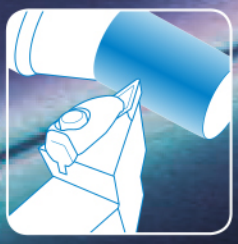
KORLOY Tools Selection Guide

Tools Selection Guide

vol. 02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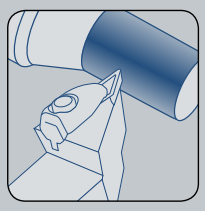
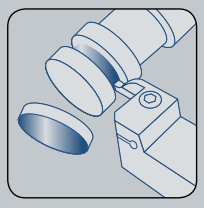
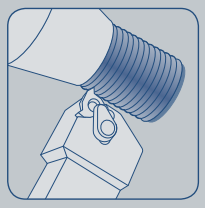


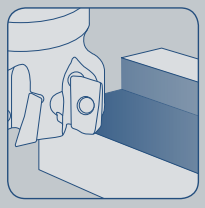
01 Turning



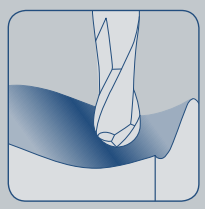
02 Grooving



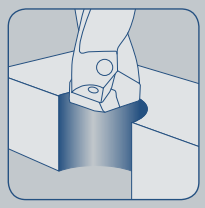
03 Threading



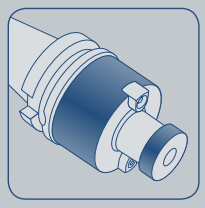
04 Milling



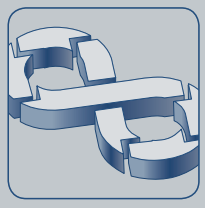
05 Endmill



06 Hole Making



07 Tooling systems



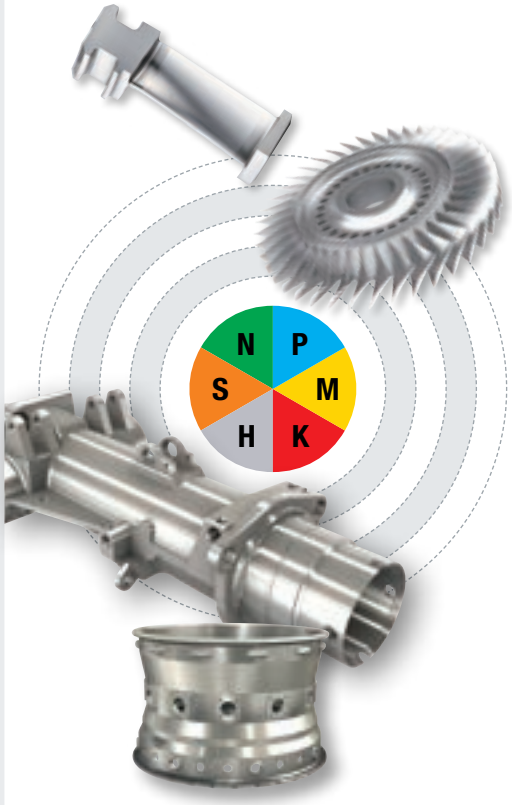
08 Smart Factory

☑ Pre-Checklist for tool selection

Machining operation analysis sequence

- To analyze machining operation, follow the steps mentioned above.
- From tool selection to troubleshooting, refer to the respective chapters for each tool category.
- For inspection criteria regarding workpieces and equipment, please refer to the detailed documentation on the following page.
- If you have any inquiries or questions, please contact the relevant sales office on the last page for a detailed explanation.

1) Workpieces



Workpiece materials

Section	Examples	
Production method	Castings	Selection of casting-specific material
	Forgings	Selection of high hardness grade
Chip shape	Sheared chip	Selection of productivity-enhancing tool (Maximum no. of tooth)
	Built-up chip	Selection of tool with maximum chip pocket capacity and surface treatment
Hardness	High hardness chip	Selection of High Grade + Rough C/B
	Low hardness chip	Selection of Low Grade + Rough C/B
Material	Steel	Selection of Medium C/B + steel specific grade
	STS, HRSA	Selection of Light C/B + hard-to-cut material specific grade

Workpiece shapes

Section	Examples	
Surface	Curved surface	Tools for profiling + Tool interference check
	Flat surface	Tools for facing + maximum machining dia. check
Hole	Shallow hole	Selection of tools with low overhang
	Deep hole	Selection of tools for deep hole cutting
Side wall	Thin side wall	Selection of tools with high fastening stability
	Normal side wall	Selection of general tools for shouldering
Slotting		Selection of tools suitable for slot shape and size

Workpiece tolerance

Section	Examples	
Dimensional accuracy	Roughing	Application of cost-effective tools + coating material
	Finishing	Consideration of applying precision-grade tools + non-coated materials
Surface finish		Consideration of applying wipers + non-coated materials

2) Equipment

Equipment

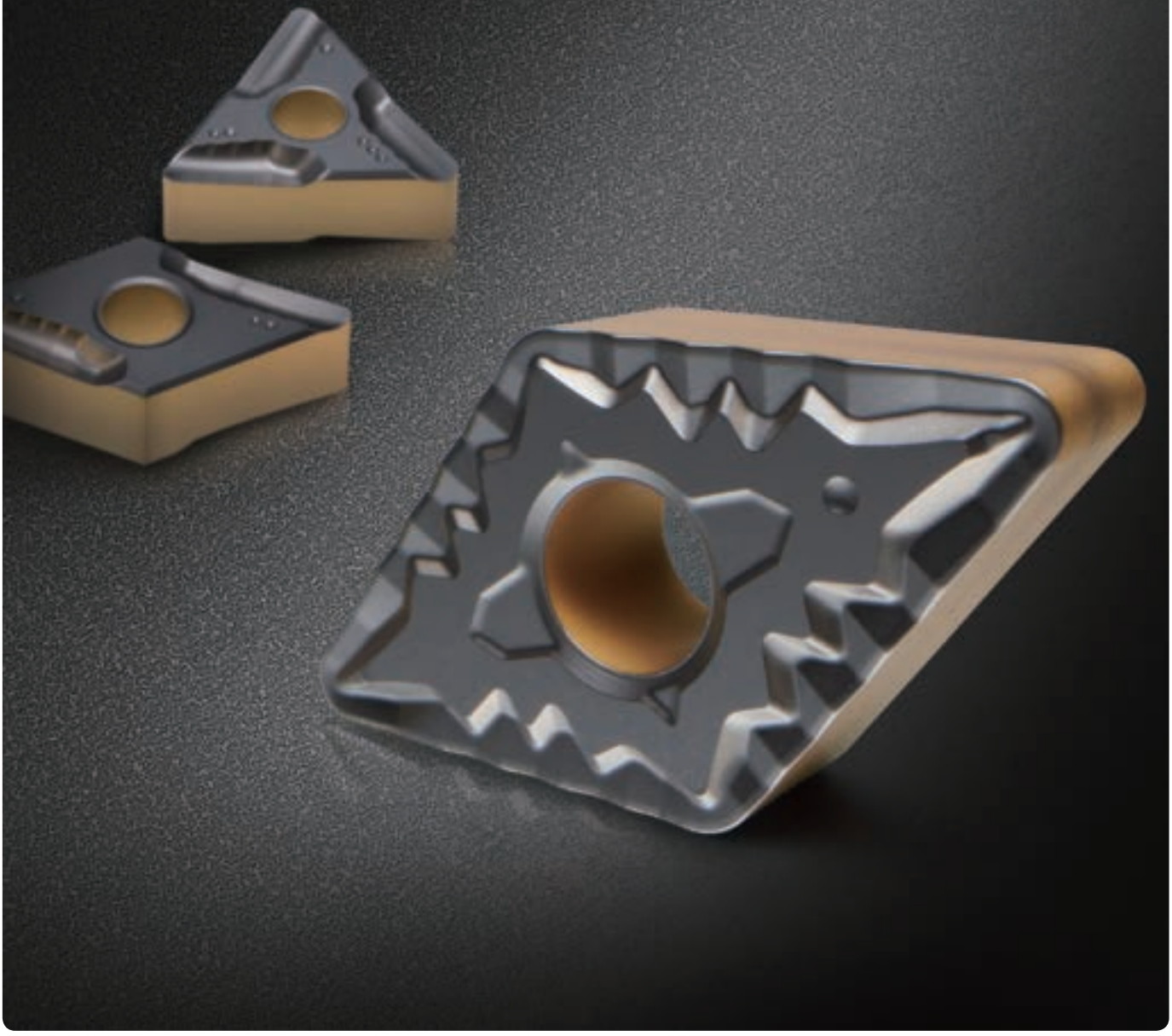
Section	Examples	
Equipment power	Low horsepower	Selection of low cutting resistant tools
	High horsepower	Selection of high-productivity tools
Equipment stability (Model year, condition)	Good	Reviewing custom tools
	Aged	ISO tool review
Number of axis	General facilities	ISO tool review
	Multiaxial equipment	Using tools with high fastening stability
Clamping workpiece	Wrong clamping	Reassessing equipment clamping status

Tooling System

Section	Examples	
Overhang	Short	Using general tools
	Long	Selection of low approach angle and Anti-vibration tools
Arbor size	Small (BT30)	Application of compact tools with fewer teeth
	Large (BT50)	Selection of high-productivity tools, application of multiple teeth
Run-out	Defect	Checking spindle condition and reviewing equipment overhaul

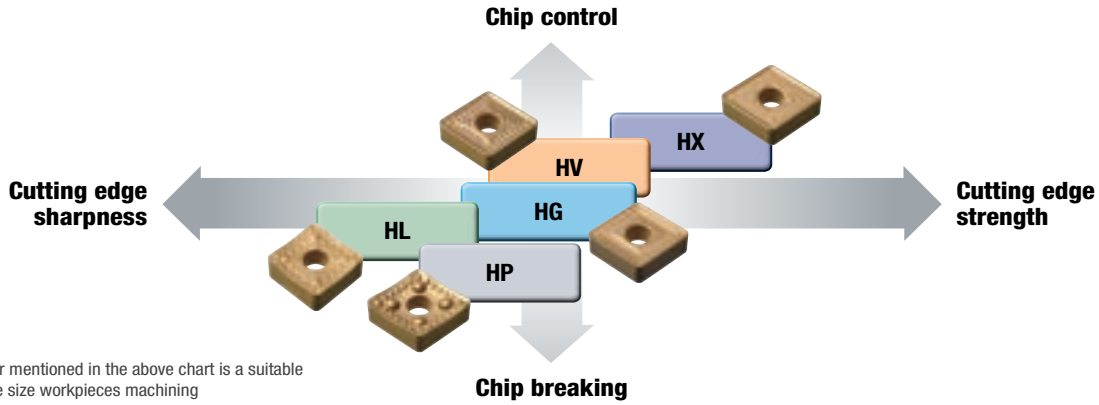
KORLOY Tools Selection Guide

Turning



01) Line-up

Heavy inserts (For large size workpieces in wind power, ships, railways, etc. industries)



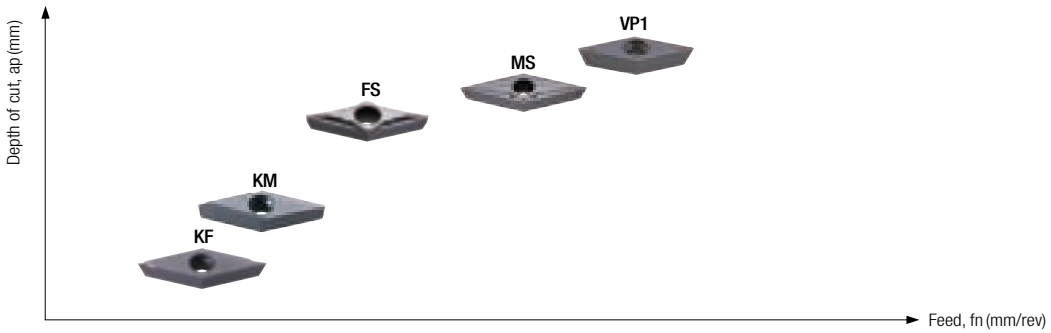
※ The chip breaker mentioned in the above chart is a suitable product for large size workpieces machining
※ Representative insert: CNMM250924

ISO insert (Automobiles, general machinery parts, etc.)

