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List of Property Symbols Complying with ISO13399

ISO13399 Property Symbols	Content
ADJLX	adjustment limit maximum
ADJRG	adjustment range
ALF	clearance angle radial
ALP	clearance angle axial
AN	clearance angle major
ANN	clearance angle minor
APMX	depth of cut maximum
AS	clearance angle wiper edge
ASP	adjusting screw protrusion
AZ	plunge depth maximum
B	shank width
BBD	balanced by design
BCH	corner chamfer length
BD	body diameter
BDX	body diameter maximum
BHCC	bolt hole circle count
BHTA	body half taper angle
BMC	body material code
BS	wiper edge length
BSR	wiper edge radius
CASC	cartridge size code
CB	chip breaker face count
CBP	chip breaker property
CBDP	connection bore depth
CBMD	chip breaker manufacturers designation
CCMS	connection code machine side
CCWS	connection code workpiece side
CCP	chamfer corner property
CDI	insert cutting diameter
CDX	cutting depth maximum
CEATC	tool cutting edge angle type code
CECC	cutting edge condition code
CEDC	cutting edge count
CF	spot chamfer
CHW	corner chamfer width
CICT	cutting item count
CNC	corner count
CND	coolant entry diameter
CNSC	coolant entry style code
CNT	coolant entry thread size
CP	coolant pressure
CRE	spot radius
CRKS	connection retention knob thread size
CSP	coolant supply property
CTP	coating property
CTX	cutting point translation X-direction
CTY	cutting point translation Y-direction
CUTDIA	work piece parting diameter maximum
CUB	connection unit basis
CW	cutting width
CWX	cutting width maximum
CXD	coolant exit diameter
CXSC	coolant exit style code
CZC	connection size code
D1	fixing hole diameter
DAH	diameter access hole
DAXN	axial groove outside diameter minimum
DAXX	axial groove outside diameter maximum
DBC	diameter bolt circle
DC	cutting diameter
DCB	connection bore diameter
DCBN	connection bore diameter minimum
DCBX	connection bore diameter maximum
DCC	design configuration style code
DCCB	counterbore diameter connection bore
DCIN	cutting diameter internal
DCINN	cutting diameter internal minimum
DCINX	cutting diameter internal maximum

ISO13399 Property Symbols	Content
DCSC	cutting diameter size code
DCN	cutting diameter minimum
DCON	connection diameter
DCONMS	connection diameter machine side
DCONWS	connection diameter workpiece side
DCSFMS	contact surface diameter machine side
DCX	cutting diameter maximum
DF	flange diameter
DHUB	hub diameter
DMIN	minimum bore diameter
DMM	shank diameter
DN	neck diameter
DRVA	drive angle
EPSR	insert included angle
FHA	flute helix angle
FHCSA	fixing hole countersunk angle
FHCSD	fixing hole countersunk diameter
FLGT	flange thickness
FMT	form type
FXHLP	fixing hole property
GAMF	rake angle radial
GAMN	rake angle normal
GAMO	rake angle orthogonal
GAMP	rake angle axial
GAN	insert rake angle
H	shank height
HA	thread height theoretical
HAND	hand
HBH	head bottom offset height
HBKL	head back offset length
HBKW	head back offset width
HBL	head bottom offset length
HC	thread height actual
HF	functional height
HHUB	hub height
HTB	body height
IC	inscribed circle diameter
IFS	insert mounting style code
IIC	insert interface code
INSL	insert length
KAPR	tool cutting edge angle
KCH	corner chamfer angle
KRINS	cutting edge angle major
KWL	keyway length
KWW	keyway width
KYP	keyway property
L	cutting edge length
LAMS	inclination angle
LB	body length
LBB	chip breaker width
LBX	body length maximum
LCCB	counterbore depth connection bore
LCF	length chip flute
LDRED	reduced body diameter length
LE	cutting edge effective length
LF	functional length
LFA	a dimension on lf
LH	head length
LPR	protruding length
LS	shank length
LSC	clamping length
LSCN	clamping length minimum
LSCX	clamping length maximum
LTA	LTA length (length from MCS to CRP)
LU	usable length
LUX	usable length maximum
M	m-dimension
M2	distance between the nominal inscribed circle and the corner of an insert that has the secondary included angle

ISO13399 Property Symbols	Content
MHA	mounting hole angle
MHD	mounting hole distance
MHH	mounting hole height
MIID	master insert identification
MTP	clamping type code
NCE	cutting end count
NOF	flute count
NOI	insert index count
NT	tooth count
OAH	overall height
OAL	overall length
OAW	overall width
PDPT	profile depth insert
PDX	profile distance ex
PDY	profile distance ey
PFS	profile style code
PL	point length
PNA	profile included angle
PSIR	tool lead angle
PSIRL	cutting edge angle major left hand
PSIRR	cutting edge angle major right hand
RAL	relief angle left hand
RAR	relief angle right hand
RCP	rounded corner property
RE	corner radius
REL	corner radius left hand
RER	corner radius right hand
RMPX	ramping angle maximum
RPMX	rotational speed maximum
S	insert thickness
S1	insert thickness total
SC	insert shape code
SDL	step diameter length
SIG	point angle
SSC	insert seat size code

ISO13399 Property Symbols	Content
SX	shank cross section shape code
TC	tolerance class insert
TCE	tipped cutting edge code
TCTR	thread tolerance class
TD	thread diameter
THFT	thread form type
THL	threading length
THLGTH	thread length
THSC	tool holder shape code
THUB	hub thickness
TP	thread pitch
TPI	threads per inch
TPIN	threads per inch minimum
TPIX	threads per inch maximum
TPN	thread pitch minimum
TPT	thread profile type
TPX	thread pitch maximum
TQ	torque
TSYC	tool style code
TTP	thread type
ULDR	usable length diameter ratio
UST	unit system
W1	insert width
WEP	wiper edge property
WF	functional width
WF2	distance between the cutting reference point and the front seating surface of a turning tool
WFS	functional width secondary
WT	weight of item
ZEFF	face effective cutting edge count
ZEFP	peripheral effective cutting edge count
ZNC	cutting edge center count
ZNF	face mounted insert count
ZNP	peripheral mounted insert count

List of Reference Symbols Complying with ISO13399

ISO13399 Property Symbols	Content
CIP	Coordinate system In Process
CRP	Cutting Reference Point
CSW	Coordinate System Workpiece side
MCS	Mounting Coordinate System
PCS	Primary Coordinate System

Spare Parts - Wrenches

Standard Items

Package quantity : 5pc/case

Item Number	Appearance
CLR-13S	
CLR-15S	
RLR-20S	
LLR-25S	
LLR-25S-20*65	
LLR-28S	

Optional Items

Package quantity : 5pc/case

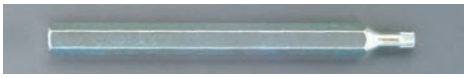
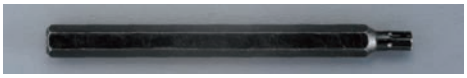
Item Number	Appearance
LLR-13S	
LLR-15S	
LLR-20S	

Driver type wrench for increased adaptability

Package quantity : 1pc/case

Item Number	Magnetic Driver Handle
XX2815-04	

Package quantity : 5pc/case

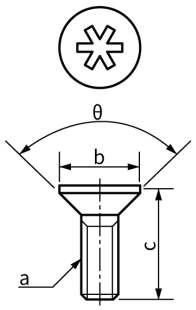
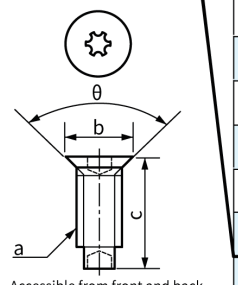
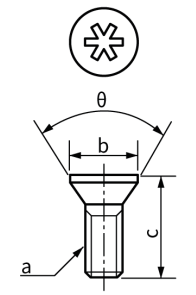
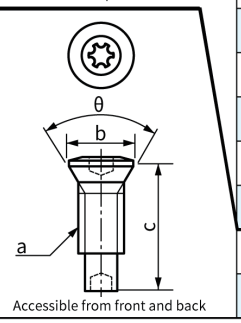
Item Number	Replaceable Bits
HLR-13S	
HLR-15S	
HLR-20S	
HLR-25S	

Driver type wrench kits

Package quantity : 1pc/case

Item Number	Contents
XX2815-04-13S	XX2815-04 with HLR-13S
XX2815-04-15S	XX2815-04 with HLR-15S
XX2815-04-20S	XX2815-04 with HLR-20S
XX2815-04-25S	XX2815-04 with HLR-25S

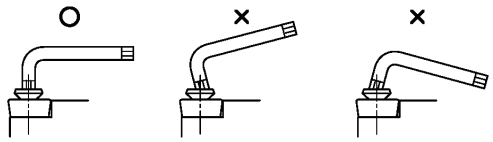
Clamp Screws and Wrenches

Clamp Screw			Dimension（mm）				Standard Wrench	
Appearance	Order Code	Item Number	a	b	c	θ (°)	Order Code	Item Number
	5704739	LR-S-2×3.5	M2×P0.4	3.1	3.5	82	5681994	CLR-13S
	5907704	LR-S-2×3.7	M2×P0.4	3.1	3.7	82		
	5907712	LR-S-2×4.4	M2×P0.4	3.1	4.4	82		
	5907720	LR-S-2×5.5	M2×P0.4	3.0	5.5	90		
	5907738	LR-S-2.5×4.8	M2.5×P0.45	3.6	4.8	82	5681978	CLR-15S
	5704747	LR-S-2.5×5.5	M2.5×P0.45	3.6	5.5	82		
	5907746	LR-S-2.5×6	M2.5×P0.45	3.5	6.0	90		
	5907753	LR-S-2.5×6.8	M2.5×P0.45	3.5	6.8	90		
 Accessible from front and back	5773619	LR-S-3×5.8	M3×P0.5	4.1	5.8	90	5485164	RLR-20S
	5907761	LR-S-3×6.2 ※1	M3×P0.5	5.2	6.2	82		
	5907779	LR-S-3×7.8 ※1	M3×P0.5	4.0	7.8	90		
	5123997	LR-5-3.5×10.6 ※2	M3.5×P0.6	5.0	10.6	90		
	5907787	LR-S-4×5.8	M4×P0.7	5.8	6.0	82		
	5907795	LR-S-4×9	M4×P0.7	5.8	9.0	82		
	5116991	LR-S-4×10PW	M4×P0.7	5.8	10.0	90	5681978	CLR-15S
	5534029	LRIS-2×6	M2×P0.4	2.6	6.0	60	5681994	CLR-13S
	5907803	LRIS-2.2×6	M2.2×P0.45	3.15	6.0	60		
	5989181	LRIS-2.5×5	M2.5×P0.45	3.6	5.0	60	5681978	CLR-15S
	5907811	LRIS-2.5×7	M2.5×P0.45	3.6	7.0	60		
	5907829	LRIS-3×6	M3×P0.5	4.0	6.0	60	5485164	RLR-20S
	5428156	LRIS-3×8	M3×P0.5	4.2	8.0	60		
 Accessible from front and back	5477328	LRIS-4×5	M4×P0.7	5.85	5.0	60	5364930 5794698	LLR-25S LLR-25S-20＊65
	5907837	LRIS-4×6	M4×P0.7	5.85	6.0	60		
	5977566	LRIS-4×8	M4×P0.7	5.85	8.0	60		
	5907845	LRIS-4×10	M4×P0.7	5.85	10.0	60		
	5684105	LRIS-4×12	M4×P0.7	5.85	12.0	60		
	5907852	LRIS-5×10	M5×P0.8	7.0	9.5	60	5364948	LLR-28S
	5116983	LRIS-4×10PW	M4×P0.7	5.7	10.0	60	5681978	CLR-15S
	5090576	LRIS-4×12PW	M4×P0.7	5.7	12.0	60		

※1 Tightening Torque 1.8(N.m)
※2 Tightening Torque 2.1(N.m)

Attention: When tightening screws

- Make sure the wrench tip and wrench hole are neither deformed nor stripped
- Engage the wrench straight to screw hole



- Do not apply more torque than the recommended amount (as shown to the right)

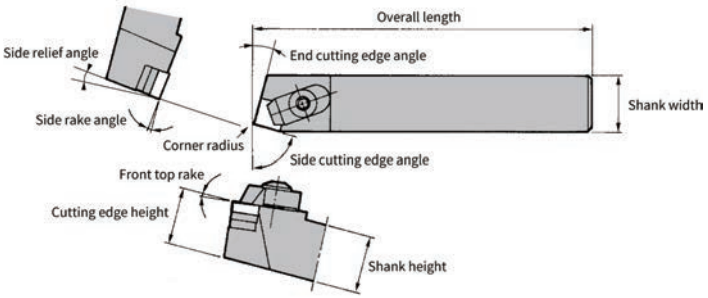
Note: Wrenches and bits come in a pack of five. Clamp screws come in a pack of ten.

