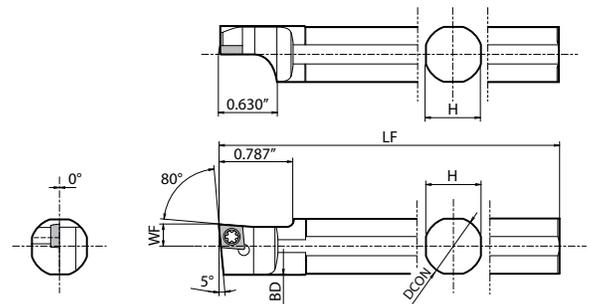
External Turning Holders (Square Shank)

Symbol	Description	Previous Symbol
B	Shank Width	B
H	Shank Height	H1
HF	Cutting Edge Height	h
HBL	Head Bottom Offset Length	L2
HBH	Head Bottom Offset Height	H2
HBKW	Head Back Offset Width	F2
LF	Functional Length	L1
LH	Head Length	L2
LU	Usable Length	T
LN	Neck Length	L3, L4
WF	Cutting Edge Distance	F1
WF ₂ , WFS	Cutting Edge Distance (Secondary)	F2
OAH	Overall Height	F1
MHD	Mounting Hole Distance	M1
MHD2	Mounting Hole Distance (Secondary)	M2



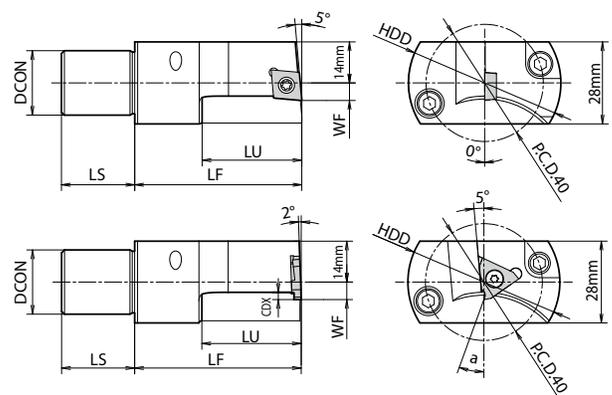
External Turning Holders (Round Shank)

Symbol	Description	Previous Symbol
DCON	Connection Diameter	$\varnothing D, \varnothing D1$
LF	Functional Length	L1
WF	Cutting Edge Distance	F1
WF ₂	Cutting Edge Distance (Secondary)	F2
BD	Body Diameter	$\varnothing d, \varnothing d1$
H	Shank Flat Width	H1



Sub-Spindle Turning Holders

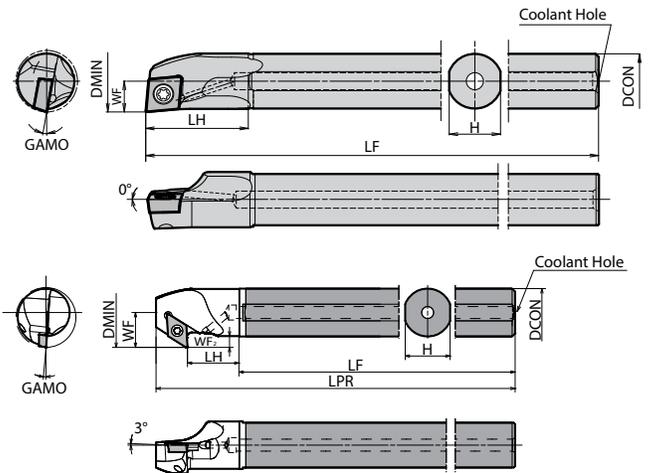
Symbol	Description	Previous Symbol
DCON	Connection Diameter	$\varnothing D$
HDD	Head Diameter	$\varnothing D1, \varnothing D2$
LF	Functional Length	L2
LS	Shank Length	-
LU	Usable Length	L3
WF	Cutting Edge Distance	F1
WF ₂	Cutting Edge Distance (Secondary)	F2
CDX	Maximum Cutting Depth	B



Boring Dimensions

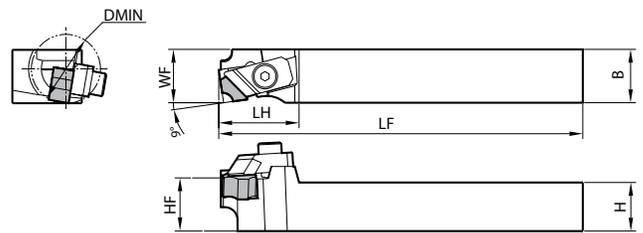
Boring Bars

Symbol	Description	Previous Symbol
DMIN	Minimum Bore Diameter	ØA
DCON	Connection Diameter	ØD, ØD1
GAMO	Rake Angle	h
H	Shank Flat Width	H
LF	Functional Length	L1
LH	Head Length	L2
LPR	Full Length	L1
LU	Usable Length	L2
RE	Corner Radius	rh
WF	Cutting Edge Distance	F
WF ₂	Cutting Edge Distance (Secondary)	F2



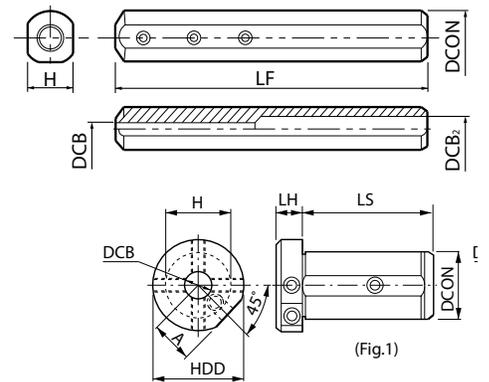
Boring Bars (Square Shank)

Symbol	Description	Previous Symbol
DMIN	Minimum Bore Diameter	ØA
B	Shank Width	B
H	Shank Height	H1
HF	Cutting Edge Height	h
LF	Functional Length	L1
LH	Head Length	L2
WF	Cutting Edge Distance	F1



Boring Bar Sleeves

Symbol	Description	Previous Symbol
DCON	Connection Diameter	ØD, ØD1
DCB	Connection Bore Diameter	Ød1
HDD	Head Diameter	ØD2
DCB ₂	Connection Bore Diameter (Secondary)	Ød1, Ød2
H	Shank Flat Width	-
LF	Functional Length	L1
LS	Shank Length	L1
LH	Head Length	L2
A	Head Flat Distance	-

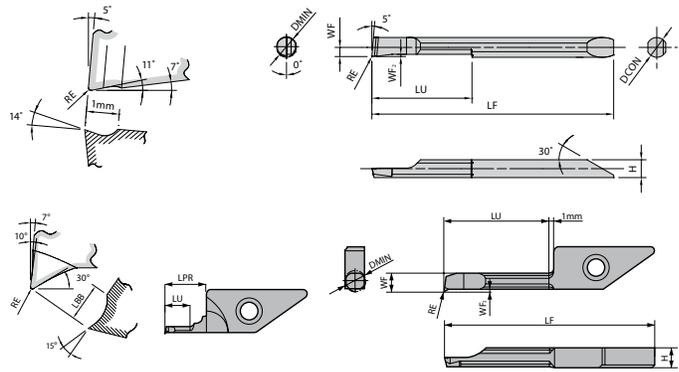


INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

Boring Dimensions (Continued)

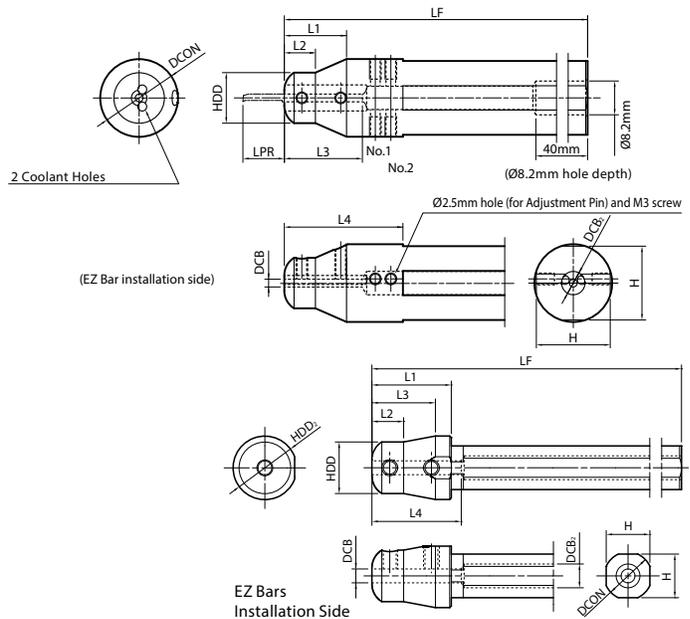
Micro Boring Bars

Symbol	Description	Previous Symbol
DMIN	Minimum Bore Diameter	ØA
H	Bar Flat Height	-
LF	Functional Length	L1
LU	Usable Length	L2
LPR	Bar Overhang Length	L3
WF	Cutting Edge Distance	F
WF ₂	Cutting Edge Distance (Secondary)	S
RE	Corner Radius	rE
LBB	Cutting Edge Width	W



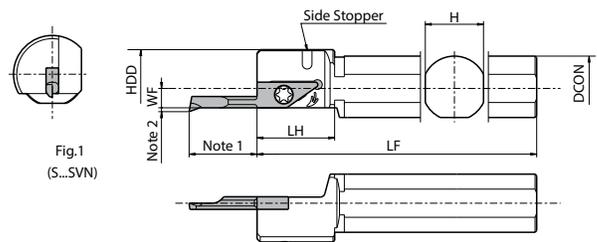
Micro Boring Bar Sleeves

Symbol	Description	Previous Symbol
DCB	Connection Bore Diameter	Ød1
DCON	Connection Diameter	ØD1
HDD	Neck Diameter	ØD2
HDD ₂	Head Diameter	ØD3
DCB ₂	Connection Bore Diameter (Secondary)	Ød2
H	Shank Flat Height	-
LF	Functional Length	L1
L1	Head Length	L2
L2	Neck Length	L3
L3	Connection Bore Depth	L4
LPR	Bar Overhang Length	T
No.1	Overhang Length of Bar at Position 1	-
No.2	Overhang Length of Bar at Position 2	-
No.3	Overhang Length of Bar at Position 3	-
No.4	Overhang Length of Bar at Position 4	-



Micro Boring Bar Holders (Round Shank)

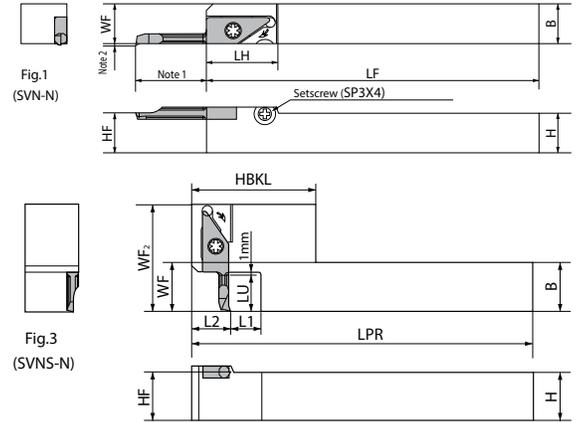
Symbol	Description	Previous Symbol
DCON	Connection Diameter	ØD1
HDD	Head Diameter	ØD2
H	Shank Flat Height	-
LF	Functional Length	L1
LH	Head Length	L2
WF	Cutting Edge Height	F1
L2	Neck Length	-



Boring Dimensions (Continued)

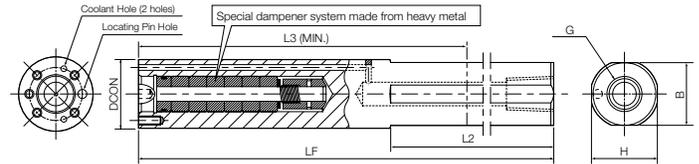
Micro Boring Bar Holders (Square Shank)

Symbol	Description	Previous Symbol
HF	Cutting Edge Height	h
H	Shank Height	H1
B	Shank Width	-
LF	Functional Length	L1
LPR	Protruding Length	L1
LH	Head Length	L2
HBKL	Head Back Offset Length	F2
HBKW	Head Back Offset Width	F2
WF	Cutting Edge Distance	F1
WF ₂	Cutting Edge Distance (Secondary)	F1
LU	Usable Length	F3
L1	Holder Clearance Distance 1	L3
L2	Holder Clearance Distance 2	L4



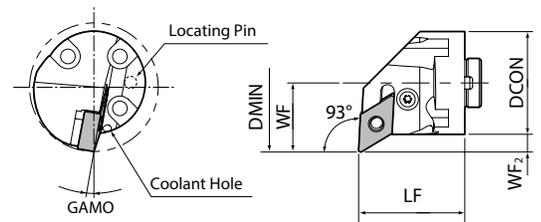
Boring Bar Adapters

Symbol	Description	Previous Symbol
DCON	Connection Diameter	ØD1
H	Shank Flat Height	-
B	Shank Flat Width	-
LF	Functional Length	L1
L2	Shank Length	-
L3 (Min)	Minimum Modification Length	-
G	Coolant Hole Thread Size	-



Replaceable Boring Bar Heads

Symbol	Description	Previous Symbol
DMIN	Minimum Bore Diameter	ØA
DCON	Connection Diameter	ØD
LF	Functional Length	L1
WF	Cutting Edge Distance	F
WF ₂	Cutting Edge Distance (Secondary)	S
GAMO	Rake Angle	h
RE	Corner Radius	rε

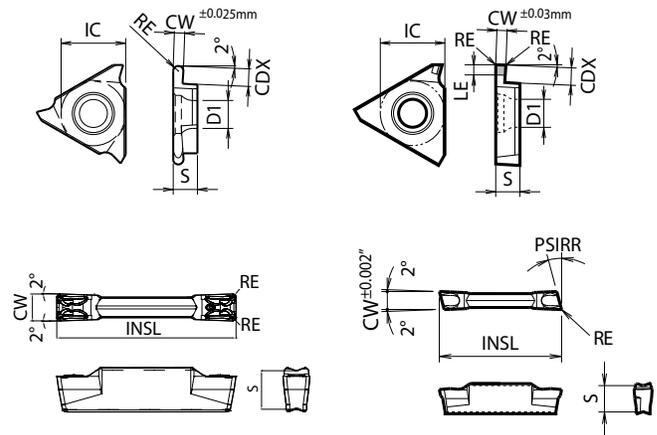


INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

Grooving and Cut-Off Dimensions

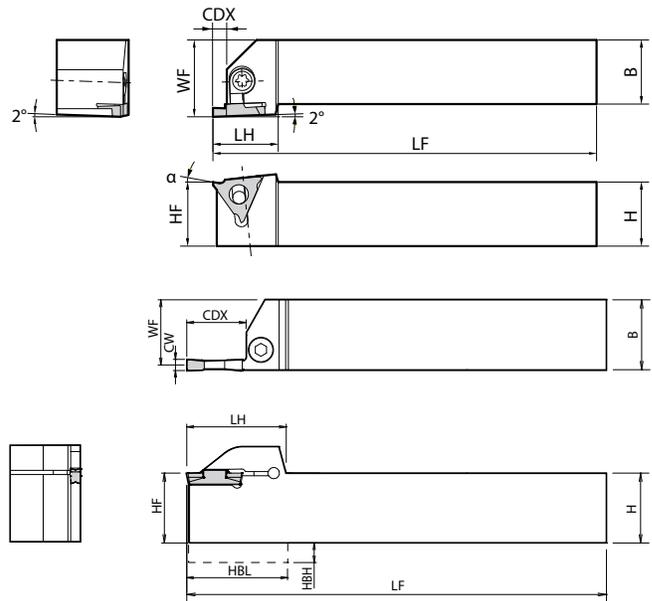
Grooving and Cut-Off Inserts

Symbol	Description	Previous Symbol
IC	Inscribed Circle Diameter	A
BCH	Corner Chamfer Length	C
CDX	Maximum Cutting Depth	B
CW	Cutting Edge Width	W
CUTDIA	Maximum Cut-Off Diameter	$\varnothing D_{max}$
LE	Edge Length (PCD / CBN Tip)	S
D1	Hole Diameter	$\varnothing d$
DAXN	Face Groove Diameter (Min.)	$\varnothing D$
DAXX	Face Groove Diameter (Max.)	$\varnothing D$
INSL	Insert Length	L
PSIRS	Lead Angle	h
RE	Corner Radius	$r\epsilon$
S	Insert Thickness	H, T, M
W1	Insert Width	A



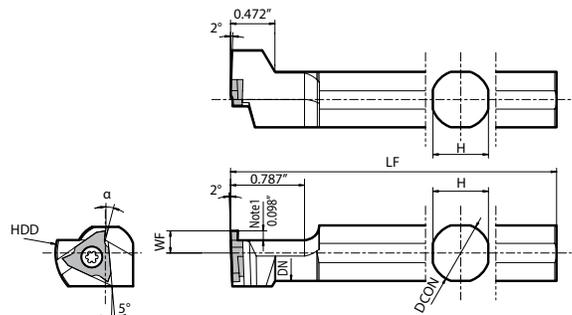
External Grooving Holders (Square Shank)

Symbol	Description	Previous Symbol
B	Shank Width	-
CDX	Maximum Cutting Depth	T
H	Shank Height	H1
HF	Cutting Edge Height	h
HBL	Head Bottom Offset Length	L3
HBH	Head Bottom Offset Height	H2
HBKW	Head Back Offset Width	F2
LF	Functional Length	L1
LH	Head Length	L2
LN	Neck Length	-
WF	Cutting Edge Distance	F1
GAMP	Axial Rake Angle	h
MHD	Mounting Hole Distance	M1
MHD2	Mounting Hole Distance (Secondary)	M2



External Grooving Holders (Round Shank)

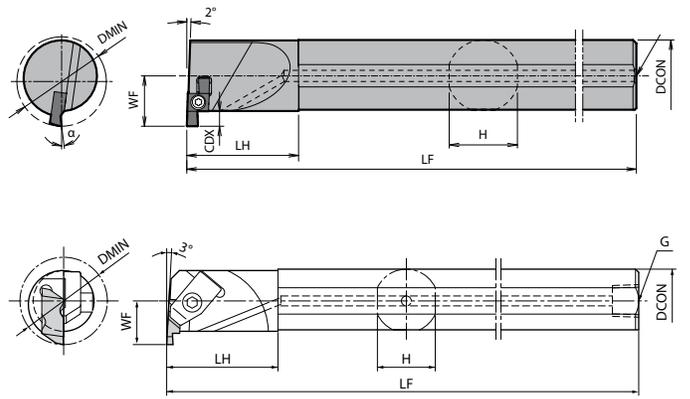
Symbol	Description	Previous Symbol
DCON	Connection Diameter	$\varnothing D$
LF	Functional Length	L1
WF	Cutting Edge Distance	F1
DN	Neck Diameter	$\varnothing d1$
HDD	Head Diameter	$\varnothing d2$
H	Shank Flat Height	H1



Grooving and Cut-Off Dimensions (Continued)

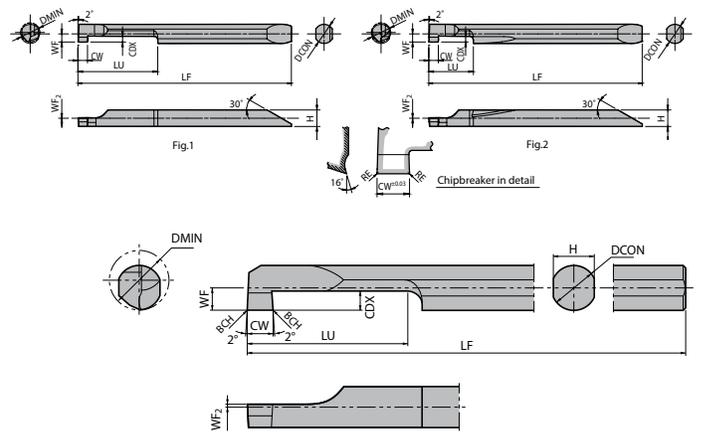
Internal Grooving Holders

Symbol	Description	Previous Symbol
DMIN	Minimum Bore Diameter	ØA
DCON	Connection Diameter	ØD
H	Shank Flat Height	H1
LF	Functional Length	L1
LH	Head Length	L2
LU	Usable Length	L2
WF	Cutting Edge Distance	F1
CDX	Maximum Cutting Depth	T
G	Coolant Hole Thread Size	-



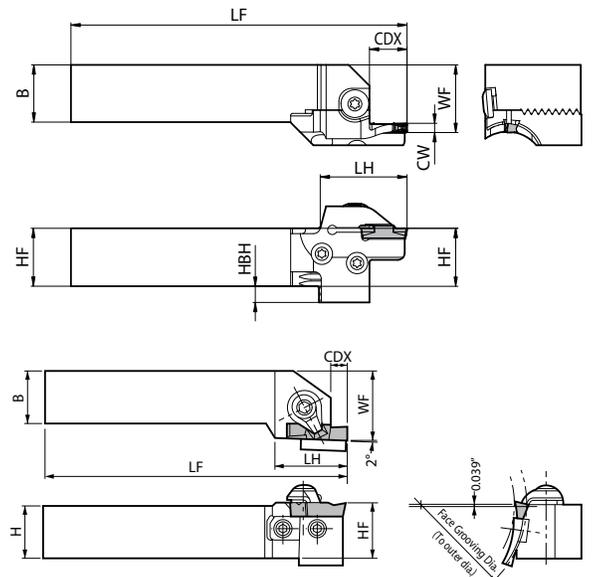
Micro Grooving Bars

Symbol	Description	Previous Symbol
DMIN	Minimum Bore Diameter	ØA
DCON	Connection Diameter	ØD
DAXN	Face Groove Diameter (Min.)	ØD
DAXX	Face Groove Diameter (Max.)	ØD
CW	Cutting Edge Width	W
BCH	Corner Chamfer Length	C
H	Bar Flat Height	H1
LF	Functional Length	L1
LU	Usable Length	L2
WF	Cutting Edge Distance	F
WF ₂	Cutting Edge Distance (Secondary)	L4
LH	Head Length	L2
CDX	Maximum Cutting Depth	T
RE	Corner Radius	rε



Face Grooving Toolholders

Symbol	Description	Previous Symbol
DAXN	Face Groove Diameter (Min.)	ØD
DAXX	Face Groove Diameter (Max.)	ØD
H	Shank Height	H1
HF	Cutting Edge Height	h
HBH	Head Bottom Offset Height	H2
B	Shank Width	-
LF	Functional Length	L1
LH	Head Length	L2
WF	Cutting Edge Distance	F, F1
WF ₂	Cutting Edge Distance (Secondary)	S
CDX	Maximum Cutting Depth	T
CW	Cutting Edge Width	W

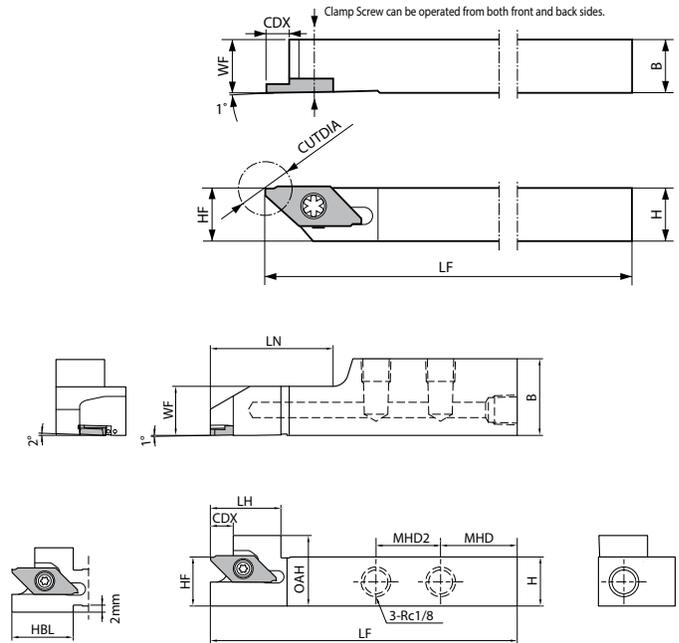


INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

Grooving and Cut-Off Dimensions (Continued)

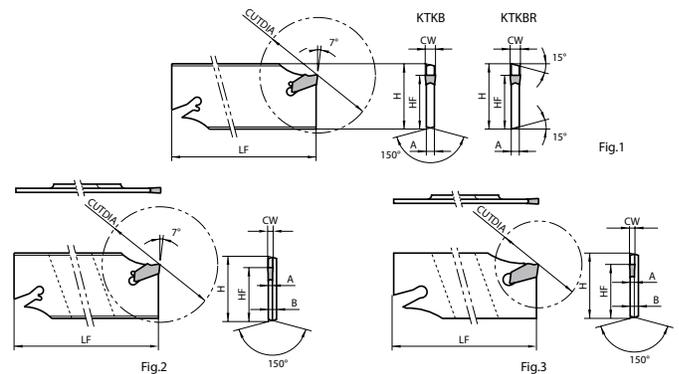
Cut-Off Toolholders

Symbol	Description	Previous Symbol
CUTDIA	Maximum Cut-Off Diameter	ØDmax
H	Shank Height	H1
HF	Cutting Edge Height	h
OAL	Overall Length	L1
B	Shank Width	-
LF	Functional Length	L1
LH	Head Length	L2
LN	Neck Length	L3
LN2	Neck Length (Secondary)	-
HBL	Head Bottom Offset Length	L3
HBH	Head Bottom Offset Height	H2
WF	Cutting Edge Distance	F1
CDX	Maximum Cutting Depth	T
GAMP	Axial Rake Angle	h
MHD	Mounting Hole Distance	M1
MHD2	Mounting Hole Distance (Secondary)	M2



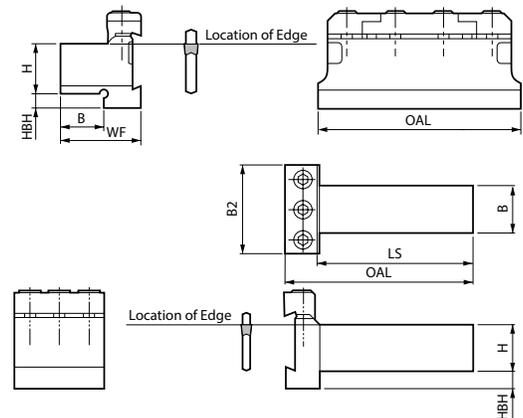
Cut-Off Blades

Symbol	Description	Previous Symbol
CUTDIA	Maximum Cut-Off Diameter	ØDmax
H	Blade Height	H1
HF	Cutting Edge Height	h
B	Blade Width	-
LF	Functional Length	L1
A	Insert Mount Width	-
CW	Cutting Edge Width	W