Workpiece	Single- sided insert (Positive)				Double- sided insert (Negative)			
	Finishing	Medium to finishing	Medium cutting	Roughing	Finishing	Medium to finishing	Medium cutting	Roughing
P Coating	FP	VL	MP	C25	VL	LP	MP	GR
P Cermet	FP	VL	MP	C25	VL	VB	VQ	GM
M	FP	VL	MP	C25	VP2	MP	MM	RM
K			MP	C25	MP	B25	MK	RK
S	LU	MU	MP		VP1	VP2	VP3	VP4
N	AK		AM	AR			HA	

※ The table represents chip breakers for different workpiece material types, and the selection of chip breakers based on chip control or toughness issues can be found in detail on the back page.
※ Representative insert: CNMG120408

Small precision machining inserts Auto Tools (Electronics, electricity, medical components, etc.)



※ The product line in the table consists of Auto Tools products for small precision component machining.
※ Representative insert : CCGT09T302.

Turning

Cermet | Coated Cermet | CVD | PVD | 1st Recommended

02) Grade selection guide

1-1 Steel Turning

Workpiece	ISO / vc (m/min)		Grade - Recommended cutting speed(m/min)							
			Wear resistance ← • → Toughness							
			P05	P15	P20	P25	P30	P35	P40	P45
P	400		NC3205 (230 ~480)							
	350			NC3215 (170 ~420)						
	300				NC5320 (150 ~370)					
	250					NC3225 (150 ~370)				
	200						NC3030 (110 ~260)	NC3235 (100 ~280)		
	150							PC5300 (100 ~250)		
	100								PC5400 (80 ~160)	
	Application		Chip breaker (Recommended cutting conditions)							
			Chip control ← • → Strength of cutting-edges							
	Negative	Roughing							HR (0.3 ~0.65)	GR (0.3 ~0.7)
		Medium cutting					VM (0.2 ~0.4)	MP (0.2 ~0.45)	HM (0.25 ~0.5)	
		Medium to finish cutting			VC (0.10 ~0.32)	LP (0.12 ~0.35)	CP (0.12 ~0.38)			
		Finishing	VL (0.05 ~0.25)	VB (0.06 ~0.28)	VF (0.07 ~0.3)					
		wiper						VW (0.15 ~0.50)	LW (0.25 ~0.70)	
	Positive	Roughing						C25 (0.10 ~0.30)		
		Medium cutting				HMP (0.07 ~0.23)	MP (0.08 ~0.25)			
		Finishing	FP (0.02 ~0.10)	VL (0.05 ~0.12)	VF (0.06 ~0.16)					

※ The recommended cutting speed mentioned above is based on SM45C carbon steel.

※ Recommended cutting conditions for different cutting materials and feed rates may be subject to change.

1-2 Steel Turning (Heavy)

* Inscribed circle, 19 or greater

Workpiece	ISO / vc (m/min)		Grade - Recommended cutting speed(m/min)					
			Wear resistance ← • → Toughness					
			P05	P15	P20	P25	P35	P40
P	130		NC3205 (115 ~150)					
	120			NC515H (110 ~135)				
	110				NC520H (100 ~125)			
	100					NC525H (90 ~115)		
	80						NC3235 (70 ~105)	
	40							NCM535 (60 ~95)
	Application		Chip breaker (Recommended cutting conditions)					
			Chip control ← • → Strength of cutting-edges					
	Negative	Roughing						HX (0.6 ~1.5)
		Medium cutting				HG (0.4 ~1.2)	HV (0.5 ~1.4)	
		Medium to finish cutting		HP (0.4 ~1.0)	HL (0.4 ~1.1)			
		Finishing	HD (0.35 ~0.8)					

Workpiece	Workpiece materials	ISO (DIN)	AISI	Cutting conditions (Adjusting cutting speeds for each cutting material based on the reference table by 100%.)		
				Cutting speed (m/min)	Feed	Depth of cut
Carbon steel	C=0.10~0.25%	(C22)	1020	105%	100% (Standard)	100% (Standard)
	C=0.25~0.55%	C45	1045	100% (Standard)		
	C=0.55~0.80%	C55	1055	90%		
Alloy steel	Unhardened	42CrMo4	4140(H)	86%	90%	
	Hardened	42CrMo4	4140(H)	78%		
	High Manganese (12~14% Mn)	22Mn6	1522	65%		

※ The first and second recommended classifications are divided into NC3200 grade for smaller than ISO19, and a separate heavy grade for ISO19 and above.

※ The first and second recommendations are connected via QR codes, providing detailed information on chip breaker lineups.

※ The lineup of recommended grades provides cutting speed information, while the chip breaker lineup provides recommended feed rates and entry conditions.

Cermet | Coated Cermet | CVD | PVD | 1st Recommended

02) Grade selection guide

1-3 Steel Turning (Cermet)

Workpiece	ISO / vc (m/min)		Grade - Recommended cutting speed(m/min)					
			Wear resistance ⟵ • ⟶ Toughness					
			P05	P10	P15	P20	P25	P30
P	350			CC1015 (250 ~450)				
	300				CN1500 (150 ~350)			
	250					CC1025 (150 ~320)		
	200						CN2500 (130 ~300)	
	Application		Chip breaker (Recommended cutting conditions)					
			Chip control ⟵ • ⟶ Strength of cutting-edges					
	Negative	Roughing						GM (0.3 ~0.65)
		Medium cutting			VQ (0.2 ~0.4)	VM (0.2 ~0.45)	HM (0.25 ~0.5)	
		Medium to finish cutting		VB (0.12 ~0.35)	CP (0.12 ~0.38)			
		Finishing	VL (0.05 ~0.25)	VG (0.06 ~0.28)				
	Positive	Roughing						C25 (0.10 ~0.30)
		Medium cutting				HMP (0.07 ~0.23)	MP (0.08 ~0.25)	
		Finishing	FP (0.02 ~0.10)	VL (0.05 ~0.12)	VF (0.06 ~0.16)			

※ The recommended cutting speed mentioned above is based on SM45C carbon steel.

※ Recommended cutting conditions for different cutting materials and feed rates may be subject to change.

Workpiece	Workpiece materials	ISO (DIN)	AISI	Cutting conditions (Adjusting cutting speeds for each cutting material based on the reference table by 100%.)		
				Cutting speed (m/min)	Feed	Depth of cut
Carbon steel	C=0.10~0.25%	(C22)	1020	105%	100% (Standard)	100% (Standard)
	C=0.25~0.55%	C45	1045	100% (Standard)		
	C=0.55~0.80%	C55	1055	90%		
Alloy steel	Unhardened	42CrMo4	4140(H)	86%	90%	
	Hardened	42CrMo4	4140(H)	78%		
Sintered ferrous alloy	Fe - Cu - C (C=0.2~1.0%)	SMF4030	-	70%	70%	

Cermet | Coated Cermet | CVD | PVD | 1st Recommended

02) Grade selection guide

2 Stainless steel Turning

Workpiece	ISO / vc (m/min)		Grade - Recommended cutting speed(m/min)							
			Wear resistance ← • → Toughness							
			M05	M10	M15	M20	M25	M30	M35	M40
M	250				NC9115 (220~260)					
	200		PC8105 (120~230)				NC9125 (190~230)		NC3235 (180~220)	
	150			PC8110 (110~210)		PC8115/ PC8120 (100~200)	PC5300 (80~190)		NC9135 (160~200)	
	125							PC9035 (70~160) PC9030 (80~180)		
	100								PC5400 (80~140)	
	Application		Chip breaker (Recommended cutting conditions)							
			Chip control ← • → Strength of cutting-edges							
	Negative	Roughing						GS (0.23~0.50)	RM (0.25~0.55)	
		Medium cutting			MP (0.2~0.45)	HS (0.2~0.47)	MM (0.2~0.50)			
		Finishing		VP2 (0.1~0.4)						
	Positive	Roughing						C25 (0.10~0.30)		
		Medium cutting			HMP (0.07~0.23)	MP (0.08~0.25)				
		Finishing	FP (0.02~0.10)	VL (0.05~0.12)						

3 Cast iron Turning

Workpiece	ISO / vc (m/min)		Grade - Recommended cutting speed(m/min)					
			Wear resistance ← • → Toughness					
			K05	K10	K15	K20	K25	K30
K	500		NC6310 (300~500)					
	400				NC6315 (200~400)			
	300					NC5320 (150~330)		
	200						NC5330 (110~270)	
	150				PC8110 (95~180)		PC5300 (75~140)	
	100							PC5400 (65~120)
	Application		Chip breaker (Recommended cutting conditions)					
			Chip control ← • → Strength of cutting-edges					
	Negative	Roughing				VR (0.25~0.65)	RK (0.25~0.7)	MA (0.3~0.7)
		Medium cutting		MK (0.2~0.5)	B25 (0.25~0.55)			
		Medium to finish cutting	MP (0.1~0.45)					
	Positive	Roughing				C25 (0.10~0.30)		
		Medium to finish cutting		MP (0.08~0.25)				

※ Recommended cutting speed avobe is for austenitic stainless steel STS304 cutting.

※ Recommended cutting conditions for different cutting materials and feed rates may be subject to change.

Workpiece	ISO (DIN)	AISI	Cutting conditions (Adjusting cutting speeds for each cutting material based on the reference table by 100%.)		
			Cutting speed (m/min)	Feed	Depth of cut
Austenitic	X5CrNi 18-9	304	100% (Standard)	100% (Standard)	100% (Standard)
	X5CrNiMo17-12-2	316	100%		
Ferritic, martensitic	-	-	110%	90%	
	X12Cr13	410	105%		
	X6Cr17	430	100%		
Precipitation series	X5CrNiCuNb 16-4	S17400	70%	80%	
Duplex	(X2CrNiMoN22-5-3)	S31803	45%	70%	

※ For large cutting materials (ø300 and above), CVD grades are recommended, while for small cutting materials (ø150 and below), PVD grades are recommended.

Workpiece	ISO (DIN)	AISI	Cutting conditions (Adjusting cutting speeds for each cutting material based on the reference table by 100%.)		
			Cutting speed (m/min)	Feed	Depth of cut
Gray cast iron	250	No35B	100% (Standard)	100% (Standard)	100% (Standard)
	350	No45b	95%		
Nodular SG iron	400-18	60-40-18	94%	90%	
	500-7	65-45-12	90%		
	600-3	80-55-06	85%		
	700-2	100-70-03	82%		

※ The recommended cutting speed mentioned above is based on GC250 gray cast iron.