Recommended Tightening Torque

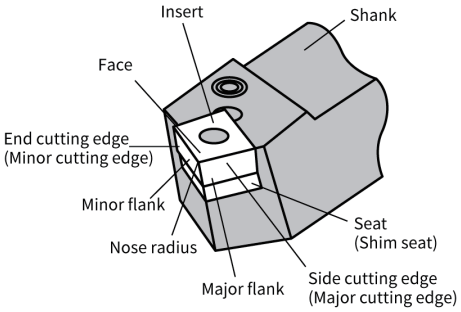
Item Number	Recommended Tightening Torque (N.m)
CLR-13S	0.7
LLR-13S	
HLR-13S	
RLR-15S	1.4
LLR-15S	
HLR15S	
RLR-20S	3.0 ※1,※2
LLR-20S	
HLR20S	
LLR-25S	5.0
LLR-25S-20*65	
HLR-25S	
LLR-28S	7.0
LW-3	5
LW-4	12
LW-5	15

Turning Tool Terminology

Toolholder part names



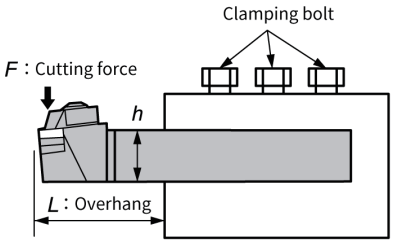
Part names of a cutting tool



Holder rigidity

Toolholder deflection

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

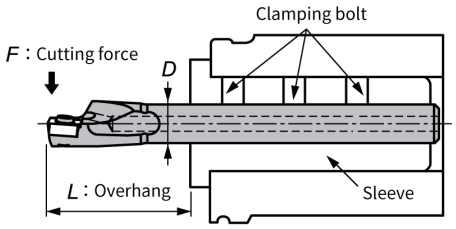


Symbol	Term	Unit
δ	Deflection amount	mm
b	Shank width	mm
h	Shank height	mm
E	Young's modulus	N/mm^2
a_p	Depth of cut	mm
f	Feed amount	mm/rev
k_c	Specific cutting force	N/mm^2
L	Overhang	mm
F	Cutting force	N

($F = k_c \times a_p \times f$)

Boring bar deflection

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



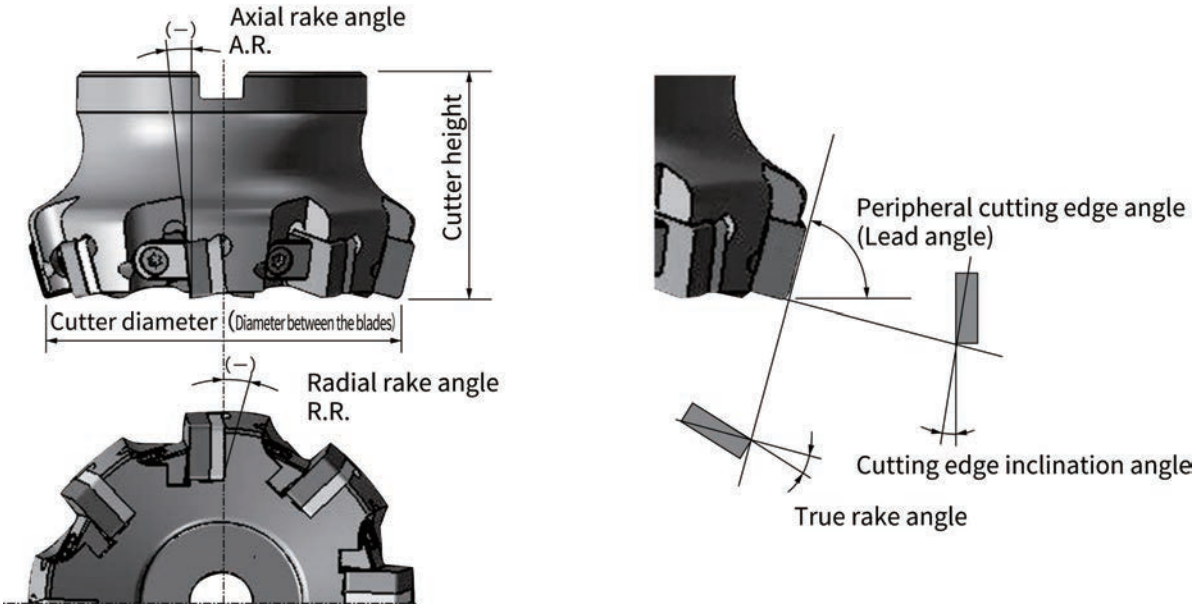
Symbol	Term	Unit
δ	Deflection amount	mm
D	Shank width	mm
E	Young's modulus	N/mm^2
a_p	Depth of cut	mm
f	Feed amount	mm/rev
k_c	Specific cutting force	N/mm^2
L	Overhang	mm
F	Cutting force	N

($F = k_c \times a_p \times f$)

An important factor in improving the rigidity of a toolholder is to ensure the overhang of the tool shank is as short as possible.

Milling Cutter Terminology

Milling cutter terminology



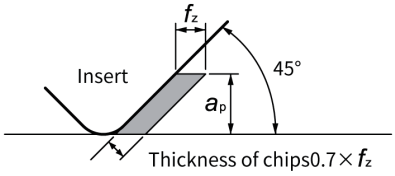
Functions of each cutting edge angle

Name	Function	Effects
Radial rake angle: R.R.	Controls the direction of chip evacuation and cutting force	Negative (-): Excels in chip control performance
Axial rake angle: A.R.	Controls the direction of chip evacuation and cutting force	Positive (+): Excels in cutting performance and BUE resistance
Lead angle	Controls the thickness and evacuation direction of chips	Larger lead angles decrease the thickness of chips and relieves cutting load
True rake angle	Actual rake angle	Larger angles excel in cutting performance and BUE resistance, but lower the cutting edge strength Smaller angles increase the cutting edge strength but lower the BUE resistance
Cutting edge tilt angle	Controls the direction of chip evacuation	Larger angles excel in chip control performance and relieve cutting load, but lower the strength of the insert corner

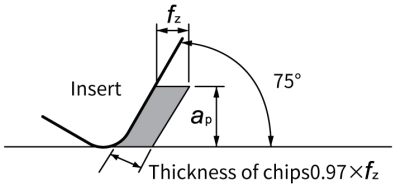
Functions of each angle

[Lead angle]: Relationship of this angle and chip thickness

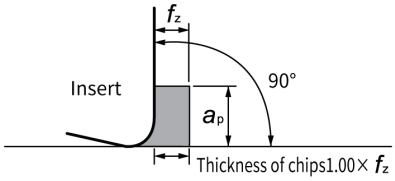
Lead angle : 45 degrees



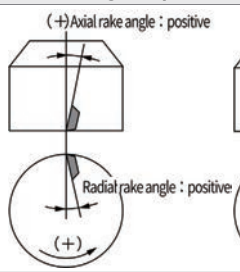
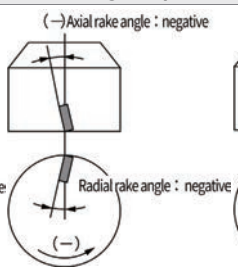
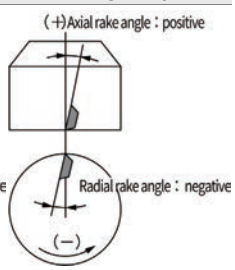
Lead angle : 75 degrees



Lead angle : 90 degrees

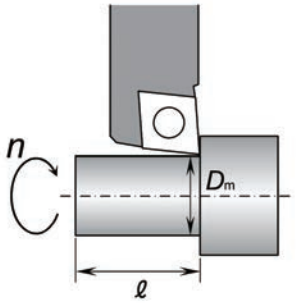


[Rake angle]: Combinations and characteristics

		Double-positive cutting edge shape (DP edge shape)	Double-negative cutting edge shape (DN edge shape)	Negative-positive cutting edge shape (NP edge shape)
Combinations of the angles for basic cutting edge shapes				
Radial rake angle(R.R.)		Positive(+)	Negative(-)	Negative(-)
Axial rake angle(A.R.)		Positive(+)	Negative(-)	Positive(+)
Insert specification		Positive (single side used)	Negative(both sides used)	Positive(single side used)
Work material	Steel	●	–	●
	Cast iron	–	●	●
	Aluminum alloy	●	–	–

Calculation Formula for Turning

Calculating the cutting speed



Calculating the cutting speed from the rotation speed

$$v_c = \frac{\pi \times D_m \times n}{1000} \quad (m/min)$$

v_c : Cutting speed (m/min)
D_m : Machining diameter (mm)
n : Spindle speed (min^{-1})
π : Pi (3.14)

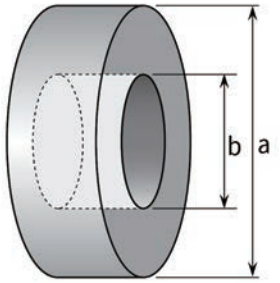
Calculating the revolution speed from the cutting speed

$$n = \frac{1000 \times v_c}{\pi \times D_m} \quad (min^{-1})$$

Example : Obtaining a cutting speed for machining a work piece of 200mm diameter at the spindle speed of 1,000 min-1:

$$v_c = \frac{\pi \times 200 \times 1000}{1000} = 628\ (m/min)$$

Calculating the cutting time



Calculating the cutting time for OD (ID) machining

$$T = \frac{\ell}{f \times n} \quad (min)$$

T : Cutting time (min)
ℓ : Cutting length (mm)
f : Feed rate (mm/rev)
n : Spindle speed (min^{-1})

Calculating the cutting time for facing

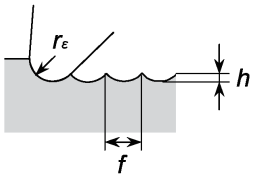
$$T = \frac{\pi \times (a^2 - b^2)}{4000 \times v_c \times f} \quad (min)$$

T : Cutting time (min)
v_c : Cutting speed (m/min)
f : Feed rate (mm/rev)
π : Pi (3.14)

Example : Obtaining a cutting time for machining of work to be cut 100mm long at the spindle speed of 1,000 rpm and at a feed rate of 0.1mm/rev:

$$T = \frac{100}{0.1 \times 1000} = 1\ (min)$$

Calculating the theoretical surface roughness



$$h = \frac{f^2}{8\ r_\varepsilon} \times 1000 \quad (\mu m)$$

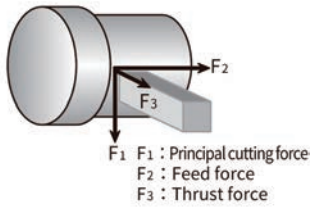
h : Theoretical surface roughness (μm)
f : Feed amount (mm/rev)
r_ε : Corner radius (mm)

Example : Obtaining the theoretical surface roughness when machining with an insert having 0.8mm corner nose radius at a feed rate of 0.1mm/rev

$$h = \frac{0.1^2}{8 \times 0.8} \times 1000 = 1.56\ (\mu m)$$

[Guidelines for actually finished surface roughness]
Steel type work: Theoretical surface roughness × 1.5 to 3
Cast iron type work: Theoretical surface roughness × 3 to 5

Calculating the cutting force



$$F_{(N)} = k_c \times a_p \times f$$

F : Cutting force (N)
k_c : Specific cutting force (N/mm²) ※See the table below.
a_p : Depth of cut (mm)
f : Feed amount (mm/rev)

Example : Calculating the cutting force for grey cast iron cut at the feed rate of 0.2 mm/rev and with a depth of cut of 3 mm:

$$F = 1800 \times 3 \times 0.2 = \underline{1080\,(N)}$$

Calculating the power required

$$P_{c\,(kW)} = \frac{v_c \times f \times a_p \times k_c}{60 \times 10^{3} \times \eta}$$

P_c : Required power (kW)
V_c : Cutting speed (m/min)
f : Feed amount (mm/rev)
a_p : Depth of cut (mm)
k_c : Specific cutting force (N/mm²) ※See the table below.
η : Mechanical efficiency (0.7 - 0.8)

Example : Calculating the cutting power for the machining of grey cast iron at a cutting speed of 700 m/min, feed rate of 0.4 mm/rev, and with a depth of cut of 2 mm
(with 0.8 set as the mechanical efficiency)

$$P_c = \frac{700 \times 0.4 \times 2 \times 1400}{60 \times 10^{3} \times 0.8} = \underline{16.33\,(kW)}$$

Specific cutting force

Work material		Tensile strength or hardness	Specific cutting force (N/mm²) "kc" to cutting feed rate (mm/rev)				
			0.1mm/rev	0.2mm/rev	0.3mm/rev	0.4mm/rev	0.6mm/rev
Soft steel		520	3610	3100	2720	2500	2280
Medium steel		620	3080	2700	2570	2450	2300
Hard steel		720	4500	3600	6250	2950	2640
Tool steel	SKD	670	3040	2800	2630	2500	2400
		770	3150	2850	2620	2450	2340
Cr-Mo steel	SCM	600	3610	3200	2880	2700	2500
		730	4500	3900	3400	3150	2850
Alloy steel	SNCM	900	3070	2650	2350	2200	1980
		HB350	3310	2900	2580	2400	2200
Gray cast iron	FC	HB200	2110	1800	1600	1400	1330

Calculating the volume of chips produced

$$Q_{(cm^3/min)} = v_c \times f \times a_p$$

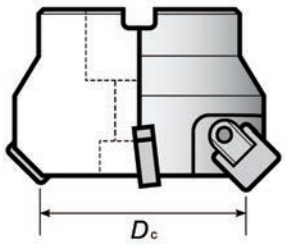
Q : Volume of evacuated chips (cm^3/min)
V_c : Cutting speed (m/min)
a_p : Depth of cut (mm)
f : Feed amount (mm /rev)

Example : Obtaining the volume of chips evacuated per minute for machining at a cutting speed of 700 m/min, feed of 0.4 mm/rev, and a depth of cut of 2mm

$$Q = 700 \times 0.4 \times 2 = \underline{560\,(cm^3/min)}$$

Calculation Formula for Milling Processes

Calculating the cutting speed



Calculating the cutting speed from the rotation speed

$$v_c = \frac{\pi \times D_c \times n}{1000} \quad (m/min)$$

V_c : Cutting speed (m/min)
D_c : Cutter diameter (mm)
n : Spindle speed (min^{-1})
π : Pi (3.14)

Calculating the revolution speed from the cutting speed

$$n = \frac{1000 \times v_c}{\pi \times D_c} \quad (min^{-1})$$

Example : Obtaining the cutting speed for machining with an 200mm diameter cutter at the Spindle speed of 1,000 rpm:

$$v_c = \frac{\pi \times 200 \times 1000}{1000} = 628(m/min)$$

Calculating the feeding speed and feed rate

Calculating the feed rate per blade

$$f_z = \frac{v_f}{z \times n} \quad (mm/t)$$

f_z : Amount per tooth (mm/t)
V_f : Table feed (mm/min)
z : Number of tooth
n : Spindle speed (min^{-1})