Cut-Off Tool Blocks

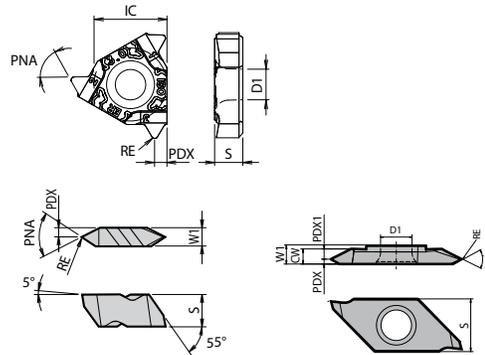
Symbol	Description	Previous Symbol
H	Shank Height	H1
HBH	Head Bottom Offset Height	H2
B	Shank Width	B1
B2	Blade Mount Width	-
OAL	Overall Length	L1
LS	Shank Length	L2



Threading Dimensions

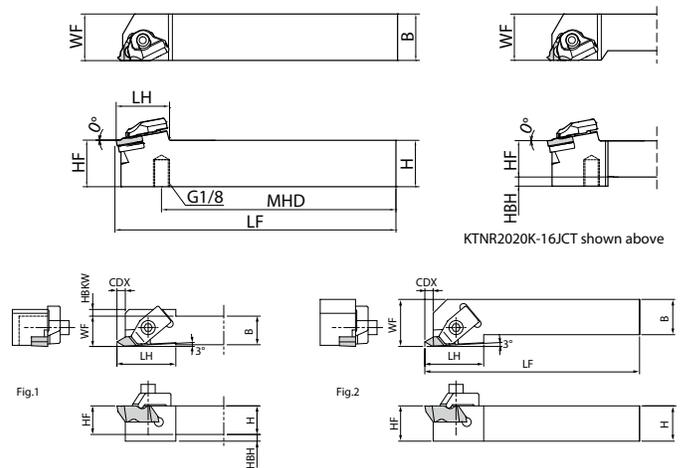
Threading Inserts

Symbol	Description	Previous Symbol
IC	Inscribed Circle Diameter	A
S	Insert Thickness	T
D1	Hole Diameter	Ød
PDX	Profile Distance	S, S1
PDX1	Profile Distance (Secondary)	S2
PNA	Included Angle	h
RE	Corner Radius	rε
W1	Insert Width	T
CW	Cutting Edge Width	W



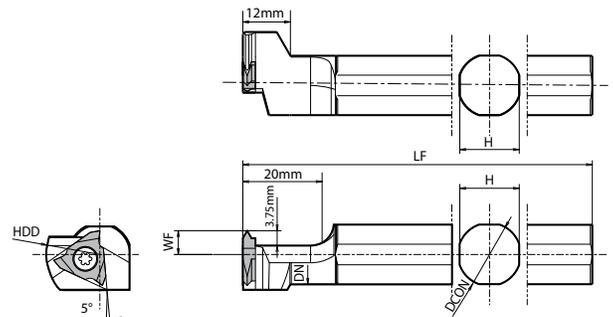
External Threading Toolholders (Square Shank)

Symbol	Description	Previous Symbol
H	Shank Height	H1
HF	Cutting Edge Height	h
HBH	Head Bottom Offset Height	H2
B	Shank Width	-
LF	Functional Length	L1
LH	Head Length	L2
WF	Cutting Edge Distance	F1
MHD	Mounting Hole Distance	M1
HBKW	Head Back Offset Width	F2
CDX	Maximum Cutting Depth	T
LPR	Protruding Length	T



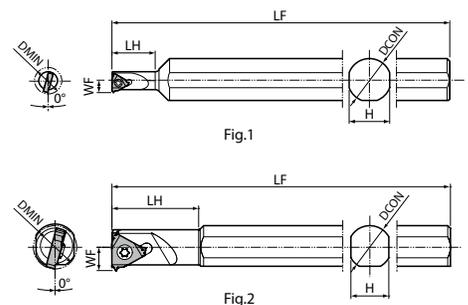
External Threading Toolholders (Round Shank)

Symbol	Description	Previous Symbol
DCON	Connection Diameter	ØD
LF	Functional Length	L1
WF	Cutting Edge Distance	F1
DN	Neck Diameter	Ød1
HDD	Head Diameter	Ød2
H	Shank Flat Height	H1



Internal Threading Toolholders

Symbol	Description	Previous Symbol
DMIN	Minimum Bore Diameter	ØA
DCON	Connection Diameter	ØD
H	Shank Flat Width	-
LF	Functional Length	L1
LH	Head Length	L2
WF	Cutting Edge Distance	F1

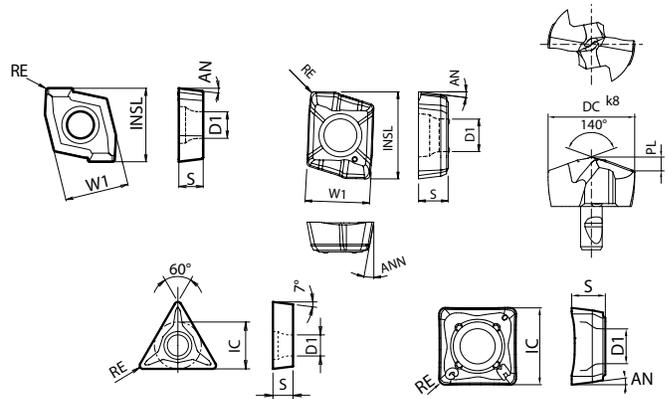


INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

Drilling Dimensions

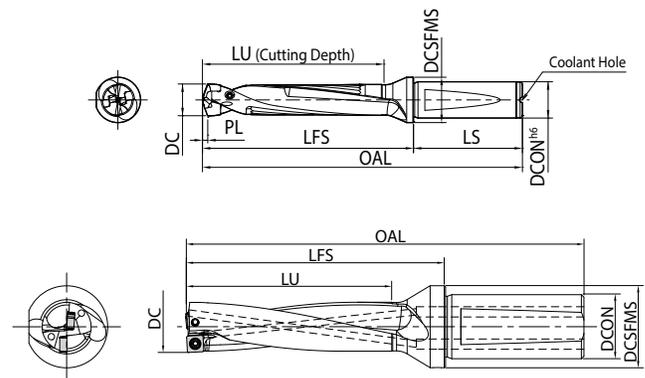
Drilling Inserts

Symbol	Description	Previous Symbol
IC	Inscribed Circle Diameter	A
S	Insert Thickness	T
W1	Insert Width	W
INSL	Insert Length	L
D1	Hole Diameter	$\varnothing d$
DC	Cutting Diameter	$\varnothing D_c$
DC ₂	Cutting Diameter	$\varnothing D_2$
PL	Point Length	L _p
RE	Corner Radius	r _ε
AN	Relief Angle (Minor)	U
ANN	Relief Angle (Major)	ff



Drilling Toolholders

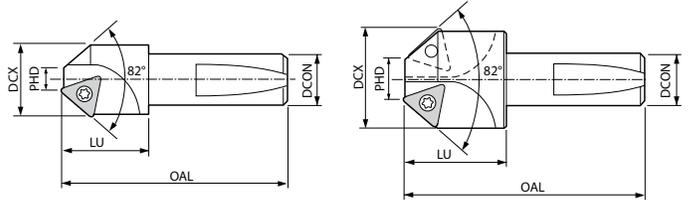
Symbol	Description	Previous Symbol
DC	Cutting Diameter	$\varnothing D_c$
DCON	Connection Diameter	$\varnothing D$
OAL	Overall Length	L
LFS	Functional Length	L1
LU	Cutting Depth	L3
LS	Shank Length	-
DCSFMS	Contact Surface Diameter Machine Side	$\varnothing d_1$
LCF	Flute Length	L2
Rc	Coolant Hole Thread Size	-



Drilling Dimensions (Continued)

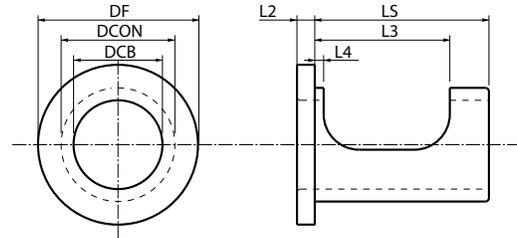
Countersinks

Symbol	Description	Previous Symbol
DCX	Maximum Cutting Diameter	ØD
PHD	Premachined Hole Diameter	ØDs
DCON	Connection Diameter	Ød
OAL	Overall Length	L
LU	Usable Length	L1



Drilling Sleeves

Symbol	Description	Previous Symbol
DCB	Connection Bore Diameter	Ød
DCON	Connection Diameter	ØD1
DF	Flange Diameter	ØD2
LS	Shank Length	L1

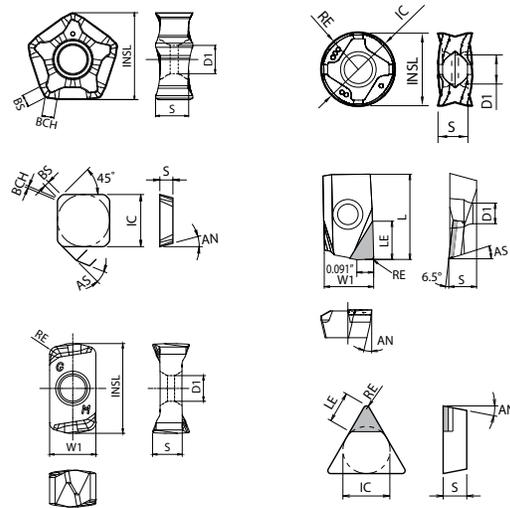


INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

Milling Dimensions

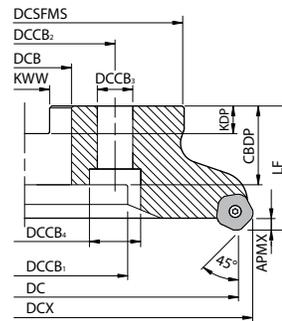
Milling Inserts

Symbol	Description	Previous Symbol
IC	Inscribed Circle Diameter	A
S	Insert Thickness	T
BCH	Corner Chamfer Length	X
RE	Corner Radius	$r\epsilon$
BS	Wiper Edge Length	Z
INSL	Insert Length	L
D1	Hole Diameter	$\varnothing d$
L	Cutting Edge Length	W
W1	Insert Width	A
AN	Relief Angle (Major)	IJ
AS	Relief Angle (Wiper Edge)	ff
LE	Edge Length (PCD / CBN Tip)	S
GAN	Insert Rake Angle	h



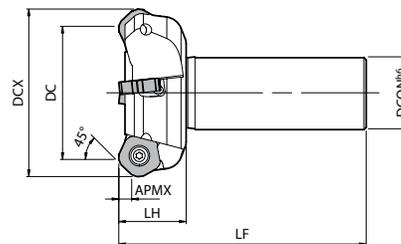
Face Mills

Symbol	Description	Previous Symbol
DC	Cutting Diameter	$\varnothing D$
DCX	Maximum Cutting Diameter	$\varnothing D1$
DCSFMS	Contact Surface Diameter Machine Side	$\varnothing D2$
DCB	Connection Bore Diameter	$\varnothing d$
DCCB ₁	Connection Counterbore Diameter	$\varnothing d1$
DCCB ₂	Mounting Bolt Hole Diameter	$\varnothing d2$
LF	Functional Length	H
CBDP	Connection Bore Depth	E
KDP	Keyway Depth	a
KWW	Keyway Width	b
PCD	Secondary Bolt Distance	$\varnothing C$
APMX	Maximum Cutting Depth	S
KAPR	Lead Angle	-



End Mills

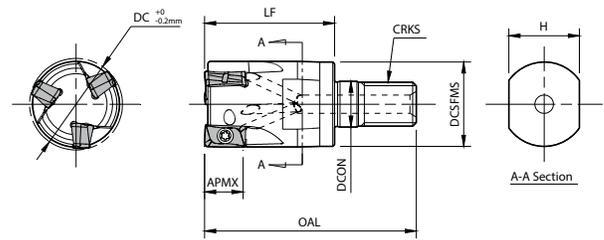
Symbol	Description	Previous Symbol
DC	Cutting Diameter	$\varnothing D$
DCX	Maximum Cutting Diameter	$\varnothing D1$
DCON	Connection Diameter	$\varnothing d, \varnothing d1$
DN	Neck Diameter	$\varnothing d2$
CW	Cutting Width	W
LF	Functional Length	L
LH	Head Length	$\kappa, \kappa1, L2$
LU	Usable Length	$\kappa2$
LS	Shank Length	L3
LN	Neck Length	L1
APMX	Maximum Cutting Depth	S
RMPX	Maximum Ramping Angle	IJ
A.R.	Axial Rake Angle	-
R.R.	Radial Rake Angle	-
KAPR	Lead Angle	-
TA	Taper Angle	h



Milling Dimensions (Continued)

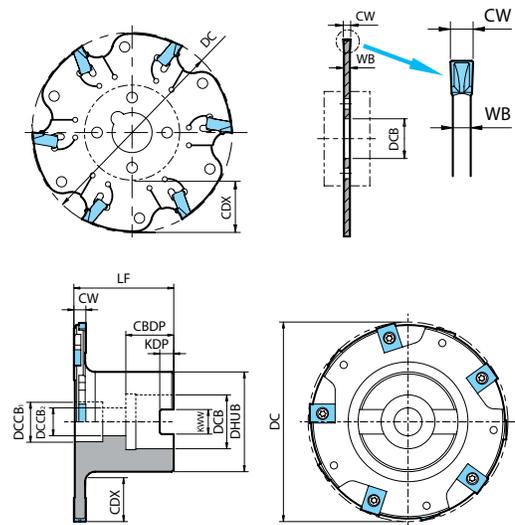
Modular End Mills

Symbol	Description	Previous Symbol
DC	Cutting Diameter	ØD
DCSFMS	Contact Surface Diameter Machine Side	ØD1
DCON	Connection Diameter	Ød
OAL	Overall Length	L
LF	Functional Length	L1
CRKS	Connection Retaining Knob Thread Size	M1
H	Weldon Flat Width	-
APMX	Maximum Cutting Depth	S
RMPX	Maximum Ramping Angle	U
A.R.	Axial Rake Angle	-
R.R.	Radial Rake Angle	-
KAPR	Lead Angle	-



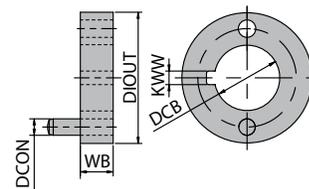
Slot Mills

Symbol	Description	Previous Symbol
CW	Cutting Edge Width	W
CDX	Maximum Cutting Depth	T
DC	Cutting Diameter	ØD
DCB	Connection Bore Diameter	Ød
WB	Body Width	A
DCSFMS	Contact Surface Diameter Machine Side	Ød1
DHUB	Hub Diameter	ØA
THUB	Hub Thickness	A
LF	Functional Length	L1
LN	Neck Leck	H
CBDP	Connection Bore Depth	E
KDP	Keyway Depth	a
KWW	Keyway Width	b
DCCB ₁	Connection Counterbore Diameter	Ød1
DCCB ₂	Mounting Bolt Hole Diameter	Ød2
APMX	Maximum Cutting Depth	W.O.C.1, S



Slot Mill Drive Rings

Symbol	Description	Previous Symbol
DCB	Connection Bore Diameter	Ød
DIOUT	Outside Diameter	ØD
WB	Body Width	A1
KWW	Keyway Width	a
DCON	Connection Diameter	Ød1



INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

Inch / Metric Conversion Chart

Cutting Speed (Vc)

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

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

SFM (Surface Feet per Minute)

D.O.C. (ap)

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

1inch = 25.4mm
0.04inch = 1mm

IPR Feed Rate (f)

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

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

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

IPT Feed Rate (fz)

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

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

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

Torque

lbft	Nm
0.738	1

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

SI Derived Units Conversion Chart

Bold units are the ones by SI derived unit.

Extracted from JIS handbook "Iron and Steel"

Force

N	kgf	dyn
1	1.019 72 x 10 ⁻¹	1 x 10 ⁵
9.806 65	1	9.806 65 x 10 ⁵
1 x 10⁻⁵	1.019 72 x 10 ⁻⁶	1

Stress

1Pa=1N/m², 1MPa=1N/mm²

Pa or N/m ²	MPa or N/mm ²	kgf/mm ²	kgf/cm ²	kgf/m ²
1	1 x 10⁻⁶	1.019 72 x 10 ⁻⁷	1.019 72 x 10 ⁻⁵	1.019 72 x 10 ⁻¹
1 x 10⁶	1	1.019 72 x 10 ⁻¹	1.019 72 x 10	1.019 72 x 10 ⁵
9.806 65 x 10⁶	9.806 65	1	1 x 10 ²	1 x 10 ⁶
9.806 65 x 10⁴	9.806 65 x 10⁻²	1 x 10 ⁻²	1	1 x 10 ⁴
9.806 65	9.806 65 x 10⁻⁶	1 x 10 ⁻⁶	1 x 10 ⁻⁴	1

Pressure

1Pa=1N/m²

Pa	kPa	MPa	bar	kgf/cm ²
1	1 x 10⁻³	1 x 10⁻⁶	1 x 10 ⁻⁵	1.019 72 x 10 ⁻⁵
1 x 10³	1	1 x 10⁻³	1 x 10 ⁻²	1.019 72 x 10 ⁻²
1 x 10⁶	1 x 10³	1	1 x 10	1.019 72 x 10
1 x 10⁵	1 x 10²	1 x 10⁻¹	1	1.019 72
9.806 65 x 10⁴	9.806 65 x 10	9.806 65 x 10⁻²	9.806 65 x 10 ⁻¹	1

Theoretical (Geometrical) Surface Roughness

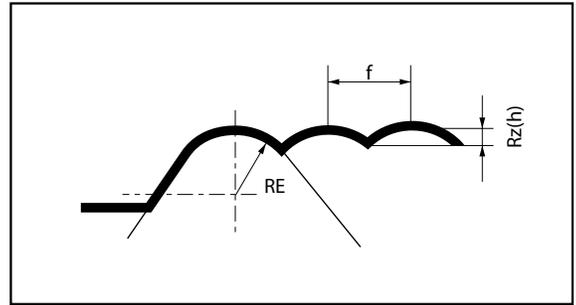
Theoretical surface roughness for turning indicates the minimum roughness value from the cutting conditions and it is shown by the formula as follows.

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

Rz(h): Theoretical surface roughness [μm]

f: Feed rate [mm/rev]

RE: 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 ". $RzJIS = \frac{(Yp1+Yp2+Yp3+Yp4+Yp5) + (Yv1+Yv2+Yv3+Yv4+Yv5)}{5}$	 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)	*(Triangle symbol)
0.025	0.1	0.1	▽▽▽▽
0.05	0.2	0.2	
0.1	0.4	0.4	
0.2	0.8	0.8	
0.4	1.6	1.6	▽▽▽
0.8	3.2	3.2	
1.6	6.3	6.3	
3.2	12.5	12.5	▽▽
6.3	25	25	
12.5	50	50	▽
25	100	100	

* Triangle symbol was removed from JIS standard in the 1994 Revision.

How to Indicate

- When Ra is $1.6\mu\text{m}$ → $1.6\mu\text{mRa}$
- When Rz is $6.3\mu\text{m}$ → $6.3\mu\text{mRz}$
- When RzJIS is $6.3\mu\text{m}$ → $6.3\mu\text{mRzJIS}$

Indication in JIS standard

Example of Ra indication		Example of Rz indication	
1. When indicating the upper limit only (when upper limit is $6.3\mu\text{mRa}$)		1. When indicating the upper limit only indicate surface roughness following the parameter symbol.	
2. When indicating both lower and upper limit (when upper limit is $6.3\mu\text{mRa}$, lower limit is $1.6\mu\text{mRa}$)		2. When indicating both lower and upper limit indicate surface roughness as (upper limit ~ lower limit) following the parameter symbol.	

Note: The indications of Ra and Rz are different.

Caution - Symbols for Surface Roughness

The above information is based on JIS B 0601-2001.

However, some symbols were revised as shown in the right table in accordance with ISO Standard from JIS B 0601-2001 version.

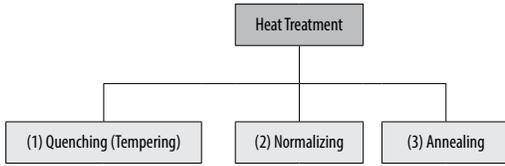
Ten Points Mean Roughness (Rz) was eliminated from 2001 version but it still remains as RzJIS reference, since it was popular in Japan.

Type	Symbol of JIS B 0601-1994	Symbol of JIS B 0601-2001
Max. height roughness	Ry	Rz
Ten points mean roughness	Rz	(RzJIS)
Arithmetical mean roughness	Ra	Ra

A INSERT GRADES
B TURNING INSERTS
C CBN/PCD INSERTS
D TURNING HOLDERS
E SMALL TOOLS
F BORING
G GROOVING
H CUT-OFF
J THREADING
K DRILLING
M MILLING
N QUICK CHANGE TOOLING
P SPARE PARTS
R TECHNICAL
T INDEX

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	Detail	Effect
	<ul style="list-style-type: none"> Quenching (Tempering) After heating to 727°C or over, 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)
	<ul style="list-style-type: none"> Normalizing After heating to 727°C or over, 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.
	<ul style="list-style-type: none"> Annealing After heating to 727°C or over, 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) Dia. Ball (HRB)	C Scale Load: 150kgf Diamond Point (HRC)		
940	-	-	85.6	-	68.0	97	
920	-	-	85.3	-	67.5	96	
900	-	-	85.0	-	67.0	95	
880	-	(767)	84.7	-	66.4	93	
860	-	(757)	84.4	-	65.9	92	
840	-	(745)	84.1	-	65.3	91	
820	-	(733)	83.8	-	64.7	90	
800	-	(722)	83.4	-	64.0	88	
780	-	(710)	83.0	-	63.3	87	
760	-	(698)	82.6	-	62.5	86	
740	-	(684)	82.2	-	61.8	84	
720	-	(670)	81.8	-	61.0	83	
700	-	(656)	81.3	-	60.1	81	
690	-	(647)	81.1	-	59.7	-	
680	-	(638)	80.8	-	59.2	80	
670	-	630	80.6	-	58.8	-	
660	-	620	80.3	-	58.3	79	
650	-	611	80.0	-	57.8	-	
640	-	601	79.8	-	57.3	77	
630	-	591	79.5	-	56.8	-	
620	-	582	79.2	-	56.3	75	
610	-	573	78.9	-	55.7	-	
600	-	564	78.6	-	55.2	74	
590	-	554	78.4	-	54.7	-	2055
580	-	545	78.0	-	54.1	72	2020
570	-	535	77.8	-	53.6	-	1985
560	-	525	77.4	-	53.0	71	1950
550	505	517	77.0	-	52.3	-	1905
540	496	507	76.7	-	51.7	69	1860
530	488	497	76.4	-	51.1	-	1825
520	480	488	76.1	-	50.5	67	1795
510	473	479	75.7	-	49.8	-	1750
500	465	471	75.3	-	49.1	66	1705
490	456	460	74.9	-	48.4	-	1660
480	448	452	74.5	-	47.7	64	1620
470	441	442	74.1	-	46.9	-	1570
460	433	433	73.6	-	46.1	62	1530
450	425	425	73.3	-	45.3	-	1495
440	415	415	72.8	-	44.5	59	1460
430	405	405	72.3	-	43.6	-	1410
420	397	397	71.8	-	42.7	57	1370
410	388	388	71.4	-	41.8	-	1330
400	379	379	70.8	-	40.8	55	1290
390	369	369	70.3	-	39.8	-	1240
380	360	360	69.8	(110.0)	38.8	52	1205
370	350	350	69.2	-	37.7	-	1170
360	341	341	68.7	(109.0)	36.6	50	1130
350	331	331	68.1	-	35.5	-	1095
340	322	322	67.6	(108.0)	34.4	47	1070
330	313	313	67.0	-	33.3	-	1035

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

Extracted from JIS handbook "Iron & steel" (SAE J 417)

Note:

1. 1 MPa = 1 N/mm²

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

INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

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
Aluminum 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
	Superalloy	Corrosion-resisting and heat-resisting superalloy bar	NCF-B
		Corrosion-resisting and heat-resisting superalloy plate and sheet	NCF-P

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

INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
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CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

Material Cross Reference Table

Steel

Classification	USA	Japan	China	UK	Germany	France	Russia
	AISI/SAE	JIS	GB	BS	DIN	NF	ГОСТ
Nickel Chromium Steel		SNC236			36NiCr6		40XH
		SNC415	12CrNi2		14NiCr10		
		SNC631	30CrNi3		36NiCr10		30XH3A
		SNC815	12Cr2Ni4	655M13	15NiCr13		
		SNC836	37CrNi3		31NiCr14		
Nickel Chromium Molybdenum Steel	8615 8617 8620 8622	SNCM220	20CrNiMo	805A20	20NiCrMo2 20NiCrMoS2	20NCD 2	
	805M20						
				805A22			
				805M22			
	8637 8640	SNCM240			40NiCrMo2-2		
		SNCM415					
	4320	SNCM420	18CrNiMnMoA		17NiCrMo6-4		20XH2M (20XHM)
		SNCM431			30CrNiMo8		
	4340	SNCM439	40CrNiMoA		40NiCrMo6		
		SNCM447			34CrNiMo6		
		SNCM616					
		SNCM625					
		SNCM630					
	SNCM815						
Chromium Steel		SCr415	15Cr 15CrA		17Cr3 17CrS3		15X 15XA
	5120	SCr420	20Cr				20X
	5130 5132	SCr430	30Cr	34Cr4 34CrS4	34Cr4 34CrS4	34Cr4 34CrS4	30X
	5132	SCr435	35Cr	37Cr4 37CrS4	37Cr4 37CrS4	37Cr4 37CrS4	35X
	5140	SCr440	40Cr	530M40 41Cr4 41CrS4	41Cr4 41CrS4	41Cr4 41CrS4	40X
		SCr445	45Cr 50Cr				45X
Chromium Molybdenum Steel		SCM415	15CrMo		15CrMo4		
		SCM418	20CrMo		18CrMo4 18CrMoS4		20XM
		SCM420		708M20	20CrMo5		20XM
		SCM421					
	4130	SCM430	30CrMo 30CrMoA				30XM 30XMA
		SCM432					
	4137	SCM435	35CrMo	34CrMo4 34CrMoS4	34CrMo4 34CrMoS4	34CrMo4 34CrMoS4	35XM
	4140 4142	SCM440	42CrMo	708M40 709M40 42CrMo4 42CrMoS4	42CrMo4 42CrMoS4	42CrMo4 42CrMoS4	
	4145 4147	SCM445					
		SCM822					