※ Recommended cutting conditions for different cutting materials and feed rates may be subject to change.

Cemented carbide | Diamond coating | Cermet | Coated Cermet | CVD | PVD | DLC coating | 1st Recommended

02) Grade selection guide

4 Heat resisting alloy Turning

Workpiece	ISO / vc (m/min)	Application		Grade - Recommended cutting speed(m/min)						
				Wear resistance ⟵ ● ⟶ Toughness						
				S05	S10	S15	S20	S25	S30	S35
S	80			PC8105 (40~70)						
	70				PC8110 (35~65)					
	60									
	50					PC8115 (30~60)	PC8120 (30~60)	PC5300 (20~60)		
	40					NC9125 (20~60)		PC9035 (30~50)	NC9135 (20~60)	
	30								PC5400 (20~50)	
		Application		Chip breaker (Recommended cutting conditions)						
				Chip control ⟵ ● ⟶ Strength of cutting-edges						
		Negative	Roughing					VP4 (0.15~0.45)		
			Medium cutting				VP3 (0.12~0.42)			
			Medium to finish cutting			VP2 (0.1~0.4)				
			Finishing		VP1 (0.07~0.2)					
		Positive	Medium cutting				MU (0.07~0.23)	MP (0.08~0.25)		
			Medium to finish cutting	LU (0.03~0.08)	VP1 (0.04~0.10)	VL (0.05~0.12)				

5 Aluminium Turning

Workpiece	ISO / vc (m/min)	Application		Grade - Recommended cutting speed(m/min)				
				Wear resistance ⟵ ● ⟶ Toughness				
				N05	N10	N15	N20	N25
N	1200			ND3000/ ND2100 (160~1200)				
	800				PD1005 (160~800)			
	600					PD1010 (160~450)		
	300						H01 (160~300)	
	200							H05 (60~220)
		Application		Chip breaker (Recommended cutting conditions)				
				Chip control ⟵ ● ⟶ Strength of cutting-edges				
		Negative	Medium cutting			HA (0.1~0.5)		
		Positive	Roughing			AR (0.05~0.5)		
			Medium cutting		AM (0.04~0.45)			
			Finishing	AK (0.03~0.4)				

Workpiece	ISO (DIN)	AISI	Cutting conditions (Adjusting cutting speeds for each cutting material based on the reference table by 100%.)		
			Cutting speed (m/min)	Feed	Depth of cut
Ti alloy	Ti-6Al-4V	Ti-6Al-4V	110%	110%	100% (Standard)
Ni series	Inconel625	Inconel625	100% (Standard)	100% (Standard)	
	Inconel718	Inconel718			
Co series	Stellite	Stellite	85%	90%	
Fe series	-	Inconel909			

※ The recommended cutting speed mentioned above is based on Inconel 718, a nickel-based alloy.

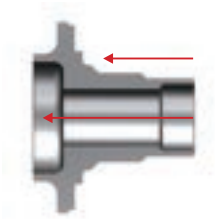
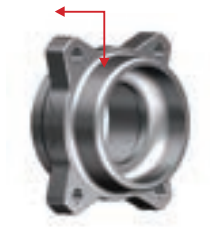
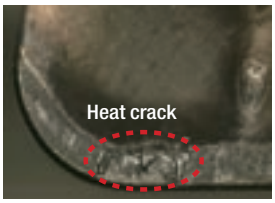
※ Recommended cutting conditions for different cutting materials and feed rates may be subject to change.

Workpiece	ISO (DIN)	AISI	Cutting conditions (Adjusting cutting speeds for each cutting material based on the reference table by 100%.)		
			Cutting speed (m/min)	Feed	Depth of cut
Graphite	Graphite	-	110%	100% (Standard)	100% (Standard)
Al alloy	G9GK0-ALi7Mg GD-AlSi10Mg GD-AlSi9Cu3	-	100% (Standard)	90%	
Composite materials	CFRP	-	90%		

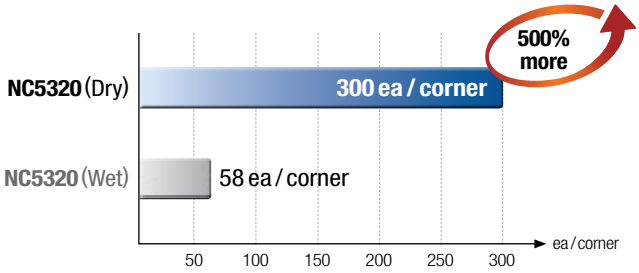
※ The recommended cutting speed mentioned above is based on A6061S Al forged alloy.

※ Recommended cutting conditions for different cutting materials and feed rates may be subject to change.

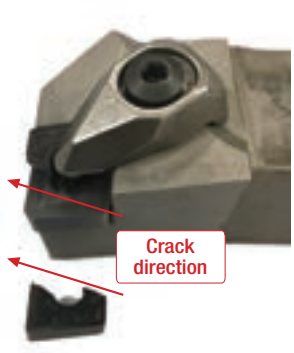
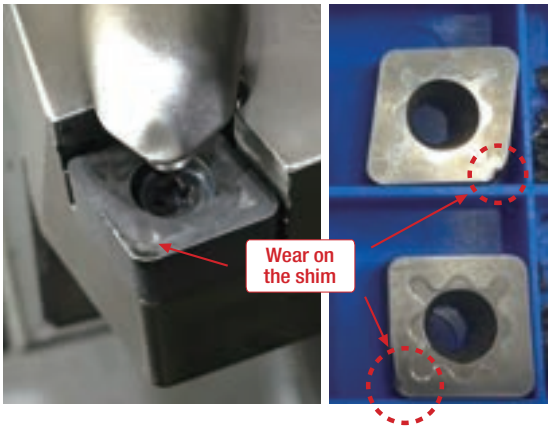
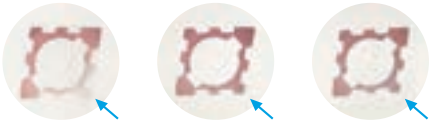
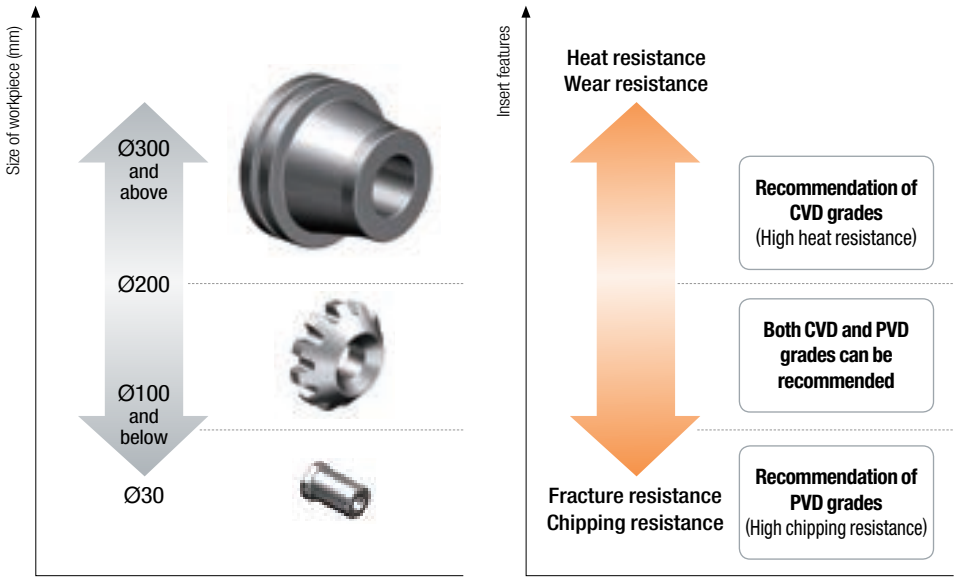
03) Useful cutting tip

Section	Contents
Hub Continuous cutting/ interrupted cutting 1st recommendation : NC5320 INFO	 Internal/ External cutting, etc. (Continuous cutting) : NC3215  External fins (Low interrupted cutting) : NC5320  (Heavy interrupted cutting) : NC3225 Wear resistance 1st recommendation Toughness
Difference in tool life based on the presence or absence of cutting fluid Recommendation for dry machining at high cutting speeds	 Interrupted and wet cutting Rapid heating and rapid cooling cycles on cutting tools  Excessive wear by heat impact  

Workpiece use	Hub bearing
Workpiece	S55CR
Cutting conditions	vc (m/min) = 250~270 fn (mm/rev) = 0.2~0.35 ap (mm) = 1



03) Useful cutting tip

Section	Contents
Insert fracture/ defect issues during heavy interrupted machining Holder shim replacement	**1) Sudden insert fracture**  **2) Cause of fracture** (excessive wear on shim)  **3) Analysis of fracture causes** (clamping force) **Contact area comparison between worn shim and normal shim** **Worn shim - Unstable clamping**  - Not able to clamp 100% - Occurrence of unstable fastening **Normal shim - Stable clamping**  - Ensuring contact area and improving fastening stability after shim replacement - More than 95% fully secure fastening state
In stainless steel cutting, the application areas of CVD and PVD coatings For large workpieces (Ø300 and above) : CVD coating is preferred. For small workpieces (Ø100 and below) : PVD coating is preferred.	

03) Useful cutting tips - **Cermet**

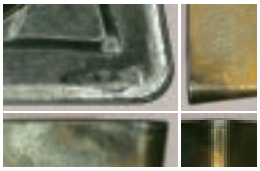
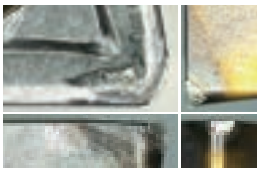
Section	Contents
Automotive and machinery components (carbon steel and alloy steel - continuous machining of external and internal diameter) 1st recommendation For continuous cutting : CC1015 1st recommendation For interrupted cutting : CN2500	 External diameter (Continuous cutting) : **CC1015**  External diameter (Continuous cutting) : **CC1500** Slotting / External diameter (Interrupted cutting) : **CC1025 / CN2500** Wear resistance → 1st recommendation → Toughness
Automotive components (sintered alloy-interrupted cutting) 1st recommendation : CC1015 CN1500 2nd recommendation : CC1025 CN2500	 Slotting / External diameter (Continuous cutting) : **CC1015 / CN1500** Slotting / External diameter (Interrupted cutting) : **CC1025 / CN2500** 1st recommendation → Toughness

Section	TPMT110304	SCMT09T308	SNMG120408	VNMG160408
Cutting speed vc (m/min)	250	200	100 ~ 150	150 ~ 180
RPM n (rpm)	1,650 ~ 2,500	1,650 ~ 2,500	1,650 ~ 2,500	1,650 ~ 2,500
Feed fn (mm/rev)	0.08 ~ 0.12	0.08 ~ 0.12	0.2 ~ 0.25	0.12 ~ 0.3
Depth of cut ap (mm)	0.2	0.4	0.5 ~ 2.0	0.2 ~ 0.4
Diameter and length of workpiece	Smaller than 100mm	Smaller than 100mm	Smaller than 100mm	Smaller than 100mm
Coolant	Wet	Wet	Wet	Wet

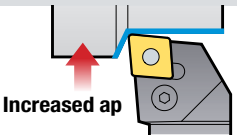
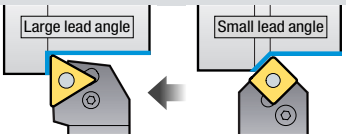
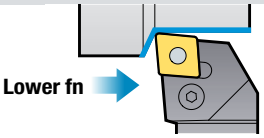
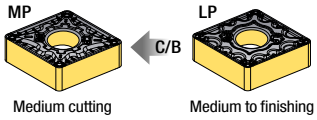
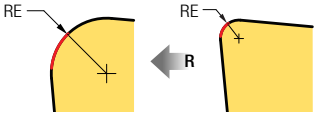
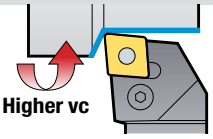
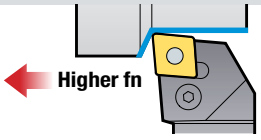
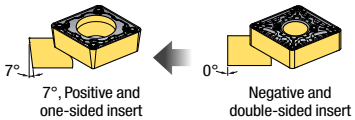
- Representative inserts used in sintered alloy components
  - TPMT110304-MP - SCMT09T308-HMP - TCMT110204-B25
  - SNMG120408-VQ - VNMG160408-VF - VBMT160404-MP
- To minimize the variation in tool life when machining sintered alloy components, the primary recommendation is to use medium-rough to medium chip breakers.