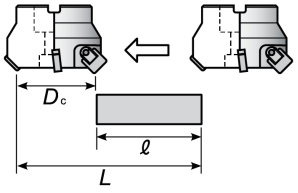
Calculating the feeding speed per minute

$$v_f = f_z \times z \times n \quad (mm/min)$$

Example : Obtaining the feed rate for milling with a 10-teeth cutter at the 0.2mm/t and the revolution speed of 1,000 rpm

$$v_f = 0.2 \times 10 \times 1000 = 2000(mm/min)$$

Calculating the machining time



$$T = \frac{L}{v_f} \quad (min)$$

T : Cutting time (min)
L : Total length of table feed (mm) ($\ell + D_c$)
v_f : Table feed (mm/min)

Example : Obtaining the machining time for milling 200mm on a work piece fed at the rate of 1000mm/min:

$$T = \frac{200}{1000} = 0.2(min)$$

Calculating the cutting power

$$P_c = \frac{a_e \times a_p \times v_f \times k_c}{60 \times 10^{6} \times \eta} \quad (kW)$$

P_c : Required power (kW)
a_e : Cutting length (mm)
a_p : Depth of cut (mm)
v_f : Feed rate (mm/min)
k_c : Specific cutting force (N/mm^2) ※See the table below.
η : Mechanical efficiency (0.7 - 0.8)

Example : Calculating the power required to machine gray cast iron for a length of 150 mm, at a feed rate of 1,100 mm/min, and with a depth of cut of 3 mm
(with 0.8 set as the mechanical efficiency and 0.2 mm as the feed per tooth/blade)

$$P_c = \frac{150 \times 3 \times 1100 \times 1400}{60 \times 10^{6} \times 0.8} = 14.44\,(kW)$$

Specific cutting force

Work material		Tensile strength or hardness	Specific cutting force (N/mm^2) "kc " to cutting feed amount (mm/rev)				
			0.1mm/t	0.2mm/t	0.3mm/t	0.4mm/t	0.6mm/t
Soft steel		520	2200	1950	1820	1700	1580
Medium steel		620	1980	1800	1730	1600	1570
Hard steel		720	2520	2200	2040	1850	1740
Tool steel	SKD	670	1980	1800	1730	1700	1600
		770	2030	2030	1800	1750	1700
Cr-Mo steel	SCM	600	2180	2000	1860	1800	1670
		730	2540	2250	2140	2000	1800
Alloy steel	SNCM	900	2000	1800	1680	1600	1500
		HB350	2100	1900	1760	1700	1530
Gray cast iron	FC	HB200	1750	1400	1240	1050	970
Aluminum alloy	AC,ADC	160	580	480	400	350	320

Calculating the volume of evacuated chips

$$Q = a_e \times a_p \times v_f \quad (cm^3/min)$$

Q : Volume of evacuated chips (cm^2/min)
a_e : Cutting length (mm)
a_p : Depth of cut (mm)
V_f : Feed rate (mm/min)

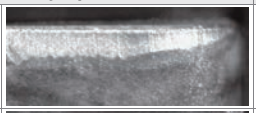
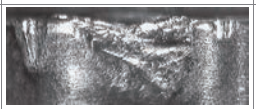
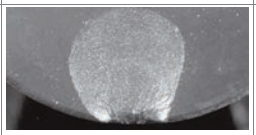
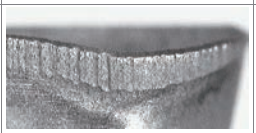
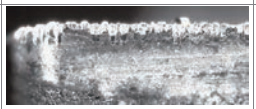
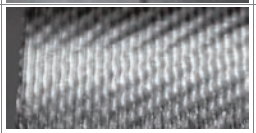
Example : Obtaining the volume of chips evacuated per minute for machining at a cutting speed of 700 m/min, feed rate of 0.4 mm/rev, and with a 2 mm depth of cut:

$$Q = 150 \times 3 \times 1100 = 495\,(cm^3/min)$$

Troubleshooting for Turning

Type of problem		Possible cause \ Corrective measures	Material/grade selection: Change to a harder material/grade	Material/grade selection: Change to a tougher material/grade	Material/grade selection: Change to a material/grade more resistant to thermal shock	Material/grade selection: Change to a material/grade more resistant to deposition	Cutting conditions: Cutting speed (Decrease ↘ / Increase ↗)	Cutting conditions: Feed rate (Decrease ↘ / Increase ↗)	Cutting conditions: Depth of cut (Decrease ↘ / Increase ↗)	Cutting conditions: Coolant: Use non-water-soluble type	Cutting conditions: Coolant: Review dry or wet operation	Tool shape: Review the type of chipbreaker	Tool shape: Rake angle (Decrease ↘ / Increase ↗)	Tool shape: Nose radius of the insert	Tool shape: Side cutting edge angle	Tool shape: Cutting edge strength, honing	Tool shape: Improve the accuracy of insert	Tool shape: Improve the rigidity of the holder	Machine/installation: Improve the installation accuracy of the cutting tool	Machine/installation: Review the overhang of the cutting tool	Machine/installation: Prevent vibration of the machine, improve the machine rigidity
Short tool life	Excessive insert wear	Unsuitable tool material/grade	●																		
		Unsuitable cutting edge shape										●	↗	↗	↗	↘					
		Improper cutting conditions					↘	↗			Wet										
	Fracture/chipping of the cutting edge	Unsuitable tool material/grade		●																	
		Improper cutting conditions						↘	↘												
		Insufficient cutting edge strength										●		↗		↗					
		Thermal shock			●		↘	↘	↘	●	Dry										
		Built-up edge				●	↗	↗		●	Wet										
		Insufficient toughness																●	●	●	●
Poor dimensional accuracy	Variation in dimensions during cutting	Improper accuracy of insert															●				
		Clearance/relief of the work/tool										●	↗	↘	↘	↘		●	●	●	●
	Need for offsetting during cutting	Increased flank wear	●											↗							
		Built-up edge				●	↗														
		Improper cutting conditions					↘	↗													
Poor surface finish	Poor surface roughness	Deposition					↗			●	Wet										
		Unsuitable cutting edge shape										●		↗							
		Chatter					↘	↘	↘									●	●	●	●
Heat	Deterioration in tool life/accuracy due to excessive heat generation	Improper cutting conditions					↘	↘	↘												
		Unsuitable cutting edge shape										●	↗			↘					
Burring, chipping, scuffing	Burring	Boundary wear	●																		
		Improper cutting conditions					↘	↓↑			Wet										
		Unsuitable cutting edge shape										●	↗	↘	↘	↘					
	Chipping	Improper cutting conditions						↘	↘												
		Unsuitable cutting edge shape										●	↗	↗	↗	↘					
		Vibration																●	●	●	●
	Scuffing	Unsuitable tool material/grade				●															
		Improper cutting conditions					↗			●	Wet										
		Unsuitable cutting edge shape										●	↗			↘					
		Vibration																●	●	●	●
Chip control	Elongated chips	Improper cutting conditions					↘	↗	↗		Wet										
		Chipbreaker's effective chip control range										●									
		Unsuitable cutting edge shape												↘	↘						

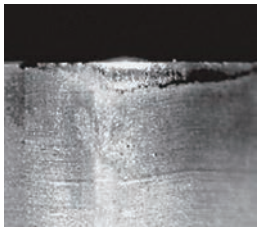
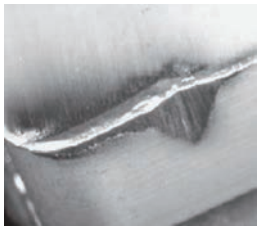
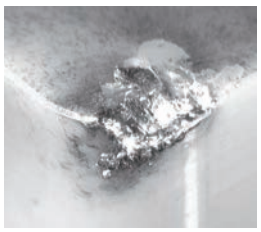
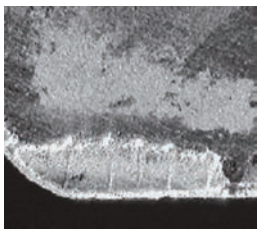
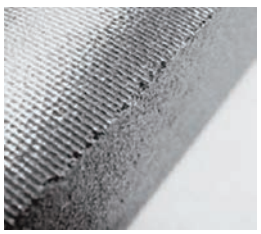
Troubleshooting Case Studies: Turning

	Case/Symptom		Possible causes	Corrective measures
Insert	VB wear		• The material / grade is too soft • Cutting speed is too high • Relief angle is too small	• Use a coated grade • Choose a material/grade highly resistant to wear • Decrease the cutting speed
	Wear on face		• High temperature causes chemical reactions between the insert material and chips	• Use a coated grade • Decrease both of the cutting speed and feed rate • Widen the rake angle
	Notching wear		• The work surface is too hard • Boundary area has been oxidized • Burrs, caused by chips in the sheared form, have been cut	• Widen the side cutting edge angle • Make the nose radius larger so that cutting is performed within the radius • Use a round insert
	Chipping/ fracture		• Feed rate is too high • Chips have become trapped • Chatter resulting in vibration	• Enlarge the honed edge • Make the nose radius larger • Narrow the rake angle to secure the cutting edge strength
	Flaking		• This is due to compressive forces being applied to the cutting edge from elastic deformation in the area being cut • This occurs when deposited/adhered material is peeled off	• Change the cutting conditions by checking the cutting edge • Choose a material/grade highly resistant to fracture • Increase the coolant rate and pressure • Improve the run-out of the main spindle of the machine
	Plastic deformation		• High cutting force and excessive heat is applied to the cutting edge	• Choose a material/grade highly resistant to wear • Decrease both of the cutting speed and feed rate • Make the nose radius larger • Use coolant
	Built-up edge		• This occurs because the cutting temperature is lower than the recrystallization temperature of the work material	• Increase the cutting speed • Use coolant with excellent lubrication performance • Change to a grade with less affinity to the work material
	Deposition		• The deposition is caused to the face by a chemical reaction of the work material due to heat generation	• Increase the cutting speed • Widen the relief angle • Hone the face with a mirror-like-surface finish • Change to a grade with less affinity to the work material
	Clamping crack		• The insert was clamped under improper seating conditions	• Clean the clamping areas and install the insert in the recommended way • Tighten to the specified torque
Work piece	Chipping		• The feed rate is too high • An unsuitable insert was selected	• Decrease the feed rate • Use a smaller edge preparation • Change to a grade highly resistant to boundary wear • Change the cutting edge angle of the holder
	Burring		• The feed rate is incorrect • The shape of insert is not suitable	• Decrease the feed rate • Use a smaller edge preparation
	Chatter mark		• The cutting force is too great • The rigidity of the work piece and cutting tool is insufficient	• Decrease the feed rate • Use a smaller edge preparation • Ensure tool overhang is minimized • Change the cutting edge angle of the holder
	Gouging		• Vibration of the cutting edge due to deposition/built-up edge	• Increase the cutting speed • Use cutting oil excellent in lubrication performance • Change to a grade with less affinity to the work material

Troubleshooting for Milling

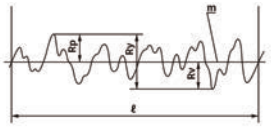
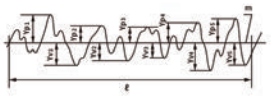
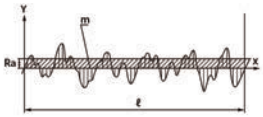
Type of problem		Possible cause \ Corrective measures	Material/grade selection: Change to a harder material/grade	Material/grade selection: Change to a tougher material/grade	Material/grade selection: Change to a material/grade more resistant to thermal shock	Material/grade selection: Change to a material/grade more resistant to deposition	Cutting conditions: Cutting speed (Decrease ↘ / Increase ↗)	Cutting conditions: Feed rate (Decrease ↘ / Increase ↗)	Cutting conditions: Depth of cut (Decrease ↘ / Increase ↗)	Cutting conditions: Review cutter diameter and cutting width	Cutting conditions: Review tool path	Cutting conditions: Coolant: Wet	Cutting conditions: Coolant: Dry	Tool shape: Relief angle of insert (Decrease ↘ / Increase ↗)	Tool shape: Nose radius of cutting edge (Decrease ↘ / Increase ↗)	Tool shape: Cutting edge strength, honing (Decrease ↘ / Increase ↗)	Tool shape: Number of teeth/blades	Tool shape: Enlarge the chip pocket	Tool shape: Check the wiper shape	Tool shape: Improve accuracy of cutting edge run-out	Tool shape: Improve rigidity of tool
Damaged or broken cutting edge of the insert	Increased flank wear	Improper cutting conditions					↘					●									
		Unsuitable cutting edge shape	●											↗		↘			●		
	Increased wear on face	Improper cutting conditions					↘	↘	↘			●									
		Unsuitable cutting edge shape	●											↗	↗	↘					
	Fracture/ chipping on cutting edge	Improper cutting conditions						↘	↘		●										
		Unsuitable cutting edge shape		●										↘	↗	↗			●	●	●
	Thermal shock	Improper cutting conditions					↘	↘	↘				●								
		Unsuitable cutting edge shape			●									↗		↘					
	Built-up edge	Improper cutting conditions					↗	↗				●									
		Unsuitable cutting edge shape				●								↗		↘					
Machining accuracy	Poor surface finish	Improper cutting conditions					↗	↘	↘			●									
		Unsuitable cutting edge shape	●			●										↘	↘		●	●	
	Burring	Improper cutting conditions						↓↑	↘	●	●										
		Unsuitable cutting edge shape												↗	↘	↘			●		
	Chipping	Improper cutting conditions						↘	↘		●										
		Unsuitable cutting edge shape												↗	↗	↘	↗		●		
	Poor flatness and parallelism	Improper cutting conditions						↘	↘			●		↗	↘	↘	↘		●	●	●
Others	Increased chatter/ vibration	Improper cutting conditions					↘	↘	↘	●	●			↗	↘	↘	↘				
	Poor chip evacuation	Improper cutting conditions					↗	↘		●		●	●								
		Unsuitable tool/blade edge shape												↗			↘	●			

Troubleshooting Case Studies: Milling

	Case/Symptom		Possible causes	Corrective measures
Insert	VB wear		• Cutting speed is too high. • Feed rate is too low. • The shape of the insert is not suitable. • The material / grade of the insert is not suitable.	• Decrease the cutting speed. • Increase the feed rate. • Make the nose radius larger. • Change to a grade highly resistant to boundary wear.
	Notching wear		• The material / grade of the inserts is not suitable. • The shape of the cutter is not suitable. • The shape of insert is not suitable.	• Change to a grade highly resistant to boundary wear. • Widen the rake angle. • Change the insert shape to a different one.
	Chipping / fracture		• The cutting speed is incorrect. • The shape of the cutter is not suitable. • The shape of insert is not suitable.	• Decrease the feed rate and depth of cut in order to reduce the cutting force. • Use a smaller edge preparation. • Prepare the cutting edge to give it a round honing. • Change to a grade highly resistant to fracture.
	Thermal crack		• The cutting conditions are incorrect. • The material / grade of insert is not suitable.	• Decrease the cutting speed. • Change to dry cutting from wet cutting. • Use a material / grade highly resistant to thermal shock.
Work piece	Chipping		• The feed rate is too high. • An unsuitable insert is selected. • The shape of the cutter is not suitable.	• Decrease the feed rate. • Use a smaller edge preparation. • Change to a grade highly resistant to boundary wear. • Set the lead angle at 45 degrees.
	Burring		• The feed rate is incorrect. • The shape of the insert is not suitable. • The shape of the cutter is not suitable.	• Adjust the feed rate. • Use a smaller edge preparation. • Make the lead angle narrower.