Material Cross Reference Table

Steel

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

INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
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Material Cross Reference Table

Steel

Classification	USA		Japan	China	UK	Germany	France	Russia
	UNS	AISI	JIS	GB	BS	DIN	NF	ГОСТ
Stainless Steel	S20100	201	SUS 201	1Cr17Mn6Ni5N			Z12CMN17-07Az	
	S20200	202	SUS 202	1Cr18Mn8Ni5N	284S16			12X17T9AH4
	S30100	301	SUS 301	1Cr18Mn10Ni5Mo3N 1Cr17Ni7	301S21	X12CrNi17 7	Z11CN17-08	07X16H6
	S30153		SUS 301L			X2CrNi18-7		
			SUS 301J1			X12CrNi17 7		
	S30200	302	SUS 302	1Cr18Ni9	302S25		Z12CN18-09	12X18H9
	S30215	302B	SUS 302B					
	S30300	303	SUS 303	Y1Cr18Ni9	303S21	X10CrNiS18 9	Z8CNF18-09	
	S30323	303Se	SUS 303Se	Y1Cr18Ni9Se	303S41			12X18H10E
	S30400	304	SUS 304	0Cr18Ni9	304S31	X5CrNi18 10	Z7CN18-09	08X18H10
	S30403	304L	SUS 304L	00Cr18Ni10	304S11	X2CrNi19 11	Z3CN19-11	03X18H11
	S30451	304N	SUS 304N1	0Cr18Ni9N			Z6CN19-09Az	
	S30452		SUS 304N2	0Cr19Ni10NbN				
	S30453	304LN	SUS 304LN	00Cr18Ni10N		X2CrNi18 10	Z3CN18-10Az	
			SUS 304J1					
			SUS 304J2					
	S30431	S30431	SUS 304J3					
	S30500	305	SUS 305	1Cr18Ni12	305S19	X5CrNi18 12	Z8CN18-12	06X18H11
			SUS 305J1					
	S30908	309S	SUS 309S	0Cr23Ni13			Z10CN24-13	
	S31008	310S	SUS 310S	0Cr25Ni20	310S31		Z8CN25-20	10X23H18
	S31600	316	SUS 316	0Cr17Ni12Mo2	316S31	X5CrNiMo17 12 2	Z7CND17-12-02	
			SUS 316F			X5CrNiMo17 13 3	Z6CND18-12-03	
	S31603	316L	SUS 316L	00Cr17Ni14Mo2	316S11	X2CrNiMo17 13 2	Z3CND17-12-02	
						X2CrNiMo17 14 3	Z3CND17-13-03	03X17H14M3
	S31651	316N	SUS 316N	0Cr17Ni12Mo2N				
	S31653	316LN	SUS 316LN	00Cr17Ni13Mo2N		X2CrNiMoN17 12 2	Z3CND17-11Az	
						X2CrNiMoN17 13 3	Z3CND17-12Az	
	S31635		SUS 316Ti			X6CrNiMoTi17 12 2	Z6CNDT17-12	08X17H13M2T
			SUS 316J1	0Cr18Ni12Mo2Cu2				
			SUS 316J1L	00Cr18Ni14Mo2Cu2				
	S31700	317	SUS 317	0Cr19Ni13Mo3	317S16			
	S31703	317L	SUS 317L	00Cr19Ni13Mo3	317S12	X2CrNiMo18 16 4	Z3CND19-15-04	
S31753		SUS 317LN				Z3CND19-14Az		
		SUS 317J1	0Cr18Ni16Mo5					
		SUS 317J2						
		SUS 317J3L						
N08367		SUS 836L						
N08904	N08904	SUS 890L			904S14		Z2NCDU25-20	
S32100	321	SUS 321	1Cr18Ni9Ti 0Cr18Ni10Ti	321S31	X6CrNiTi18 10	Z6CNT18-10	08X18H10T	
S34700	347	SUS 347	0Cr18Ni11Nb	347S31	X6CrNiNb18 10	Z6CNNb18-10	08X18H12S	
S38400	384	SUS 384				Z6CN18-16		
S30430	304Cu	SUS XM7	0Cr18Ni9Cu3	394S17		Z2CNU18-10		
S38100		SUS XM15J1	0Cr18Ni13Si4			Z15CNS20-12		
S32900	329	SUS 329J1	0Cr26Ni5Mo2					
S39240	S31803	SUS 329J3L				Z3CNDU22-05Az	08X21H6M2T	
S39275	S31260	SUS 329J4L				Z3CNDU25-07Az		

Material Cross Reference Table

Steel

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

Representative Classification of Stainless Steel (JIS)

Austenitic Stainless Steel

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	

Ferritic Stainless Steel

JIS
SUS405
SUS429
SUS430
SUS430F
SUS434
SUSXM27

Martensitic Stainless Steel

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

Precipitation Hardened Stainless Steel

JIS
SUS630
SUS631



Material Cross Reference Table

Steel

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

Representative Classification of Heat Resisting Steel (JIS)

Austenitic Heat Resisting Steel

JIS
SUH31
SUH35
SUH36
SUH37
SUH38
SUH309
SUH310
SUH330
SUH660
SUH661

Ferritic Heat Resisting Steel

JIS
SUH21
SUH409
SUH446

Martensitic Heat Resisting Steel

JIS
SUH1
SUH3
SUH4
SUH11
SUH600
SUH616

Material Cross Reference Table

Steel

Classification	USA	Japan	China	UK	Germany	France	Russia
	AISI/ASTM	JIS	GB	BS	DIN	NF	ГОСТ
Carbon Tool Steel		SK140 (SK1)	T13			C140E3U	Y13
	W1-11¹/₂	SK120 (SK2)	T12			C120E3U	Y12
	W1-10	SK105 (SK3)	T11		C105W1	C105E2U	Y11
	W1-9	SK95 (SK4)	T10			C90E2U	Y10
	W1-8	SK85 (SK5)	T8Mn T9		C80W1	C90E2U C80E2U	Y8F Y9
		SK75 (SK6)	T8		C80W1	C80E2U C70E2U	Y8
		SK65 (SK7)	T7		C70W2	C70E2U	Y7
High Speed Tool Steel	T1	SKH2	W18Cr4V	BT1		H518-0-1	P18
	T4	SKH3	W18Cr4VCo5	BT4	S18-1-2-5	H518-1-1-5	P18K5Φ2
	T5	SKH4	W18Cr4V2Co8	BT5		H518-0-2-9	P18K5Φ
	T15	SKH10	W12Cr4V5Co5	BT15	S12-1-4-5	H512-1-5-5	
	M2	SKH51	W6Mo5Cr4V2	BM2	S6-5-2	HS6-5-2	P6M5
	M3-1	SKH52	CW6Mo5Cr4V2 W6Mo5Cr4V3				P6M5Φ3
	M3-2	SKH53	CW6Mo5Cr4V3		S6-5-3	HS6-5-3	P6M5Φ3
	M4	SKH54		BM4		HS6-5-4	
	M35 M41	SKH55	W6Mo5Cr4V2Co5 W7Mo5Cr4V2Co5	BM35	S6-5-2-5	HS6-5-2-5HC	P6M5K5
	M36	SKH56					
		SKH57		BT42	S10-4-3-10	H510-4-3-10	
	M7	SKH58	W2Mo9Cr4V2			HS2-9-2	
	M42	SKH59	W2Mo9Cr4VCo8	BM42	S2-10-1-8	HS2-9-1-8	
	Alloy Tool Steel	F2	SKS11				
		SKS2			105WCr6	105WCr5	XBF
		SKS21	W				
		SKS5					
L6		SKS51					
		SKS7					
		SKS8	Cr06			C140E3UCr4	13X
S1		SKS4	5CrW2Si 6CrW2Si				6XB2C 5XB2CΦ
S1		SKS41	4CrW2Si				4XB2C
W2-9¹/₂		SKS43		BW2		100V2	
W2-8		SKS44					
		SKS3	9CrWMn				9XBF
		SKS31	CrWMn		105WCr6	105WCr5	XBF
		SKS93					
		SKS94					
		SKS95	8MnSi				
D3		SKD1	Cr12	BD3	X210Cr12	X200Cr12	X12
D2		SKD10	Cr12Mo1V1		X153CrMoV12		X12MΦ
D2		SKD11	Cr12MoV	BD2	X153CrMoV12	X160CrMoV12	
A2		SKD12	Cr5Mo1V	BA2		X100CrMoV5	
	SKD4				X32WCrV3		
H21	SKD5	3Cr2W8V	BH21	X30WCrV9-3	X30WCrV9		
H11	SKD6	4Cr5MoSiV	BH11	X38CrMoV51	X38CrMoV5	4X5MΦC	
H13	SKD61	4Cr5MoSiV1	BH13	X40CrMoV51	X40CrMoV5	4X5MΦ1C	
H12	SKD62		BH12		X35CrWMoV5	3X3M3Φ	
H10	SKD7	4Cr3Mo3SiV	BH10	X32CrMoV33	32CrMoV12-18		
H19	SKD8		BH19				
	SKT3				55CrNiMoV4		
	SKT4	5CrNiMo	BH224/5	55NiCrMoV6	55NiCrMoV7	5XHM	

INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
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Material Cross Reference Table

Steel

Classification	USA	Japan	China	UK	Germany	France	Russia
	AISI/ASTM	JIS	GB	BS	DIN	NF	ГОСТ
Spring Steel	1075 1078	SUP3					75 80 85
		SUP6	55Si2Mn		56SiCr7	60Si7	60C2
	9260	SUP7	60Si2Mn 60Si2MnA		61SiCr7	60Si7	60C2Г
	5155	SUP9	55CrMnA		55Cr3	55Cr3	
	5160	SUP9A	60CrMnA		55Cr3	60Cr3	
	6150	SUP10	50CrVA	735A51, 735H51	50CrV4	51CrV4	ХФА50ХГФА
	51B60	SUP11A	60CrMnBA		51CrV4		50ХГР
	9254 4161	SUP12 SUP13	 60CrMnMoA	 705A60, 705H60	 60CrMn3-2	 60CrMo4	
Free Cutting Carbon Steel	1110	SUM11					
	1108	SUM12	Y12				
	1212	SUM21					
	1213	SUM22	Y15	(230M07)	95Mn28	S250	
	12L13	SUM22L	Y12Pb		95MnPb28	S250Pb	
	1215	SUM23					
		SUM23L					
	12L14	SUM24L	Y15Pb		95MnPb28	S250Pb	
		SUM25			95Mn36	S300	
	1117	SUM31			15S10		
		SUM31L					
		SUM32	Y20	210M15, 210A15		(13MF4)	
	1137	SUM41	Y30 Y35			(35MF6)	
	1141	SUM42	Y40Mn			(45MF6.1)	
1144	SUM43		(226M44)		(45MF6.3)		
Carbon Chromium Bearing Steel	51100	SUJ1	GCr4				
	52100	SUJ2	GCr15		100Cr6	100Cr6	ШХ15
	ASTM A 485 Grade 1	SUJ3	GCr15SiMn				
		SUJ4	GCr15SiMo				
		SUJ5	GCr18Mo				

Material Cross Reference Table

Cast Iron

Classification	USA	Japan	China	UK	Germany	France	Russia
	AISI/SAE	JIS	GB	BS	DIN	NF	ГОСТ
Gray Cast Iron	NO.20	FC100	HT100	100	GG10		CY10
	NO.30	FC150	HT150	150	GG15	FGL150	CY15
	NO.35	FC200	HT200	200	GG20	FGL200	CY20
	NO.45	FC250	HT250	250	GG25	FGL250	CY25
	NO.50	FC300	HT300	300	GG30	FGL300	CY30
	NO.60	FC350	HT350	350	GG35	FGL350	CY35
					GG40	FGL400	CY40
Modular Cast Iron	60-40-18	FCD400	QT400-18	400/17	GGG40	FGS370-17	BY40
	65-45-12	FCD450	QT450-10	420/12		FGS400-12	BY45
	70-50-05	FCD500	QT500-7	500/7	GGG50	FGS500-7	BY50
	80-60-03	FCD600	QT600-3	600/7	GGG60	FGS600-2	BY60
	100-70-03	FCD700	QT700-2	700/2	GGG70	FGS700-2	BY70
	120-90-02	FCD800	QT800-2	800/2	GGG80	FGS800-2	BY80
			QT900-2	900/2			BY100

Non-Ferrous Metals

Classification	USA	Japan	China	UK	Germany	France	Russia
	ASTM	JIS	GB	BS	DIN	NF	ГОСТ
Aluminum Alloys	1199		1A99		A199.99R		A99
			1A97		A199.98R		A97
			1A95				A95
		A1080	1A80	1080(1A)	A199.90	1080A	A8
	1050	A1050	1A50	1050(1B)	A199.50	1050A	A5
	5052	A5052	5A02	NS4	AlMg2.5	5052	Amg
			5A03	NS5			AMg3
	5056	A5056	5A05	NB6	AlMg5		AMg5V
	5456	A5556	5A30	NG61		5957	
	2036	A2117	2A01		AlCu2.5Mg0.5	2117	D18
		A2017	2A11	HF15	AlCuMg1	2017S	D1
	2124	A2024	2A12		AlCuMg2	2024	D16AVTV
	2319		2B16				
		A2N01	2A80				AK4
	2218	A2018	2A90				AK2
2014	A2014	2A14		AlCuSiMn	2014	AK8	
7175	A7075	7A09		AlZnMgCu1.5	7075	V95P	
Aluminum Alloy Casting	356.2	AC4C	ZAISI7Mn	LM25	G-ALSi7Mg		
	413.2	AC3A	ZAISI12	LM6	G-AL12	A-S12-Y4	AL2
	355.2		ZAISI5Cu1Mg				AL5
	413.0	AC8A	ZAISI2Cu2Mg1		G-AL12(Cu)		
			ZAlCu5Mn				AL19
	201.0		ZAlCu5MnCdVA				
	520.2		ZAlMg10	LM10	G-ALMg10	AG11	AL8
		ZAlMg5Si		G-ALMg5Si		AL13	

INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

Insert Grade 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	MOLDINO (Mitsubishi Hitachi Tool)	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
P (Steel)	P01	CA510	JC110V	HG8010 HG3305	MC6115 MC6015		GC4405 GC4305 GC4315	TP0501	AC8015P AC810P	T9205 T9105	KCP05B KCP05 KCPK05	IC8150 IC5005
	P10	CA115P CA510 CA515	JC110V JC215V	GM8015 HG8010	MC6115 MC6015 MY5015 MC6125	CP7	GC4405 GC4415 GC4305 GC4315 GC4325	TP0501 TP1501	AC8015P AC8020P AC810P	T9205 T9105 T9215 T9115	KCP05B KCP05 KCPK05 KCP10B KCP10	IC8150 IC8250 IC5005
	P20	CA125P CA025P CA525 CR9025	JC110V JC215V	GM8020 HG8025	MC6115 MC6015 MY5015 MC6125 MC6025 UE6020	CP7	GC4415 GC4315 GC4425 GC4325 GC4335	TP1501 TP2501 TP3501 TP25 TP40	AC8020P AC8025P AC820P	T9215 T9115 T9225 T9125	KCP10B KCP10 KCP25B KCP25	IC8150 IC8250 IC8350
	P30	CA125P CA025P CA525 CA530 CR9025	JC215V JC325V JC450V	GM25 GM8035 HG8025	MC6125 MC6025 UE6020 MC6035 UH6400	CP7	GC4425 GC4325 GC4335	TP2501 TP3501 TP25 TP40	AC8035P AC830P AC6030M AC630M	T9225 T9125 T9235 T9135	KCP25B KCP25 KCP30B KCP30	IC8250 IC8350
	P40	CA530	JC325V JC450V	GX30	MC6035 UH6400		GC4335 GC4325	TP3501 TP40	AC8035P AC830P AC6030M AC630M	T9235 T9135 T6215	KCP30B KCP30 KCP40B KCP40	IC8350
M (Stainless Steel)	M10	CA6515	JC605X JC110V	HG8025	MC7015 US7020		GC2015 GC1515	TM1501	AC6020M	T6215 T6120	KCM15B KCM15	IC6015 IC8150
	M20	CA6515 CA6525	JC605X JC110V	HG8025 GM8020	MC7015 US7020 MC7025		GC1515 GC2015 GC2025 GC2220	TM1501 TM2501	AC6020M AC6030M AC630M	T6215 T6120 T6130	KCM15B KCM15 KCM25B KCM25	IC6015 IC6025 IC8150 IC8250
	M30	CA6525	JC110V JC525X	HG8025 GM25 GM8035	MC7025 US7020 US735		GC2025 GC2220 GC235	TM1501 TM2501 TM3501	AC6030M AC630M AC8035P AC830P	T6215 T6130	KCM25B KCM25 KCM35B KCM35	IC6025 IC8350
	M40		JC525X	GX30 GM8035	MC7025 US735		GC235	TP40 TM2501 TM3501	AC6030M AC630M		KCM35B KCM35	
K (Cast Iron)	K01	CA410K CA310 CA4505	JC050W JC105V JC605W	HX3505 HX3515	MC5105 MC5005		GC3210 GC3005 GC4305	TK0501	AC4010K	T5105 T505	KCK05B KCK05	IC5005 IC428
	K10	CA410K CA415K CA310 CA315 CA4505 CA4515	JC050W JC105V JC110V JC108W	HX3305 HX3515 HG8010 HG8025 GM8020	MC5105 MC5115 MC5005 MC5015 MY5015 MH515	CP1	GC3210 GC3005 GC4305 GC4315	TK0501 TK1501	AC4010K AC4015K	T5105 T5115 T505 T515	KCK05B KCK05 KCK15B KCK15	IC5005 IC5010 IC418 IC428 IC8150
	K20	CA415K CA315 CA320 CA4515	JC110V JC108W JC215V	HX3515 HG8010 GM8020 HG8025	MC5115 MC5125 MC5015 MY5015 MH515	CP1	GC3210 GC3225 GC4315 GC4325	TK0501 TK1501	AC4015K AC420K AC425K AC8025P	T5115 T5125 T515	KCK15B KCK15 KCK20B KCK20	IC5005 IC5010 IC418 IC428 IC8150
	K30	CA320	JC108W JC215V	GM8020 HG8025	MC5125		GC3225 GC4325	TK1501		T5125	KCP25B KCK20	

Insert Grade Cross Reference Table

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	MOLDINO (Mitsubishi Hitachi Tool)	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
P (Steel)	P01	PR1705										
	P10	PR1705 PR1215 PR1725 PR2015		IP2000	MS6015 VP10MF VP10RT	VM1 DT4 DM4		TS2000 CP200	AC1030U ACZ150 AC5005S AC5015S AC5025S AC520U	AH8005	KCS10 KCU10 KC5010	IC807 IC907 IC1007
	P20	PR1215 PR1225 PR1625 PR1725 PR2015 PR2025		IP2000	MS6015 VP10MF VP10RT VP15TF	VM1 QM3 DT4 TM4 DM4	GC1125 GC15	TS2000 TS2500 CP200	AC1030U AC5025S AC520U AC530U	AH8015 AH6225 AH120 AH725 SH725	KCS10 KCU10 KC5010 KCU25 KC5025	IC807 IC808 IC907 IC908 IC1007
	P30	PR1225 PR1535 PR2025		IP2000 IP3000	MS6015 MS7025 VP15TF VP20MF VP20RT	QM3 TM4	GC1125	TS2500 CP500 CP600	AC1030U AC530U	AH8015 AH6225 AH7025 SH730 J740	KCU25 KC5025	IC808 IC908 IC830 IC1008 IC228 IC528
	P40	PR1535 PR2025		IP3000	VP15TF VP20MF VP20RT	QM3 TM4		CP500 CP600	AC1030U	AH6225		IC830 IC228 IC528 IC3028
	M (Stainless Steel)	M10	PR1215 PR1225 PR2025 PR1205	JC5003 JC8015	IP050S IP100S	VP10MF VP10RT	VM1 DT4 DM4	GC1115 GC1125 GC15	TS2000 TS2050 TS2500 CP200	AC5005S AC5015S AC510U AC520U ACZ150	AH8005 AH6225	KCS10 KCU10 KC5010
M20		PR1215 PR1725 PR1225 PR1515 PR2025 PR1205	JC5003 JC8015 JC5015 JC5118	IP100S	MS7025 MS9025 VP10MF VP10RT VP15TF	VM1 QM3 DT4 TM4 DM4 ZM3 ST4	GC1115 GC1125 GC15	TS2000 TS2500 CP200 CP500	AC5015S AC5025S AC1030U AC520U	AH8015 AH6225 AH7025 AH120 AH725	KCS10 KCU10 KC5010 KCU25 KC5025	IC808 IC908 IC1008
M30		PR1125 PR1535 PR2025	JC5015 JC5118	IP100S	MS7025 MS9025 VP15TF VP20MF VP20RT	QM3 DT4 TM4 DM4 ZM3 ST4	GC2035 GC1125	TS2500 CP500 CP600	AC5025S AC6040M AC1030U AC520U AC530U	AH6235 SH725 SH730 J740	KCU25 KC5025	IC908 IC830 IC1008
M40		PR1535	JC5118		MP7035 VP15TF VP20MF VP20RT	QM3 TM4 ST4	GC2035	CP500 CP600	AC6040M AC1030U AC530U	AH6235		IC830 IC3028
K (Cast Iron)	K01	PR2015								AH110	KCS10 KCU10 KC5010	
	K10	PR1215 PR2015			VP10RT		GC15	TS2000 CP200	AC1030U AC510U ACZ150 AC5015S	AH110 GH110	KCS10 KCU10 KC5010	
	K20	PR1215 PR2015			VP10RT VP15TF VP20RT			TS2000 TS2500 CP200	AC1030U AC510U ACZ150 AC5015S AC5025S	AH8015 AH6225 AH7025 AH120	KCS10 KCU10 KC5010 KCU25 KC5025	IC807 IC907 IC908 IC1007 IC1008
	K30	PR2015			VP15TF VP20RT			TS2000 TS2500 CP200 CP500	AC1030U AC530U	AH120 GH130	KCU25 KC5025	IC807 IC907 IC908 IC1007 IC1008
S (Difficult-to-cut material)	S01	PR005S PR115S	JC5003		MV9005 MP9005 VP05RT			TH1000		AH8005		IC804
	S10	PR005S PR015S PR115S PR120S	JC8015 JC5015 JC5118	HS910S JP910S	MP9005 MP9015 VP10RT		GC1105	TH1000 TS2000 TS2050 CP200	AC5005S AC5015S AC510U ACZ150	AH8005 AH8015 AH6225	KCS10 KCU10 KC5010	IC806 IC807 IC907 IC1007
	S20	PR015S PR115S PR120S PR1535	JC5015 JC5118	HS911S JP911S	MP9015 MP9025 MS9025 VP15TF		GC1105 GC1115 GC1125 GC15	TS2000 TS2050 TS2500 CP200	AC5015S AC5025S AC1030U AC520U	AH8015 AH7025 AH6225	KCS10 KCU10 KCU25	IC907 IC908 IC1007 IC1008
	S30	PR1535			MP9025 MS9025 VP20RT		GC1125			AH7025 AH6235	KCU25 KC5025	IC908 IC1008

INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

Insert Grade 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		Kyocera	Dijet	MOLDINO (Mitsubishi Hitachi Tool)	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
P (Steel)	P01	TN610 PV710	LN10		AP25N VP25N	T15 Q15	CT5015 CT525		T1000A T1500Z	NS520	KT315 KTP10	IC20N IC520N
	P10	TN610 TN620 TN60 PV710 PV720 PV7040 CCX	LN10 NIT		NX2525 AP25N VP25N	T15 Q15 Z15	CT5015 CT525 GC1525	TP1020 TP1030	T1000A T1500A T1500Z	AT9530 GT9530 J9530	KT315 KTP10	IC20N IC30N IC520N IC530N
	P20	TN620 TN90 PV730 PV720	NIT CX75 PX90	CZ25	NX2525 NX3035 MP3025 AP25N VP45N	C7X N40 C7Z	CT5015 GC1525	TP1020 TP1030	T1500A T2500A T1500Z T2500Z	NS9530 AT9530 GT9530 J9530		IC20N IC30N IC520N IC530N
	P30	PV730	CX75 PX90	CZ25	NX3035 MP3025 VP45N	C7X N40 C7Z	GC1525		T2500A T2500Z	NS9530		IC30N IC530N
M (Stainless Steel)	M10	TN610 TN620 PV710 PV720	LN10 NIT CX75		AP25N VP25N	T15 Z15 Q15	CT525 GC1525		T1000A	NS520	KT315 KTP10	IC20N IC520N
	M20	TN620 TN90 PV720 PV730	LN10 NIT CX75 PX90		NX2525 AP25N VP25N	Q15	GC1525	TP1030	T1000A T1500A	NS9530 AT9530 GT9530 J9530		IC20N IC30N IC520N IC530N
	M30	PV730	PX90	CZ25					T1500A	NS9530		IC30N IC530N
K (Cast Iron)	K01	PV7005 CCX	LN10 NIT		AP25N VP25N	T15 Q15	CT5015			NS520	KT315 KTP10	
	K10	TN610 CCX PV7005 PV7040	LN10 NIT	CZ25	NX2525 AP25N VP25N	T15 Q15 Z15	CT5015		T1000A	NS9530 AT9530 GT9530 J9530	KT315 KTP10	
	K20		NIT	CZ25	NX2525 AP25N VP25N					NS9530		

Boldface grade shows PVD Coated Cermet. (CCX is CVD Coated Cermet grade)