03) Useful cutting tips - **Heavy cutting**

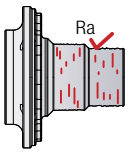
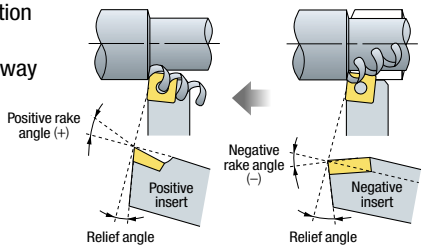
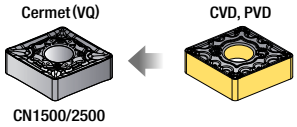
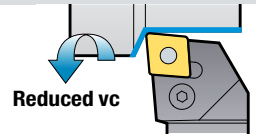
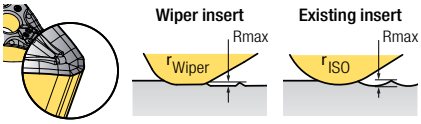
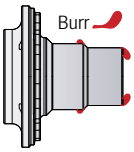
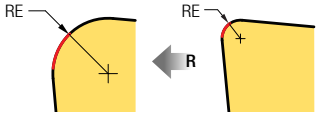
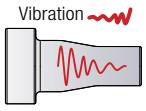
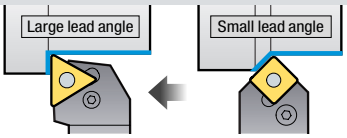
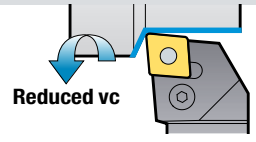
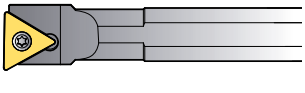
Section	Contents
1st recommended chip breaker for heavy cutting 1st recommended chip breaker for vertical machining : **HV** 1st recommended chip breaker for horizontal machining : **HG** INFO	**1) In vertical cutting of a flange**  Slotting / external diameter cutting (vertical direction of holders) : 1st recommended **HV** **2) In horizontal cutting of a shaft**  External diameter cutting (horizontal direction of holders) : 1st recommended **HG** **[Chip breaker features]** Rigidity of cutting edge Wear resistance
Cases of insert damage caused by screw issues and solutions Recommended to use genuine screws and holders	• Checking the screw head protrusion → Suspecting the insert attachment condition → Verifying the screw size   Damaged holder  Genuine screw  Fracture or counterfeit screw

Section	Contents	
Undamaged holder + genuine screw	 Stable clamping	 Normal wear
Damaged holder + counterfeit screw	 Wear phenomenon (vibrations)	 Abnormal wear/ fracture

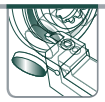
04) Troubles in cutting and solutions

Troubles	Factors	Solutions
Chip jamming The phenomenon where chips do not break so the long chip is tangled around the tools or a workpiece 	→ Selection of a wrong chip breaker for the application area	→ Selection of an appropriate chip breaker that matches the cutting conditions Refer to the tool selection guide p. 7
	→ Too low feed	→ Increased feed 
	→ Low depth of cut	→ Increased depth of cut 
	→ Too large nose radius	→ Select smaller nose radius 
	→ Improper lead angle	→ Select a holder with large lead angle or shape 
Excessive chip fragmentation The excessive formation of very short chips due to high cutting forces, leading to shortened tool life and tool damage 	→ Too high feed	→ Decreased feed 
		→ Select a chip breaker designed for higher feed 
	→ Too small nose radius	→ Select larger nose radius 
Built-up-edge/ welding The simultaneous occurrence of burrs and chipping, causing accumulated burrs to detach along with the insert material, resulting in damage 	→ Low speed	→ Optimize the cutting speed 
	→ Low feed	→ Optimize the feed 
	→ Negative insert shape	→ Select a positive shape 

04) Troubles in cutting and solutions

Troubles	Factors	Solutions
Surface roughness defect Rough surface finish and fail to meet the tolerance requirements 	→ Leaving marks on the surface as chips break towards the workpiece	→ Choose a chip evacuation configuration that discharges chips far away 
	→ Rough surface due to notch wear	→ Select a cermet grade 
		→ Reduce cutting speed 
	→ High feed and too small cutting radius	→ Select a wiper insert or larger nose radius → Lower feed 
Burr formation The formation of burrs at the end of cutting when the cutting edge deviates from the workpiece 	→ Dull cutting edge	→ Use a sharp insert 
	→ Notch wear on the part of depth of cut	→ Select larger nose radius 
Vibration Tool scratched the workpiece due to chattering 	→ Improper lead angle	→ Use larger lead angle 
	→ Too large nose radius	→ Select smaller nose radius 
	→ Excessive front wear of the cutting edge	→ Reduce cutting speed or select a better wear resistance grade 
	→ Vibration caused by excessive overhang during steel boring bar usage	→ Using carbide boring bar which has better rigidity than steel boring bar and minimizes vibration during deep machining 

Grooving



01) Line-up

Tool-specific cutting width, depth of cut, and recommended machining forms

★ 1st recommended ☆ 2nd recommended

Tools	No. of corners	Width of cutting edge (CW, mm) 2 4 6 8 / Max. Depth of cut (CDX, mm) 5 10 20 60	Recommended cutting conditions													Promotional materials Link
			For external machining						For external machining					Face grooving		
			Grooving	Parting	Turning	Copying	Reliefing	Threading	Grooving	Turning	Copying	Reliefing	Threading	Grooving	Turning	
Saw Man-X 	1	2.0 – 8.0 60.0	☆	★												INFO
			• Tool for external diameter cutting, deep hole cutting • For high speed and high feed													
Saw Man 	1	1.6 – 9.0 60.0	☆	★												-
			• Tool for external diameter cutting, deep hole cutting													
Fine Tools 	1	0.75 – 4.02 4.6							★	☆	☆		☆			-
			• Precision tool for internal diameter cutting													
MSB 	1, 2	1.0 – 3.0 3.5							★	☆	☆		☆	☆		INFO
			• Precision tool for less than Ø10 internal diameter cutting													
KGT 	1, 2	1.5 – 8.0 36	★	☆	★	★	☆		★	★	★	☆		★	☆	INFO
			• Multi-functional tool capable of various operations such as external diameter, inner diameter, cross-section, and more													
MGT 	1, 2	1.5 – 8.0 37	★	☆	★	★	☆		★	★	★	☆		★	☆	INFO
			• Multi-functional tool capable of various operations such as external diameter, inner diameter, cross-section, and more													
K-Notch 	2	0.79 – 6.35 6.35	★	☆	☆	☆			★	☆	☆					INFO
			• Precision cutting tool for external diameter and internal diameter													
Auto Tools (Blade) 	2	1.0 – 4.0 8.0	★	☆	☆			☆								INFO
			• Tool for external diameter machining on automatic lathes. • Small-sized parting off operations with a diameter of Ø16 or less													
Auto Tools (Multi utility) 	2	0.5 – 2.5 8.3	★	☆	☆			☆								INFO
			• Tool for external diameter machining on automatic lathes • Capable to apply various inserts for multiple purposes onto a single holder													
TB 	3	0.5 – 4.5 6.5	★	☆	☆	☆										INFO
			• Cutting tool for external diameter • Pipe parting off													
Hexa Blade 	6	1.78 – 4.0 5.0	★	☆	☆											INFO
			• Tool for external diameter machining • Economical 6-corner groove machining													

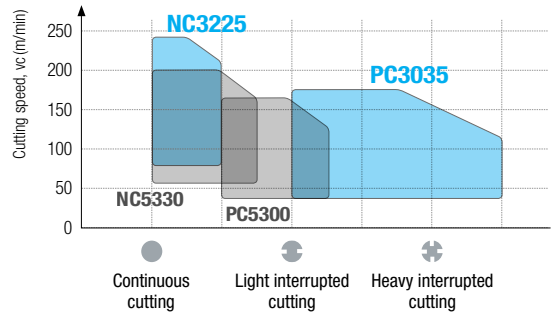
02) Grade selection guide

Features

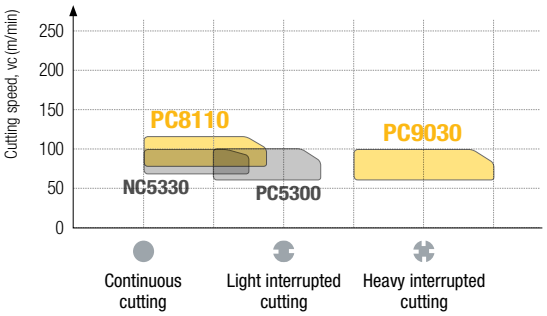
Grade		Recommended workpiece	ISO Grade (Wear resistance ● Toughness) 5 10 15 20 25 30 35 40 45	Features
CVD	NC3225	P	P20~25	• Steel, mild steel general prupose grade
	NC5330	P	P30~35	• Universal grade • Stable in high speed machining
		M	M25~35	
		K	K15~25	
		S	S15~25	
	NC6315	K	K10~20	• Gray cast iron general purpose machining
PVD	PC3035	P	P30~40	• Exclusive for steel grooving and parting
	PC5300	P	P30~40	• Universal grade • Good wear resistance and interrupted cutting
		M	M20~30	
		K	K20~25	
		S	S15~25	
	PC8110	M	M10~20	• Machining heat resistant alloy and stainless steel at high speed
		S	S5~15	
	PC9030	M	M25~35	• Medium to roughing for Stainless steel
Carbide	H01	N	N10~20	• Non-ferrous metal

Application range

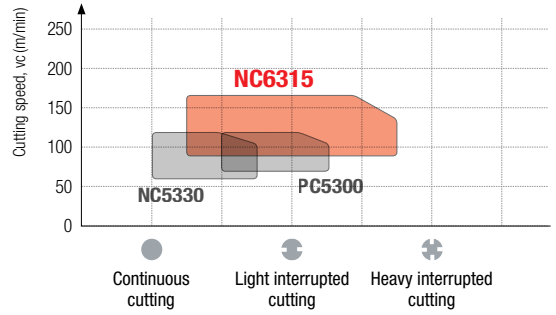
P Steel



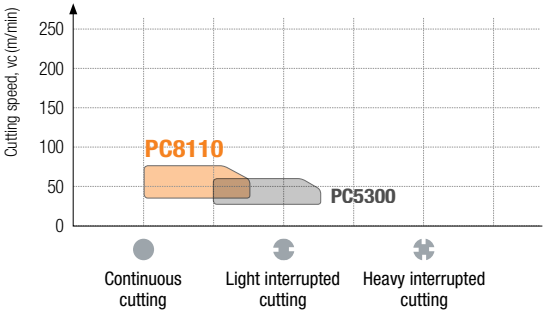
M Stainless steel



K Cast iron

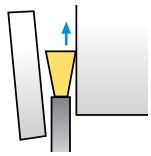
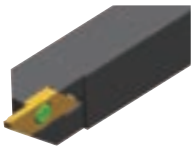