Surface Roughness Standards

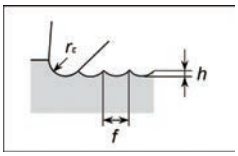
Obtaining the surface roughness

Type	New symbol JIS B0601:'01	Old symbol JIS B0601:'94	Calculation	Obtaining method (example)
Max. height (Peak)	Rz	Ry	The addition of the max. value for the depth Rv and the max. height Rp on the roughness curve for the reference length $Rz = Rp + Rv$	
Average roughness of 10 points	RzJIS	Rz	The addition of the average of the maximum to fifth highest values and the average of the deepest to the fifth deepest values on the roughness curve for the reference length $Rz_{JIS} = \frac{(Yp1+Yp2+Yp3+Yp4+Yp5)+(Yv1+Yv2+Yv3+Yv4+Yv5)}{5}$	
Arithmetic average of roughness	Ra	Ra	The average of absolute values on the roughness curve f (x) for the reference length: $Ra = \frac{1}{\ell}\int_0^{\ell}\{f(x)\}$	

Theoretical surface roughness

The theoretical surface roughness for lathe machining is the minimum value which can be obtained under the set machining conditions, and can be expressed by the following formula.

$$h_{(\mu m)} = \frac{f^2}{8\,r_\varepsilon} \times 1000$$



h : Theoretical surface roughness (μm)
f : Feed amount (mm/rev)
r_ε : Nose radius (mm)

Actual surface roughness

- When machining steel: Theoretical surface roughness x 1.5 – 3
- When machining cast iron: Theoretical surface roughness x 3 – 5

Relationship with triangle symbols

Arithmetic average roughness Ra(μm)	Maximum height Rz(μm)	10-point average roughness Rz_{JIS}(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	

Examples of reading

1. When Ra = 1.6μm ➡ 1.6μm Ra
2. When Rz = 6.3μm ➡ 6.3μm Rz
3. When Rz_{JIS} = 6.3μm ➡ 6.3μm Rz_{JIS}

※The finishing symbols (triangle symbol ▽ and symbol ~) are no longer used in JIS pursuant to the 1994 revision.

Hardness Comparison Chart

Brinell hardness,10mm balls 3000kg(fHB)		Vickers Hardness (HV)	Rockwell hardness			Shore hardness (HS)	Tensile strength Kgf/mm2 [N/m2] Approximate value Mpa(1)
Standard ball	Tungsten carbide ball		Scale A Load: 60 kgf brale indenter (HRA)	Scale B Load: 100 kgf Diameter 1/16" indenter (HRB)	Scale C Load: 150 kgf brale indenter (HRC)		
–	–	940	85.6	–	68	97	
–	–	920	85.3	–	67.5	96	
–	–	900	85	–	67	95	
–	(767)	880	84.7	–	66.4	93	
–	(757)	860	84.4	–	65.9	92	
–	(745)	840	84.1	–	65.3	91	
–	(733)	820	83.8	–	64.7	90	
–	(722)	800	83.4	–	64	88	
–	(710)	780	83	–	63.3	87	
–	(698)	760	82.6	–	62.5	86	
–	(684)	740	82.2	–	61.8	84	
–	(670)	720	81.8	–	61	83	
–	(656)	700	81.3	–	60.1	81	
–	(647)	690	81.1	–	59.7	–	
–	(638)	680	80.8	–	59.2	80	
–	630	670	80.6	–	58.8	–	
–	620	660	80.3	–	58.3	79	
–	611	650	80	–	57.8	–	
–	601	640	79.8	–	57.3	77	
–	591	630	78	–	56.8	–	
–	582	620	79.2	–	56.3	75	
–	573	610	78.9	–	55.7	–	
–	564	600	78.6	–	55.2	74	
–	554	590	78.4	–	54.7	–	
–	545	580	78	–	54.1	72	
–	535	570	77.8	–	53.6	–	
–	525	560	77.4	–	53	71	
–	517	550	77	–	52.3	–	
–	507	540	76.7	–	51.7	69	
–	497	530	76.4	–	51.1	–	
–	488	520	76.1	–	50.5	67	
–	479	510	75.7	–	49.8	–	
–	471	500	75.3	–	49.1	66	
–	460	490	74.9	–	48.4	–	
–	452	480	74.5	–	47.7	64	
–	442	470	74.1	–	46.9	–	
–	433	460	73.6	–	46.1	62	
–	425	450	73.3	–	45.3	–	
–	415	440	72.8	–	44.5	59	
–	405	430	72.3	–	43.6	–	

Brinell hardness,10mm balls 3000kg(fHB)		Vickers Hardness (HV)	Rockwell hardness			Shore hardness (HS)	Tensile strength Kgf/mm2 [N/m2] Approximate value Mpa(1)
Standard ball	Tungsten carbide ball		Scale A Load: 60 kgf brale indenter (HRA)	Scale B Load: 100 kgf Diameter 1/16" indenter (HRB)	Scale C Load: 150 kgf brale indenter (HRC)		
–	397	420	71.8	–	42.7	57	
–	388	410	71.4	–	41.8	–	
–	379	400	70.8	–	40.8	55	
–	369	390	70.3	–	39.8	–	
–	360	380	69.8	(110.0)	38.8	52	
–	350	370	69.2	–	37.7	–	
–	341	360	68.7	–	36.6	50	
–	331	350	62.1	–	35.5	–	
–	322	340	67.6	–	34.4	47	
–	313	330	67	–	33.3	–	
247	247	260	62.4	(101.0)	24	37	825
243	243	255	62	–	23.1	–	805
238	238	250	61.6	99.5	22.2	36	795
233	233	245	61.2	–	21.3	–	780
228	228	240	60.7	98.1	20.3	34	765
219	219	230		96.7	(18.0)	33	730
209	209	220		95	(15.7)	32	695
200	200	210		93.4	(13.4)	30	670
190	190	200		91.5	(11.0)	29	635
181	181	190		89.5	(8.5)	28	605
171	171	180		87.1	(6.0)	26	580
162	162	170		85	(3.0)	25	545
152	152	160		81.7	(0.0)	24	515
143	143	150		78.7		22	490
133	133	140		75		21	455
124	124	130		71.2		20	425
114	114	120		66.7		–	390
105	105	110		62.3		–	–
95	95	100		56.2		–	–
90	90	95		52		–	–
86	86	90		48		–	–
81	81	85		41		–	–

(1) 1 MPa = 1 N/mm²
(2) This table is an excerpt from the JIS Iron and Steel Handbook
(3) Values in parentheses in the above table are not usually used

Grade Comparison Chart

BIDEMICS / Ceramics / NTK CeramiX

	NTK	GREENLEAF	HERTEL	INDEXABLE	ISCAR	KENNAMETAL	KYOCERA	NEWCOMER	ROMAY	SANDVIK	SPK	SSANGYONG	SUMITOMO	TAEGUTEC	TUNGALOY	VALENITE
K Cast iron	HC1 HW2	GEM19	AC5	I50	IN11	K060	KA30	NP5200	CC10			SZ200 SZ300		AB120 AW20		
	HC2 HC5 HC6	GEM7	HT610CA MC2	I100	IN22 IN23	K090 KY1615	A65 A66N PT600M	NP5000	CC20 CC30	CC620 CC650 CC6050	SN60 SN80 SH2	SD200 ST100 ST300 ST500 SD200 TA300 TC300	NB90S	AB30	LX11 LX21 CX710	Q32
	SX6 SP9	CSN100 CSN200 GSN100 HSN100 HSN200		MW30 MW43	IS6 IS8 IS80	KY3000 KY3400 KY3500 KYK25 KYK35 KY4400 KYK10 KY1320	CS7050 KS500 KS6000 KS6050		CC510 CC513 CC514 CC514SC CC515 CC516 CC516SC	CC1690 CC6090 CC6190	SL506 SL508 SL550C SL554C SL654 SL808 SL854C	SN26 SN300 SN400 SN500 SN600 SN700 SN800	NS260 NS260C SN2000K SN2100K	AS10 AS500 SC10 AW20 AB30 AB20	CX710 FX105	VPQ130 VPQ135
S Heat resistant alloy	JX1 JX3															
	WA1	WG300 WG600 WG700			IW7	KY1525 KY4300			CC60	CC670		SW400 SW500 SW700 SW800	WX1500 WX120	TC430		
	SX3 SX5 SX7 SX9	XSYTIN-1		MW37	IS9	KY1540 KY2100 KYS25 KYS30 KYSP30 KYSM10	CF1 KS6030 KS6040		CC5477	CC6060 CC650 CC6065		SN800 SN900	WX2500 WX2000	AS20	M101S	
H Hardened material	450 HC4 ZC4 HC5 HC7 ZC7	GEN7	HT610CA	I100	IN22 IN23 IN420	KY1615 KY4400	A65 A66N KT66 PT600M		CC30SC	CC6050 CC650		ST500 TM300 TC100 TC300	NB90S NB150H	AW120 AB30	LX11	Q35 VPZ205 VPZ215
	WA1	WG300 WG600 WG700			IW7	KY4300 KYS25				CC670		SW400 SW500 SW700 SW800				

BIDEMICS / CBN

	NTK	DIJET	MOLDINO	INDEXABLE	ISCAR	KENNAMETAL	KYOCERA	MITSUBISHI	SANDVIK	SECO	SPK	SSANGYONG	SUMITOMO	TAEGUTEC	TUNGALOY	WALTER
K Cast iron	B23 B30 B99	JBN330 JBN795	BH200 BH250	CBN90 CBN95 CBN100	IB50 IB55 IB85	KB1345 KB1630 KB5630 KB9610 KB9640 KB1340	KBN60M KBN65B KBN900	BC5030 MB710 MB730 MB5015 MBS140	CB7525 CB7925	CBN20 CBNO50C CBN200 CBN300 CBN300P CBN350 CBN600	WBN100 WBN105 WBN115 WBN120 WBN750	SBN1000 SBN1600	BN500 BN600 BN700 BNS800	KB90 KB9OA TB650 TB670 TB730	BX470 BX480 BX850 BX870 BX90S BX910 BX930 BX950 BXC90	
P Heat resistant alloy	JP2															
	120			CBN80		KB1340 KB1630 KB5630		MB730		CBN170			BN700	KB90 TB730	BX950	
H Hardened material	B52 B36 B40 B5K B6K	JBN245 JBN300	BH200 BH250	CBN45 CBN50 CBN60 CBN70	IB10HC IB20H IB25HA IB25HC IB50 IB55	KB1340 KB1610 KB1625 KB5610 KB5625 KB5630 KB9610 KB9640	KBNO5M KBN10C KBN10M KBN25C KBN25M KBN30M KBN35N KBN510 KBN525 KBN900	BC8020 MB810 MB825 MB835 MB8025 MBC010	CB20 CB50 CB7015 CB7025 CB7525	CBN10 CBNO50C CBN100 CBN150 CBN160P CBN170 CBN200 CBN300P CBN350	WBN500 WBN550 WBN600 WBN650	SBN1000 SBN2000 SBN4000	BN250 BN300 BN350 BN1000 BN2000 BNC80 BNC100 BNC150 BNC160 BNC200 BNC300 BNC2010 BNC2020 BNX10 BNX20 BNX25 BNX300	KB50 TB610 TB650 TB670	BX310 BX330 BX360 BX380 BX530 BXC50 BXM10 BXM20	VPC225 WLB30 WLB50

PCD

	NTK	DIJET	INDEXABLE	ISCAR	KENNAMETAL	KYOCERA	MITSUBISHI	SANDVIK	SECO	SSANGYONG	SUMITOMO	TAEGUTEC	TUNGALOY	WALTER
N Non-ferrous material	PD1 PD2	JDA10 JDA30 JDA40 JDA715 JDA735 JDA745	PCD3 PCD-F PCD-UF	ID5 ID8	KD1400 KD1405 KD1425 KD1410 KD1415 KD1425	KPD001 KPD010 KPD230	MD205 MD220 MD230	CD10	PD10 PD20 PD30	SPD1000 SPD2000 SPD3000	DA10 DA90 DA150 DA200 DA1000 DA2200	KP100 KP300 KP500	DX110 DX120 DX140 DX160 DX180	WCD10

Note: This chart is based on published data and not authorized by each manufacturer

Non coated carbide

	NTK	DIJET	GREENLEAF	MOLDINO	INDEXABLE	ISCAR	KENNAMETAL	KYOCERA	MITSUBISHI	ROMAY	SANDVIK	SECO	SUMITOMO	TAEGUTEC	TUNGALOY	WALTER
P Steel	KM1	DX30 DX35 SR30 SRT	G20M G60 G50 G70	EX35 EX40 EX45 WS10	CI5 CI6 CI7 CI9	IC50M IC54 IC70 IC28	KU10 K420 K125M	PW30	UTi20T			S10M 525M S60M	A30 ST10P ST20E ST30E ST40E	CT3000	TX40 UX25 UX30	
N Non-ferrous material	KM1	CR1 KG03 KG1 KG10 KG20 KG30 KT9 LF12	G02 G23	WH02 WH05 WH10 WH20D	CI1 CI2 CI3 CI4 CI65	IC04 IC10 IC20 IC28	K313 K68 K110M K115M K600 K1	GW15 GW25 KW10	HTi05T HTi10 UTi20T	R600	H10 H10F H13A	883 890 HX	EH520 G10E H1	UF1	G1F G2 G2F G3 KS05F KS15F KS20 TH03 TH10 TU10	WK1 WSN10