Carbide

Classification		Kyocera	Dijet	MOLDINO (Mitsubishi Hitachi Tool)	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
K (Cast Iron)	K01	KW10	KG03	WH01 WH05	HTi05T				H2 H1	TH03	K313 K68 GH1 K115M	
	K10	KW10 GW15	KG10 KT9 CR1	WH10	HTi05T HTi10		H13A	HX 890	H1 EH510	TH10	K313 K68 K110M	IC20
	K20	GW15 GW25	KT9 CR1 KG20	WH20	HTi10 UTi20T		H13A	HX 890 883	G10E H10E EH520	KS15F KS20	K313 K68 GH2	IC20
	K30		KG30		UTi20T		H13A	HX 883	G10E H10E			
N (Non-Ferrous Alloys)	N01	GW05			HTi10 MT2010		H10	H15		KS05F	GH1 K115M	
	N10	KW10 GW15 GW25	KT9 CR1	WH10	HTi10 MT2010	KM1	H10 H13A	KX HX 890 H15 H25		TH10	K313 K68 K110M	IC4 IC20 IC28
	N20	GW15 GW25	KT9 CR1		HTi10 MT2010 TF15		H10 H13A	KX HX 890 883 H15 H25		KS15F	K313 K68 GH2	IC20 IC28
	N30				TF15			KX HX 883 H25				IC28
S (Difficult-to-Cut Material)	S01	SW05			MT9005 RT9005		H10A					
	S10	KW10 SW10 GW15 GW25	KG10	WH10	MT9005 RT9005 MT9015 RT9010		H10A H10F H13A	HX 890 883	EH510 EH520	KS05F TH10	K313 K68 K110M	IC20
	S20	SW10 SW25 GW25	KG20		MT9015 RT9010 TF15 RT9020	KM1	H10A H10F H13A	HX 890 883 H25	EH510 EH520	KS15F TH10	K313 K68 GH2	IC20 IC28
	S30	SW25			TF15 RT9020		H10F H13A	HX 883				



Insert Grade Cross Reference Table

Coated Carbide (Milling / Drilling)

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

Classification		Kyocera	Dijet	MOLDINO (Mitsubishi Hitachi Tool)	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
P (Steel)	P10	PR1825 PR1525	DH108 DH110 DH111 DH115	PCA12M PN15M PN208 JP4105	MV1020		GC1010	F40M MK2050 MP1501 MP2501	ACP200 ACP2000 ACP100	AH120 AH725	KC505M KC510M KC515M	IC608 IC902 IC5400
	P20	PR1825 PR1835 PR1525 CA520D	DH111 DH115 JC8015 JC8118	CY150 CY9020 JP4120	MP6120 VP15TF MC7020 FH7020 F7030	TM1 DT4 DM4	GC1130 GC4220 GC4330 GC3040	F40M MP3000 MP1501 MP2501 MP3501	ACP3000 ACU2500 ACP200 XCU2500 ACP2000	AH3135 AH9030 AH3225 T3225	KC522M KC525M	IC808 IC810 IC900 IC908 IC910 IC5500
	P30	PR1825 PR1835 PR1525 PR1535	JC8118 JC8050 JC7550 JC7560	HC844 CY25 CY405 JS4045 GF30	MP6130 VP15TF VP20RT UP20M F7030	ZM3	GC1130 GC2030 GC4330 GC3040	F40M F25M MP3000 MP2501 MP3501	ACP3000 ACU2500 ACP300 XCU2500	AH3225 AH6030 AH130 T3130 T3225	KC530M KC725M KC735M KCPM40 KCPK30	IC300 IC830 IC845 IC908 IC910
	P40	PR1835 PR1535	JC5240 JC8050 JC7550 JC7560	PTH30E PTH40H JS4060 GX2140 GX2160	VP30RT		GC2040 GC4340	F40M MP2050 MP2501 MP3501	ACP3000 ACU2500 ACP300	AH140	KC725M KC735M KCPM40 KCPK30	IC328 IC330 IC830 IC928 IC4050
M (Stainless Steel)	M10	PR1835 PR1535 CA6535	DH108 DH111 DS108 JC8015	PN15M PN215	MC7020		GC1010 GC1130	F40M F25M	ACM100 ACK300 XCS2000 ACM200	AH725	KC515M	IC608 IC902 IC5400
	M20	PR1835 PR1525 PR1535 CA6535	DH108 DH111 DS108 JC8015 JC8118	JP4120	VP15TF MC7020 F7030	DT4 DM4	GC2030 S30T GC1130	F40M MS2050	ACS2500 ACU2500 ACP300 XCU2500 ACM200	AH3135 AH3225 AH6030 AH725 T3225	KC522M KC525M	IC300 IC808 IC900 IC908 IC5820
	M30	PR1835 PR1525 PR1535 CA6535	JC8118 JC8050 JC7550 JC7560	HC844 CY250 JS4045 PTH30E	MP7130 MP7030 VP20RT UP20M	ZM3	GC1040 S30T GC2040 GC4230 GC4240	F40M MS2050 T25M MM4500	ACM300 ACS2500 ACS3000 XCU2500 ACM200	AH3135 AH130 T3225 T3130	KC530M KC725M KC735M KCPM40 KCSM30	IC330 IC830 IC882 IC928 IC5820
	M40	PR1835 PR1525 PR1535 CA6535	JC8050 JC7550 JC7560	PTH40H JM4160 AX2040 GX2160	MP7140 VP30RT		GC1040 S40T GC2040 GC4240	F40M MP2050 MM4500	ACM300 ACS3000	AH140	KC725M KCPM40 KCSM40	IC328 IC882
K (Cast Iron)	K01	PR1810 PR1510 CA415D	DH102 DH103	ATH80D ATH08M TH308	MP8010 MV1020 MC5020		GC1010	MK2050 MH1000 MK1500	ACK3000	AH110		IC902
	K10	PR1810 PR1510 CA415D CA420M	DH108 DH110 DH111 JC8015	ATH10E TH315 CY100H	MP8010 MV1020 MC5020		GC1020 GC3220 K15W	MK2050 MH1000 MK1500	ACK3000 XCK2000 ACK2000 ACK200	AH110 AH120 T1215 T1115	KC514M KCK15 KCK20	IC608 IC903 IC5100
	K20	PR1810 PR1510 CA415D CA420M	DH115 JC8015 JC8118	CY9020 CY150 PTH135 JP4120 GX2120	VP15TF MV1020 MC5020 MC520		GC3330 GC3040 K15W K20W K20D	MK2050 MK1500 MP3501	ACK3000 ACU2500 XCK2000 XCU2500 ACK2000	AH120 AH9030 T1215	KC520M KC524M KCK20	IC808 IC810 IC908 IC910 DT7150
	K30	PR1810 PR1510	JC8118 JC5240	CY250 JS4045 GX2040 GX2160	VP20RT MC5020		GC3330 GC3040 K20W	MK2050 F40M MK1500 MP3501	ACK3000 ACU2500 ACK300	AH120	KC522M KC524M KCPK30	IC808 IC810 IC908 IC910
S (Difficult-to-Cut Material)	S10	PR1535 CA6535	DS108 DS118 JC8015 JC8118	JP4120 JS1025	MP9120 VP15TF		GC1010 GC1130	F40M MS2050 MS2500	ACM100 ACU2500 ACK300 ACP300	AH120 AH725	KC510M	IC380 IC902 IC908 IC928
	S20	PR1535 CA6535	DS150 JC8050 JC8118	PTH30H	MP9120 MP9130 VP15TF		S30T GC2030 GC1130	F40M MS2050 MS2500	ACS2500 ACU2500 ACP300	AH725 AH130 AH6030	KC522M KC525M KCSM30	IC840 IC882 IC900 IC5280
	S30	PR1535	JC7550 JC7560	JM4160	MP9140		GC1040 S40T GC2040	MS2050	ACM300 ACS2500 ACS3000	AH130	KC522M KC725M KCSM40	IC328 IC330 IC830 IC928

INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

Boldface grade shows CVD Coated Carbide

800.823.7284

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Insert Grade Cross Reference Table

Cermet (Milling)

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

Classification		Kyocera	Dijet	MOLDINO (Mitsubishi Hitachi Tool)	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
P (Steel)	P10	TN60 TN620M PV60M	CX75	CH550 MZ1000	NX2525 VP25N		CT530			NS740	KTPK20	IC30N
	P20	TN620M TN100M PV60M	CX75 CX90	CH7000	NX2525 MX3020 VP25N		CT530			NS740	KTPK20	IC30N
	P30	TN620M TN100M	CX90		MX3030 NX4545				T2500A T250A T4500A			IC30N
M (Stainless Steel)	M10	TN100M	CX75		NX2525 VP25N		CT530			NS740		IC30N
	M20	TN100M	CX75	CH550	NX2525 MX3020 VP25N		CT530			NS740	KTPK20	IC30N
	M30				MX3030 NX4545							
K (Cast Iron)	K01		CX75									
	K10		CX75		NX2525 VP25N					NS740	KTPK20	
	K20		CX75		NX2525 MX3020 MX3030 VP25N						KTPK20	

Boldface grade shows PVD Coated Cermet.

Ceramic

Classification		Kyocera	Dijet	Nippon Tungsten	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
K (Cast Iron)	K01	KA30 A65 KS6015 A66N PT600M CS7050		NPC-H2 NPC-A2		HC1 HC2 HC6 HW2 WA1 WA5	CC6190 CC620 CC650		NB90S	TZ120 LX21	KYK10	IN110 IN22 IN23 IS6 IS8 IS80
	K10	A65 KS6015 KS6050 A66N PT600M CS7050		NX NXA Whisker WIN		HC1 HC2 HC6 HW2 WA1 WA5 SX6 SP9	CC6190			FX105 CX710	KYK10 KY3500 KYK25	IN110 IN22 IN23 IS6 IS8 IS420 IS80
	K20	KS6050				SX6 SX9				FX105 CX710	KY3500	IS8 IS80
S (Difficult-to-Cut Material)	S10	KS6030				JX1 JX3 JP2 120	CC6060 CC6160 CC6065 CC670	CS100	WX120	WG300 FX510 TS300		IN110 IS25
	S20	KS6030 KS6040	CA200	Whisker WIN		JX1 JX3 WA1 WA5 SX3 SX7 JP2 120	CC6060 CC6160 CC6065 CC670	CS100 CS300 CW100	WX120		KYS30 KYSP30 KYS25	IS25 IS35 IS9 IW7
	S30	KS6040				JX1 JX3 SX9 JP2 120			WX120		KYS30	IS9 IW7
H (Hardened Materials)	H01	A65 A66N PT600M		NPC-A2		HC2 HC7 450 ZC7	CC6050 CC650		NB100C	LX10 LX11		
	H10	A65 A66N PT600M		NPC-A2 Whisker WIN		450	CC670		NB100C	WG300	KY1615	IN22 IN23 IW7 IN420

Boldface grade shows PVD Coated Ceramic.

Insert Grade Cross Reference Table

CBN

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

Classification		Kyocera	Dijet	MOLDINO (Mitsubishi Hitachi Tool)	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
K (Cast Iron)	K01	KBN475 KBN60M KBN900	JBN795 JBN330 JBN500		MB710 BC5110	B23 B30 B52	CB7925 CB50 CB7525	CBN300	BN7125 BN500 NCB100 BNC500	BX910 BX930 BX870	KB1630 KB5630	IB50
	K10	KBN60M KBN900	JBN795 JBN300 JBN330 JBN500 JBN245	BH200	MB730 MB4120	B23 B30 B52	CB7925 CB50 CB7525	CBN200 CBN300 CBN600 CK2065 CH3515 CBN160C CBN300P CBN400C	BN7125 BN500 BNC500	BX470 BX480	KB1630 KB1340 KB5630	IB50 IB55 IB90
	K20	KBN900	JBN245	BH250	MB730 MB4120 MBS140	B16	CB50	CBN200 CBN300 CBN500 CBN600 CK2065 CH3515 CBN160C CBN300P CBN400C	BN7125 BNS8125 BNC8115	BX90S BXC90	KB1630 KB1340 KB1345 KB5630 KBK45	
H (Hardened Materials)	H01	KBN510 KBN010 KBN05M KBN10M	JBN245 JBN795 JBN500		BC8105	B52 B5K	CB20 CB50 CB7105	CBN010 CH0550	BN1000 BN2000 BNX10 BNC2105 BNC2010 BNC2115	BX310 BXM10	KBH10	IB50 IB10H IB10HC
	H10	KBN510 KBN525 KBN010 KBN015 KBN020 KBN05M KBN10M KBN25M KBN900	JBN795 JBN500	BH200	MB8110 MB8120 BC8110 BC8120 BC8210 BC8220	B36 B6K	CB50 CB7105 CB7015	CBN010 CBN150 CH0550 CH1050 CBN060K	BN2000 BNC2010 BNC2020 BNC2115 BNC2125 BNC160 BNC200	BX330 BX530 BXA10 BXM10	KBH10 KB5610	IB50 IB55 IB10H IB10HC
	H20	KBN015 KBN020 KBN25M KBN35M KBN900		BH250	MB8120 BC8120 BC8220	B36 B40	CB7025 CB7125 CB7525	CBN150 CH1050 CBN060K CH2540 CH2581 CH3515	BN2000 BNX20 BNC2020 BNC2125 BNC200	BX360 BX850 BXA20 BXM20	KBH10 KBH20 KB5625	IB55 IB20H IB25HA IB25HC
	H30	KBN020 KBN35M KBN900		BH250	MB8130 BC8220 BC8130	B40 B22	CB7135 CB7525	CH2540 CH2581 CH3515	BN350 BNC300	BX380 BXC50 BR35F	KBH20 KB1630 KB5625 KB5630	IB55 IB20H IB25HA IB25HC
Sintered Steel	-	KBN570 KBN70M	JBN795 JBN330		MB4120	B23 B30	CB7135 CB7125	CBN200	BN7115 BN7125	BX470 BX480	KB5630	IB05S IB10S IB90

Boldface grade shows PVD Coated CBN.

PCD

Classification		Kyocera	Dijet	MOLDINO (Mitsubishi Hitachi Tool)	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Class	Symbol											
N (Non-Ferrous Metals)	N01	KPD001 KPD230 KPD250	JDA30 JDA735			UC1 PD1 PD2	CD05 CD10	PCD05	DA90 DA150 DA1000	DX160 DX180	KD1400 KD1405	ID5
	N10	KPD001 KPD010 KPD230 KPD250	JDA735 JDA10		MD220	PD1 PD2	CD05 CD10	PCD05 PCD20 PCD30	DA150 DA1000	DX140 DX160	KD1400 KD1405 KD1410 KD1415 KD1425	ID5
	N20	KPD001 KPD010 KPD230 KPD250	JDA10 JDA715		MD220 MD2030	PD1 PD2		PCD05 PCD20 PCD30 PCD30M	DA1000 DA2200	DX110 DX120	KD1400 KD1425	



Molded Chipbreaker Cross Reference Table

Molded Chipbreaker Cross Reference Table

Negative Inserts

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

Cutting Range	Kyocera		Dijet	MOLDINO (Mitsubishi Hitachi Tool)	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar	
	General Chipbreaker	Chipbreaker for Gummy Material / Soft Steel											
Carbon Steel / Alloy Steel	Finishing (with wiper edge)	WF WP	-	-	-	SW	-	WL WF	W-FF2 W-MF2	SEW LUW	AFW FW	FW	WF
	Finishing - Medium (with wiper edge)	WE WQ	-	-	-	MW	-	WM WMX	W-M3 W-M5	GUW	ASW SW	MW	WG
	Finishing	DP GP PP	XF XP	F1 FA FT PF	BE BH FE	F FH FS FY PK FP	UL WM ZF1	XF QF	FF1	FP FB FE SP FA FL LU	TF 01 AS TSF	FF UF FS LF	F3P SF PF
	Finishing - Medium	HQ PQ CQ CJ VC VF	XQ	UA UT	AB B CE CT	SH C SA LP SY	WV WR	LC PF	FF2 MF2	SU EX SJ SE UJ SX	TS NS CB 11 17 27 ZF	K RP FN FM	NF SM
	Medium - Roughing	PMG PG GS PS	XS	UR UB	AE DE AH	MV MP MA MH	Z5 ZW1	XM QM SM SMC PM PMC	M3 MF3	UA UG GE GU	AM DM NM TM ZM	MN	M3P TF PP
	Medium - Roughing High Feed Rate	PT GT	-	GC PQ	AR AY	GH RP	GS	MR XMR	M5 MR5 MR6	MU UX ME	TH 32Y 32 37	RP RN	R3P NR
	Roughing	Standard PH	-	GG LG GQ	RE	MT Standard	G	Standard 23 HM	MR7	MC MU MX UZ	31 33 F-K THS	PR MG	GN
	Roughing Single-sided High Feed Rate	PX	-	GS RM UC UP UD	H HX HE TE UE	HV HR HX HZ HL HM	-	QR PR HR	R4 R5 R6 R7 RR6 R57 RP	HG HP MP HF	TU TRS 57 65 TUS	RP RH RM RW	TNM NM
Stainless Steel, Difficult-to-Cut Material	Finishing	MQ SQ	-	SF	BH MP	FS SH FJ LM LS	ZF1	MF	M1	SU EF	SF SS	FP	F3M VL F3S
	Medium - Roughing	MS MU TK SG SX	-	GP SZ	DE SE PV VI	MS MA GM MJ MM ES MH GH GJ RM RS	ZP WS	MM MMC MR XMR SM SMR SF SGF SMC MRR	MF1 MF3 A3 A5 M5 56 R8 RR9 MF4	EG EX MU UP EM	HMM SM SA S SH HRM HPF	P MP MS UP	TF PP M3M R3M
Cast Iron	Medium	KQ KG C Standard	-	-	AH VA V	LK MF Standard	-	KF KM	-	UZ UX UJ	Standard 33 CF	FN	GN
	Roughing	KH GC ZS	-	-	-	GH RK	-	KR KRR	MR9	GZ	CM CH	RP UN	NR
Non-Ferrous Metals	Medium - Roughing	AH	-	-	-	-	-	AL	95	AG	P	GP MS	PP

Molded Chipbreaker Cross Reference Table

Positive Inserts

Cutting Range		Kyocera		Dijet	MOLDINO (Mitsubishi Hitachi Tool)	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
		General Chipbreaker	Chipbreaker for Gummy Material / Soft Steel										
Carbon Steel / Alloy Steel	Minute D.O.C.	CF	-	-	-	-	-	-	-	-	01	-	-
	Finishing (with wiper edge)	WP	-	-	-	SW	-	WF WK WM	W-F1 W-F2	LUW SDW	SW	FW	WF
	Finishing	PF DP GP PP VF	XP	ASF	-	FV SQ FP SMG	AZ3 AMX AZ7 FG	PF UF XF	FF1	FB GU 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 M3	LB SF SU SS	PS PSS 24	LF	14
	Finishing - Medium (2)	GK	-	BM	JQ	Standard	QD CL	PF PMC XM	MF2 M5	US GU	-	-	F3P
	Medium	Standard	-	-	J	MP No Indication	AM5 AM3 AZ8	PR UR KM XR	F2	MU SC	PM	GM MP MR	Standard
Stainless Steel, Difficult-to- Cut Material	Finishing - Medium	MQ	-	-	MP	FM FV SV LM LS MS	-	MF MMC SM MR MM	-	LU	PSS JS PF PSF PS PM	FW FP MW	PF WF F2M
Non-Ferrous Metals	Finishing - Medium	AP AH	-	ALU	-	AZ	-	AL	AL	AG AW	AL	HP	AF AS

Positive Inserts (for Small Parts Machining)

Cutting Range		Kyocera	Dijet	MOLDINO (Mitsubishi Hitachi Tool)	Mitsubishi	NTK	Sandvik	Seco	Sumitomo	Tungaloy	Kennametal	Iscar
Carbon Steel / Alloy Steel	Minute D.O.C.	CF	-	-	-	-	-	-	-	01	-	-
	Finishing	PF CK GF SKS	ASF	JQ	FP FV SMG LS-P	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 LM	-	MF	-	LU	JS PF PSF	FW FP MW	WF
Non-Ferrous Metals	Finishing - Medium	AP AH	ALU AWI	-	AZ	-	AL	AL	AG AW	AL	HP	AF AS

Cera-Notch Conversion Table

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

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



Milling Insert Cross Reference Table

Milling Insert Cross Reference Table

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Kyocera		Class	Applications	MOLDINO (Mitsubishi Hitachi Tool)	Mitsubishi	Sandvik	Sumitomo	Tungaloy	Iscar
ANSI	ISO								
SDMR42AUER-H SDKR42AUEN-S	SDMR1203AUER-H SDKR1203AUEN-S	M K	Steel		(SDNR1203AEEN-JS)		SDMR1203AEEN SDMR1203AETN	SDMR1203AETN-MJ SDKR1203AESR-MJ SDKR1203AETN-MJ SDKR1203AEPN-MS SDKR42ZSR-MJ SDKR42ZPN-MS	SDKR1203AUTR-HS SDKR1203AUN-76
SDKN42AUTN	SDKN1203AUTN	K			SDKN1203AEN SDKN1203AETN (SDNN1203AETN1)		SDKN42MT (SDNN1203AETN)	SDKN1203AETN-12 SDKN42ZTN	SDKN1203AETN
SDKN42AUFN	SDKN1203AUFN	K	Cast Iron				SDKN42M (SDNN1203AEEN)	SDKN1203AEFN-12 SDKN42ZFN	
			Non-Ferrous				SDKN42M	(SDCN1203AEFN-D) (SDCN42ZFN-DIA)	
SDKN53AUTN	SDKN1504AUTN	K	Steel		SDKN1504AEN SDKN1504AETN		SDKN53MT	SDKN1504AETN SDKN53ZTN	SDKN1504AETN
SEMR42AFER-H SEKR42AFEN-S	SEMR1203AFER-H SEKR1203AFEN-S	M K	Steel		(SEER1203AFEN-JS)	SEKR1203AZ-WM (SEER1203AZ-WL)	SEMR1203AFEN (SEER1203AFEN)	SEMR1203AFTN-MJ SEKR1203AFSR-MJ SEKR1203AFTN-MJ SEKR1203AFPV-MS	SEKR1203AFTR-HS SEKR1203AFR-HS SEKR1203AFN-76 SEKR1203AF-N-42
SEEN42AFTN	SEEN1203AFTN	E			SEEN1203AFTN	SEEN1203AFTN1		SEEN42MT	SEEN1203AFTNCR-14
SEKN42AFTN	SEKN1203AFTN	K		SEKN1203AFTN	SEKN1203AFTN1 (SENN1203AFTN1)	SEKN1203AZ (SEMN1203AZ)	SEKN42MT (SENN1203AFTN)	SEKN1203AFTN SEKN1203AFTN-16 SEKN42AFTN SEKN42AFTN16	
SEKN42AFFN	SEKN1203AFFN	K	Cast Iron	SEKN1203AFFN	(SEEN1203AFFN1)	SEKN1203AZ (SEMN1203AZ)	SEKN42M (SENN1203AFEN)	SEKN1203AFFN SEKN42AFFN	
SEEN42AFFN	SEEN1203AFFN	E	Non-Ferrous	(SEKN1203AFFN)	(SECN1203AFFR1)				
SEKN42EFTR	SEKN1203EFTR	K	Steel		SEKN1203EFTR1	(SECN1203EER)		SEKN1203EFTR (SECN1203EFTR) (SEEN1203EFTR) (SECN42EFTRCR) (SEEN42EFTRCR)	
SEKN53AFTN	SEKN1504AFTN	K	Steel	SEKN1504AFTN		SEKN1504AZ	SEKN53MT		SEKN1504AFTN
SPEN42EESR	SPEN1203EESR	E	Cast Iron		SPEN42EFSR1 SPEN1203EESR1 SPEN1203EEER1 (SPNN1203EEER1)				
SPMR42EDER-H SPKR42EDER-S	SPMR1203EDER-H SPKR1203EDER-S	M K	Steel	SPKN1203EDER SPEN1203EDR-WC	(SPER1203EDER-JS)	SPKN1203EDR-WH		SPKR1203EDSR-MJ SPKR42SSR-MJ	SPKR1203EDR-76 SPKR1203EDTR-HS
SPCN42EDTR	SPCN1203EDTR	C		SPKN1203EDT31R SPAN1203EDR	(SPEN1203EDR)	(SPAN1203EDR)	SPCH42TR-R	SPCN1203EDTR SPCN42STR	
SPKN42EDTR	SPKN1203EDTR	K		SPKN1203EDTR	SPKN1203EDR	SPKN1203EDR	(SPCH42TR) (SPCH42TR-R)	SPKN1203EDTR SPKN42STR (SPEN1203EDTR) (SPEN42STR)	SPKN1203EDTR SPKN1203EDTR-42
SPKN42EDFR	SPKN1203EDFR	K	Cast Iron	SPKN1203EDFR		SPKN1203EDR	(SPCH42R)	SPKN1203EDFR SPKN42SFR	SPKN1203EDFR
SPKN53EDTR	SPKN1504EDTR	K	Steel	SPKN1504EDT32R SPKN1504EDTR	SPKN1504EDR	SPKN1504EDR	(SPCH53TR-R)	SPKN1504EDTR SPKN53STR (SPCN1504EDTR) (SPCN53STR)	SPKN1504EDTR
SPKN53EDFR	SPKN1504EDFR	K	Cast Iron	SPKN1504EDFR			(SPCH53R-R) (SPCH53TR-R)	SPKN1504EDFR SPKN53SFR	SPKN1504EDFR

Note 1. Tolerance is different for part numbers in ().