S HRSA



03) Tool selection guide

External diameter parting off

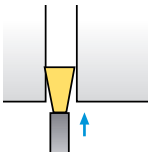
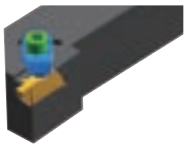
Usage	Recommended tools for external diameter parting off			
	General external diameter parting off	Shallow external diameter parting off	Deep external diameter parting off	Pipe external diameter parting off
	**Saw Man-X** 	**Auto Tools** (Blade) 	**Saw Man-X** 	**Saw Man-X** 

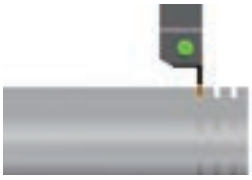
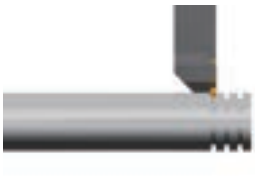
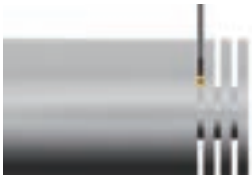
Machining type	Type	P	M	K	S	N
General external diameter parting off (CUTDIA Ø70 and below) 	Main	**Saw Man-X**  KSP-N PC5300	**Saw Man-X**  KSP-S PC5300	**Saw Man-X**  KSP-N PC5300	**Saw Man-X**  KSP-S PC8110	**Saw Man**  SP A30
	Sub	**KGT**  KGMN-T PC5300	**KGT**  KGMN-TL PC5300	**KGT**  KGMN-T PC5300	**KGT**  KGMN-TL UPC810	**KGT**  KGGN-A H01
Shallow external diameter parting off (CUTDIA Ø16 and below) 	Main	**Auto Tools** (Blade)  SBCR PC5300	**Auto Tools** (Blade)  SBCR PC5300	**Auto Tools** (Blade)  SBCR PC5300	**Auto Tools** (Blade)  SBCR PC8110	**Auto Tools** (Blade)  SBCR PC8110
	Sub	**Triangle Blade**  TB-M PC5300	**Auto Tools** (Multi)  SCR PC9030	**Triangle Blade**  TB-M PC5300	**Auto Tools** (Multi)  SCR PC9030	
Deep external diameter parting off (CUTDIA Ø70 over Ø120 and below) 	Main	**Saw Man-X**  KSP-N PC5300	**Saw Man-X**  KSP-S PC5300	**Saw Man-X**  KSP-N PC5300	**Saw Man-X**  KSP-S PC8110	**Saw Man**  SP A30
	Sub	**Saw Man**  SP PC5300	**Saw Man**  SP PC9030	**Saw Man**  SP PC5300	**Saw Man**  SP PC8110	
Pipe external diameter parting off (CUTDIA Ø120 and below) 	Main	**Saw Man-X**  KSP-N PC5300	**Saw Man-X**  KSP-S PC5300	**Saw Man-X**  KSP-N PC5300	**Saw Man-X** KSP-S PC8110	**Saw Man** SP A30
	Sub	**KGT** KGMN-T PC5300	**KGT** KGMN-TL PC5300	**KGT** KGMN-R PC5300	**KGT** KGMN-TL UPC810	**KGT** KGGN-A H01

*CUTDIA : Workpiece parting diameter maximum

03) Tool selection guide

External diameter Grooving

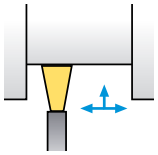
Usage	Recommended tools for external diameter grooving			
	General external diameter grooving	Shallow external diameter grooving	Deep external diameter grooving	Precision external diameter grooving
	**KGT** 	**Hexa Blade** 	**Saw Man-X** 	**K-Notch** 

Machining type	Type	P	M	K	S	N
General external diameter grooving (CDX 36 mm and below) 	Main	**KGT**  KGMN-T PC5300	**KGT**  KGMN-TL PC5300	**KGT**  KGMN-R PC5300	**KGT**  KGMN-TL UPC810	**KGT**  KGGN-A H01
	Sub	**KGT**  KGMN-R PC5300	**KGT**  KGMN-T PC5300	**KGT**  KGMN-T PC5300	**KGT**  KGMN-T UPC810	**MGT**  MGGN-A H01
Shallow external diameter grooving (CDX 5 mm and below) 	Main	**Hexa Blade**  HB-M PC5300	**Triangle Blade**  TB-M PC5300	**Hexa Blade**  HB-M PC5300	**Auto Tools** (Blade)  SBGR PC8110	
	Sub	**Triangle Blade**  TB-M PC5300	**Auto Tools** (Blade)  SBGR PC8110	**Triangle Blade**  TB-M PC5300		
Deep external diameter grooving (CDX 36 mm over) 	Main	**Saw Man-X**  KSP-N PC5300	**Saw Man-X**  KSP-S PC5300	**Saw Man-X**  KSP-N PC5300	**Saw Man-X**  KSP-S PC8110	**Saw Man**  SP A30
	Sub	**Saw Man**  SP PC5300	**Saw Man**  SP PC9030	**Saw Man**  SP PC5300	**Saw Man**  SP PC8110	
Precision external diameter grooving (CWTOL: ±0.025, Using clamp, CDX 6.5 mm and below) 	Main	**K-Notch**  KNG PC5300	**K-Notch**  KNGP PC5300	**K-Notch**  KNG PC5300	**K-Notch**  KNGP PC8110	**K-Notch**  KNGP PC8110
	Sub	**TB** TB-M PC5300	**TB** TB-M PC5300	**TB** TB-M PC5300	**Blade** SBGR PC8110	

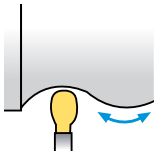
*CWTOL : Cutting width tolerance

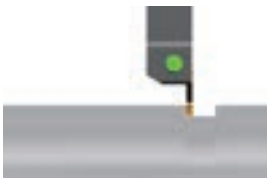
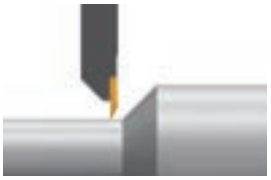
03) Tool selection guide

External diameter Turning

Usage	Recommended tool for external turning	
	General external diameter machining	Back turning
	**KGT** 	**Auto Tools** (Blade) 

External copying, Relief

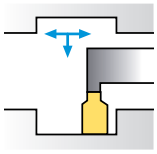
Usage	Recommended tool for external copying and relief cutting	
	General external diameter machining	General external diameter relief
	**KGT** 	**KGT** 

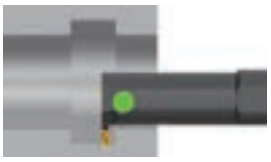
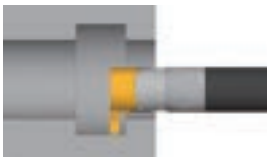
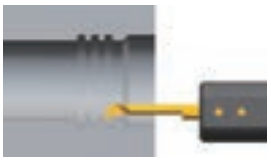
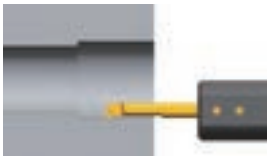
Machining type	Type	P	M	K	S	N
General external diameter machining 	Main	**KGT**  KGMN-T PC5300	**KGT**  KGMN-TL PC5300	**KGT**  KGMN-T PC5300	**KGT**  KGMN-TL UPC810	**KGT**  KGGN-A H01
	Sub	**Hexa Blade**  HB-M PC5300	**Triangle Blade**  TB-M PC5300	**Hexa Blade**  HB-M PC5300	**K-Notch**  KNG PC8110	**MGT**  MGGN-A H01
Back turning 	Main	**Auto Tools** (Blade)  SBBR PC5300	**Auto Tools** (Blade)  SBBR PC5300	**Auto Tools** (Blade)  SBBR PC5300	**Auto Tools** (Blade)  SBBR PC8110	
	Sub		**Auto Tools** (Multi)  SBR PC9030		**Auto Tools** (Multi)  SBR PC9030	

Machining type	Type	P	M	K	S	N
General external diameter machining 	Main	**KGT**  KRMN-C PC5300	**KGT**  KRGN-CM PC5300	**KGT**  KRMN-C PC5300	**KGT**  KRGN-CM UPC810	**KGT**  KRGN-A H01
	Sub	**MGT**  MRMN-M PC5300	**KGT**  KRMN-C PC5300	**MGT**  MRMN-M PC5300	**KGT**  KRMN-C PC5300	**MGT**  MRGN-A H01
General external diameter relief (CDX 3.3 and below) 	Main	**KGT**  KRMN-C PC5300	**KGT**  KRGN-CM PC5300	**KGT**  KRMN-C PC5300	**KGT**  KRGN-CM UPC810	**KGT** KRGN-A H01
	Sub	**MGT** MRMN-M PC5300	**KGT** KRMN-C PC5300	**MGT** MRMN-M PC5300	**KGT** KRMN-C PC5300	**MGT** MRGN-A H01

03) Tool selection guide

Internal grooving and Turning

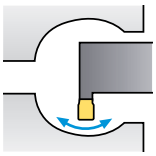
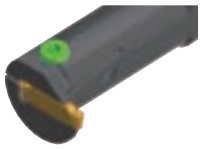
Usage	Recommended tools for internal grooving and turning			
	General internal grooving, turning	Small internal grooving, turning	Micro internal grooving	Micro internal turning
	**KGT** 	**Fine Tools** 	**MSB** 	**MSB** 

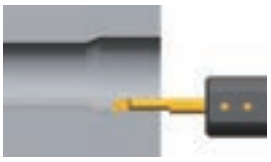
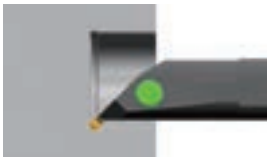
Machining type	Type	P	M	K	S	N
General internal grooving, turning (Dmin Ø20) 	Main	**KGT**  KGMI-T PC5300	**KGT**  KGMI-T PC5300	**KGT**  KGMI-T PC5300		
	Sub	**KGT**  KGMN-T PC5300	**KGT**  KGMN-T PC5300	**KGT**  KGMN-T PC5300		
Small internal grooving, turning (Dmin Ø8, Ø11, Ø14, Ø16) 	Main	**Fine Tools**  NFTG PC5300	**Fine Tools**  NFTG PC5300	**Fine Tools**  NFTG PC5300		
Micro internal grooving (Dmin Ø3.2, Ø4.2, Ø6.2, Ø8.2, Ø10.2) 	Main	**MSB**  MGR PC30M	**MSB**  MGR PC30M	**MSB**  MGR PC30M		
Micro internal turning (Dmin Ø3.2~10.2) 	Main	**MSB**  MBR PC30M	**MSB**  MBR PC30M	**MSB**  MBR PC30M		