PVD coated carbide

	NTK	DIJET	GREENLEAF	MOLDINO	INDEXABLE	ISCAR	KENNAMETAL	KYOCERA	MITSUBISHI	SANDVIK	SECO	SUMITOMO	TAEGUTEC	TUNGALOY	WALTER
P Steel	VM1 ZM3 QM3 TM4 DT4 DM4	JC5003 JC5015 JC5030 JC5040	G915 G920 G925 G935	CY15 CY150 CY250 CY9020 HC844 IP2000 IP3000	CI25A C29	IC328 IC507 IC807 C907 C908 IC928 IC3028 IC830 IC570	KC5010 KC5025 KC5510 KC5525 KCU10 KCU25 KC710 KC720 KC722 KC730 KC735M KC792M	PR915 PR930 PR1005 PR1025 PR1115 PR1215 PR1225	VP10MF VP10RT VP15TF VP20MF VP20RT	GC1125 GC1525 GC15 GC1025 GC1145 GC2035 GC2145 GC4125	CP200 CP250 CP500	AC350 AC520U AC530U ACZ150 ACZ310 ACZ330 ACZ350	TT1040 TT7220 TT8010 TT8020 TT9030 TT9080	AH120 AH130 AH140 AH710 AH725 AH730 AH740 GH130 GH330 SH730 AH330 GH730	WSM30 WXM33 WXP20 WXP43
M Stainless steel	ST4 VM1 ZM3 QM3 TM4 DT4 DM4	JC5003 JC5015 JC5030 JC5040	G915 G920 G925	CY250 CY9020 P050S P100S	C23 CI24 C129	IC308 IC507 IC520 IC807/907 IC908 IC928 IC1008 IC1028 IC3028 IC830 IC570	KC5010 KC5025 KC5510 KC5525 KCU10 KCU25 KC710 KC720 KC722 KC730 KC735M KC792M	PR915 PR930 PR1025 PR1125 PR1215 PR1225	VP10MF VP10RT VP15TF VP20MF VP20RT	GC15 GC1005 GC1025 GC1105 GC1115 GC1125 GC1145 GC1525 GC2030 GC2035 GC4125	CP200 CP250 CP500 T52000 T52500	AC350 AC510U AC520U AC530U AC6040M ACZ150 ACZ310 ACZ330 ACZ350 EH510Z EH520Z AC6030M AC610M AC830P AC630M	TT1040 TT5080 TT7010 TT7080 TT7220 TT8010 TT8020 TT9030 TT9080 TT9020	AH120 AH130 AH140 AH710 AH725 AH730 GH130 GH330 GH730 SH730 AH330	WXM20 WXM33 WXN10 WXP20 WXP43
K Cast iron	QM3 DM4	JC5003 JC5015		CY10H CY100H CY9020		IC507 IC508 IC908 IC910 IC808 IC1008	KC5010 KC5025 KC5510 KC5525 KCU10 KCU25 KC720 KC730	PR905 PR1215	VP10RT VP15TF VP20RT	GC1020 GC1125 GC15	CP200 CP250 CP500 DTS2500 TK1000 TK2000 TS2000	AC510U AC520U AC530U ACZ310 EH10Z EH20Z EH510Z AC405K	TT1040 TT6080 TT7010 TT7080	AH110 AH120 GH110 GH130	
S Heat resistant alloy			G920 G925			IC807/907 IC908 IC830	KC5010 KC5510 KC5525 KC7310 KCU10 KCU25			GC15 GC1005 GC1025 GC1105 GC1115 GC1125 GC2145 GC4125		AC510U AC520U AC530U	TT8125 TT8135 TT8020 TT9030 TT9080 TT9020	AH905	
H Hardened material							KC5010 KC5510 KCU10 KCU25			GC1010 GC1025 GC1030		AC503U			

CVD coated carbide

	NTK	DIJET	GREENLEAF	MOLDINO	INDEXABLE	ISCAR	KENNAMETAL	KYOCERA	MITSUBISHI	ROMAY	SANDVIK	SECO	SUMITOMO	TAEGUTEC	TUNGALOY	WALTER
K Cast iron	CP1	JC050W JC105V JC110V JC215V JC605W JC605X JC610	GA5022 GA5023	GM25 GM8015 GM8020 GM8025 HG3305 HG3315 HG8010 HX3505 HX3515	CIN2 CINX CIT3 CIT6 CIX	IC418 IC428 IC9007 IC9015 IC9150	KCK05 KCK15 KCK20 KCP05 KCP10 KCP25 KCP30 KC9325	CA4010 CA4115 CA4120 CA4505 CA4515 CA5505	MC5005 MC5015 MY5015 UC5105 UC5115 UE6110	R100 R200 R500	GC3005 GC3205 GC3210 GC3215 GC4215 GC4315	MK1500 TH1000 TK1000 TK2000 TP200 TP2500 TX150	AC300G AC410K AC420K AC700G AC810P AC820P AC8025P ACK200	TT6300 TT6800 TT7005 TT7015	T1115 T5105 T5115 T5125	WPP01 WPP10 WPP20

Material Cross Reference Chart

Machine structural carbon steel

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

Machine structural carbon steel

Grade	Japan JIS	China GB	USA AISI/SAE	UK BS	Germany DIN	France NF	Russia ГОСТ
Nickel-chromium steel	SNC236				36CrNi6		40XH
	SNC415	12CrNi2			14CrNi10		
	SNC631	30CrNi3			36CrNi10		30XH3A
	SNC815	12Cr2Ni4		655M13	15CrNi13		
	SNC836	37CrNi3			31CrNi14		
Nickel-chromium molybdenum steel	SCNM220	20CrNiMo	8615 8617 8620 8622	805A20 805M20 805A22 805M22	20NiCrMo2 20NiCrMoS2	20NCD 2	
	SCNM240		8637 8640		40NiCrMo2-2		
	SCNM415						
	SCNM420	18CrNiMnMoA	4320		17NiCrMo6-4		20XH2M (20XHM)
	SCNM431				30CrNiMo8		
	SCNM439	40CrNiMoA	4340		40NiCrMo6		
	SCNM447				34CrNiMo6		
	SCNM616						
	SCNM625						
	SCNM630						
	SCNM815						
Chromium steel	SCr415	15Cr 15CrA			17Cr3 17CrS3		15X 15XA
	SCr420	20Cr	5120				20X
	SCr430	30Cr	5130 5132	34Cr4 34CrS4	34Cr4 34CrS4	34Cr4 34CrS4	30X
	SCr435	35Cr	5132	37Cr4 37CrS4	37Cr4 37CrS4	37Cr4 37CrS4	35X
	SCr440	40Cr	5140	530M40 41Cr4	41Cr4 41CrS4	41Cr4 41CrS4	40X
	SCr445	45Cr 50Cr					45X
Chromium molybdenum steels	SCM415	15CrMo			15CrMo4		
	SCM418	20CrMo			18CrMo4 18CrMoS4		20XM
	SCM420			708M20	20CrMo5		20XM
	SCM421						
	SCM430	30CrMo 30CrMoA	4231				30XM 30XMA
	SCM432						
	SCM435	35CrMo	4137	34CrMo4 34CrMoS4	34CrMo4 34CrMoS4	34CrMo4 34CrMoS4	35XM
	SCM440	42CrMo	4140 4142	708M40 709M40 42CrMo4 42CrMoS4	42CrMo4 42CrMoS4	42CrMo4 42CrMoS4	
	SCM445		4145 4147				
	SCM822						

Machine structural carbon steel

Grade	Japan	China	USA	UK	Germany	France	Russia
	JIS	GB	AISI/SAE	BS	DIN	NF	ГОСТ
Manganese steel	SMn420	20Mn2	1522	150M19	20Mn5		
	SMn433	30Mn2 35Mn2	1534	150M36	34Mn5		30Г2 35Г2
	SMn438	40Mn2	1541	150M36	36Mn5		35Г2 40Г2
	SMn443	45Mn2	1541				40Г2 45Г2
	SMnC420	15CrMn	5115		16MnCr5		
	SMnC443	40CrMn	5140				
Structural steel (H steel)	SMn420H		1522H				
	SMn433H						
	SMn438H		1541H				
	SMn443H		1541H				
	SMnC420H						
	SMnC433H						
	SCr415H	15CrH			17Cr3 17CrS3		15Х
	SCr420H	20Cr1H	5120H		17Cr3		20Х
	SCr430H		5130H 5132H	34Cr4 34CrS4	34Cr4 34CrS4	34Cr4 34CrS4	30Х
	SCr435H		5135H	37Cr4 37CrS4	37Cr4 37CrS4	37Cr4 37CrS4	35Х
	SCr440H	40CrH	5140H	41Cr4 41CrS4	41Cr4 41CrS4	41Cr4 41CrS4	40Х
	SCM415H	15CrMoH	4118H		15CrMo5		
	SCM418H				18CrMo4 18CrMoS4		
	SCM420H	20CrMoH	4118H	708H20	18CrMo4		
	SCM435H		4135H 4137H	34CrMo 34CrMoS4	34CrMo 34CrMoS4	34CrMo 34CrMoS4	
	SCM440H		4140H 4142H	42CrMo 42CrMoS4	42CrMo 42CrMoS4	42CrMo 34CrMoS4	
	SCM445H		4145H 4147H				
	SCM822H						
	SNC415H						
	SNC631H						
	SNC815H	12Cr2Ni4H		655H13	15NiCr13		
	SNCM220H	20CrNiMoH	8617H 8620H 8622H	805H17 805H20 805H22	21NiCrMo2	20N CD 2	
	SNCM420H	20CrNiMoH	4320H		20CrNiMoS6-4		

Stainless steel , Heat-resistant alloy

Grade	Japan	China	USA		UK	Germany	France	Russia
	JIS	GB	UNS	AISI	BS	DIN	NF	ГОСТ
Stainless steel	SUS201	1CrMn6Ni5N	S20100	201			Z12CMN17-07Az	
	SUS202	1CrMn8Ni5N	S20200	202	284S16			12Х17Г9АН4
	SUS301	1CrMn10Ni5Mo3N 1Cr17Ni7	S30100	301	301S21	X12CrNi17 7	Z11CN17-08	07Х16Н6
	SUS301L					X2CrNiN18-7		
	SUS301J1					X12CrN117 7		
	SUS302	1Cr18Ni9	S30200	302	302S25		Z12CN18-09	12Х18Н9
	SUS302B		S30215	302B				
	SUS303	Y1Cr18Ni9	S30300	303	303S21	X10CrNiS18 9	Z8CNF18-09	
	SUS303Se	Y1Cr18Ni9Se	S30323	303Se	303S41			12Х18Н10Е
	SUS304	0Cr18Ni9	S30400	304	304S31	X5CrNi18 10	Z7CN18-09	08Х18Н10
	SUS304L	00Cr18Ni10	S30403	304L	304S11	X2CrNiN19 11	Z3CN19-11	03Х18Н11
	SUS304N1	0Cr18Ni9N	S30451	304N			Z6CN19-09Az	
	SUS304N2	OCr19NiNbN	S30452					
	SUS304LN	OOCR18Ni10N	S30453	304LN		X2CrNiN18 10	Z3CN18-10Az	
	SUS304J1							
	SUS304J2							
	SUS304J3		S30431	30431				
	SUS305	1Cr18Ni12	S30500	305	305S19	X5CrNi18 12	Z8CN18-12	06Х18Н11
	SUS305J1							
	SUS309S	0Cr23Ni13	S30908	309S			Z10CN24-13	
	SUS310S	0Cr25Ni20	S31008	310S	310S31		Z8CN25-20	10Х23Н18
	SUS316	0Cr17Ni12Mo2	S31600	316	316S31	X5CrMo17 12 2 X5CrMo17 12 3	Z7CND17-12-02 Z6CND18-12-03	
	SUS316L	OOCR17Ni14Mo2	S31603	316L	316S11	X2CrNiMo17 13 2 X2CrNiMo17 13 2	Z3CND17-12-02 Z3CND17-12-03	03Х17Н14М3
	SUS316N	0Cr17Ni12Mo2N	S31651	316N				
	SUS316LN	00Cr17Ni13Mo2N	S31653	316LN		X2CrNiMoN17 12 2 X2CrNiMoN17 12 3	Z3CND17-11Az Z3CND17-11Az	
	SUS316Ti		S31635			X6CrNiMoTi17 12 2	Z6CNDT17-12	08Х17Н13М2Т
	SUS316J1	0Cr18Ni12Mo2Cu2						
	SUS316J1L	00Cr18Ni14Mo2Cu2						
	SUS317	OCr19NiMo3	S31700	317	317S16			
	SUS317L	00Cr19Ni13Mo3	S31703	317L	317LS12	X2CrNiMo18 16 4	Z3CND19-15-04	
	SUS317LN		S31753				Z3CND19-14Az	
	SUS317J1	0Cr18N116Mo5						
	SUS317J2							
	SUS317J3							
	SUS836L		N08367					
	SUS890L		N08904	N08904	904S14		Z2NCDU25-20	
	SUS321	1Cr18Ni9Ti 0Cr18Ni10Ti	S32100	321	321S31	X6CrNiTi18 10	Z6CNT18-10	08Х18Н10Т
	SUS347	0Cr18Ni11Nb	S34700	347	347S31	X6CrNiNb18 10	Z6CNNb18-10	08Х18Н12Б
	SUS384		S38400	384			Z6CN18-16	
	SUSXM7	0Cr18Ni9Cu3	S30430	304Cu	394S17		Z2CNU18-10	
	SUSXM15J1	0Cr18Ni13Si4	S38100				Z15CNS20-12	
	SUS329J1	0Cr26Ni5Mo2	S32900	329				
	SUS329J3L		S32924	S31803			Z3CNDU22-05Az	08Х21Н5М2Т
	SUS329J4L		S39275	S31260			Z3CNDU25-07 Az	
	SUS405	0Cr13AI 0Cr13	S40500	405	405S17	X6CrAl13	Z8CA12	
	SUS410L	00Cr12					Z3C14	
	SUS429		S42900	429				
	SUS430	1Cr17	S43000	430	430S17	X6Cr17	Z8C17	12Х17
	SUS430F	Y1Cr17	S43020	430F		X7CrMoS18	Z8CF17	
	SUS430LX		S43035			X6CrTi17	Z4CT17	
	SUS430J1L					X6CrNb17	Z4CNB17	