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

Milling Insert Cross Reference Table

Milling Insert Cross Reference Table

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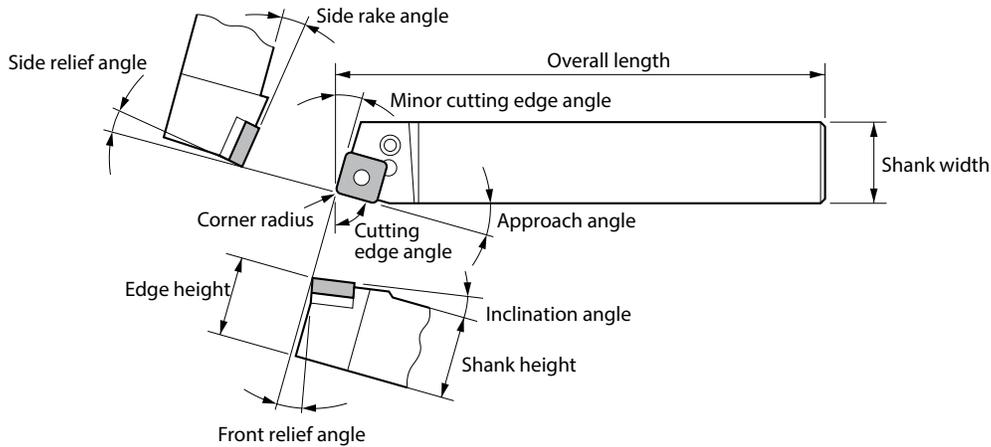
Kyocera		Class	Applications	MOLDINO (Mitsubishi Hitachi Tool)	Mitsubishi	Sandvik	Sumitomo	Tungaloy	Iscar
ANSI	ISO								
SPCN42XPTR	SPCN1203XPTR	C	Steel					SPCN1203ZPTR SPCN42ZTR	
SPKN42XPTR	SPKN1203XPTR	K						SPKN1203ZPTR SPKN42ZTR (SPEN1203ZPTR) (SPEN42ZTR)	
SPKN42XPFR	SPKN1203XPFR	K	Cast Iron					SPKN1203ZPFR SPKN42ZFR	
SPKN53XETR	SPKN1504XETR	K	Steel		SPK53C2SR				
TPMR32PDER-H	TPMR1603PDER-H	M	Steel		(TPER1603PPER-JS)	(TPKN1603PPR-WH)			(TPKR1603PPTR-HS)
TPKN32PDTR	TPKN1603PDTR	K		TPKN1603PRR	TPKN1603PPR (TPEN1603PPR)	TPKN1603PPR	TPKN32TR		TPKN1603PPTR
TPKN32PDFR	TPKN1603PDFR	K	Cast Iron	TPKN1603PDR		TPKN1603PPR	TPKN32R		TPKN1603PPFR
TPMR43PDER-H TPKR43PDER-S	TPMR2204PDER-H TPKR2204PDER-S	M K	Steel		(TPER2204PDER-JS)	TPKN2204PDR-WH		TPMR2204PDSR-MJ TPKR2204PDSR-MJ TPKR43ZSR-MJ	TPKR2204PDTR-HS TPKR2204PD-R-76
TPKN43PDTR	TPKN2204PDTR	K		TPKN2204PDR	TPKN2204PDR (TPEN2204PDR)	TPKN2204PDR	(TPCH43TR)	TPKN2204PPTR TPKN43ZTR (TPCN2204PPTR) (TPCN43ZTR)	TPKN2204PDTR TPKN2204PDTR-42
TPKN43PDFR	TPKN2204PDFR	K	Cast Iron	TPKN2204PDFR			(TPCH43R)	TPKN2204PPFR TPKN43ZFR (TPCN2204PPFR) (TPCN43ZFR) (TPEN2204PPTR-16) (TPEN43ZTR)	TPKN2204PDFR
TEMR32PTER-H	TEMR1603PTER-H	M	Steel		(TEER1603PEER-JS)			(TEKR1603PEPR-MS)	
TEKN32PTTR	TEKN1603PTTR	K			(TEEN1603PETR1)		TEKN32TR	(TECN1603PETR) (TEEN1603PETR) (TECN32ZTR) (TEEN32ZTR)	
TEKN32PTFR	TEKN1603PTFR	K	Cast Iron		(TEEN1603PEFR1)		TEKN32R	(TEEN1603PEFR) (TEEN32ZFR)	
TEEN32PTFR	TEEN1603PTFR	E	Non-Ferrous		(TECN1603PEFR1)		TEEN32R	(TECN1603PEFR-D) (TECN32ZFR-DIA)	
TEMR43PTER-H TEKR43PTER-S	TEMR2204PTER-H TEKR2204PTER-S	M K	Steel		(TEER2204PEER-JS)			TEKR2204PEPR-MS	
TEEN43PTTR	TEEN2204PTTR	E			TEEN2204PETR1		TEEN43TR	TEEN2204PETR (TECN2204PETR) TEEN43ZTR (TECN43ZTR)	
TEKN43PTTR	TEKN2204PTTR	K	Cast Iron Non-Ferrous		TEKN2204PETR1		TEKN43TR	(TEEN2204PETR) (TECN2204PETR) (TEEN43ZTR) (TECN43ZTR)	
TEKN43PTFR	TEKN2204PTFR	K			(TEEN2204PEFR1)		TEKN43R	(TEEN2204PEFR) (TEEN43ZFR)	
				(TECN2204PEFR1)		(TEEN43R)	(TECN2204PEFR-D) (TECN43ZFR-DIA)		
SNCN43XNTN	SNCN1204XNTN	C	Steel		SNC43B2S		(CSN43MT)	SNCN1204ZNTN SNCN43ZTN	
SNKN43XNTN	SNKN1204XNTN	K				SNK43B2S		(CSN43MT)	SNKN1204ZNTN SNKN43ZTN
SNMF43XNTN	SNMF1204XNTN	M	Steel		(SNKF43B2S)		(CSNB43MT)	(SNKF1204ZNTN) (SNKF43ZFN)	

Note 1. Tolerance is different for part numbers in ().

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

INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

Terms and Angles of Turning Toolholder



Function of Tool Angles

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	· 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.
	Side relief angle		
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

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
LPR	Overhang	mm
F	Cutting force	N

(F = k x ap x f)

$$\delta = \frac{4 \times F \times (LPR)^3}{E \times B \times H^3} = \frac{4 \times k \times ap \times f \times (LPR)^3}{E \times B \times H^3}$$

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

2. Flexure of Boring Bar

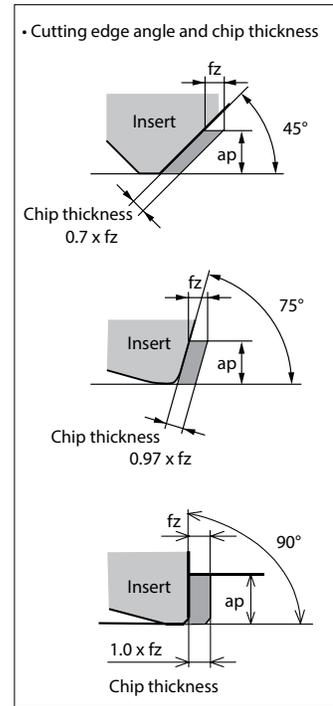
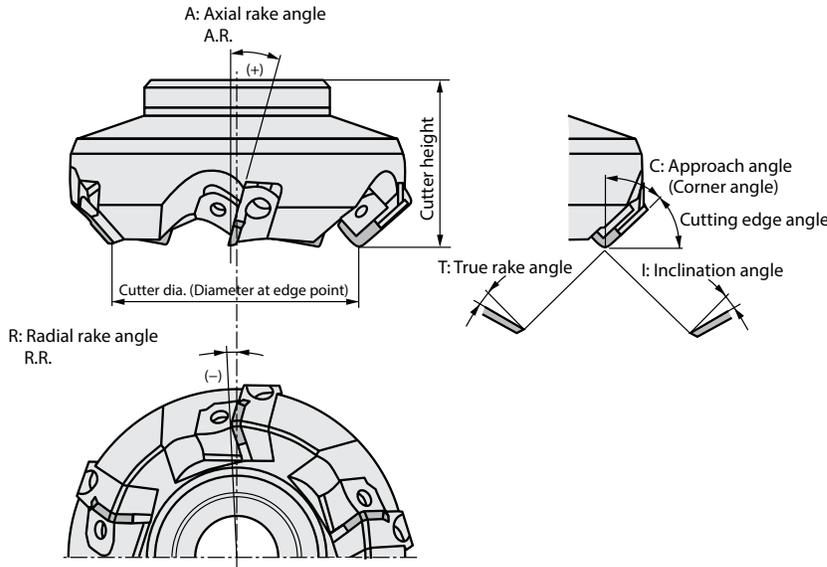
Symbol	Name	Unit
δ (delta)	Deflection	mm
DCON	Shank dia.	mm
E	Young ratio	N/mm ²
ap	Depth of cut	mm
f	Feed rate	mm/rev
k	Specific cutting force	N/mm ²
LPR	Overhang	mm
F	Cutting force	N

(F = k x ap x f)

$$\delta = \frac{64 \times F \times (LPR)^3}{3 \times E \times \pi \times (DCON)^4} = \frac{64 \times k \times ap \times f \times (LPR)^3}{3 \times E \times \pi \times (DCON)^4}$$

R TECHNICAL

Terms and Angles of Milling Cutters



Function of Tool Angles

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

The formula for true rake angle: $\tan T = \tan R \times \cos C + \tan A \times \sin C$

The formula for inclination angle: $\tan I = \tan A \times \cos C - \tan R \times \sin C$

No. of Inserts (Z)

1) If the number of stages is one

If the number of stages 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.

Toolholder dimensions

Description	Availability	Dimension (mm)				
		DC	DCOM	LF	LH	ARMK
MECK 08-S10-07-3T	●	1	8	10	16	
14-S12-07-2T	●	2	14	12	18	
17-S16-07-3T	●	3	17			100

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

Toolholder dimensions

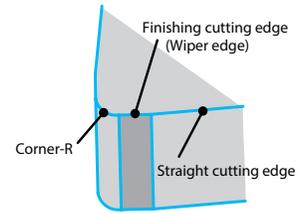
Description	Availability	R	Inserts	Flutes	Stages
MSR 063R-1M	●	4	8	1	1
063R-2M	●	8	8	2	2
080R-1M	●	4	4	1	1
080R-2M	●	8	8	2	2
080R-4M	●	16	16	4	4

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

Precautions when using Wiper Inserts

About Wiper Inserts

A wiper insert is designed with a wiper edge that is located between corner radius and straight cutting edge shown in figure on the right.

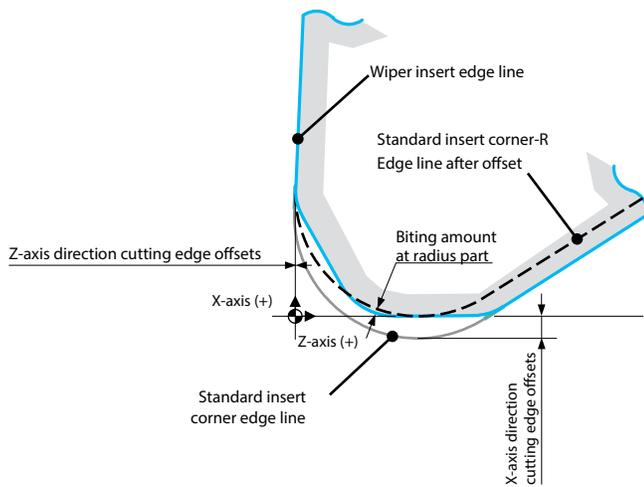


Advantages

- A wiper edge geometry provides improved surface finish quality even at increased feed rates
- Improved machining efficiency : Reduced cutting time with higher feed rate as well as consolidation of roughing and finishing provide high machining efficiency
- Longer tool life : Reduced cutting time with higher feed rate leads to increase part production
- Excellent chip control : Higher feed rate makes chips thicker, which allows chips to be broken easier

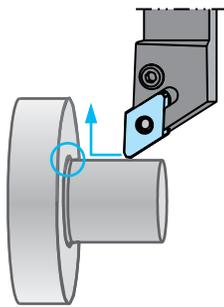
Precautions when using WF / WE Chipbreaker (Negative Insert)

Tip of Corner-R (DNMX, TNMX)



Caution when Machining Inside Corner-R

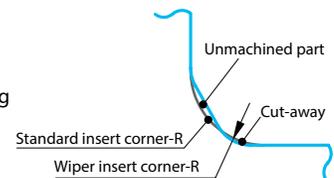
Do not use this wiper insert if a precise inside corner-R is required like shown in the figure below.



* From external turning to up facing without arc complement (A wiper edge does not work during up facing)

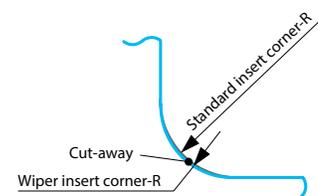
DNMX / TNMX WF chipbreaker

- More incomplete cutting and excessive cutting during machining with this chipbreaker than the machining with a standard insert
- The inside corner-R dimension become smaller than the requirement.



CNMG / WNMG WF / WE chipbreaker

- The inside corner-R dimension would be smaller than the requirement (Cutting excessively).



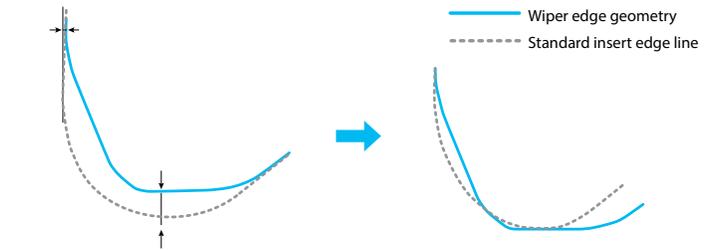
Precautions when using Wiper Inserts

WF / WE Chipbreaker Edge Position Offset Adjustment

For D type and T type inserts, cutting edge offsets are required.

Cutting Edge Offsets (in)					
DNMX431WF DNMX441WF		DNMX432WF DNMX442WF		DNMX433WF DNMX443WF	
X-axis direction	Z-axis direction	X-axis direction	Z-axis direction	X-axis direction	Z-axis direction
0.0094	0.0008	0.0055	0.0004	0.0043	0.0004

Cutting Edge Offsets (in)					
TNMX331WF		TNMX332WF		TNMX333WF	
X-axis direction	Z-axis direction	X-axis direction	Z-axis direction	X-axis direction	Z-axis direction
0.0094	0.0004	0.0063	0.0000	0.0043	0.0000

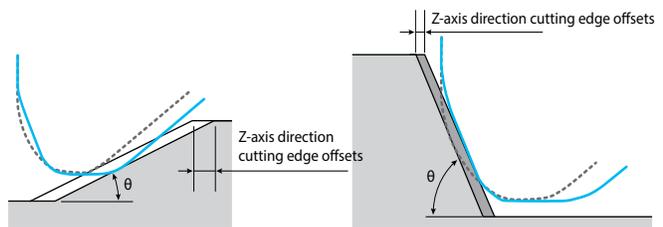


For D type and T type inserts, program corrections are required for ramping and up facing.

Program corrections for tapered part of workpiece (Z-axis direction cutting edge offsets)

DNMX43 / DNMX44 Inserts

Z-axis Cutting Edge Offsets (in)	Corner-R (RE) (in)	Ramping Angle θ					
		0°	5°	10°	15°	20°	25°
1/64	1/64	0.0000	-0.0134	-0.0138	-0.0142	-0.0142	-0.0142
	1/32	0.0000	-0.0102	-0.0102	-0.0098	-0.0094	-0.0087
	3/64	0.0000	-0.0059	-0.0067	-0.0063	-0.0059	-0.0059



Z-axis Cutting Edge Offsets (in)	Corner-R (RE) (in)	Up Facing Angle θ																		
		0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°
1/64	1/64	0.0000	-0.0008	-0.0012	-0.0012	-0.0016	-0.0020	-0.0024	-0.0028	-0.0031	-0.0035	-0.0039	-0.0043	-0.0047	-0.0039	-0.0031	-0.0024	-0.0016	-0.0008	0.0000
	1/32	0.0000	0.0051	0.0047	0.0043	0.0035	0.0028	0.0020	0.0016	0.0008	0.0000	-0.0008	-0.0020	-0.0028	-0.0024	-0.0016	-0.0008	-0.0004	-0.0004	0.0000
	3/64	0.0000	0.0142	0.0134	0.0122	0.0106	0.0094	0.0079	0.0063	0.0051	0.0035	0.0020	0.0000	-0.0016	-0.0016	-0.0012	-0.0008	-0.0004	-0.0004	0.0000

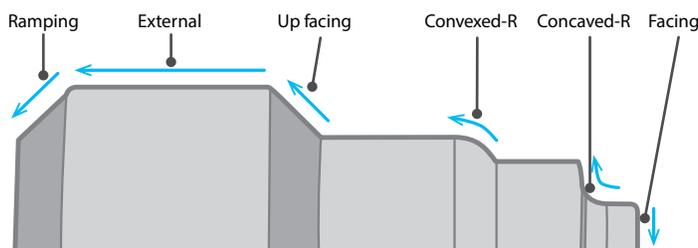
TNMX33 Inserts

Z-axis Cutting Edge Offsets (in)	Corner-R (RE) (in)	Ramping Angle θ					
		0°	5°	10°	15°	20°	25°
0.4	0.4	0.0000	/	/	/	/	/
	0.8	0.0000	/	/	/	/	/
	1.2	0.0000	/	/	/	/	/

Do not use TNMX33 insert for ramping.

Z-axis Cutting Edge Offsets (in)	Corner-R (RE) (in)	Up Facing Angle θ																		
		0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°
1/64	1/64	0.0000	-0.0024	-0.0020	-0.0020	-0.0024	-0.0028	-0.0031	-0.0031	-0.0035	-0.0039	-0.0043	-0.0047	-0.0051	-0.0047	-0.0039	-0.0028	-0.0020	-0.0008	0.0000
	1/32	0.0000	0.0043	0.0043	0.0039	0.0031	0.0024	0.0016	0.0008	0.0000	-0.0008	-0.0016	-0.0024	-0.0031	-0.0031	-0.0024	-0.0016	-0.0008	-0.0004	0.0000
	3/64	0.0000	0.0134	0.0126	0.0114	0.0098	0.0087	0.0075	0.0059	0.0055	0.0031	0.0016	0.0000	-0.0020	-0.0020	-0.0012	-0.0004	0.0000	0.0000	0.0000

Caution (Finished Edge Line)



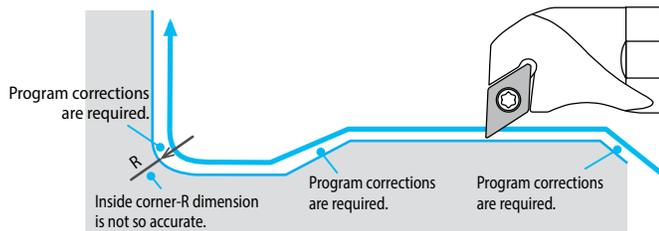
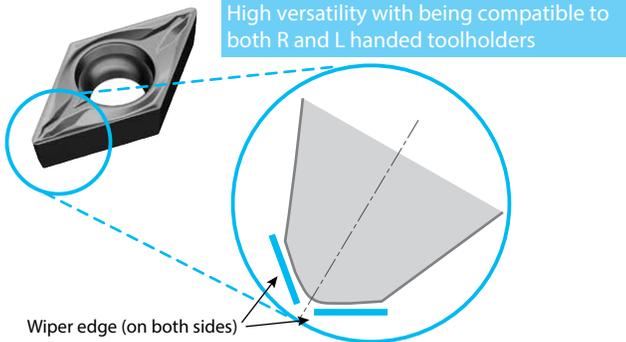
Applications	Notes
External / Facing	Please check the applicable toolholder to confirm the lead angle matches the angle of the wiper.
Up Facing Ramping	For D type and T type inserts, Z-axis program corrections are required.
Convexed-R / Concaved-R	Do not use wiper inserts if a precise radial shape is needed.

Precautions when using Wiper Inserts

Precautions when using WP chipbreaker (Positive insert)

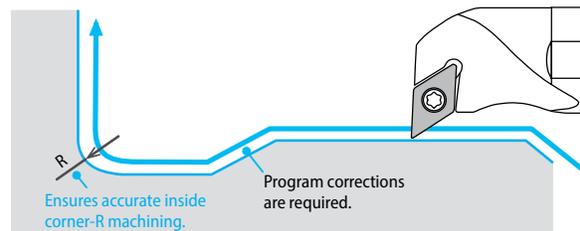
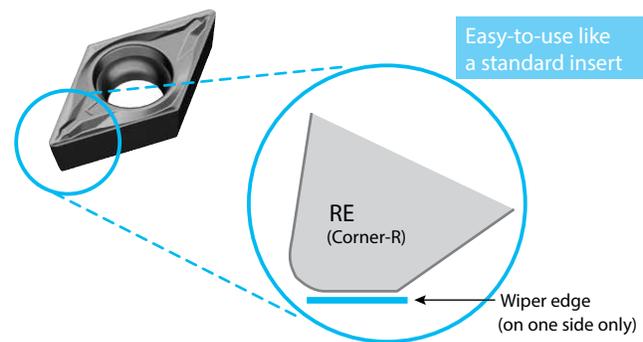
Proper use for a neutral insert and a handed insert

Neutral



- When use a neutral type insert,
- you need to correct programs for three areas.
 - it should be used for machining which does not require inside corner-R accuracy.

Handed (Left-hand shown)

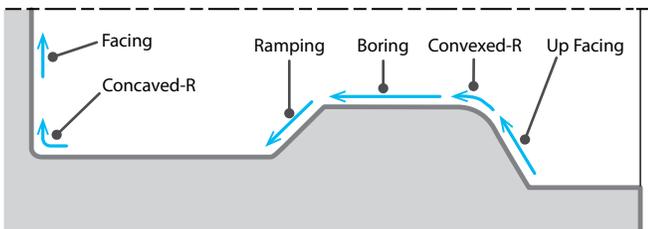


- When use a handed insert,
- you need to correct program for ramping.
 - it provides accurate inside corner-R machining.

➔ Less program correction is required as well as easy-to-use like a standard insert

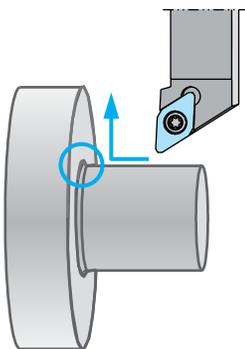
* Position of cutting edge differs from a standard insert. Cutting edge adjustment is required.

Caution (Finished Edge Line)



Caution when Machining Inside Corner-R

Do not use this wiper insert if a precise inside corner-R is required when such a machining in the figure below.



DCMX / TC(P)MX * Neutral WP chipbreaker

- Incomplete or excessive cutting when machining with this chipbreaker than machining with a standard insert
- The inside corner-R dimension become smaller

CCMT * Neutral DCMX / TPMX * Handed WP Chipbreaker

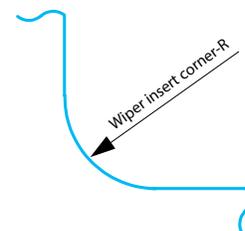
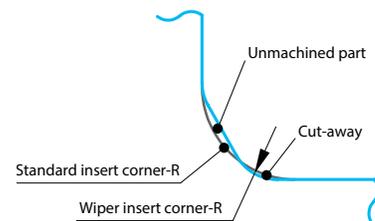
- No problem in the finished line on workpiece (Adjustments are required)

Neutral

Applications	Caution
Boring / Facing	Please check the applicable toolholder to confirm the lead angle matches the angle of the wiper.
Up Facing / Ramping	For D type and T type inserts, Z-axis program corrections are required.
Convexed-R / Concaved-R	Do not use wiper inserts if a precise R shape is needed.

Handed

Applications	Caution
Boring	Please check the applicable toolholder to confirm the lead angle matches the angle of the wiper.
Ramping	For D type and T type inserts, Z-axis program corrections are required.
Convexed-R / Concaved-R	Surface finish quality is as standard insert is.
Up Facing	Surface finish quality is as standard insert is.
Facing	Surface finish quality is as standard insert is.

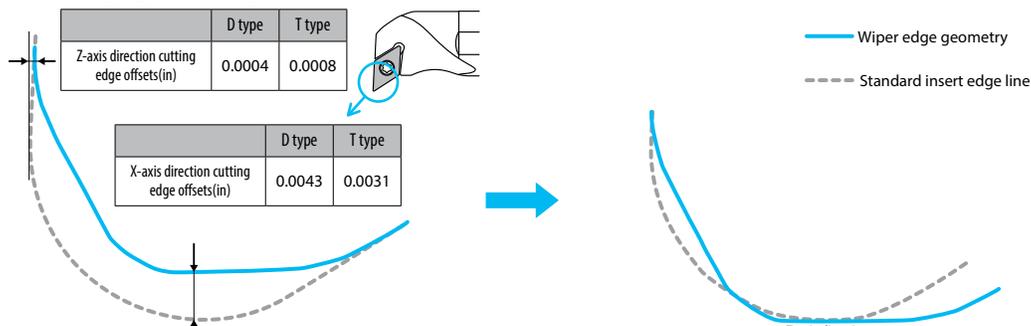


Precautions when using Wiper Inserts

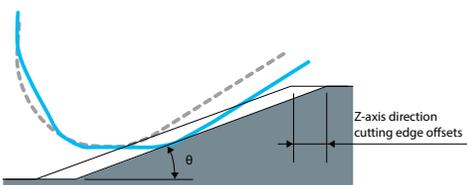
WP Chipbreaker (Positive Insert) Edge Position Offset Adjustment

Neutral

For D type and T type inserts, cutting edge offsets are required.



For D type and T type inserts, program corrections are required for ramping and up facing.



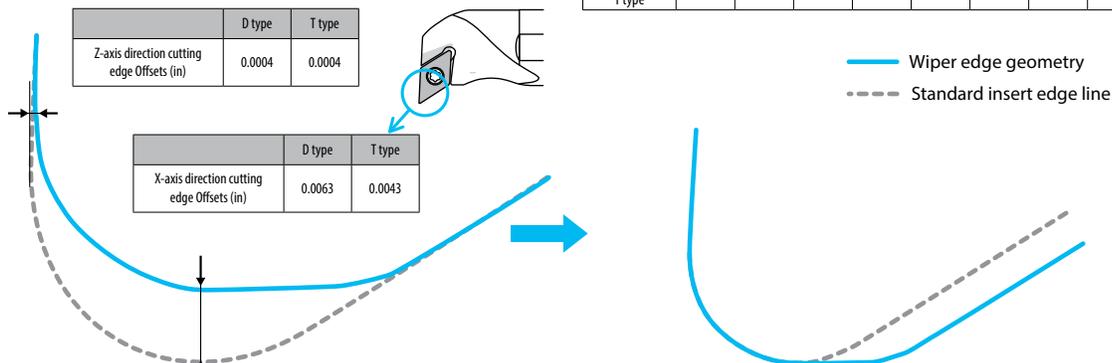
Ramping Angle θ	0°	5°	10°	15°	20°	25°
Z-axis direction cutting edge offsets (in) D type	0	-0.0055	-0.0059	-0.0063	-0.0063	-0.0067
Z-axis direction cutting edge offsets (in) T type	0	-0.0063	-0.0067	-0.0067	-0.0067	-

Profiling Angle θ	0°	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°
Z-axis direction cutting edge offsets (in) D type	0.0000	0.0028	0.0024	0.0016	0.0012	0.0008	0.0004	0.0000	-	-	-
Z-axis direction cutting edge offsets (in) T type	0.0000	0.0028	0.0024	0.0020	0.0020	0.0016	0.0012	0.0008	0.0004	0.0004	0.0000

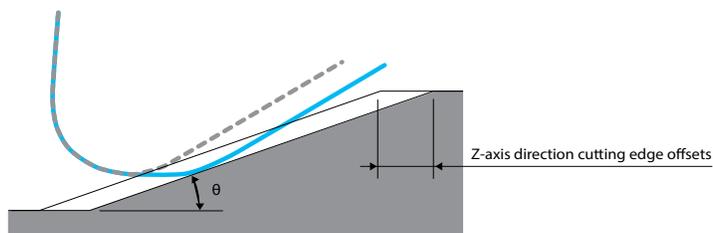
Profiling Angle θ	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°
Z-axis direction cutting edge offsets (in) D type	-0.0004	-0.0008	-0.0012	-0.0016	-0.0020	-0.0020	-0.0016	-0.0012	-0.0008	-0.0004	0.0000
Z-axis direction cutting edge offsets (in) T type	-	-	-	-0.0004	-0.0008	-0.0012	-0.0016	-0.0012	-0.0008	-0.0004	0.0000

Handed Insert

For D type and T type inserts, cutting edge offsets are required.