*Dmin : Minimum bore diameter

03) Tool selection guide

Internal copying, Relief

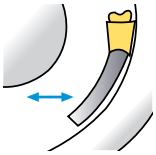
Usage	Recommended tools for internal grooving and turning			
	General internal copying	Small internal copying	Micro internal copying	General internal relief
	**KGT** 	**Fine Tools** 	**MSB** 	**KGT** 

Machining type	Type	P	M	K	S	N
General internal copying (Dmin Ø20) 	Main	**KGT**  KRMN-C PC5300	**KGT**  KRGN-CM PC5300	**KGT**  KRMN-C PC5300	**KGT**  KRGN-CM UPC810	**KGT**  KRGN-A H01
	Sub	**MGT**  MRMN-M PC5300	**MGT**  MRMN-M PC5300	**MGT**  MRMN-M PC5300	**MGT**  MRMN-M PC8110	**MGT**  MRGN-A H01
Small internal copying (Dmin Ø8, Ø11, Ø14, Ø16) 	Main	**Fine Tools**  NFTF PC5300	**Fine Tools**  NFTF PC5300	**Fine Tools**  NFTF PC5300		
Micro internal copying (Dmin Ø4.2, Ø6.2) 	Main	**MSB**  MBCR PC30M	**MSB**  MBCR PC30M	**MSB**  MBCR PC30M		
General internal relief (Dmin Ø35) 	Main	**KGT**  KRMN-C PC5300	**KGT**  KRGN-CM PC5300	**KGT**  KRMN-C PC5300	**KGT**  KRGN-CM UPC810	**KGT**  KRGN-A H01

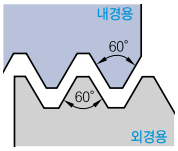
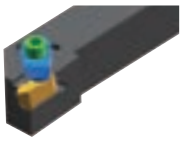
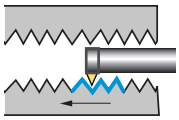
*Dmin : Minimum bore diameter

03) Tool selection guide

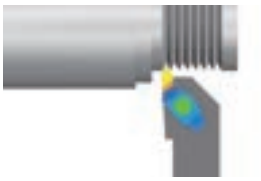
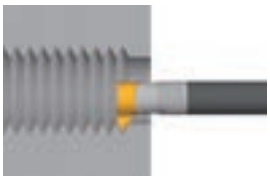
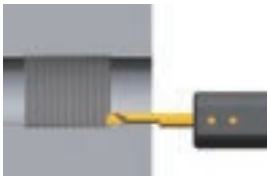
Face grooving, Turning

Usage	Recommended tool for face grooving and turning
	General face grooving, turning
	KGT 

Thread

Usage	Recommended tool for external treading	Usage	Recommended tool for internal treading
	General external tread		General internal tread
	K-Notch 		Fine Tools 

Machining type	Type	P	M	K	S	N
General face grooving, turning 	Main	MGT  FMM PC5300	MGT  FMM PC5300	MGT  FMM PC5300	MGT  FMM PC8110	KGT  KGGN-A H01
	Sub	KGT  KGMN-T PC5300	KGT  KGMN-T PC5300	KGT  KGMN-T PC5300	KGT  KGMN-T UPC810	MGT  MGGN-A H01

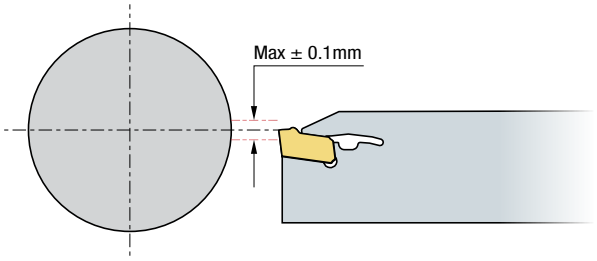
Machining type	Type	P	M	K	S	N
General external tread 	Main	K-Notch  KNT PC5300	K-Notch  KNT PC5300	K-Notch  KNT PC5300	K-Notch  KNT PC8110	
	Sub	Auto Tools (Blade)  SBTR PC5300	Auto Tools (Multi)  STR PC9030	Auto Tools (Blade)  SBTR PC5300	Auto Tools (Multi)  STR PC9030	
General internal tread (Dmin Ø8, Ø11, Ø14, Ø16) 	Main	Fine Tools  NFTT PC5300	Fine Tools  NFTT PC5300	Fine Tools  NFTT PC5300		
Micro internal tread (Dmin Ø3.3, Ø4.3, Ø6.2) 	Main	MSB  MTR PC30M	MSB  MTR PC30M	MSB  MTR PC30M		

*Dmin : Minimum bore diameter

04) Useful cutting tip

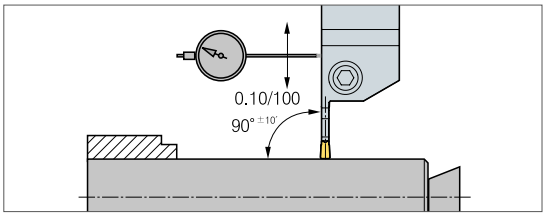
Insert cutting edge height setting

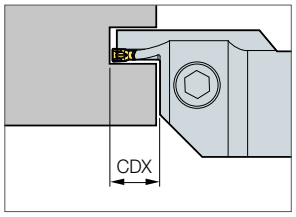
- The insert cutting edge height needs to be set within ±0.1mm from the workpiece center.
- It is recommended to machine as close as possible to the chuck in order to reduce vibration

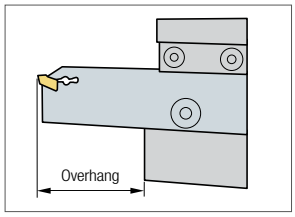


Holder setting method

- To minimize and suppress vibration, the position of the insert's cutting edge should be accurately installed to be parallel or perpendicular to the machining axis.
- The shortest CDX holder should be selected based on the machining depth of the workpiece material being machined.
- Overhang should be set as short as possible for optimal usage.

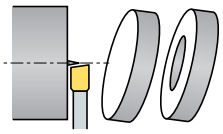




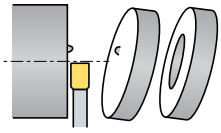


Recommended lead angles for different workpiece types' parting off

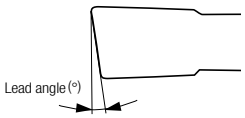
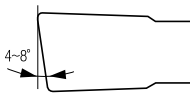
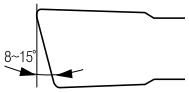
- It is possible to minimize chip (PIP) and burr formation by choosing a proper lead angled insert.
- If there is minimal chip and burr formation, it is recommended to use inserts without a positive lead angle.



Hand-type insert



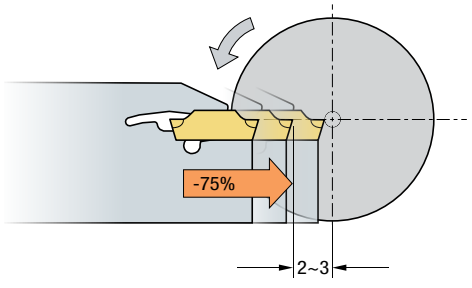
Insert without hand

Applicable workpieces per insert's lead angle	Lead angle 0° (N-type)	Lead angle 4°~ 8°	Lead angle 8°~ 15°
			
• 4° - Hollow (pipe) • 6° - Pipe and solid bar • 8° - Solid bar • 15° - Solid bar with small diameter	• For parting off solid bar shaped workpiece • Center stub can be occurred after parting off • Preventing deflection of the parting off direction during machining • Optimized for deep cutting depth machining	• For parting off solid bar shaped workpiece, reducing center stub • For machining applications with hollow bar inserts to minimize burr formation	• For parting off hollow bars with thin cross-sectional thickness • For parting off small diameter workpieces and minimizing burr and center stub

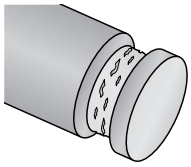
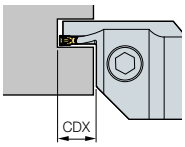
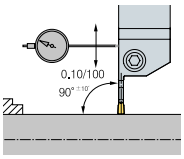
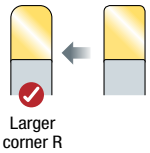
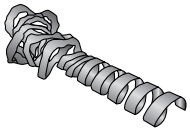
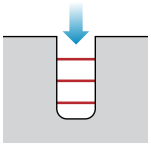
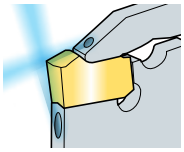
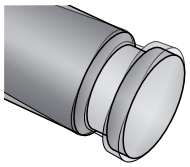
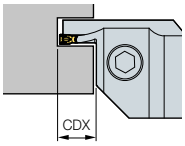
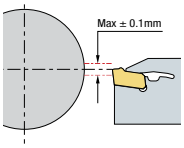
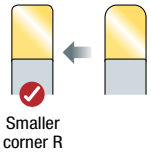
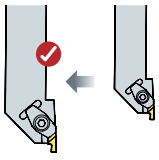
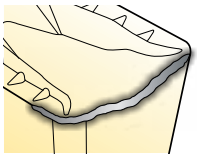
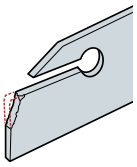
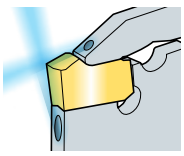
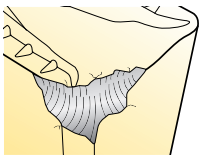
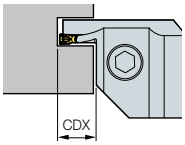
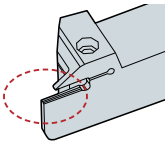
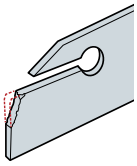
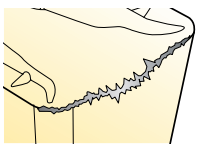
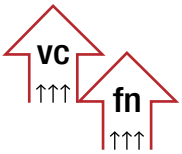
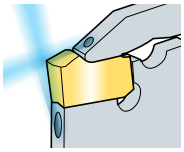
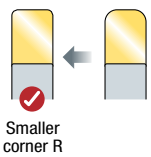
※ Applicable inserts : MGMR/L-□□-Lead angle-PS/PT, KGMR/L-□□-Lead angle-LP/RP