Stainless steel , Heat-resistant alloy

Grade	Japan	China	USA		UK	Germany	France	Russia
	JIS	GB	UNS	AISI	BS	DIN	NF	ГОСТ
Stainless steel	SUS434	1Cr17Mo	S43400	434	434S17	X6CrMo17 1	Z8CD17-01	
	SUS436L		S43600	436				
	SUS436J1L							
	SUS444		S44400	444			Z3CDT18-02	
	SUS447J1	00Cr30Mo2	S44700					
	SUSXM27	00Cr27Mo	S44627				Z1CD26-01	
	SUS403	1Cr12	S40300	403				
	SUS410	1Cr13	S41000	410	410S21	X10Cr13	Z13C13	
	SUS410S		S41008	410S	403S17	X6Cr13	Z8C12	08X13
	SUS410F2							
	SUS410J1	1Cr13Mo 1Cr12Mo	S41025			X12CrS13		
	SUS416	Y1Cr13	S41600	416	416S21		Z11CF13	
	SUS420J1	2Cr13	S42000	420	420S29	X20Cr13	Z20C13	20X13
	SUS420J2	3Cr13	S42000	420	420S37	X30Cr13	Z33C13	30X13
	SUS420F	Y3Cr13	S42020	420F			Z30CF13	
	SUS420F2							
	SUS429J1							
	SUS431	1Cr17Ni2	S43100	431	431S29	X20CrNi17 2	Z15CN16-02	20X17H2
	SUS440A	7Cr17	S44002	440A			Z70C15	
	SUS440B	8Cr17	S44003	440B				
	SUS440C	9Cr18 11Cr17 9Cr18Mo	S44004	440C			Z100CD17	95X18
	SUS440F	Y11Cr17	S44020	S44020				
	SUS630	0Cr17Ni4CuNb	S17400	S17400		X5CrNiCuNb16-4	Z6CNU17-04	
	SUS631	0Cr17Ni7AI	S17700	S17700		X7CrNiAI17-7	Z9CNA17-07	09X17H7 Ю
	SUS632J1							
Heat-resistant alloy	SUH31				331S42		Z35CNWS14-14	45X14H14B2M
	SUH35				349S52		Z52CMN21-09Az	
	SUH36	5Cr21Mn9Ni4N	S63008		349S54	X53CrMnNi21 9	Z55CMN21-09Az	55X20Г9АН4
	SUH37	2Cr21Ni12	S63017		381S34			
	SUH38							
	SUH309	2Cr23Ni13	S30900	309	309S24		Z15CN24-13	
	SUH310	2Cr25Ni20	S31000	310	310S24	CrNi2520	Z15CN25-20	20X25H20CX2
	SUH330	1Cr16Ni35	N08330	N08330			Z12NC35-16	
	SUH660	0Cr15Ni25Ti2MoAIVB	S66286				Z6NCTV25-20	
	SUH661		R30155					
	SUH21					CrAI1205		
	SUH409		S40900	409	409S19	X6CrTi12	Z6CT12	
	SUH409L						Z3CT12	
	SUH446	2Cr25N	S44600	446			Z12C25	15X28
	SUH1	4Cr9Si2	S65007		401S45	X45CrSi9 3	Z45CS9	
	SUH3	4Cr10Si2Mo					Z40CSD10	40X10C2M
	SUH4	8Cr20Si2Ni			443S65		Z80CSN20-02	
	SUH11							40X9C2
	SUH660	2Cr12MoVNbN						20X12ВНМБФР
	SUH616	2Cr12NiMoWV	S42200					

Tool steel

Grade	Japan	China	USA	UK	Germany	France	Russia
	JIS	GB	AISI/STM	BS	DIN	NF	ГОСТ
Carbon tool steel	SK140(SK1)	T13				C140E3U	Y13
	SK120(SK2)	T12	W1-1111/2			C120W3U	Y12
	Sk105(SK3)	T11	W1-10		C105W1	C105E2U	Y11
	SK95(SK4)	T10	W1-9			C90E2U	Y10
	SK85(SK5)	T8Mn T9	W1-8		C80W1	C90E2U C80E2U	Y8Г Y9
	SK75(SK6)	T8			C80W1	C80E2U C70E2U	Y8
	SK65(SK7)	T7			C70W2	C70E2U	Y7
High speed tool steel	SKH2	W18Cr4V	T1	BT1		HS18-0-1	P18
	SKH3	W18Cr4Co5	T4	BT4	S18-1-2-5	HS18-1-1-5	P18K5Ф2
	SKH4	W18Cr4V2Co8	T5	BT5		HS18-0-2-9	P18K5Ф
	SKH10	W12Cr4VCo5	T15	BT15	S12-1-4-5	HS12-1-5-5	
	SKH51	W6Mo5Cr4V2	M2	BM2	S6-5-2	H6-5-2	P6M5
	SKH52	CW6Mo5Cr4V2 W6Mo5Cr4V3	M3-1				P6M5Ф3
	SKH53	CW6Mo5Cr4V3	M3-2		S6-5-3	H6-5-3	P6M5Ф3
	SKH54		M4	BM4		HS6-5-4	
	SKH55	W6Mo5Cr4V2Co5 W7Mo5Cr4V2Co5	M35 M41	BM35	S6-5-2-5	HS6-5-2-5HC	P6M5K5
	SKH56	M36					
	SKH57			BT42	S10-4-3-10	HS10-4-3-10	
	SKH58	W2Mo9Cr4V2	M7			HS2-9-2	
	SKH59	W2Mo9Cr4VCo8	M42	BM42	S2-10-1-8	HS2-9-1-8	
Alloy tool steel	SKS11		F2				XB4
	SKS2				105WCr6	105WCr5	XBГ
	SKS21	W					
	SKS5						
	SKS51		L6				
	SKS7						
	SKS8	Cr06				C140E3UCr4	13X
	SKS4	5CrW2Si 6CrW2S1	S1				6XB2C 5XB2CФ
	SKS41	4CrW2Si	S1				4XB2C
	SKS43		W2-91/2	BW2		10V2	
	SKS44		W2-8				
	SKS3	9CrWMn					9XBФ
	SKS31	CrWMn			105WCr6	105WCr5	XBГ
	SKS93						
	SKS94						
	SKS95	8MnSi					
	SKD1	Cr12	D3	B03	X210Cr12	X200Cr12	X12
	SKD10	Cr12Mo1V1	D2		X153CrMoV12		X12M
	SKD11	Cr12MoV	D2	BD2	X153CrMoV12	X160CrMoV12	
	SKD12	Cr5Mo1V	A2	BA2		X100CrMoV5	
	SKD4					X32WCrV3	
	SKD5	3Cr2W8V	H21	BH21	X30WCrV9-3	X30WCrV9	
	SKD6	4Cr5MoSiV	H11	BH11	X38CrMoV51	X38CrMoV5	4X5MФC
	SKD61	4CrMoSiV1	H13	BH13	X40CrMoV51	X40CrMoV5	4X5MФ1C
	SKD62		H12	BH12		X35CrWMoV5	3X3M3Ф
	SKD7	4CrMo3SiV	H10	BH10	X32CrMoV33	32CrMoV12-18	
	SKD8		H19	BH19			
	SKT3					55CrNiMo9V4	
	SKT4	5CrNiMo		BH225/5	55NiCrMoV6	55NiCrMoV7	5XHM

Special application steel

Grade	Japan	China	USA	UK	Germany	France	Russia
	JIS	GB	AISI/STM	BS	DIN	NF	ГОСТ
Spring steel	SUP3		1075 1078				75 80 85
	SUP6	55Si2Mn			56SiCr7	60Si7	60C2
	SUP7	60Si2Mn 60Si2MnA	9260		61SiCr7	60Si7	60C2Г
	SUP9	55CrMnA	5155		55Cr3	55Cr3	
	SUP9A	60CrMnA	5160		55Cr3	60Cr3	
	SUP10	50CrVA	6150	735A51 735H51	50CrV4	51CrV4	ХФА50ХГФА
	SUP11	60CrMnBA	51B60		51CrV4		50ХГР
	SUP12		9254	685A57 685H57	54SiCr6	54SiCr6	
	SUP13	60CrMnMoA	4161	705A60 705H60	60CrMn3-2	60CrMo4	
Sulfur and Sulfur Composite Free-cutting Steel	SUM11		1110				
	SUM12	Y12	1108				
	SUM21		1212				
	SUM22	Y15	1213	(230M07)	9SMn28	S250	
	SUM22L	Y12Pb	12L13		9SMnPb28	S250Pb	
	SUM23		1215				
	SUM23L						
	SUM24L	Y15Pb	12L14		9SMnPb28	S250Pb	
	SUM25				9SMn36	S300	
	SUM31		1117		15S10		
	SUM31L						
	SUM32	Y20		210M15 210A15		(13MF4)	
	SUM41	Y30 Y35	1137			(35MF6)	
	SUM42	Y40Mn	1141			(45MF6.1)	
	SUM43		1141	(226M44)		(45MF6.3)	
High carbon chromium bearing steel	SUJ1	GCr4	51100				
	SUJ2	GCr5	52100		100Cr6	100Cr6	ЩХ15
	SUJ3	GCr15SiMn	ASTMA485 Grade1				
	SUJ4	GCr15SiMo					
	SUJ5	GCr18Mo					

Cast iron

Grade	Japan	China	USA	UK	Germany	France	Russia
	JIS	GB	AISI/SAE	BS	DIN	NF	ГОСТ
Gray cast iron	FC100	HT100	NO.20	100			cy10
	FC150	HT150	NO.30	150	GG15	GGL150	cy15
	FC200	HT200	NO.35	200	GG20	GGL200	cy20
	FC250	HT250	NO.45	250	GG25	GGL250	cy25
	FC300	HT300	NO.50	300	GG30	GGL300	cy30
	FC350	HT350	NO.60	350	GG35	GGL350	cy35
					GG40	GGL400	cy40
Ductile cast iron	FCD400	QT400-18	60-40-18	400/17	GGG40	FGS370-17	By40
	FCD450	QT450-10	65-45-12	420/12		FGS400-12	By45
	FCD500	QT500-7	70-50-05	500/7	GGG50	FGS500-7	By50
	FCD600	QT600-3	80-60-03	600/7	GGG60	FGS600-2	By60
	FCD700	QT700-2	100-70-03	700/2	GGG70	FGS700-2	By70
	FCD800	QT800-2	120-90-02	800/2	GGG80	FGS800-2	By80
		QT900-2		900/2			By100

Nonferrous metals

Grade	Japan	China	USA	UK	Germany	France	Russia
	JIS	GB	ASTM	BS	DIN	NF	ГОСТ
Aluminum alloy		1A99	1119		A199.99R		A99
		1A97			A199.98R		A97
		1A95					A95
	A1080	1A80		1080(1A)	A199.90	1080A	A8
	A1050	1A50	1050	1050(1B)	A199.50	1050A	A5
	A5052	5A02	5052	NS4	AlMg2.5	5052	Amg
		5A03		NS5			AMg3
	A5056	5A05	5056	NS6	AlMg5		AMg5V
	A5556	5A30	5456	NG61		5957	
	A2117	2A01	2036		AlCu2.5Mg0.5	2117	D18
	A2017	2A11		HF15	AlCuMg1	2017S	D1
	A2024	2A12	2124		AlCuMg2	2024	D16AVTV
		2B16	2319				
	A2N01	2A80					AK4
	A2018	2A90	2218				AK2
	A2014	2A14	2014		AlCuSiMn	2014	AK8
	A7075	7A09	7175		AlZnMgCu1.5	7075	V95P
Cast aluminum alloy	AC4C	ZAlSi7Mn	356.2	LM25	G-AlSi7Mg		
	AC3C	ZAlSi12	413.2	LM6	G-Al12	A-S12-Y4	AL2
		ZAlSi5Cu1Mg	355.2				AL5
		ZAlSi2Cu2Mg1	413		G-Al12(Cu)		
		ZAlCu5Mn					AL19
		ZAlCu5MnCdVA	201				
		ZAlMg10	520	LM10	G-AlMg10	AG11	AL8
		ZAlMg5Si			G-AlMg5Si		AL13