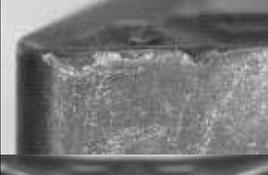
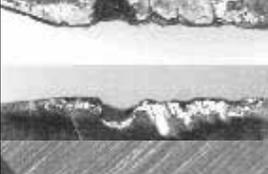
For D type and T type inserts, program corrections are required for ramping.



Ramping angle θ	0°	5°	10°	15°	20°	25°
Z-axis direction cutting edge offsets (in) D type	0	-0.0087	-0.0094	-0.0094	-0.0098	-0.0098
Z-axis direction cutting edge offsets (in) T type	0	-0.0094	-0.0094	-0.0098	-0.0094	-

INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

Cutting Edges Figuration and Countermeasures

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

Turning

Trouble	Countermeasures	Check Item	Insert Grades				Cutting Conditions				Tool Geometry				Setting		Machine						
			Change to Harder Grade	Change to Tougher Grade	Change to More Thermal Shock Resistant Grade	Change to More Welding Resistant Grade	Vc	f	D.O.C.	Tool path review	Coolant		Chipbreaker Review	Rake Angle	Corner-R (RE)	Approach Angle	Edge Strength / Honing	Change to Higher Tolerance (M→G)	Toolholder Rigidity	Workpiece / Tool Installation	Overhang Length	Power Rigidity	
											Wet	Dry											Higher (Larger) ↑ Lower (Smaller) ↓
Unstable Dimension	Unstable Workpiece Dimension	Unsuitable insert tolerance															●						
		Tool and workpiece evacuation										●	●↑	●↓	●↓				●	●	●	●	
	Frequent Offset During Machining	Flank wear increase	●											●↑									
Surface Roughness Deterioration	Poor Surface Roughness	Unsuitable cutting conditions				●↓	●↑																
		Built-up edge				●	●↑																
		Poor cutting by tool wear	●			●	●↓				●		●	●↑	●↑	●↓	●						
		Chipping		●			●↓	●↓			●		●	●↑	●↑	●↑	●			●	●	●	
		Welding, built-up edge				●	●↑				●		●	●↑	●↑	●↓	●						
		Unsuitable cutting conditions				●↑	●↓	●↓			●												
		Unsuitable tool geometry										●		●↑	●↓	●							
Heat	Deterioration of Accuracy or Tool Life by Cutting Heat	Vibration, chattering	●			●↓	●↓ ^{*1}	●↓			●	●↑	●↓	●↓	●↓			●	●	●	●		
		Unsuitable cutting conditions				●↓	●↓	●↓		●													
Burr, Workpiece Chip off and Scuffing	Burr	Unsuitable insert grades and tool geometry	●									●	●↑	●↓	●↓	●↓							
		Unsuitable cutting conditions				●↓	●↑		●	●													
Burr, Workpiece Chip off and Scuffing	Workpiece Chip Off	Unsuitable cutting conditions				●↓	●↓	●															
		Unsuitable insert grades and tool geometry	●								●	●↑	●↑	●↑	●↓			●	●	●	●		
Burr, Workpiece Chip off and Scuffing	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	●			●↓	●↓	●↓				●	●↓	●↑	●↑	●↑							
Chip Control	Long, Tangling Chips	Work hardness, unsuitable insert grades and cutting conditions				●	●↑	●↑		●		●	●↑	●↓	●								
		Unsuitable cutting conditions				●↓	●↑	●↑	●														
	Chips Scattering	Unsuitable tool geometry										●		●↓	●↓								
		Unsuitable cutting conditions										●		●↑	●↑								

*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.

INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

Milling

Trouble	Countermeasures	Check Item	Insert Grades		Cutting Conditions						Tool Geometry						Setting		Machine							
			Change to Harder Grade	Change to Tougher Grade	Change to More Thermal Shock Resistant Grade	Change to More Welding Resistant Grade	Vc	fz	D.O.C.	Cutter Dia. Cutting Width Review	Tool Path Review	Coolant		Relief Angle	Corner Angle	Edge Strength / Honing	No. of Inserts	Chip Pocket	Wiper Edge (Relief Angle) Review	Insert Runout Check	Cutter Rigidity	Workpiece / Tool Installation	Overhang Length	Power, Rigidity		
												Usage of Mist	Dry												Larger ↑ Smaller ↓	More ↑ Less ↓
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 / Parallelism	Tool and workpiece evacuation					● ↓	● ↓				● ⁵		●	● ↑	● ↓	● ↓	● ↓		●	●	●	●	●	●		
Others	Heavy Chattering, Vibration	Unsuitable cutting conditions, installation				● ↓	● ^{*1}	● ^{*2}	●	● ^{*4}			●	● ↑	● ↓	● ↓	● ↓				●	●	●	●		
		Unsuitable cutting conditions				● ↑	● ^{*3}	● ↓		●		● ^{*6}	●													
	Damaging Chips	Unsuitable tool geometry											●	● ↑			● ↓	● ↑								

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

*2. To prevent chattering, the larger ap may be suitable.

*3. Higher fz may be suitable.

*4. Down-cut method is recommended for helical end milling.

*5. If the surface is warped by cutting heat.

*6. Compressed air is recommended.

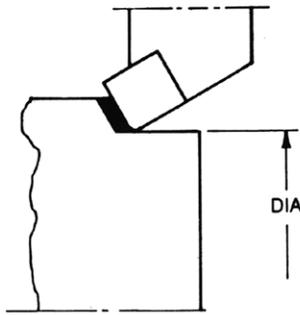
Drilling (Magic Drill Series)

Trouble	Check Item	Insert Grades		Cutting Conditions		Tool Geometry			Setting			Machine						
		Change to Harder Grade	Change to Tougher Grade	Vc	fz	Coolant Discharge Condition	Chipbreaker Review	Inner Edge's Center Height Check (Core Dia. Check)	Toolholder Rigidity Improvement (Short Type)	Workpiece / Tool Installation	Insert Installation	Offset Check	Adjustable Sleeve Usage	Power, Rigidity				
				Higher (Larger)↑ Lower (Smaller)↓	Larger ↑ Smaller ↓													
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 insert 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			● ↑	● ↓					●	●						●
		Unsuitable chipbreaker			● ↑					●								
Long Chips		Unsuitable cutting conditions			● ↑													
		Unsuitable chipbreaker								●								
Machine Failure		Lack of machine power			● ↓	● ↓			●									●

*1. For lathe operation

INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

Turning



Surface Speed per Minute

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

Revolutions per Minute

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

Feedrate (inches/minute)

$$IPM = IPR \times RPM$$

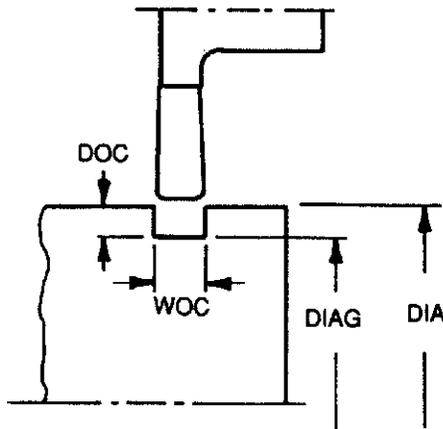
Chip Thinning for Non-Round Inserts (inches/revolution)

$$\text{Programmed IPR} = \frac{t_{chip\ Max}}{\cos 1}$$

Chip Thinning for Round Inserts (inches/revolution)

$$\text{Programmed IPR} = \frac{t_{chip\ Max}}{\sqrt{-\frac{4ap}{ic} - \left(\frac{2ap}{ic}\right)^2}}$$

External Grooving



Surface Speed per Minute

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

Revolutions per Minute

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

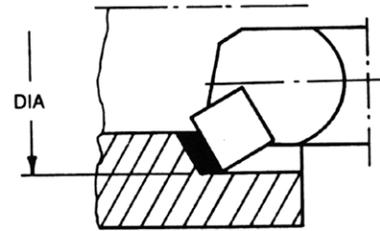
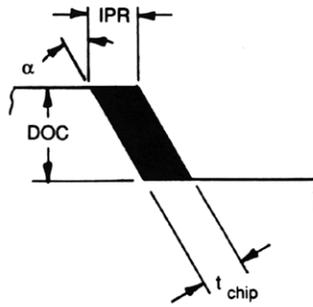
Feedrate (inches/minute)

$$IPM = IPR \times RPM$$

Feedrate (inches/revolution)

$$IPR = t_{chip}$$

Boring



Metal Removal Rate

$$Q = 12 \times DOC \times IPR \times SFM \text{ (in}^3\text{/minute)}$$

Horsepower Required at the Spindle

$$HPS = Q \times UHP$$

Horsepower Required at the Motor

$$HPM = \frac{HPS}{EFF}$$

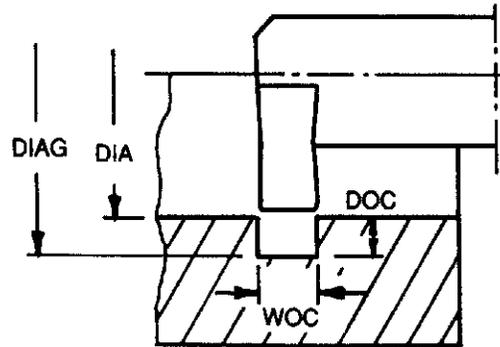
Time in Cut (seconds)

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

or

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

Internal Grooving



Metal Removal Rate

$$Q = 12 \times WOC \times IPR \times SFM \text{ (cu.in/minute)}$$

Horsepower Required at the Spindle

$$HPS = Q \times UHP$$

Horsepower Required at the Motor

$$HPM = \frac{HPS}{EFF}$$

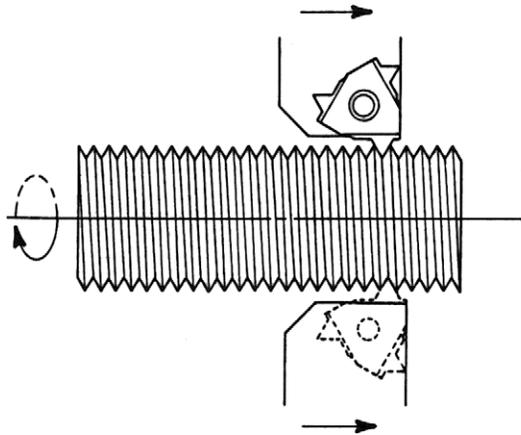
Time in Cut (seconds)

$$T = \frac{7.85 \times DOC \times (DIA + DIAG)}{SFM \times IPR}$$

or

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

External Threading



Surface Speed per Minute

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

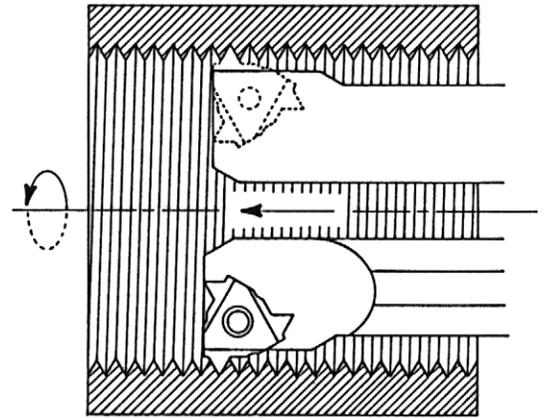
Revolutions per Minute

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

Feedrate (inches/minute)

$$IPM = IPR \times RPM$$

Internal Threading



Time in Cut (seconds)

$$T = \frac{60 \times LOC \times NO. OF PASSES}{IPR \times RPM}$$

Feedrate

Standard Threads

$$IPR = \frac{1}{TPI}$$

Metric Threads

$$IPR = \frac{P_{mm}}{25.4}$$

Definition of Terms

DIA = Diameter of the Workpiece (Inches)

DOC = Depth of Cut (Inches)

EFF = Machine Efficiency

f = Feedrate (See IPM and IPR)

HPM = Horsepower Required at the Motor

HPS = Horsepower Required at the Spindle

IPM = Feedrate (Inches per Minute)

IPR = Feedrate (Inches per Revolution)

IC = Insert inscribed circle (inches)

LOC = Length of Cut (Inches)

Q = Metal Removal Rate (Cubic Inches per Minute)

RPM = Revolutions per Minute

SFM = Surface Speed (Feet per Minute)

T = Time (in Seconds)

tchip Max = Maximum Recommended Chip Thickness (Inches)

UHP = Unit Horsepower Factor

1 = Lead Angle

INSERT GRADES	A
TURNING INSERTS	B
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GROOVING	G
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DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
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Turning

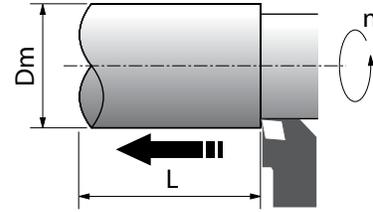
Cutting Speed

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

V_c : Cutting speed [m/min]

D_m : Workpiece dia. [mm]

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



Power Requirement

$$P_c = \frac{K_s \times V_c \times a_p \times f}{6,120 \times \eta}$$

P_c : Power requirement [kW]

P_{HP} : Power requirement (Horse power) [HP]

V_c : Cutting speed [m/min]

a_p : Depth of cut [mm]

f : Feed rate [mm/rev]

K_s : Specific cutting force [kgf/mm^2]

η : Mechanical efficiency (0.7 ~ 0.8)

$$P_{HP} = \frac{K_s \times V_c \times a_p \times f}{4,500 \times \eta}$$

K_s [kgf/mm^2]	
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

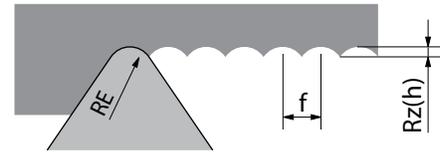
Theoretical Surface Roughness

$$R_z(h) = \frac{f^2}{8 \times RE} \times 1,000$$

$R_z(h)$: Theoretical surface roughness [μm]

f : Feed rate [mm/rev]

RE : Corner radius of insert [mm]



Chip Removal Volume

$$Q = V_c \times a_p \times f$$

Q : Chip removal volume [$\text{cm}^3/\text{min}=\text{cc}/\text{min}$]

V_c : Cutting speed [m/min]

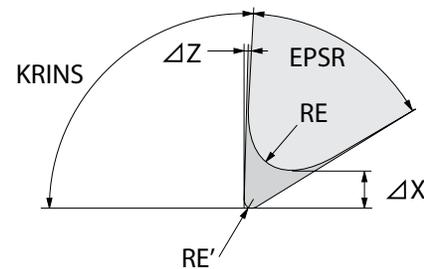
a_p : Depth of cut [mm]

f : Feed rate [mm/rev]

Edge Position Compensation when Changing Corner-R(RE)

$$\Delta X = (RE - RE') \times \left\{ \frac{\cos\left(\frac{EPSR}{2} + (KRINS - 90^\circ)\right)}{\sin\frac{EPSR}{2}} - 1 \right\}$$

$$\Delta Z = (RE - RE') \times \left\{ \frac{\sin\left(\frac{EPSR}{2} + (KRINS - 90^\circ)\right)}{\sin\frac{EPSR}{2}} - 1 \right\}$$



ΔX : X-axis direction cutting edge offsets [mm]

ΔZ : Z-axis direction cutting edge offsets [mm]

RE : Corner-R before change [mm]

RE' : Corner-R after change [mm]

$EPSR$: Insert corner angle [$^\circ$]

$KRINS$: Toolholder's cutting edge angle [$^\circ$]

Toolholder type	Insert corner angle EPSR	Cutting edge angle KRINS	ΔX	ΔZ
DCLN/PCLN	80°	95°	0.100 x (RE-RE')	0.100 x (RE-RE')
DTGN/PTGN	60°	91°	0.714 x (RE-RE')	0.030 x (RE-RE')
DDJN/PDJN	55°	93°	0.866 x (RE-RE')	0.099 x (RE-RE')
DDHN/PDHN	55°	107.5°	0.531 x (RE-RE')	0.531 x (RE-RE')
DVLN/PVLN	35°	95°	2.072 x (RE-RE')	0.273 x (RE-RE')
DVPN/PVPN	35°	117.5°	1.351 x (RE-RE')	1.351 x (RE-RE')
DSBN/PSBN	90°	75°	0.225 x (RE-RE')	-0.293 x (RE-RE')

Example: Compensation when changing corner-R from 0.8 to 0.4, using PCLN toolholder,

$$\Delta X = 0.100 \times (0.8 - 0.4) = 0.04(\text{mm})$$

$$\Delta Z = 0.100 \times (0.8 - 0.4) = 0.04(\text{mm})$$

Turning (Cutting time)

Cutting time (External turning case 1: 1 pass machining)

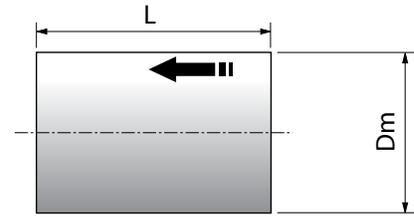
At constant revolution

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

At constant cutting speed

$$T = \frac{60 \times \pi \times L \times D_m}{1,000 \times f \times V_c}$$

- T : Cutting time [sec]
- L : Cutting length [mm]
- f : Feed rate [mm/rev]
- n : Spindle revolution [min⁻¹]
- D_m : Workpiece dia. [mm]
- V_c : Cutting speed [m/min]



Cutting time (External turning case 2: multi-pass machining)

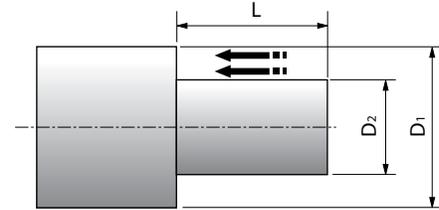
At constant revolution

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

At constant cutting speed

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

- T : Cutting time [sec]
- L : Cutting length per pass [mm]
- ap : Depth of cut per pass [mm]
- f : Feed rate [mm/rev]
- n : Spindle revolution [min⁻¹]
- D₁ : Max. dia. of workpiece [mm]
- D₂ : Min. dia. of workpiece [mm]
- V_c : 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)

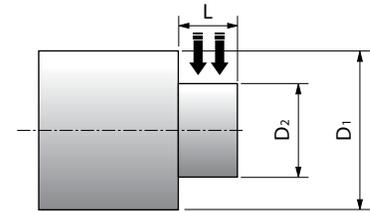
At constant revolution

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

At constant cutting speed

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

- T : Cutting time [sec]
- T₁ : Cutting time before reaching Max. spindle revolution [sec]
- L : Cutting length [mm]
- ap : Depth of cut per pass [mm]
- f : Feed rate [mm/rev]
- n : Spindle revolution [min⁻¹]
- D₁ : Max. dia. of workpiece [mm]
- D₂ : Min. dia. of workpiece [mm]
- V_c : 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)

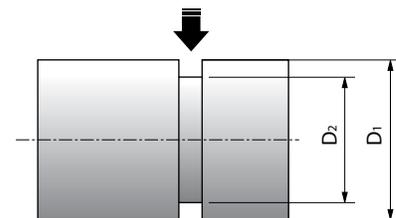
At constant revolution

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

At constant cutting speed

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

- T : Cutting time [sec]
- T₁ : Cutting time before reaching Max. spindle revolution [sec]
- L : Cutting length [mm]
- f : Feed rate [mm/rev]
- n : Spindle revolution [min⁻¹]
- D₁ : Max. dia. of workpiece [mm]
- D₂ : Min. dia. of workpiece [mm]
- V_c : Cutting speed [m/min]



Cutting time (Cut-off)

At constant revolution

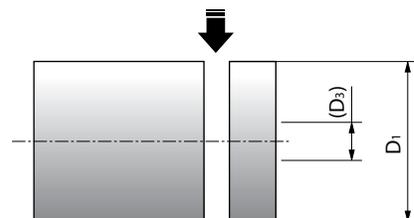
$$T = \frac{60 \times D_1}{2 \times f \times n}$$

At constant cutting speed

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

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

- T : Cutting time [sec]
- T₁ : Cutting time before reaching Max. spindle revolution [sec]
- T₃ : Cutting time when reaching Max. spindle revolution [sec]
- f : Feed rate [mm/rev]
- n : Spindle revolution [min⁻¹]
- n_{max} : Max. spindle revolution [min⁻¹]
- D₁ : Max. dia. of workpiece [mm]
- D₃ : Diameter when reaching max. spindle revolution [mm]
- V_c : Cutting speed [m/min]



INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

Milling

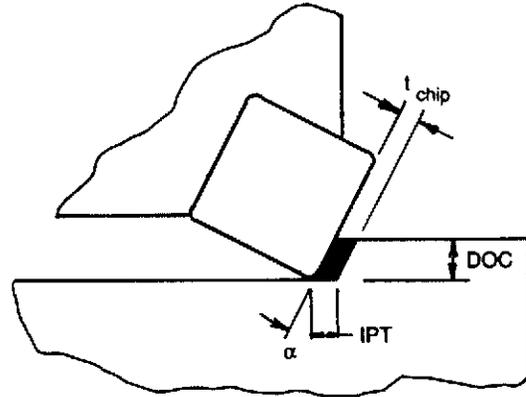
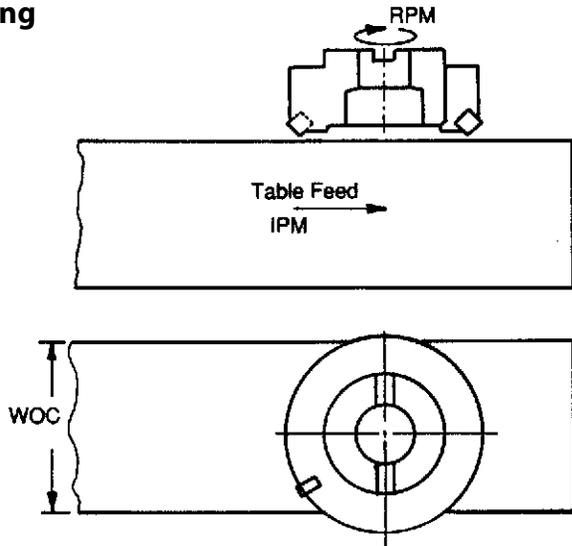


Table Feed with f_1 Compensation (inches/minute)
 $= IPT \times N \times RPM \times f_1$

Surface Speed per Minute

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

Revolutions per Minute

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

Feedrate (inches/minute)

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

Feedrate (inches/tooth)

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

Radial Chip Thinning for 90° Cutters

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

Metal Removal Rate

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

Horsepower Required at the Spindle

$$HPS = Q \times UHP$$

Horsepower Required at the Motor

$$HPM = HPS / EFF$$

Time in Cut (Seconds)

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

or

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

Definition of Terms

DIA = Diameter of the Workpiece (Inches)

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

EFF = Machine Efficiency

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

HPM = Horsepower Required at the Motor (HP)

HPS = Horsepower Required at the Spindle (HP)

IPM = Feedrate (Inches per Minute)

IPR = Feedrate (Inches per Revolution)

IPT = Feedrate (Inches per Tooth)

f₁ = Cutter Compensation Factor

WOC = Width of Cut (Inches)

LOC = Length of Cut (Inches)

N = Number of Effective Teeth in Cutter

Q = Metal Removal Rate (Cubic Inches per Minute)

RPM = Revolutions per Minute

SFM = Surface Speed (Feet per Minute)

T = Time (in Seconds)

tchip Max = Maximum Recommended Chip Thickness (Inches)

UHP = Unit Horsepower Factor

IJ = Lead Angle

INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

Milling

Cutting Speed

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

- V_c : Cutting speed [m/min]
- DC : Cutter dia. [mm]
- n : Spindle revolution [min⁻¹]

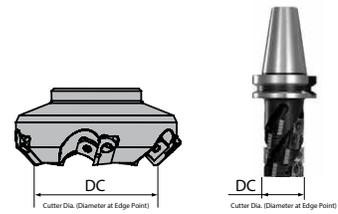
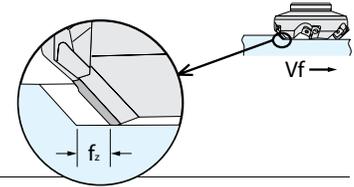


Table Feed and Feed Per Tooth

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

- f_z : Feed per tooth [mm/t]
- V_f : Table feed [mm/min]
- Z : No. of inserts
- n : Spindle revolution [min⁻¹]



Power Requirement

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

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

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

- P_c : Power requirement [kW]
- P_{HP} : Power requirement (Horse power) [HP]
- a_e : Width of cut [mm]
- V_f : Table feed [mm/min]
- f_z : Feed per tooth [mm/t]
- Z : No. of inserts
- n : Spindle revolution [min⁻¹]
- a_p : Depth of cut [mm]
- K_s : Specific cutting force [kgf/mm²]
- η : Mechanical efficiency (0.7 ~ 0.8)
- Q : Chip removal volume [cm³/min=cc/min]

K _s [kgf/mm ²]	
Low carbon steel	190
Medium carbon steel	210
High carbon steel	240
Low alloy steel	190
High alloy steel	245
Cast iron	93
Malleable cast iron	120
Bronze, Brass	70