Reducing feed before parting off the center of workpiece

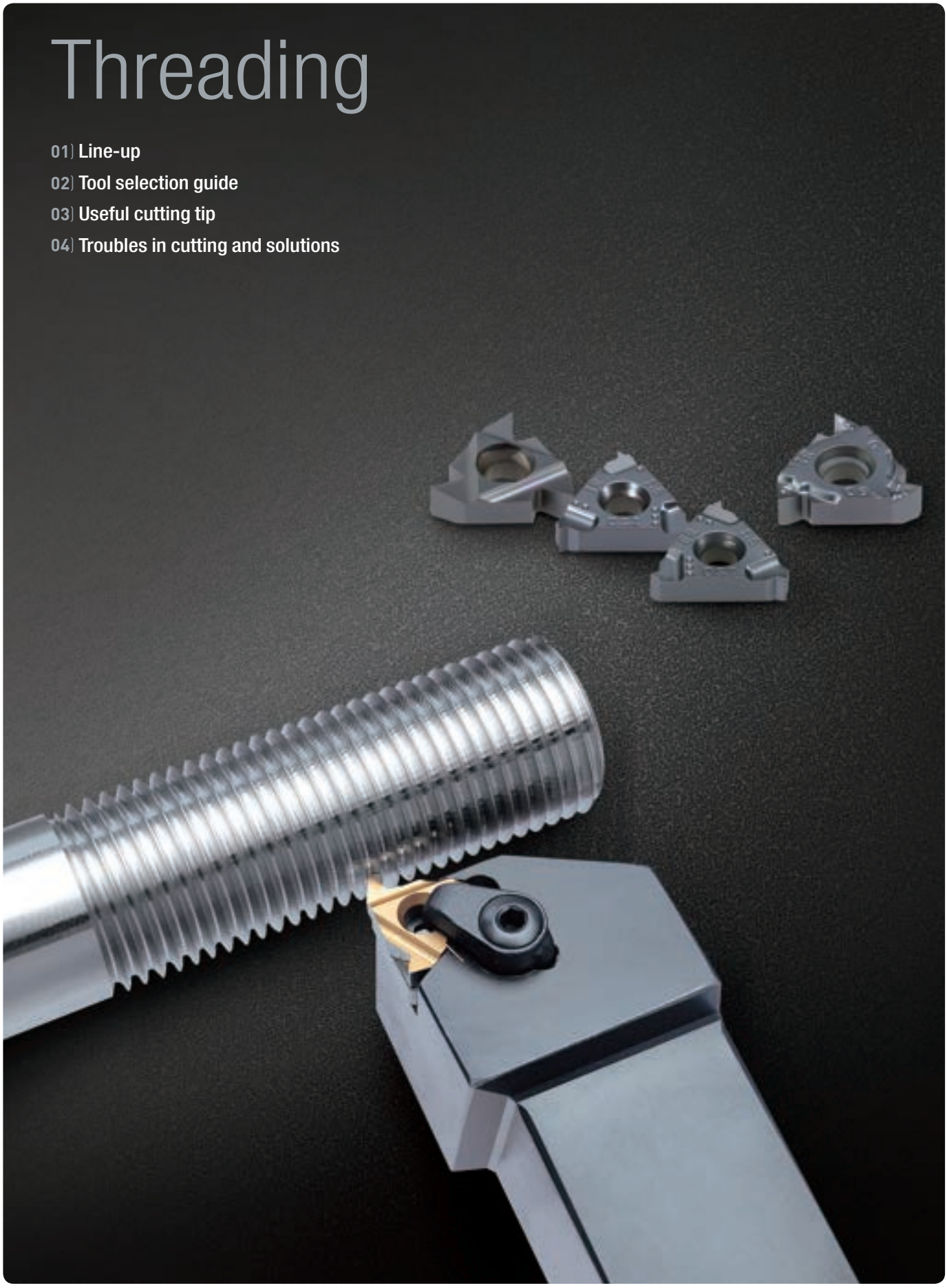
- Tool breakage can be occurred if the tools approaches the workpiece's center with high feed while parting off
- It is necessary to always reduce feed by 75% at a position 2~3mm ahead of the center.
- Lower feed near the center reduces cutting load and decreases the risk of tool breakage.



05 Troubles in cutting and solutions

Troubles	Factors	Solutions			
		Checkpoint 1	Checkpoint 2	Checkpoint 3	Checkpoint 4
Bad surface finish 	Chattering and wrong tool setting	Use a short CDX holder 	Tool setup at 90° 	Use larger Nose R 	Change to another chip breaker Refer to the tool selection guide p. 7
Bad chip control 	Setting improper cutting condition and chip breaker	Increase the feed within recommended cutting conditions 	Machining multiple times with divided cutting depth 	Increase coolant amount and pressure (Recommended inner coolant) 	Change to another chip breaker Refer to the tool selection guide p. 7
Vibration 	Long overhang, wrong setting of holder and lack of holder rigidity	Use a short CDX holder 	Check the center height ±0.1mm from the insert's cutting edge 	Use smaller nose R 	Use a bigger shank 
Short tool life 	Selecting improper grade and chip breaker, lower clamping force of holder	Select a proper grade depending on workpiece materials 	Don't use any damaged holders 	Increase coolant amount and pressure (Recommended inner coolant) 	Change to another chip breaker Refer to the tool selection guide p. 7
Fracture of insert 	Put excessive power when clamping an insert, damaged holder and too long overhang	Use a short CDX holder 	Use the provided wrench (prohibited to use a pipe as an extension) 	Remove all debris from the clamping part (chips, coolant oil and etc.) 	Don't use any damaged holders 
Built-up edge 	Setting improper cutting condition and chip breaker, lack of coolant	Increase the cutting speed and feed within recommended cutting conditions 	Increase coolant amount and pressure (Recommended inner coolant) 	Use smaller nose R 	Change to another chip breaker Refer to the tool selection guide p. 7

Threading

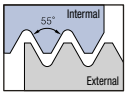
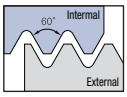
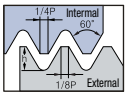
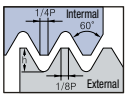
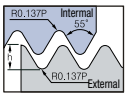
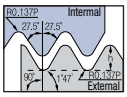
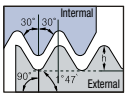
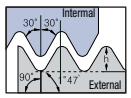
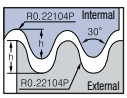
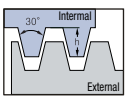


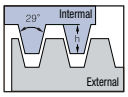
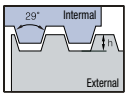
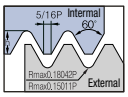
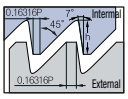
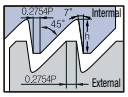
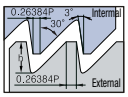
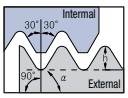
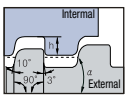
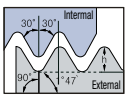
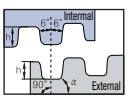
01 Line-up

Grade

Thread for turning						Thread for milling			Solid		
PVD											
PC3030T		PC9070T	PC5300 (M class thread)			PC9570T			PC9070M		
P	K	M	P	M	K	P	M	K	P	M	K

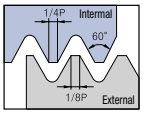
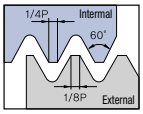
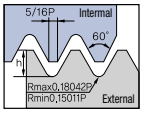
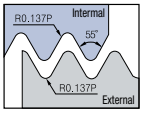
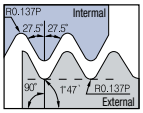
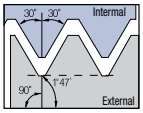
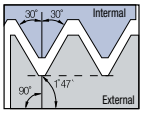
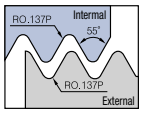
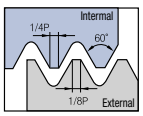
Turning line-up

Division	Appli-cation	Geometries	Unit	Grinding	M-type	U-type
Partial profile (55°)	General threading		mm	0.5~6.0	0.5~5.0	0.5~3.0
			tpi	48~4	48~5	48~8
Partial profile (60°)	General threading		mm	0.5~6.0	0.5~5.0	0.5~3.0
			tpi	48~4	48~5	48~8
ISO metric	General industry		mm	0.35~6.0	1.0~3.0	1.5~2.0
			tpi	-	-	-
American UN (UN, UNC)	General industry		mm	-	-	-
			tpi	72~4	-	-
Withworth (BSW, BSF)	Industrial pipe		mm	-	-	-
			tpi	72~4	14~11	14~11
British standard pipe (BSPT)	Gas and water pipe (55°)		mm	-	-	-
			tpi	28~11	-	-
National pipe (NPT)	Gas and water pipe		mm	-	-	-
			tpi	27~8	-	-
Nationa pipe (NPTF) _Dryseal	Gas and water pipe		mm	-	-	-
			tpi	27~8	–	-
Round DIN405 (RD)	Fire-fighting and food industry		mm	-	-	-
			tpi	10~4	-	-
Trapez DIN103 (TR)	Power transfer		mm	1.5~6.0	-	-
			tpi	-	-	-

Division	Appli-cation	Geometries	Unit	Grinding	M-type	U-type
American ACME (ACME)	Power transfer (feed screw)		mm	-	-	-
			tpi	16~4	-	-
Stub ACME (STACME)	Power transfer (thin shape)		mm	-	-	-
			tpi	16~3	-	-
UNJ	Aero-space industry		mm	-	-	-
			tpi	48~4	-	-
American buttress (ABUT)	One direction		mm	-	-	-
			tpi	20~6	-	-
British buttress (BBUT)	One direction		mm	-	-	-
			tpi	16~8	-	-
Metric buttress (SAGE)	One direction (DIN513)		mm	2.0~4.0	-	-
			tpi	-	-	-
API	Oil and gas industry		mm	-	-	-
			tpi	6~4	-	-
API buttress casing (BUT)	Oil and gas industry (tube, casing)		mm	-	-	-
			tpi	5	-	-
API round casing (APIRD)	Oil and gas industry		mm	-	-	-
			tpi	10~8	-	-
Extreme line casing (EL)	Oil and gas industry (tube, casing)		mm	-	-	-
			tpi	6~5	-	-

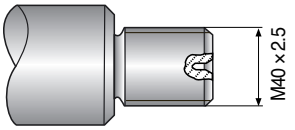
01) Line-up

Milling line-up

Division	Appli-cation	Geometries	Unit	Indexable	Internal coolant Helical	Internal coolant Helical, drill/chamfer	Deep drilling	External coolant Helical	External coolant straight
									
ISO metric	General industry		mm	0.5~6.0	0.5~3.0	1.0~1.75	0.25~2.5	0.5~3.0	0.5~6.0
American UN (UN, UNC)	General industry		tpi	32~4	32~8	-	80~1	32~8	-
UNJ	Aerospace industry		tpi	24~11	32~13	-	32~13	-	-
Withworth (BSW, BSF)	Industrial pipe		tpi	28~4	26~11	-	-	-	-
British standard pipe (BSPT)	Gas and water pipe (55°)		tpi	19~11	28~11	-	-	28~11	28~11
National pipe (NPT)	Gas and water pipe		tpi	18~8	27~8	-	-	27~8	27~8
National pipe (NPTF) _Dryseal	Gas and water pipe		tpi	14~8	27~8	-	-	27~8	27~8
BSP (G)	General industry		tpi	-	28~11	-	-	28~11	28~11
MJ	General industry		mm	-	-	-	0.5~2.0	-	-

02) Tool selection guide - Thread Turning

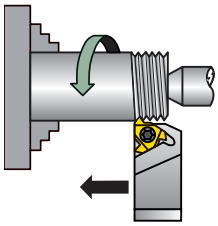
Thread turning steps



Application

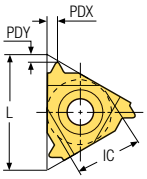
- **Thread** : External right hand ISO metric M40 × 2.5
- **Material** : 4140 (25 HRC)

1 Choose the thread turning method



Use a right hand threading insert with a right hand external threading holder as threading direction is towards the chuck.