Swiss Machine List

Citizen

Cincom

Machine Model	Gang Station				Number of tools	Turret Station						Sleeve Station		Hand	Max. cutting dia.
	Inch		Metric			Inch		Metric		Number of tools		Inch	Metric		
	H×B	LF	H×B	LF		H×B	LF	H×B	LF	Turret	Station	"	mm		mm
A12	□3/8	4.75	□10	100	5			–	–	–	–	φ3/4	φ19.05/φ20	R	φ12
A16	□3/8	4.75	□10	100	5			–	–	–	–	φ3/4	φ19.05/φ20	R	φ16
A20	□1/2	4	□12(□13)	120	5-7			–	–	–	–	φ1	φ25.4	R	φ20
A25	□1/2	4	□12(□13)	120	5/6			–	–	–	–	φ1	φ25.4	R	φ25
A32	□5/8	4.75	□16	150	6			–	–	–	–	φ1	φ25.4	R	φ32
B12, B12E	□3/8	4.75	□10	100	5			–	–	–	–	φ3/4	φ19.05/φ20	R	φ12
B16E	□3/8	4.75	□10	10	5			–	–	–	–	φ3/4	φ19.05/φ20	R	φ16
B20	□1/2	4.75	□12(□13)	120	6			–	–	–	–	φ3/4	φ19.05/φ20	R	φ20
BL12	□3/8	4.75	□10	60-120	5			–	–	–	–	φ3/4	φ20(φ19.05)	R	φ12
BL20			□12(□13)	120	7			–	–	–	–	φ3/4	φ20(φ19.05)	R	φ20
BL25			□12(□13)	120	7			–	–	–	–	φ3/4	φ20(φ19.05)	R	φ25
C12	□3/8	4.75	□10	120	6			–	–	–	–	φ3/4	φ19.05	R	φ12
C16	□3/8	4.75	□10	120	6			–	–	–	–	φ3/4	φ19.05	R	φ16
C32	□5/8	4.75	□16	130	5			–	–	–	–	φ1	φ25.4	R	φ32
D25			□16(□19)	150	7	–	–	–	–	–	–	φ1	φ25.4	R	φ25
D25 VIII	□5/8		□16	–	10							φ1	φ25.4	R	φ25
E32			–	–	–			□16(19×13)	90	2	10/Turret	φ1	φ25.4	R	φ32
F10			–	–	–			□10	60	1	10	φ3/4	φ19.05	R	φ10
F12			–	–	–			□10	60	1	10	φ3/4	φ19.05	R	φ12
F16			–	–	–			□10	60	1	10	φ3/4	φ19.05	R	φ16
F20			–	–	–			□16(19×13)	90	1	10	φ1	φ25.4	R	φ20
F25			–	–	–			□16(19×13)	90	1	10	φ1	φ25.4	R	φ25
FL25			–	–	–			□16	90	1	12		φ16	R	φ25
FL42			–	–	–			□16	90	1	12		φ16	R	φ42
G10			–	–	–			□10	60	1	8	–	–	R	φ10
G16			–	–	–			□10	60	1	8	–	–	R	φ16
G32			–	–	–			□16(19×13)	90	1	10	–	–	R	φ32
K12, K12E	□3/8		□10	100	7			–	–	–	–		φ20	R	φ12
K16, K16E	□3/8		□12	100	6			–	–	–	–		φ20	R	φ16
L10			□8	100-130	5			–	–	–	–	φ5/8	φ15.875	R	φ10
L12	□3/8	4	□10	100	6			–	–	–	–	φ3/4	φ19.05	R	φ12
L12X(L12-2M10)			□10(□12)	110	7(6)	–	–	–	–	–	–	φ3/4	φ19.05	R	φ12
L16, L16E			□12(□10)	130	5			–	–	–	–	φ3/4	φ19.05	R	φ16
L20, L20E, L20X	□1/2	4.75	□12	130	5			–	–	–	–	φ3/4	φ19.05	R	φ20
L20XIIB5, L20VII			□12(□13/16)	130	6	–	–	–	–	–	–	φ3/4	φ19.05	R	φ20
L25	□5/8	4.75	□16	130	5			–	–	–	–	φ1	φ25.4	R	φ25
L32	□5/8	4.75	□16	130	5			–	–	–	–	φ1	φ25.4	R	φ32
$M_2$12, $M_3$12	□3/8		□10	120	5			□10	60	1	10	φ3/4	φ19.05	R	φ12
$M_2$16, $M_3$16, $M_4$16	□3/8		□10	120	5			□10	60	1	10	φ3/4	φ19.05	R	φ16
$M_2$20, $M_3$20	□5/8	4.75	□12	130	5	□3/4		□16	90	1	10	φ1	φ25.4	R	φ20
$M_2$32, $M_3$32, $M_4$32	□5/8	4.75	□16	130	5	□3/4		□16	90	1	10	φ1	φ25.4	R	φ32
M20	□1/2	4	□13(□12)	150	5	□1/2		□10	60	1	10	φ3/4	φ19.05	R	φ20
MSL12			□10	120	–			–	–	–	–	–	–	R	φ12
R04			□8	120	7			–	–	–	–	φ5/8	φ15.875	R	φ4
R07			□8	120	5			–	–	–	–	φ5/8	φ15.875	R	φ7
RL02			□16	60-150	Max 6			–	–	–	–		φ16/φ20	L	φ20
RL21			□10(□12)	90	–			–	–	–	–	φ3/4	φ19.05	R	φ20

*□ : H x B dimensions are the same

Miyano

Machine Model	Turret Station	Number of tools(Top/Bottom)	Hand	Sleeve dia.	Max. cutting dia.
ABX-51TH3	20×20×100	12+12/12	R	φ25	φ51
ABX-64TH3	20×20×100	12+12/12	R	φ25	φ64
ABX-51THY	20×20×100	12+12/12	R	φ20,2540	φ51
ABX-64THY	20×20×100	12+12/12	R	φ20,25,40	φ64
ABX-51SYY	20×20×100	12/12	R	φ20,25,40	φ51
ABX-64SYY	20×20×100	12/12	R	φ20,25,40	φ64
ANX-42SYY	20×20×100	12/12	R	φ25	φ42
ABX-51SY	20×20×100	12/12	R	φ25	φ51
ABX-64SY	20×20×100	12/12	R	φ25	φ64
BNA-34C	20×20×100	8(16)/-	R	φ25	φ34
BNA-42C	20×20×100	8(16)/-	R	φ25	φ42
BNA-34S	20×20×100	8(16)/-	R	φ25	φ34
BNA-42S	20×20×100	8(16)/-	R	φ25	φ42
BNA-34DHY	20×20×100	8(16)/6	R	φ25	φ34
BNA-42DHY	20×20×100	8(16)/6	R	φ25	φ42
BNA-34MSY	20×20×100	8(16)/-	R	φ25	φ34
BNA-42MSY	20×20×100	8(16)/-	R	φ25	φ42
BNA42CY	20×20×100	12/-	R	φ25	φ42
BNA42SY	20×20×100	12/-	R	φ25	φ42
BNA42GTY	Gang 20×20×125 Turret 20×20×100	Gang 3 Turret 8	R	φ25	φ42
BNC-34C5	20×20×100	8/-	R	φ25	φ34
BNC-34S6	20×20×100	8/-	R	φ25	φ34
BNC-42C5	20×20×100	8/-	R	φ25	φ42
BNC-42S6	20×20×100	8/-	R	φ25	φ42
BNC-42C7	20×20×100	8(16)/-	R	φ25/φ32	φ42
BND-51C2/S2/SY2	20×20×100	12/-	R	φ25	φ51
BNE-34S5/SY5	20×20×100	12/12	R	φ25	φ34
BNE-42S6/SY6	20×20×100	12/12	R	φ25	φ42
BNE-51S5/SY5	20×20×100	12/12	R	φ25	φ51
BNE-51S6/SY6	20×20×100	12/12	R	φ25	φ51
BNE-51MSY	20×20×100	12/12	R	φ25	φ42
BNJ-34S3/SY3	20×20×100	12/6	R	φ25	φ34
BNJ-42S3/SY3	20×20×100	12/6	R	φ25	φ42
BNJ-51SY3	20×20×100	12/6	R	φ25	φ51
BNX-42SY	20×20×100	12/-	R	φ25	φ42
BX-20S	16×16×100	8/-	R	φ20	φ20
BX-26S	16×16×100	10/-	R	φ20	φ26
BX-26T	16×16×100	8/-	R	φ20	φ26

On the sub-spindle side, the left-hand byte can be used as the reverse byte.

Ocean Cincom

Machine Model	Gang Station	Number of tools	Hand	Sleeve dia.	Max. cutting dia.
RL01	10×10×60-120	4※1	L	φ16/φ20	φ12
RL03	10×10×100※2 12×12×100 16×16×100	max5	L	φ20	Collet chuck Stationary type φ35 Pull Type φ40
GN-3200	10×10×100※2 12×12×100 16×16×100	max5	L	φ20	Collet chuck Stationary type φ35 Pull Type φ40
GN-3200W	10×10×100※2 12×12×100 16×16×100	max10	L	φ20	Collet chuck Stationary type φ35 Pull Type φ40
GN-4200	10×10×100※2 12×12×100 16×16×100	max6	L	φ20	Collet chuck Stationary type φ35 Pull Type φ40

※1: Total number of sleeves
※2: Shank size is selectable

STAR

Machine Model	Gang Station					Turret Station					Sleeve Station				Max. cutting dia.
	Inch		Metric		Number of tools	Inch		Metric		Number of tools	Inch	Metric	Hand	DS-Sleeve item number	
	H×B	LF	H×B	LF		H×B	LF	H×B	LF	Turret Station	"	mm			mm
ECAS-12			□10	95-150	6							φ22	R	SS-DSU-L23 SS-DSU-SK	φ13
ECAS-20			□12(16)	80-144	6							φ22	R	SS-DSU-L23 SS-DSU-SK	φ20
ECAS-20T								□12(16)	80	3 8/Turret		φ22	R	SS-DSU-B8D34	φ20
ECAS-32T			□16	80-120	4			□16	60-78	2 10/Turret		φ22/32	R	SS-DSU-SK	φ32
JNC-10								□8	65	1 6		-	L	–	φ10
JNC-16								□10	80	1 6		-	L	–	φ16
JNC-25/32								□16	78-120	1 10		φ22	R	–	φ25/φ32
KJR-16B/25B								□16	78	1 12/16		φ22	R	–	φ16/φ25
KNC-16/20								□16	68	1 16		φ22	R	–	φ16/φ20
KNC-25II/32II								□16	78	1 20		φ22/32	R	–	φ25/φ32
RNC-10/16			□10	80-120	5							φ22	R	–	φ10/φ16
RNC-16II/16BII			□10	80-120	5							φ22	R	–	φ16
SA-16R			□10	95-120	6							φ22	R	–	φ16
SB-12II/12R/16II	□1/2 (3/8)		□12(10)	95-130	6(7)							φ22	R	SS-DSU-L23 SS-DSU-SK	φ12/φ13/φ16
SB-16/16R	□1/2 (3/8)		□12(10)	95-130	6(7)							φ22	R	SS-DSU-L23 SS-DSU-SK	φ16
SB-20/20R	□1/2 (3/8)		□12(10)	95-130	6(7)							φ22	R	SS-DSU-L23 SS-DSU-SK	φ20
SC-20			□12	95-130	6							φ22	R	–	φ20
SE-12/12B, 16/16B			□10	95-120	5							φ22	R	–	φ13/φ16
SF-25								□16	73-98	1 10		φ22/32	R	–	φ25
SG-42								□16(20)	84-88	1 10		φ22/32	R	–	φ42
SH-12/16			□10	95-120	5							φ22	R	–	φ13/φ16
SH-7			□8	95-120	5							φ22	R	–	φ7
SI-12/12C			□10	80-130	6							φ22	R	–	φ13
SR-10J	□5/16		□8	67-110	6							φ22	R	SS-DSU-L23 SS-DSU-SK	φ10
SR-16/20			□12	95-120	5							φ22	R	–	φ16/φ20
SR-20J	□1/2		□12	100-135	6							φ22	R	SS-DSU-L23 SS-DSU-SK	φ20
SR-20R/20RII/20RIII			□12	100-135	6							φ22	R	SS-DSU-L23 SS-DSU-SK	φ20
SR-20RIV	□1/2		□12	100-130	7							φ22	R	SS-DSU-B8L23	φ20
SR-25J/32J	□5/8		□16	95-155	6							φ22/32	R	SS-DSU-L23 SS-DSU-SK	φ25/φ32
SR-32, SR-32J, SR-38			□16	100-135	6							φ22	R	–	φ32
SR32JII	□5/8		□16		6							φ22	R	SS-DSU-B8L23 SS-DSU-B8D34	φ32
SR-32JIII	□5/8		□16	100-135	6							φ22	R	SS-DSU-B8L23	φ32
SST-16			□12	95-115	5							φ22	R	–	φ16
ST-20								□12(16)	70-78	3 8/Turret		φ22	R	–	φ20
ST-38								□16(20)	85	3 10/Turret		φ22/32	R	–	φ38
SV-12/20			□12	95-135	4			□12	70-78	1 8		φ22	R	–	φ13/φ20
	□1/2		□12/□16	95-135	5			□16	65-70	1 8		φ22	R	–	φ13/φ20
SV-32			□16	95-135	4			□16	80-88	1 10		φ22/32	R	–	φ32
SV-32J/32JII			□16	95-135	4			□16	65-70	1 8		φ22/32	R	–	φ32
SV-38R			□16+□20 (Cut-off)	95-135	5			□16(20)	84-88	1 10		φ22/32	R	SS-DSU-B8D34	φ38
SW-12RII			□10	80-115	6							φ16	R	SS-DSU-B8L23	φ13
SW-20	□1/2 (5/8)		□12(16)	80-144	6							φ22	R	SS-DSU-B8L23	φ20
SW-7			□8	80-120	4							–	R	–	φ7
SX-38			□16+□20	95-135	3+1			□16(□20)	84-88	10		φ22/32	R	SS-DSU-B8D34	φ38