Chip Removal Volume

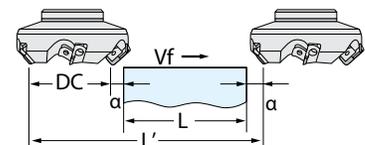
$$Q = \frac{a_e \times V_f \times a_p}{1,000} = \frac{a_e \times f_z \times Z \times n \times a_p}{1,000}$$

- Q : Chip removal volume [cm³/min=cc/min]
- a_e : Width of cut [mm]
- V_f : Table feed [mm/min]
- f_z : Feed per tooth [mm/t]
- Z : No. of inserts
- n : Spindle revolution [min⁻¹]
- a_p : Depth of cut [mm]

Cutting Time

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

- T : Cutting time [sec]
- L' : Total table transfer length [mm]
(= L+DC+2α)
- L : Workpiece length [mm]
- DC : Cutter dia. [mm]
- α : Idling distance [mm]
- V_f : Table feed [mm/min]
- f_z : Feed per tooth [mm/t]
- Z : No. of inserts
- n : Spindle revolution [min⁻¹]



True Rake Angle

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

Inclination Angle

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

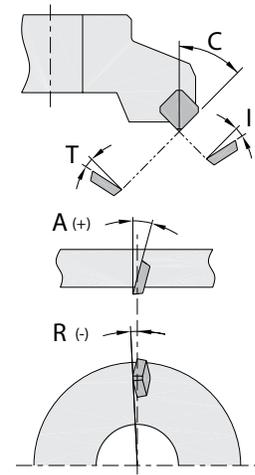
A (GAMP) : Axial rake angle (A.R.) [°] (-90° < A < 90°)

R (GAMF) : Radial rake angle (R.R.) [°] (-90° < R < 90°)

C (KAPR) : Approach angle [°] (0° < C < 90°)

T (GAMN) : True rake angle [°] (-90° < T < 90°)

I (GAMO) : Inclination angle [°] (-90° < I < 90°)



Ball-Nose End Mill Cutting Speed and Revolution

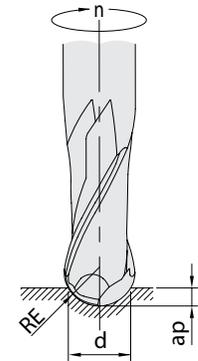
$$n = \frac{1,000 \times V_a}{2 \times \pi \times \sqrt{a_p(2RE - a_p)}}$$

n : Revolution [min⁻¹]

RE : Radius of ball-nose end mill (Ball part's radius) [mm]

a_p : Depth of cut [mm]

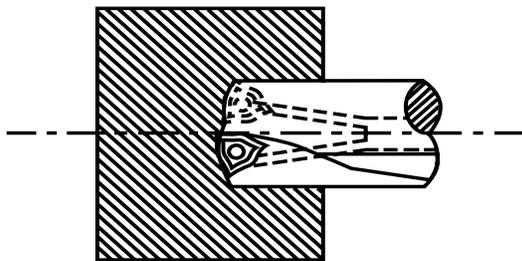
V_a : Cutting speed at actual dia. d [m/min]



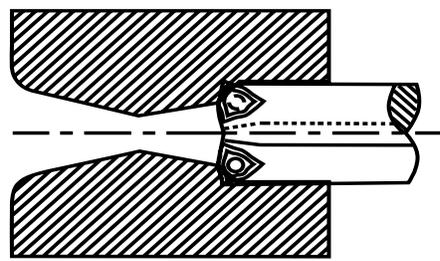
INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
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Drilling

DRILLING



CORE DRILLING



Surface Speed Per Minute

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

Revolutions Per Minute

$$RPM = \frac{3.82 \times SFM}{DIA}$$

Feedrate (inches/minute)

$$IPM = IPR \times RPM$$

Feedrate (inches/revolution)

$$IPR = IPT \times N$$

Metal Removal Rate (in³ per minute)

$$\text{Drill: } Q = 3 \times DIA \times IPR \times SFM$$

$$\text{Coredrill: } Q = 12 \times DOC \times IPR \times SFM$$

Horsepower Required at the Spindle

$$HPS = Q \times UHP$$

Horsepower Required at the Motor

$$HPM = \frac{HPS}{EFF}$$

Time in Cut

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

or

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

Definition of Terms

DIA = Diameter of the Drill (Inches)

DOC = Depth of Cut (Inches)

EFF = Machine Efficiency

HPM = Horsepower at Motor

HPS = Horsepower at Spindle

IPM = Feedrate (Inches Per Minute)

IPR = Feedrate (Inches Per Revolution)

IPT = Chipload (Inches Per Tooth)

LOC = Length of Cut (Inches)

N = Number of Effective Flutes

N = 1 For Drills

N = 2 For Coredrills

Q = Metal Removal Rate (Cubic Inches Per Minute)

RPM = Revolutions Per Minute

SFM = Surface Speed (Feet Per Minute)

T = Time (Seconds)

UHP = Unit Horsepower (See Table Below)

UNIT HORSEPOWER FACTORS

Material	Hardness (BHN)	UHP Factor (HP/in3/min)	Material	Hardness (BHN)	UHP Factor (HP/in3/min)
Aluminum	---	0.25	1050	225	0.80
Brass	---	0.25	4140	275	0.70
Copper	---	0.30	52100	225	0.67
Gray Cast Iron	200	0.33	6150	375	1.30
Nodular Iron	225	0.54	Cast Steel	225	0.62
Inconel 700	330	1.10	Stainless Steel	225	0.73
1020	165	0.58			

Drilling (Magic Drill Series)

Cutting Speed

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

- V_c : Cutting speed [m/min]
- DC : Drill dia. [mm]
- n : Spindle revolution [min⁻¹]

Feed Rate (Milling)

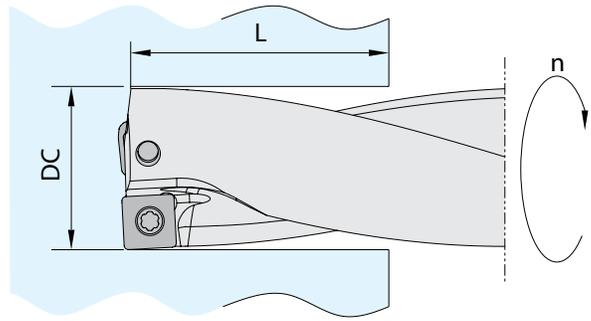
$$V_f = f_z \times Z \times n$$

- V_f : Table feed [mm/min]
- f_z : Feed per tooth [mm/t]
- Z : No. of inserts (No. of insert = 1)
- n : Spindle revolution [min⁻¹]

Cutting Time

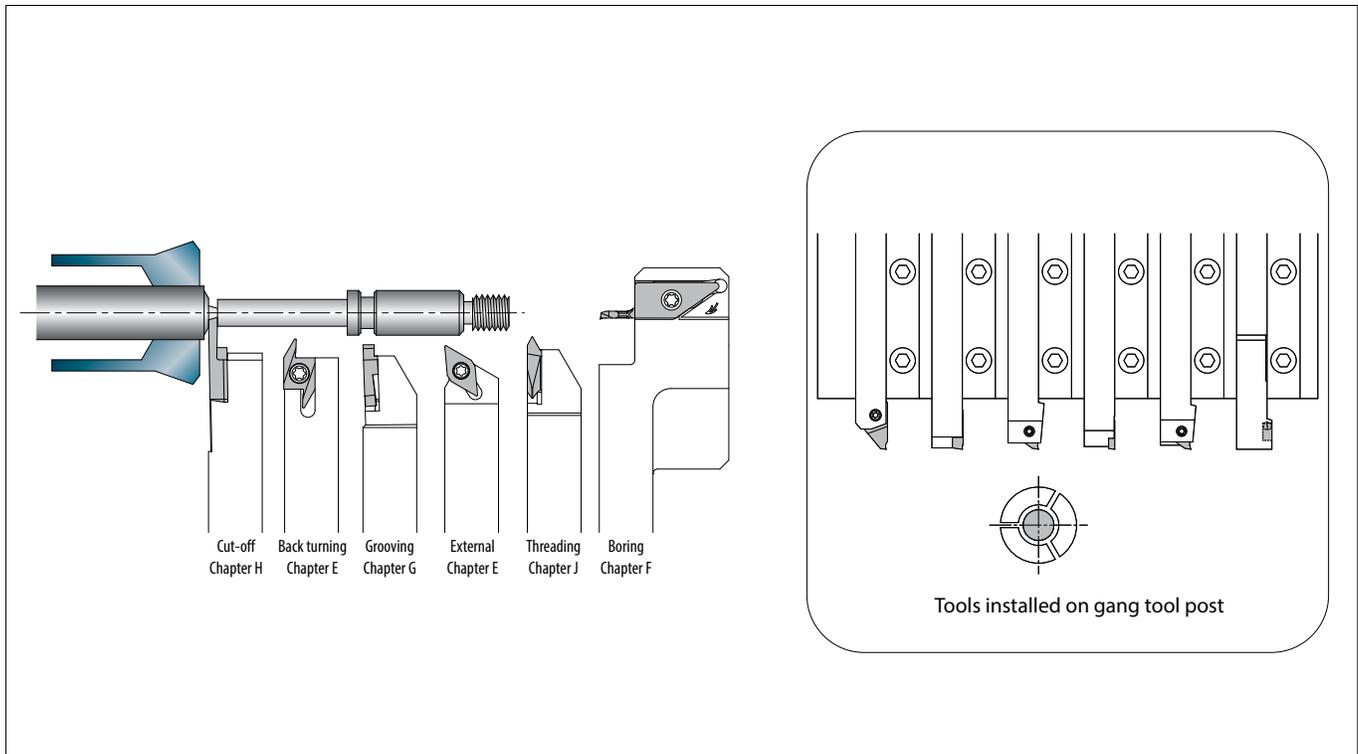
$$T = \frac{60 \times L}{f \times n} = \frac{60 \times \pi \times DC \times L}{1,000 \times V_c \times f}$$

- T : Cutting time [sec]
- L : Drilling depth [mm]
- f : Feed rate [mm/rev]
- n : Spindle revolution [min⁻¹]
- DC : Drill dia. [mm]
- V_c : Cutting speed [m/min]

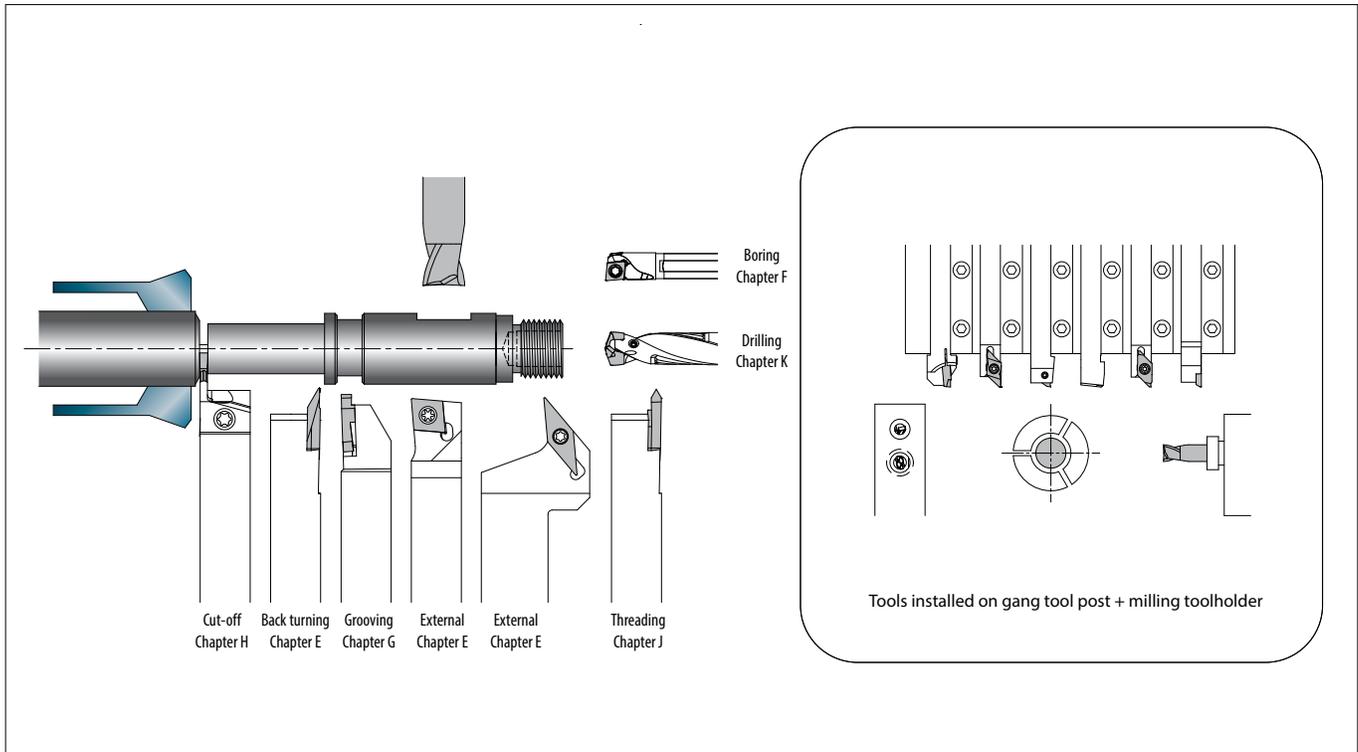


INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

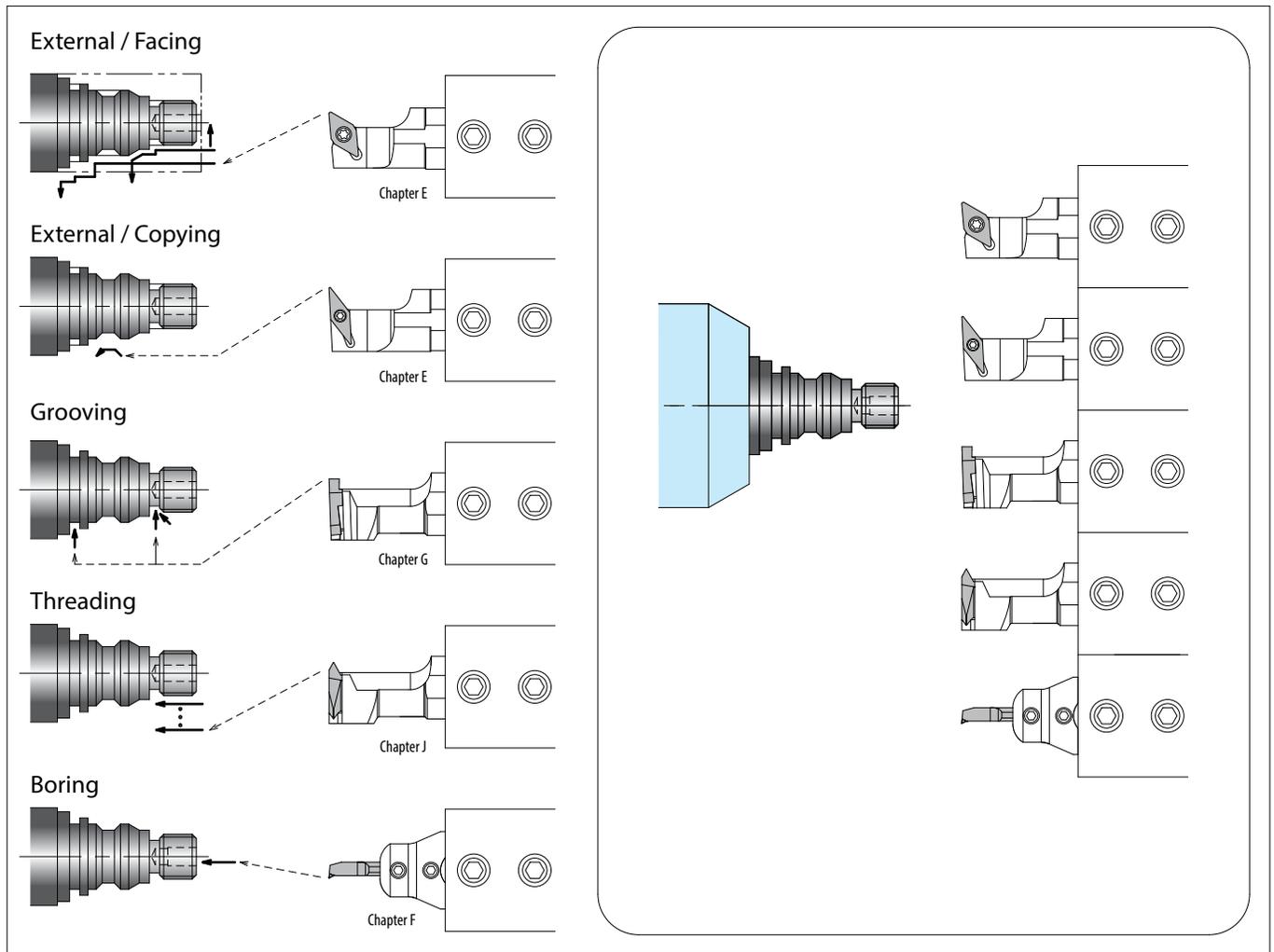
Tooling Example 1: CNC Swiss Style Lathe (Gang Type)



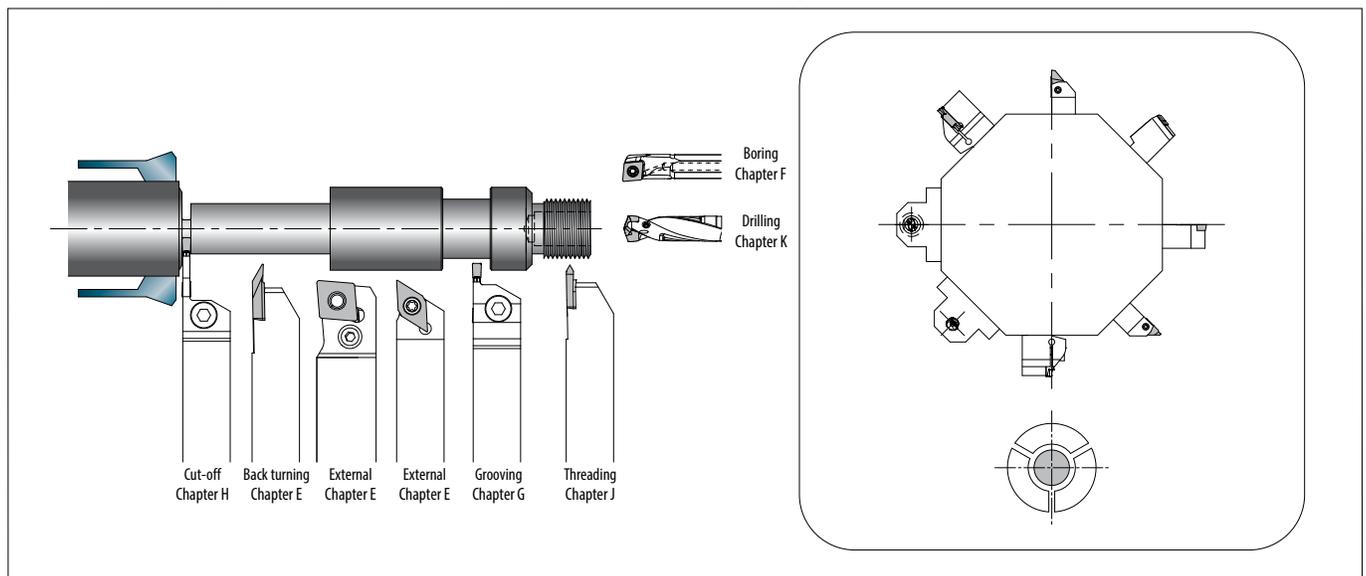
Tooling Example 2: CNC Swiss Style Lathe (Gang Type)



Tooling Example 3: CNC Swiss Style Lathe (Opposed Gang Type)



Tooling Example 4: CNC Swiss Style Lathe (Turret type)



For Tooling Layout and Swiss Style Lathe List by Manufacturer, See Page R46~R54

INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
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Swiss Style Lathe List by Manufacturer

Citizen Machinery (Cincom Products)

(Dimensions: mm)

Model	Toolholder Dimensions (Gang Tool Post)	Number of Tools	Toolholder Dimensions (Turret Tool Post)	Number of Tools	Sleeve Dia. (Horizontal/Opposed)	Max. Cutting Dia.	Notes
A12/16	10 x 10 x 100	5			ø19.05/ø20	ø12/ø16	
A20	12(13) x 12(13) x 120 * Cut-off toolholder: □16mm	6			ø25.4	ø20	
A20 VII	12(13) x 12(13) x 120 * Cut-off toolholder: □16mm	6			ø25.4	ø20	
A32	16 x 16 x 150	6			ø25.4	ø32	
B12	10 x 10 x 100	5			ø19.05/ø20	ø12	
B12E/B16E	10 x 10 x 120(60)	5			ø19.05(ø20 ^{OP})	ø12/ø16	
B20	12(13) x 12(13) x 120	6			ø19.05/ø20	ø20	
BL12	10 x 10 x 60 ~ 120	5			ø20(ø19.05)	ø12	
BL20/25	12(13) x 12(13) x 120	4 ~ 7			ø20(ø19.05)	ø20/ø25	
C12/16	10 x 10 x 120	6			ø19.05	ø12/ø16	
C32	16 x 16 x 130	5			ø25.4	ø32	
D25	16 x 16 x 150 * Cut-off toolholder: □19mm				ø25.4	ø25	
F10			10 x 10 x 60	10	ø19.05	ø10	
F12			10 x 10 x 60	10	ø19.05	ø12	
F16			10 x 10 x 60	10	ø19.05	ø16	
F20			16(19) x 16(13) x 90	10	ø25.4	ø20	
F25			16(19) x 16(13) x 90	10	ø25.4	ø25	
FL25			16 x 16 x 90	12		ø25	
FL42			16 x 16 x 90	12		ø42	
G32			16(19) x 16(19) x 90	10	-	ø32	
K12/16	12(10) x 12(10) x 100	6(7)			ø19.05/ø20	ø12/ø16	
K12E/K16E	12 x 12 x 120	6			ø19.05/ø20	ø12/ø16	
L10	8 x 8 x 100 ~ 130	5			ø15.875	ø10	
L12	10 x 10 x 100	6			ø19.05	ø12	
L16	12(10) x 12(10) x 130	5			ø19.05	ø16	
L20,L20E	12 x 12 x 130 * Cut-off toolholder: □16mm	5			ø19.05	ø20	
L20X,L220	12(13,16) x 12(13,16) x 120 * Cut-off toolholder: □16mm	5 ~ 7			ø19.05	ø20	
L25	16 x 16 x 130	5			ø25.4	ø25	
L32	16 x 16 x 130	5			ø25.4	ø32	
M12	10 x 10 x 120	5	10 x 10 x 60	10 + α	ø19.05	ø12	
M16	10 x 10 x 120	5	10 x 10 x 60	10 + α	ø19.05	ø16	
M20	16 x 16 x 130	5	16 x 16 x 90	10 + α	ø25.4	ø20	
M32	16 x 16 x 130	5	16 x 16 x 90	10 + α	ø25.4	ø32	
MC20	13 x 13 x 120	2 + 2 + 2			ø19.05/ø20.0	ø20.0	
MSL12	10 x 10 x 120				-	ø12	
R04	8 x 8 x 120	5			ø15.875	ø4	
R07	8 x 8 x 120	5			ø15.875	ø7	
RL01	10(8) x 10(8) x 90				ø16(ø20)	ø10	
RL02	16 x 16 x 90				ø20	ø20	
RL21	10(12) x 10(12) x 90				ø19.05	ø35	

Manufacturers are in random order.