*□ : H x B dimensions are the same

Machine Model	Gang Station				Number of tools	Turret Station					Sleeve Station		Hand	Max. cutting dia.
	Inch		Metric			Inch		Metric		Number of tools				
	H×B	LF	H×B	LF		H×B	LF	H×B	LF	Turret	Station	Inch "	Metric mm		mm
P013H/P014H			□8	100-120	6			–	–	–	–		φ16	R	φ1
P033H/P034H			□8	100-120	6			–	–	–	–		φ16	R	φ3
B007-III	–	–	□7(□8/□10)	85	8			–	–	–	–		φ25	R	φ7
B073-II	–	–	□8	85	9								φ20	R	φ7
B074/B07-V	–	–	□8	85	9			–	–	–	–		φ20	R	φ7
B074-II	–	–	□8	85	6			–	–	–	–		φ20	R	φ7
B0123/B0124/B0125/B0126	–	–	□12	85	9			–	–	–	–		φ20	R	φ12
B012F/B012-V/BE12-V	–	–	□12	85	9			–	–	–	–		φ20	R	φ12
B0123-II/B0124-II/B0125-II/ B0126-II	–	–	□12	85	9			–	–	–	–		φ20	R	φ12
B016MF	–	–	□12	85	9			–	–	–	–		φ20	R	φ16
B018-III	–	–	□12	85	9			–	–	–	–		φ20	R	φ18
B0203/B0204/B0205/B025-II/ B0205-III/B0206-II	–	–	□12	85	9			–	–	–	–		φ20	R	φ20
B0203-II/B0204-II/B0206-II	–	–	□12	85	9			–	–	–	–		φ20	R	φ20
B020F/B020-V/BE20-V	–	–	□12	85	9			–	–	–	–		φ20	R	φ20
B026-V	–	–	□12(□16)	85	6			–	–	–	–		φ25	R	φ26
B0265-II/B0266-II	–	–	□16	100	12								φ25	R	φ26
B0325-II/B0326-II	–	–	□16	100	12								φ25	R	φ32
B0385/B0385L	–	–	□16	125	8			–	–	–	–		φ32	R	φ38
B038T	–	–	□16	125	3			□20	125	1	8		φ25/φ32	R	φ38
BA20-III			□12	85	6			–	–	–	–		φ25	R	φ20
BA26-III			□12(□16)	85	6			–	–	–	–		φ25	R	φ26
BC18	□1/2		□12	85	10			–	–	–	–		φ25	R	φ18
BC25	□1/2		□12	85	10			–	–	–	–		φ10/φ25	R	φ25
BE18	□1/2		□12	85	9			–	–	–	–		φ20	R	φ18
BH20/BH20Z	□1/2		□12	85	4			□12	85	1	12		φ25/φ32	R	φ20
BH38	□5/8		□16	125	7			□20	125	1	12		φ25/φ32	R	φ38
BM07			□8	85	9			–	–	–	–		φ20	R	φ7
BM163/BM164/BM165	□1/2		□12	85	9			–	–	–	–		φ20	R	φ16
BM20-V	□1/2		□12	85	9			–	–	–	–		φ20	R	φ20
BN12-III			□12	85	7			–	–	–	–		φ20	R	φ12
BN20-III			□12(□16)	85	7			–	–	–	–		φ20	R	φ20
BS12-V	□1/2		□12	85	8(12)			–	–	–	–		φ20/φ25	R	φ12
BS18-III	□1/2		□12	85	7(10)			–	–	–	–		φ14/φ25	R	φ18
BS20-V	□1/2		□12	85	8(12)			–	–	–	–		φ20/φ25	R	φ20
BS26(ABC)-V	□5/8		□16	100	7(10)			–	–	–	–		φ16/φ25	R	φ26
BS32C-V	□5/8		□16	100	6			–	–	–	–		φ16/φ25	R	φ32
BU12			□12	85	4			□12	80	1	8		φ20	R	φ51
BU20			□12	85	4			□12	80	1	8		φ20	R	φ20
BU26			□16	100	7			□20	80	1	8		φ20/φ32	R	φ26
BU38	□1/2		□16	100	7			□20	80	1	8		φ20/φ32	R	φ38
BW07-III	□1/2		□12	85	7			–	–	–	–		φ20	R	φ7
BW12-III/BW129Z	□1/2		□12	85	7			–	–	–	–		φ20	R	φ12
BW20-III/BW209Z	□1/2		□12(□16)	85	7			–	–	–	–		φ20	R	φ20
BW269Z/ZJ	□5/8		□16	100	7	–	–	–	–	–	–		φ25	R	φ26
BW329Z/ZJ	□5/8		□16	100	7	–	–	–	–	–	–		φ25	R	φ32
C004-III			□13	60-100	6-8			–	–	–	–		-φ10	R/L	φ120
C150	–	–	□10	60-100	4-6			–	–	–	–		-φ8	R/L	φ80
C180	–	–	□12	60-100	4-6			–	–	–	–		-φ10	R/L	φ120
C220	–	–	□13	60-100	6-8			–	–	–	–		-φ10	R/L	φ120
C300-III	–	–	□16	100-130	6-10			–	–	–	–		-φ14	R/L	φ170
CH154			□12	60-100	-16			–	–	–	–		-φ10	R/L	φ15
M34J			–	–	–			□20	125	1	12		φ20/φ32	R	φ34
M42J/M42D/M42SD			–	–	–			□20	125	1	12		φ25/φ32	R	φ42
M50SY-III			–	–	–			□20	100	1	12		φ32	R	φ51
M50J			–	–	–			□20	100	1	12		φ20/φ32	R	φ51
MB25			–	–	–			□20	80	2	8/Turret		φ20/φ32	R	φ25
MB35-III			–	–	–			□20	80	2	8/Turret		φ20/φ32	R	φ35
MB38-III			–	–	–			□20	80	2	8/Turret		φ20/φ32	R*	φ38
MB50-III			–	–	–			□20	80	2	8/Turret		φ20/φ32	R	φ50
MU26			–	–	–			□20	80	2	8/Turret		φ20/φ32	R	φ26
MU38			–	–	–			□20	80	2	8/Turret		φ20/φ32	R	φ38
NU50-III			–	–	–			□20	100	1	12		φ20/φ32	R	φ51
B020M-II/SS20M/SS20M-5AX			□10 Can be mounted on the spindle	46	–			BT15 spindle			24		φ20	R	φ20
S205/S206	□1/2		□12(□16)	100	8			–	–	–	–		φ20/φ22	R	φ20

Machine Model	Gang Station				Turret Station					Sleeve Station			Max. cutting dia.
	Inch	Metric		Number of tools	Inch	Metric		Number of tools		Inch	Metric	Hand	
	H×B LF	H×B	LF		H×B LF	H×B	LF	Turret	Station	"	mm		mm
SS20	□1/2	□16	100	8		–	–	–	–		φ20/φ22	R	φ20
SS207/SS207-5AX	□1/2	□12(□16)	100	8		–	–	–	–		φ20/φ22	R	φ20
SS26	□5/8	□16	100	7		–	–	–	–		φ20/φ22	R	φ26
SS267/SS267-5AX	□5/8	□16	100	8							φ25	R	φ26
SS32/SS32L	□5/8	□16	100	7		–	–	–	–		φ20/φ22	R	φ32
SS327/SS327-5AX	□5/8	□16	100	8							φ25	R	φ32
TMB2		–	–	–		□20	125	1	16		φ32	R	φ51
TMU1		–	–	–		□20	125	1	16		φ32	R	φ38
TMA8-IV/TMA8J		□20 Can be mounted on the spindle	100			KM40 spindle			30			R	φ220
M06J						□25	150	1	8		φ32/φ40	R	φ260
M06SY						□25	150	1	12		φ32/φ40	R	φ260
M06JC						□20	125	1	8		φ32/φ40	R	φ260
M08J						□25	150	1	8		φ32/φ40	R	φ280
M08SY/M08D/M08SD						□25	150	1	12		φ32/φ40	R	φ280

*□ : H x B dimensions are the same

DMG MORI

Machine Model	Gang Station				Number of tools	Sleeve Station		Hand	Max. cutting dia
	Inch		Metric			Inch	Metric		
	H×B	LF	H×B	LF		"	mm		mm
Sprint 20/5			□12		6		φ20	R	φ20
Sprint 20/8			□12		6		φ20	R	φ20
Sprint 32/5			□16		6		φ20	R	φ32
Sprint 32/8			□16		6		φ20	R	φ32

*□ : H x B dimensions are the same

NOMURA

Machine Model	Gang Station				Number of tools	Sleeve Station		Hand	Max. cutting dia
	Inch		Metric			Inch	Metric		
	H×B	LF	H×B	LF		"	mm		mm
NS-P1053A			□9.5	130	5	—	—	R	φ10
NN-10C			□10	130	6		φ17	R	φ10
NN-10E			□10	130	6		φ16	R	φ10
NN-10C2			□10	130	6		φ17	R	φ10
NN-10CS			□10	130	6		φ17	R	φ10
NN-10CS (No live tools)			□10	130	5		φ17	R	φ10
NN-10SII			□10	130	5		φ23	R	φ10
NN-10T			□10	130	7		φ23	R	φ10
NN-10SB5			□10	130	5		φ23	R	φ16
NN-16SB5			□10	130	5		φ23	R	φ16
NN-16SB6 Type1	□1/2	5.12	□12.7	130	5		φ17(φ22)	R	φ16
NN-16SB6 Type2	□1/2	5.12	□12.7	130	5		φ17(φ22)	R	φ16
NN-16SB6 Type2.5	□1/2	5.12	□12.7	130	5		φ17(φ22)	R	φ16
NN-16SB6 Type3	□1/2	5.12	□12.7	130	5		φ17(φ22)	R	φ16
NN-16SB7	□1/2	5.12	□12.7		5(7)		φ16	R	φ16
NN-16HIII			□12	130	6		φ23	R	φ16
NN-20HIII			□12	130	6		φ23	R	φ20
NN-16UIII			□12	130	5		φ23	R	φ16
NN-20UIII			□12	130	5		φ23	R	φ20
NN-20CS	□1/2	5.12	□12.7	130	5(6)		φ22	R	φ20(φ25)
NN-20U5	□1/2	5.12	□12.7	130	5(6)		φ22	R	φ20(φ25)
NN-16UB5			□12	130	5		φ23	R	φ16
NN-20UB5			□12	130	5		φ23	R	φ20
NN-20UB7			□12	130	6		φ23	R	φ20
NN-20UB8	□1/2	5.12	□12.7	130	5(6)		φ22	R	φ20(φ25)
NN-20YB			□12	130	8		φ23	R	φ20
NN-25UB8	□1/2	5.12	□12		5		φ22	R	φ25
NN-32UB8	□1/2	5.12	□16		5		φ22	R	φ32
NN-38UB8	□3/4		□20		5		φ22/φ32	R	φ38
NN-25YB/32YB			□16	130	8		φ22/φ32	R	φ25
NN-32YB2			□16	130	5		φ23/φ32	R	φ32
NN-32YB3	□5/8		□16		5		φ22/φ32	R	φ32
NN-32YB3XB	□5/8		□16		6		φ22/φ32	R	φ32
NN-16J	□1/2	5.12	□12.7	130	6		φ23	R	φ16
NN-20J	□1/2	5.12	□12.7	130	6		φ23	R	φ20
NN-20J2	□1/2	5.12	□12.7	130	6		φ22	R	φ20
NN-20J3	□1/2	5.12	□12.7		6		φ23	R	φ20
NN-20J3XB	□1/2	5.12	□12.7		5		φ23	R	φ20

*□ : H x B dimensions are the same

TORNOS

Machine Model	Gang Station					Turret Station					Sleeve Station			Max. cutting dia.
	Inch		Metric		Number of tools	Inch		Metric		Number of tools	Inch	Metric	Hand	
	H×B	LF	H×B	LF		H×B	LF	H×B	LF		"	mm		mm
EvoDECO 10/10	□5/16		□8		8							φ20/φ25	R	φ10
EvoDECO 10/8	□5/16		□8		8							φ20/φ25	R	φ10
EvoDECO 16/10	□1/2		□12		10							φ20/φ25	R	φ16
EvoDECO 16/8	□1/2		□12		10							φ20/φ25	R	φ16
EvoDECO 20	□5/8		□16		10							φ20/φ25	R	φ25.4
EvoDECO 32	□5/8		□16		10							φ20/φ25	R	φ32
Swiss ST 26	□1/2		□12		17							φ20/φ22/φ25	R	φ25.4
Sigma 20/6	□5/8		□16		14						φ1	φ20	R	φ25.4
Sigma 32/6	□5/8		□16		14						φ1.26	φ32	R	φ32
SwissNano	□5/16		□8		7							φ12/φ16	R	φ4
Delta 12/4	□1/2		□12	85	5							φ20	R	φ12
Delta 12/5	□1/2		□12	85	5							φ20	R	φ12
Delta 20/4	□1/2		□12	85	5							φ20	R	φ20
Delta 20/5	□1/2		□12	85	5							φ20	R	φ20
Delta 38/5B			□20	125	8							φ25/φ32	R	φ38
Delta 38/5BL			□20	125	8							φ25/φ32	R	φ38
Gamma 20/5			□16	100	8							φ20/φ22	R	φ20
Gamma 20/6			□16	100	8							φ20/φ22	R	φ20
CT20	□1/2		□12	100	5								R	φ20
MultiSwiss 6X16								□16		6		φ25		
MultiSwiss 8X26								□16		8		φ25		
MultiSwiss 6X32								□16		8		φ25		
Swiss GT13			□12		8							φ20/φ22		13
Swiss GT26			□16		9							φ20/φ22		26
Swiss GT26B			□16		8							φ20/φ22		26
Swiss GT32			□16		9							φ20/φ22		32
Swiss GT32B			□16		8							φ20/φ22		32
SwissDeco 26-G			□16		8							φ20/φ25		26
SwissDeco 26-T			□16					□16		8		φ20/φ25		26
SwissDeco 26-TB			□16					□16		8		φ20/φ25		26
SwissDeco 32-G			□16		8							φ20/φ25		32
SwissDeco 26-T			□16					□16		8		φ20/φ25		32
SwissDeco 26-TB			□16					□16		8		φ20/φ25		32

*□ : H x B dimensions are the same

Hanwha Machinery

Machine Model	Gang Station					Turret Station					Sleeve Station			Max.
	Inch		Metric		Number of tools	Inch		Metric		Number of tools	Inch	Metric	Hand	cutting dia.
	H×B	LF	H×B	LF		H×B	LF	H×B	LF		"	mm		mm
XD 03			□8		6							φ15.875	R	φ3
XD 07			□8		6							φ15.875	R	φ7
XD 12			□12		5							φ20	R	φ12
XD 16			□12		5							φ20	R	φ16
XD 20 / 20V			□12		6							φ25	R	φ20
XDI20			□12		6							φ25	R	φ20
XD 26			□16		5							φ25	R	φ26
XD32			□16		5							φ32	R	φ32
XD 38			□16		5							φ32	R	φ38
XD 42			□20		5							φ32	R	φ42
XE 12			□12		6							φ20	R	φ12
XE 16			□12		6							φ20	R	φ16
XE 20			□12		6							φ25	R	φ20
XE 26			□16		5							φ25	R	φ26
XE 35			□16		5							φ32	R	φ35
XP 12 /12S			□12		6							φ20	R	φ12
XP 16 /16S			□12		6							φ20	R	φ16
XP 20			□12		6							φ25	R	φ20
XP 26 / 26S			□16		5							φ25	R	φ26
STL38H			□16		5			□16				φ32	R	φ38

*□ : H x B dimensions are the same