Swiss Style Lathe List by Manufacturer

Citizen Machinery (Miyano Products)

(Dimensions: mm)

Model	Toolholder Dimensions (Gang Tool Post)	Number of Tools	Toolholder Dimensions (Turret Tool Post)	Number of Tools	Sleeve Dia. (Horizontal/Opposed)	Max. Cutting Dia.	Notes	Notes
ABX-51SY2			20 x 20 x 125(100)	24	ø25	48	ø51	
ABX-51SYY2			20 x 20 x 125(100)	24	ø25	48	ø51	
ABX-51TH5			20 x 20 x 125(100)	36	ø25	72	ø51	
ABX-51THY2			20 x 20 x 125(100)	36	ø25	72	ø51	
ABX-64SY2			20 x 20 x 125(100)	24	ø25	48	ø64	
ABX-64SYY2			20 x 20 x 125(100)	24	ø25	48	ø64	
ABX-64TH5			20 x 20 x 125(100)	36	ø25	72	ø64	
ABX-64THY2			20 x 20 x 125(100)	36	ø25	72	ø64	
BNA-34C			20 x 20 x 125(100)	8(16)	ø25	24	ø34	
BNA-34DHY			20 x 20 x 125(100)	14(22)	ø25	27	ø34	
BNA-34S			20 x 20 x 125(100)	8(16)	ø25	24	ø34	
BNA-42C/C2			20 x 20 x 125(100)	8(16)	ø25	24	ø42	
BNA-42DHY			20 x 20 x 125(100)	14(22)	ø25	27	ø42	
BNA-42DHY2			20 x 20 x 125(100)	14(22)	ø25	27	ø42	
BNA-42DHY3			20 x 20 x 125(100)	14(22)	ø25	27	ø42	
BNA-42GTY	20 x 20 x 125(100)	3	20 x 20 x 125(100)	8(16)	ø25	24(7)	ø42	
BNA-42MSY2			20 x 20 x 125(100)	8(16)	ø25	24	ø42	
BNA-42S/S2			20 x 20 x 125(100)	8(16)	ø25	24	ø42	
BNA-42C5/SY5			20 x 20 x 125(100)	12(24)	ø25	24	ø42	
BNC-42C7			20 x 20 x 125(100)	8(16)	ø25	24	ø42	
BND-51C2			20 x 20 x 125(100)	12	ø25	24	ø51	
BND-51S2			20 x 20 x 125(100)	12	ø25	24	ø51	
BND-51SY2			20 x 20 x 125(100)	12	ø25	24	ø51	
BNE-42S6			20 x 20 x 125(100)	24	ø25	48	ø42	
BNE-42SY6			20 x 20 x 125(100)	24	ø25	48	ø42	
BNE-51S6			20 x 20 x 125(100)	24	ø25	48	ø51	
BNE-51SY6			20 x 20 x 125(100)	24	ø25	48	ø51	
BNE-51MSY			20 x 20 x 125(100)	24	ø25	48	ø51	
BNE-51MY			20 x 20 x 125(100)	24	ø25	48	ø51	
BNE-65MY			20 x 20 x 125(100)	24	ø25	48	ø65	
BNJ-34S3/S5			20 x 20 x 125(100)	18	ø25	30	ø34	
BNJ-34SY3/SY5			20 x 20 x 125(100)	18	ø25	30	ø34	
BNJ-42S3/S5			20 x 20 x 125(100)	18	ø25	30	ø42	
BNJ-42S6			20 x 20 x 125(100)	20	ø25	40	ø42	
BNJ-42SY3/SY5			20 x 20 x 125(100)	18	ø25	30	ø42	
BNJ-42SY5			20 x 20 x 125(100)	18	ø25	30	ø42	
BNJ-42SY6			20 x 20 x 125(100)	20	ø25	40	ø42	
BNJ-51S3/S5			20 x 20 x 125(100)	18	ø25	30	ø51	
BNJ-51SY3/SY5			20 x 20 x 125(100)	18	ø25	30	ø51	
BNJ-51SY6			20 x 20 x 125(100)	20	ø25	40	ø51	
GN-3200	12(16) x 12(16) x 70 ~ 120	4 ~ 5			ø20		ø40	
GN-3200W	12(16) x 12(16) x 70 ~ 120	4 ~ 5			ø20		ø40	"Number of tools" is per turret.
GN-4200	12(16) x 12(16) x 70 ~ 120	6 ~ 7			ø20		ø40	
LX-06E2			20 x 20 x 125(100)	8	ø32	8		6 inch power chuck
LX-06E3			20 x 20 x 125(100)	8	ø32	8		6 inch power chuck
LX-08C			25 x 25 x 150	10	ø40	10		8 inch power chuck
LX-08E2			25 x 25 x 150	8	ø40	8		8 inch power chuck
LX-08E3			25 x 25 x 150	8	ø40	8		8 inch power chuck
LX-08R			20 x 20 x 125(100)	10	ø25	20		8 inch power chuck
LZ-01R2			20 x 20 x 125(100)	12	ø25	24		6 inch power chuck
LZ-01RY2			20 x 20 x 125(100)	12	ø25	24		6 inch power chuck
LZ-02R2			20 x 20 x 125(100)	10	ø25	20		8 inch power chuck
LZ-02RY2			20 x 20 x 125(100)	10	ø25	20		8 inch power chuck
RL01III	10 x 10 x 70 ~ 120	2 ~ 3			ø16		ø10	
RL01V	10 x 10 x 70 ~ 120	2 ~ 3			ø16		ø10	
RL03	12(16) x 12(16) x 70 ~ 120	4 ~ 5			ø20		ø40	
VCO3	12(16) x 12(16) x 70 ~ 120	4 ~ 5			ø20		ø40	

* Number of tools shown in parentheses is the maximum number of toolholder mountable including ø25mm sleeves.

Manufacturers are in random order.

INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
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Swiss Style Lathe List by Manufacturer

Star Micronics

(Dimensions: mm)

Model	Toolholder Dimensions (Gang Tool Post)	Number of Tools	Toolholder Dimensions (Turret Tool Post)	Number of Tools	Sleeve Dia. (Front/Rear)	Number of Tools	Max. Cutting Dia.	Notes
SB-16 (A/C/D/E)	12 x 12 x 95 ~ 130	5			ø22/ø22	4/4	ø16	Only D/E for rear-end sleeves
	12(10) x 12(10) x 95 ~ 130	6			ø22/ø22	4/4	ø16	
SB-12II (C/E)	12 x 12 x 95 ~ 130	6			ø22/ø22	4/4	ø13	Only E for rear-end sleeves
SB-16II (C/E)	12(10) x 12(10) x 95 ~ 130	6			ø22/ø22	4/4	ø16	
SB-20 A/C/E	12 x 12 x 95 ~ 130	6			ø22/ø22	4/4	ø20	
SB-12R typeG	12 x 12 x 95 ~ 130	6			ø22/ø22	4/4	ø13	
SB-16III	10 x 10 x 95 ~ 130	7			ø22/ø22	4/4	ø16	
	12 x 12 x 95 ~ 130	5			ø22/ø22	4/4	ø16	
SB-16R/20R typeN	10 x 10 x 95 ~ 130	6			ø22/ø22	4/4	ø16/ø23	
	12 x 12 x 95 ~ 130	7			ø22/ø22	4/4	ø16/ø23	
SB-16R/20R typeG	12 x 12 x 95 ~ 130	6			ø22/ø22	4/4	ø16/ø23	
	10 x 10 x 95 ~ 130	7			ø22/ø22	4/4	ø16/ø23	
SB-16R/20R typeGB	12 x 12 x 95 ~ 130	6			ø22/ø22	4/4	ø16/ø23	
	10 x 10 x 95 ~ 130	7			ø22/ø22	4/4	ø16/ø23	
SC20	12 x 12 x 95 ~ 130	5			ø22/-	4/-	ø20	
	10 x 10 x 95 ~ 130	6			ø22/-	4/-	ø20	
SG-42			16 x 16 x 84 ~ 88(71 ~ 82)		ø22+ø32/-		ø42	
			20 x 20 x 84 ~ 88					
SL-7/10	10 x 10 x 95 ~ 115	6			ø16+ø22/ø16+ø22	4~6/6	ø10	
	8 x 8 x 68 ~ 115	6						
SR-10J	8 x 8 x 67 ~ 110 (Spacer is needed)	6			ø16/ø16+ø22	4/4	ø10	
SR-20RII	12 x 12 x 100 ~ 135	6			ø22/ø22	4/4	ø23	Toolpost for 2 toolholders (deep boring) on the front side
SR-20RIII	12 x 12 x 95 ~ 135	6			ø22/ø22	6/4	ø23	
SR-20J typeC	12 x 12 x 95 ~ 135	6			ø22/ø22	6/4	ø23	
SR-20J typeN	12 x 12 x 95 ~ 135	6			ø22/ø22	6/4	ø23	
SR-20JII typeA	12 x 12 x 100 ~ 135	6			ø22/ø22	7/4	ø23	
SR-20JII typeB	12 x 12 x 100 ~ 135	6			ø22/ø22	7/8	ø23	
SR-20IV typeA	12 x 12 x 100 ~ 130	7			ø22/ø22	6/8	ø23	
SR-20IV typeB	12 x 12 x 100 ~ 130	7			ø22/ø22	6/8	ø23	
SR-25J/32J	16 x 16 x 95 ~ 155	6			ø22+ø32/ø22	4/4	ø32	
SR-32JII typeA	16 x 16 x 95 ~ 165	6			ø22+ø32/ø22	5/6	ø34	
SR-32JII typeB	16 x 16 x 95 ~ 165	6			ø22+ø32/ø22	5/8	ø34	
SB-32JII typeA	16 x 16 x 95 ~ 165	6			ø22+ø32/ø22	5/6	ø34	
	16 x 16 x 95 ~ 165	6						
	16 x 16 x 95 ~ 165	6						
SB-32JII typeB	16 x 16 x 95 ~ 165	6			ø22+ø32/ø22	5/8	ø34	
	16 x 16 x 95 ~ 165	6						
	16 x 16 x 95 ~ 165	6						
SR-38 typeA	16 x 16 x 95 ~ 135	4			ø22+ø32/ø22	5/8	ø38	
	16 x 16 x 100	2						
	20 x 20 x 105 ~ 135 (Cut-off)	1						
SR-38 typeB	16 x 16 x 95 ~ 135	4			ø22+ø32/ø22	5/8	ø38	
	16 x 16 x 100	2						
	20 x 20 x 105 ~ 135 (Cut-off)	1						
SR-38J	16 x 16 x 95 ~ 135	4			ø22+ø32/ø22	5/4	ø38	
	16 x 16 x 95 ~ 135 (Optional)	3						
	20 x 20 x 105 ~ 135 (Cut-off)	1						
ST-20			12 x 12 x 73 ~ 79		ø22+ø32/ø22+ø32		ø20	
			12 x 12 x 65 ~ 73 (Cut-off)					
			16 x 16 x 64 ~ 73					
			16 x 16 x 65 ~ 73 (Cut-off)					
ST-38			16 x 16 x 83 ~ 88		ø22+ø32/ø22+ø32		ø38	
			16 x 16 x 71 ~ 82					
			16 x 16 x 84 ~ 88 (Cut-off)					
			20 x 20 x 84 ~ 88					
			20 x 20 x 84 ~ 88 (Cut-off)					
SV-12/20	12 x 12 x 95 ~ 135	5	12 x 12 x 70 ~ 78		ø22+ø32/-		ø12/ø20	
	16 x 16 x 95 ~ 135	4	16 x 16 x 65 ~ 70					
SV-20R	12 x 12 x 95 ~ 135	7	12 x 12 x 70 ~ 78		ø22+ø32/ø22	- / 8	ø23	
	16 x 16 x 95 ~ 135	6	16 x 16 x 65 ~ 70					
SV-32	16 x 16 x 95 ~ 135	4	16 x 16 x 60 ~ 78(80 ~ 88)		ø22+ø32/-		ø32	
	16 x 16 x 105 ~ 135	4	16 x 16 x 84 ~ 88					
SV-38R	20 x 20 x 115 ~ 135 (Cut-off)	1	16 x 16 x 71 ~ 82		ø22+ø32/ø34	- / 8	ø38	
			20 x 20 x 84 ~ 88					
SW-12RII	10x 10 x 95 ~ 115	7			ø16/ø22	4/8	ø13	
SW-20	12 x 12 x 80 ~ 150	6			ø22/ø22	4/8	ø23	
	16 x 16 x 80 ~ 144							
SX-38 typeA	16 x 16 x 95 ~ 135	4	16 x 16 x 84 ~ 88		ø22+ø32/ø34	- / 8	ø38	
	20 x 20 x 105 ~ 135 (Cut-off)	1	16 x 16 x 71 ~ 82					
SX-38 typeB			20 x 20 x 84 ~ 88		ø22+ø32/ø34	- / 8	ø38	
	16 x 16 x 95 ~ 135	4	16 x 16 x 84 ~ 88					
	20 x 20 x 105 ~ 135 (Cut-off)	1	16 x 16 x 71 ~ 82					
			20 x 20 x 84 ~ 88					

Manufacturers are in random order.

Swiss Style Lathe List by Manufacturer

Eguro

(Dimensions: mm)

Model	Toolholder Dimensions (Gang Tool Post)	Number of Tools	Toolholder Dimensions (Turret Tool Post)	Number of Tools	Sleeve Dia. (Horizontal/Opposed)	Number of Tools	Max. Cutting Dia.	Notes
NUCBOY-8EX	12 x 12	6			ø20 or ø25 or ø30	5	ø20	
NUCLET-10EX/EL	16 x 16	6			ø20 or ø25 or ø30	5	ø25.5	
NUCPAL-10EX/EL	16 x 16	10			ø20 or ø25 or ø30	8	ø25.5	
NUCLET-10vv	16 x 16	6			ø20 or ø25 or ø30	5	ø25.5	
NUCBOY-8LL	12 x 12	2			ø20 or ø25 or ø30	2	ø20	
NUCLET-10LL	16 x 16	2			ø20 or ø25 or ø30	2	ø25.5	
NUCROBO-8EX	12 x 12	6			ø20 or ø25 or ø30	5	ø20	
NUCROBO-101	16 x 16	6			ø20 or ø25 or ø30	5	ø25.5	
NUCROBO-202	16 x 16	10			ø20 or ø25 or ø30	8	ø25.5	
SANAX-6	12 x 12	10			ø12 or ø16/ø30	3~6/2	ø15	
SANAX-10	16 x 16	10			ø20 or ø30/ø30	5~8/3	ø25.5	
SANATURN-6	12 x 12	5			ø16/ø30	3~5/2	ø15	
SANATURN-10	16 x 16	6			ø20/ø30	7/3	ø25.5	
EBN-10EX	12 x 12	5			ø20 or ø25 or ø30	4	ø25.5	
GL-120	12 x 12	4			-		ø20	
EB-6	8 x 8	2			-		ø15	
EB-8	10 x 10	2			-		ø20	
EB-10	10 x 10	2			-		ø25.5	

Manufacturers are in random order.

INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
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Swiss Style Lathe List by Manufacturer

Tsugami

(Dimensions: mm)

Model	Toolholder Dimensions (Gang Tool Post)	Number of Tools	Toolholder Dimensions (Turret Tool Post)	Number of Tools	Sleeve Dia. (Horizontal/Opposed)	Number of Tools	Max. Cutting Dia.	Notes
B073-III	8 x 8 x 85	9	-	-	ø20/-	4/-	ø7	
B074/075-III	8 x 8 x 85	9	-	-	ø20/ø20	4/4(8)	ø7	
B0123-III	12 x 12 x 85	9	-	-	ø20/-	4/-	ø12	
B0124/125/126-III	12 x 12 x 85	9	-	-	ø20/ø20	4/4(8)	ø12	
B0128W	12 x 12 x 85	9	-	-	ø20/ø20	4/8	ø12	
B0203-III	12 x 12 x 85	9	-	-	ø20/-	4/-	ø20	
B0204/205/206-III	12 x 12 x 85	9	-	-	ø20/ø20	4/4(8)	ø20	
B0208W	12 x 12 x 85	9	-	-	ø20/ø20	4/8	ø20	
BM163-III	12 x 12 x 85	9	-	-	ø20/-	4/-	ø16	
BM164/165-III	12 x 12 x 85	9	-	-	ø20/ø20	4/4(8)	ø16	
BW127J-I/II	12 x 12 x 85	7	-	-	ø20/ø20	3/9	ø20	
BW128J-I/II	12 x 12 x 85	7	-	-	ø20/ø20	3/9	ø20	
BW128ZJ-I/II	12 x 12 x 85	7	-	-	ø20/ø20	3/9	ø20	
BW129ZJ-I/II	12 x 12 x 85	7	-	-	ø20/ø20	3/9	ø20	
BW207J-I/II	12 x 12 x 85/16 x 16 x 85	5/2	-	-	ø20/ø20	3/9	ø20	
BW208J-I/II	12 x 12 x 85/16 x 16 x 85	5/2	-	-	ø20/ø20	3/9	ø20	
BW208ZJ-I/II	12 x 12 x 85/16 x 16 x 85	5/2	-	-	ø20/ø20	3/9	ø20	
BW209ZJ-I/II	12 x 12 x 85/16 x 16 x 85	5/2	-	-	ø20/ø20	3/9	ø20	
B0265/265B/266-II	16 x 16 x 100	12	-	-	ø25/ø25	5/4	ø26	
B0325/325B/326-II	16 x 16 x 100	12	-	-	ø25/ø25	5/4	ø32	
B0385/385L	20 x 20 x 125	8	-	-	ø32/ø32	3/5	ø38	
B0265/266-III B0266/326-III	16 x 16 x 100	12	-	-	ø25/ø25	5/4	ø26/ø32	
B0265/325V-III B0266/326V-III	16 x 16 x 100	6	-	-	ø25/ø25	5/4	ø26/ø32	
B0385/6 (L)-III	16 x 16 x 100/20 x 20 x 125	11/1	-	-	ø32,ø25/ø32	3-2/5	ø38	
B0385/6 (L)V-III	16 x 16 x 100/20 x 20 x 125	5/1	-	-	ø32,ø25/ø32	3-2/5	ø38	
B038T	-	-	20 x 20 x 125	St.8	ø32/ø25	-	ø38	
BH20/BH20Z	12 x 12 x 85	4	12 x 12 x 85	St.12	ø25/ø32	-	ø20	
BH38	16 x 16 x 125	5	20 x 20 x 125	St.12	ø25/ø32	-	ø38.1	
C150/CH154	12 x 12 x 60 ~ 100	4 ~ 6	-	-	-	-	ø80	
C180	12 x 12 x 60 ~ 100	4 ~ 6	-	-	-	-	ø120	
C220/220T	12 x 12 x 60 ~ 100	6 ~ 8	-	-	-	-	ø120	
C300-IV	16 x 16 x 100 ~ 130	6 ~ 10	-	-	-	-	ø165	
C300H	16 x 16 x 100 ~ 130	6 ~ 10	-	-	-	-	ø165	
P013	8 x 8 x 100 ~ 120	6	-	-	ø16/-	3/-	ø1	
P014	8 x 8 x 100 ~ 120	6	-	-	ø16/ø16	3/3	ø1	
P033	8 x 8 x 100 ~ 120	6	-	-	ø16/-	3/-	ø3	
P034	8 x 8 x 100 ~ 120	6	-	-	ø16/ø16	3/3	ø3	
S205/206	12 x 12 x 100	8	-	-	ø22/ø20	5/4	ø20	
S205/206-II	12 x 12 x 100	9	-	-	ø25/ø25	7/4(8)	ø20	
SS207/SS207-5AX	12 x 12 x 100	8	-	-	ø22/ø20	4/4	ø20	
SS26	16 x 16 x 100	7	-	-	ø22/ø20	5/3	ø26	
SS32/32L	16 x 16 x 100	7	-	-	ø22/ø20	5/3	ø32	
SS267/SS267-5AX	16 x 16 x 100	8	-	-	ø25/ø25	4/4	ø26	
SS327/SS327-5AX	16 x 16 x 100	8	-	-	ø25/ø25	4/4	ø32	
BW269ZJ	16 x 16 x 100	7	-	-	ø25/ø25	5/(8)	ø26	
BW329ZJ	16 x 16 x 100	7	-	-	ø25/ø25	5/(8)	ø32	
MB25	-	-	20 x 20 x 90	2 x St.8	ø20/ø32	5/4	ø25	
M06JC-II	-	-	20 x 20 x 125	St.8	ø25	-	ø220/ø42	
M06J-II	-	-	25 x 25 x 150	St.8	ø32/ø40	-	ø260/ø51	
M08J-II	-	-	25 x 25 x 150	St.8	ø32/ø40	-	ø280/ø65	
M08JL5-II	-	-	25 x 25 x 150	St.8	ø32/ø40	-	ø280/ø65	
M08JL8-II	-	-	25 x 25 x 150	St.8	ø32/ø40	-	ø280/ø65	
M06D-II	-	-	25 x 25 x 150	St.12	ø40	-	ø260/ø51	
M08D-II	-	-	25 x 25 x 150	St.12	ø40	-	ø280/ø65	
M06DY-II	-	-	25 x 25 x 150	St.12	ø40	-	ø260/ø51	
M08DY-II	-	-	25 x 25 x 150	St.12	ø40	-	ø280/ø65	
M06SJ-II	-	-	25 x 25 x 150	St.12	ø40	-	ø260/ø51	
M08SJ-II	-	-	25 x 25 x 150	St.12	ø40	-	ø280/ø65	
M06SD-II	-	-	25 x 25 x 150	St.12	ø40	-	ø260/ø51	
M08SD-II	-	-	25 x 25 x 150	St.12	ø40	-	ø280/ø65	
M06SY-II	-	-	25 x 25 x 150	St.12	ø40	-	ø260/ø51	
M08SY-II	-	-	25 x 25 x 150	St.12	ø40	-	ø280/ø65	
TMU1	20 x 20 x 100 ~ 125	1	20 x 20 x 125	St.16	ø32/ø32	-	ø38	
TMB2	20 x 20 x 100 ~ 125	1	20 x 20 x 125	St.16	ø32/ø32	-	ø51	
TMA8F	20 x 20 x 100 ~ 125	1	-	-	ø32/ø32	-	ø65	
TMA8J	20 x 20 x 100 ~ 125	1	-	-	ø32/ø32	-	ø65	
TMA8H	20 x 20 x 100 ~ 125	1	-	-	ø32/ø32	-	ø65	

Manufacturers are in random order.

Swiss Style Lathe List by Manufacturer

Nomura DS

(Dimensions: mm)

Model	Toolholder Dimensions (Gang Tool Post)	Number of Tools	Toolholder Dimensions (Turret Tool Post)	Number of Tools	Sleeve Dia. (Horizontal/Opposed)	Number of Tools	Max. Cutting Dia.	Notes
NN-10C	10 x 10 x 130	6			ø17		ø10	
NN-10CS	10 x 10 x 130	5			ø17	4	ø10	
NN-10SII	10 x 10 x 130	5			ø23		ø10	
NN-10T	10 x 10 x 130	7			ø23		ø10	
NN-10SB5	10 x 10 x 130	5			ø23		ø13	
NN-10EX2	10 x 10 x 120	6			ø16	4	ø10	
NN-10EX2	10 x 10 x 80	7			ø16	4	ø10	
NN-16SB5	10 x 10 x 130	5			ø23		ø16	
NN-16SB6 Type1	12.7 x 12.7 x 130*	7			ø17(ø22)	4	ø16	
NN-16SB6 Type2	12.7 x 12.7 x 130*	5			ø17(ø22)	4	ø16	
NN-16SB6 Type2.5	12.7 x 12.7 x 130*	6			ø17(ø22)	5	ø16	
NN-16SB6 Type3	12.7 x 12.7 x 130*	5			ø17(ø22)	4	ø16	
NN-16SB7	12.7 x 12.7 x 130*	5			ø16	4	ø16	
NN-16SB7-M8	12.7 x 12.7 x 130*	5			ø16	4	ø16	
					ø22	2	ø20	
NN-20SB	12.7 x 12.7 x 130*	5			ø23		ø16	
NN-16HIII	12 x 12 x 130	6			ø23		ø20	
NN-20HIII	12 x 12 x 130	6			ø23		ø16	
NN-16UIII	12 x 12 x 130	5			ø23		ø20	
NN-20UIII	12 x 12 x 130	5			ø23		ø20	
NN-20CS	12.7 x 12.7 x 130	5(6)			ø22	4	ø20(ø25)	
NN-20U5	12.7 x 12.7 x 150	5(6)			ø22	4	ø20(ø25)	
NN-32U5	12.7 x 12.7 x 150	3(4)			ø32	1	ø32	
	16 x 16 x 130	2			ø22	3		
NN-16UB5	12 x 12 x 130	5			ø23		ø16	
NN-20UB5	12 x 12 x 130	5			ø23		ø20	
NN-20UB7	12 x 12 x 130	6			ø23		ø20	
NN-20UB8	12.7 x 12.7 x 150*	5(6)			ø22	4	ø20(ø25)	
NN-20UB10	12.7 x 12.7 x 150*	5(6)			ø22	4	ø20(ø25)	
NN-32UB8	12.7 x 12.7 x 150*	3(4)			ø32	1	ø32	
	16 x 16 x 130	2			ø22	3		
NN-32UB10W	12.7 x 12.7 x 150*	3(4)			ø32	1	ø32	
	16 x 16 x 130	2			ø22	3		
NN-20YB	12 x 12 x 130	6			ø23		ø20	
NN-25YB/32YB	16 x 16 x 130	5			ø23/ø32		ø25/ø32	
NN-32YB5	16 x 16 x 130	5			ø22/ø32	4	ø32	
NN-32YB5 XB	16 x 16 x 130	6			ø22/ø32	5/1	ø32	
NN-16J	12.7 x 12.7 x 130*	6			ø23		ø16	
NN-20J	12.7 x 12.7 x 130*	6			ø23		ø20	
NN-20J2	12.7 x 12.7 x 130*	6			ø22	4	ø20	
NN-20J5	12.7 x 12.7 x 130*	6			ø22	4	ø20	
NN-20J5 XB	12.7 x 12.7 x 130*	5			ø22	4	ø20	
NN-32J	16 x 16 x 130	6			ø25	2	ø32	
					ø32	3		
NN-32DB	16 x 16 x 130	8			ø22	4	ø32	
					ø32	1		
NN-38KM	16 x 16 x 130	5			ø25	3	ø38	
					ø32	2		

* 12 x 12 toolholder mountable

Manufacturers are in random order.

INSERT GRADES	A
TURNING INSERTS	B
CBN/PCD INSERTS	C
TURNING HOLDERS	D
SMALL TOOLS	E
BORING	F
GROOVING	G
CUT-OFF	H
THREADING	J
DRILLING	K
MILLING	M
QUICK CHANGE TOOLING	N
SPARE PARTS	P
TECHNICAL	R
INDEX	T

List of instruments and Applicable Small Tools and Toolholders

Models of major machine tool manufacturers				Applicable Toolholders
Manufacturer	Model (Automatic Lathe)	Toolholder Size	Total Length of Attached Toolholder (Max.)	
Citizen Machinery	A12,A16,B12,L12,RL01,RL21	10 x 10	100	... 1010F-..
	K12,K16	12 x 12		... 1212F-..
	RL02	16 x 16		... 1616H-..
	B12E,B16E,BL12,C12,C16,M12,M16 MSL12	10 x 10	120	... 1010JX-..
	A20,A20VII,B20,BL20,BL25,K12E,K16E L20X,L220,MC20	12 x 12		... 1212JX-..
	L16,L20,L20E	12 x 12	130	... 1212JX-..
	C32,L25,L32,M20,M32	16 x 16	150	... 1616JX-..
A32,D25				
Star Micronics	SW-12RII	10 x 10	120	... 1010JX-..
	SB-16A,SB-16C,SB-16D,SB-12II,SB-16II SB-12R/16R/20R,SR-20IV,SB-20A/C/E,SC20	12 x 12	130	... 1212JX-..
	SR-20RII,SR-20III,SV-12,SV-20,SR-20J	12 x 12	135	... 1212JX-..
	SV-20R,SV-32,SV-38R,SR-38J, SX-38	16 x 16		... 1616JX-..
	SR-25J,SR-32J,SW-20	16 x 16	150	... 1616JX-..
Tugami	B0,BH20,BM,BW2	12 x 12	85	... 1212F-..
	C150,C180,C220,S205,S206,SS207	12 x 12	100	... 1212F-..
	BH38,B0265,B0266,B0325,B0326 SS26,SS32/32L,SS267,SS327	16 x 16		... 1616H-..
Nomura DS	NN-10C,NN-10CS,NN-10EX2,NN-10SII NN-10SB5,NN-10T,NN-16SB5	10 x 10	130	... 1010JX-..
	NN-16HIII,NN-16UB5,NN-16UIII NN-20HIII,NN-20UIII,NN-20UB5,NN-20YB	12 x 12		... 1212JX-..
	NN-25YB,NN-32YB5,NN-32J,NN-38KM	16 x 16		... 1616JX-..

Manufacturers are in random order.