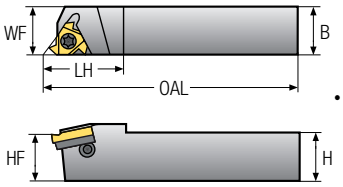
2 Choose the insert size



- **Chosen insert** : ER16-2.5 ISO

Insert size	Pitch	Ordering code	Shim	Tool holder
IC	**mm**	**RH** (Right Hand)	**RH** (Right Hand)	
9.525	2.5	ER16-2.5ISO	ATE16	ERH□□-16

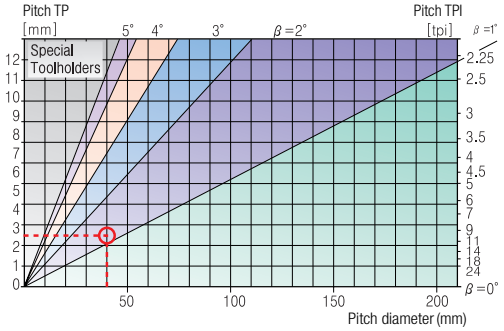
3 Choose the tool holder



- **Chosen tool holder** : ERH25–16

Insert size	Ordering code	Dimensions (mm)				
IC	**RH** (Right Hand)	**H= HF**	**B**	**WF**	**OAL**	**LH**
9.525	ERH25-16	25	25	25	153.6	30

4 Determine the helix angle



- From the table, using a pitch of 2.5 mm (10 tpi) and a workpiece diameter of 40 mm (1.57"), we find the helix angle to be 1.5°

5 Choose the correct shim

Helix angle		1.5°
Insert size	**IC**	9.525
	L	16
Shim designation		ATE16

6 Choose the carbide grade and cutting speed

- **Carbide grade chosen** : PC3030T
- **Cutting speed** : 140m/min

Workpiece			HB	**vc** (m/min)
				PC3030T
P	**Low alloy steel** (alloying elements ≤ 5%)	Non-hardened	180	85~145
		Hardened	275	75~140
		Hardened	350	70~135

7 Determine the number of passes

- **Carbide grade chosen** : PC3030T
- **Cutting speed** : 140m/min

Pitch	mm	1.50	1.75	2.00	2.50	3.00	3.50	4.00
	tpi	16	14	12	10	8	7	6
No.of passes		6~10	7~12	7~12	8~14	9~16	10~18	11~18

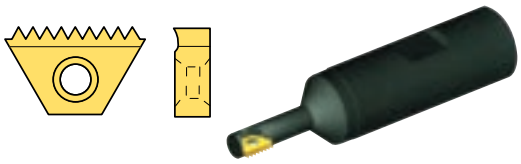
8 Summary

Thread type	ISO M40 × 2.5 External right hand
1. Feed direction	Towards the chuck
2. Insert and grade	ER16–2.5ISO, PC3030T
3. Tool holder	ERH25–16
4. Helix angle	1.5°
5. Shim	ATE16
6. Cutting speed	140 m/min
7. Number of passes	10

02) Tool selection guide - **Thread Milling**

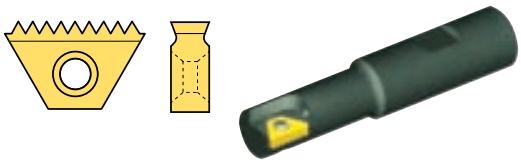
The right tool for the job

Small diameter type



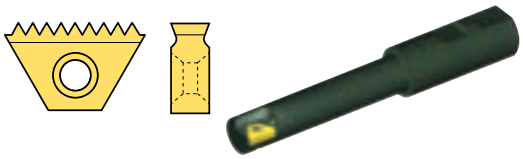
- **Tool holder** : TMSR • **Insert** : TM (L = 10.4 mm)
- For small bore diameters down to 9.5 mm

Standard type



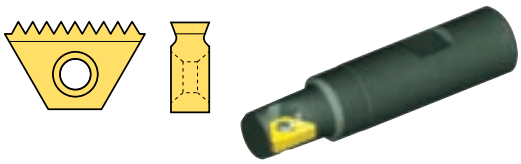
- **Tool holder** : TMSR • **Insert** : TM2
- For standard length threads

Long type



- **Tool holder** : TMSR • **Insert** : TM2
- Long shank thread milling

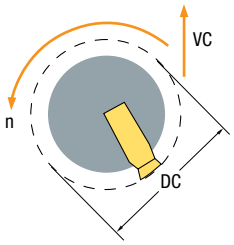
Tapered type



- **Tool holder** : TMSR • **Insert** : TM2 (BSPT, NPT, NPTF)
- Taper thread millings

Preparing for the thread milling operation

{ Calculation of rotational velocity and feed at the cutting edge }



$$n = \frac{vc \times 1000}{\pi \times DC}$$

$$vc = \frac{n \times \pi \times DC}{1000}$$

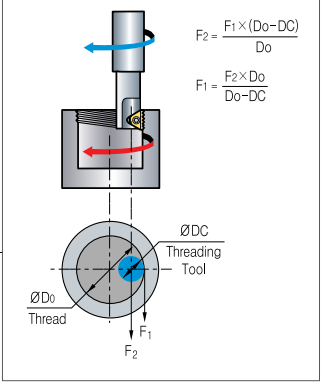
$$F_1 = n \times z \times fn$$

n – Rotational Velocity (min^{-1})
vc – Cutting Speed (m/min)
DC – Tool holder Cutting Dia. (mm)
F_1 – Real Feed rate at the Cutting edges (mm/min)
z – No. of Cutting Edges
fn – Feed per Rooth per Rotation (mm/rev)

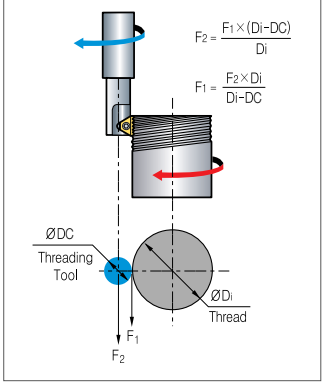
{ Calculation of feed rates at the tool center line }

- Feed rate from the center-line of the tools is required for most of the CNC machine's programming. When dealing with linear tool movement, the feed rate at the cutting edge and the center line are identical, but with a milling tool, this is not the case. The value can be defined relatively by the feed rate at the cutting edge and the feed rate rate at the tool's center-line.

Internal thread



External thread



{ Grades and applications }

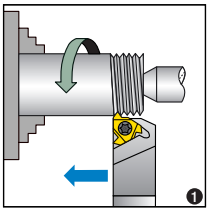
- **Grade** : PC9570T
- **Application** : First Choice for steel and cast iron A tough sub-micron substrate with TiCN coating Provides good fracture toughness and excellent wear resistance

03) Useful cutting tip - Thread Turning

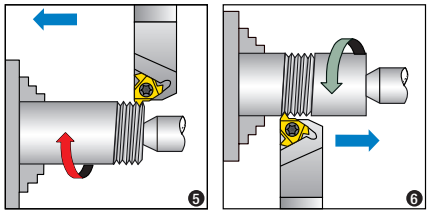
Thread turning method

Thread	Inserts & Tool holder	Rotation	Feed direction	Helix method	Drawing no.
Right Hand External	EX RH	Counter clockwise	Towards chuck	Regular	❶
	EX LH	Clockwise	Outwards chuck	Reversed	❷
Right Hand Internal	EX RH	Counter clockwise	Towards chuck	Regular	❸
	IN LH	Clockwise	Outwards chuck	Reversed	❹
Left Hand External	EX LH	Clockwise	Towards chuck	Regular	❺
	EX RH	Counter clockwise	Outwards chuck	Reversed	❻
Left Hand Internal	IN LH	Clockwise	Towards chuck	Regular	❼
	IN RH	Counter clockwise	Outwards chuck	Reversed	❽

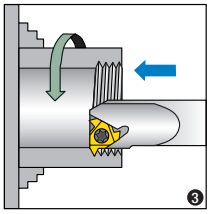
External RH thread



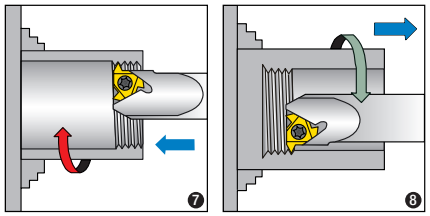
External LH thread



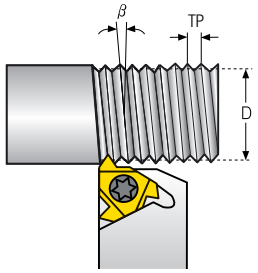
Internal RH thread



Internal LH thread



Calculating the helix angle (β)



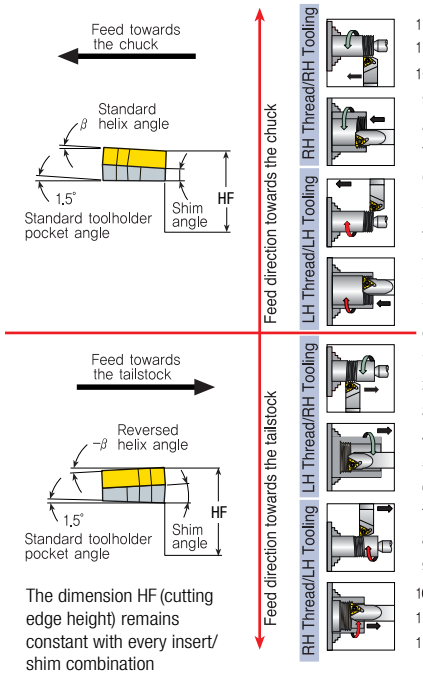
- The helix angle is calculated by the following formula

$$\beta = \tan^{-1}\frac{TP \times N}{\pi \times D}$$

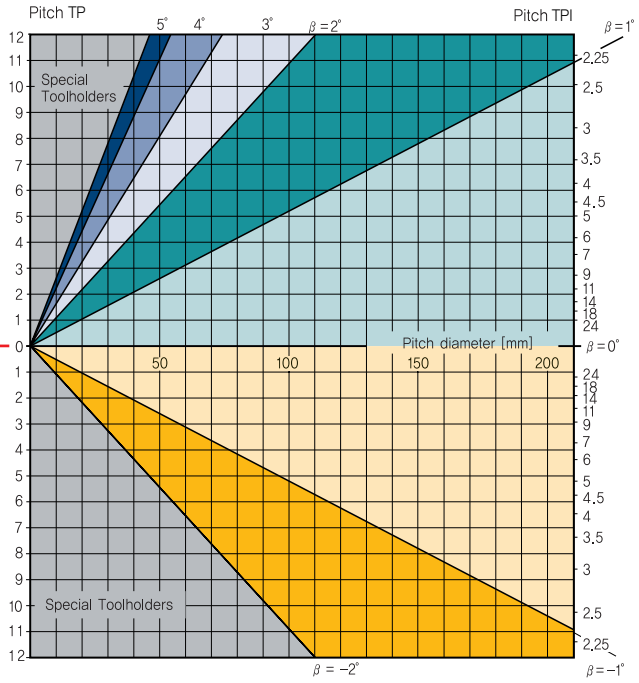
β : Helix angle (°)
P: Pitch (mm)
N: No. of starts
D: Pitch diameter (mm)
Lead = TP × N

- The helix angle can also be found from the diagram below

(Helix angle diagram)



The dimension HF (cutting edge height) remains constant with every insert/shim combination

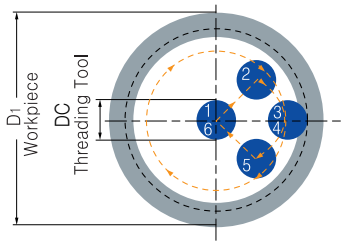


03) Useful cutting tip - **Thread Milling**

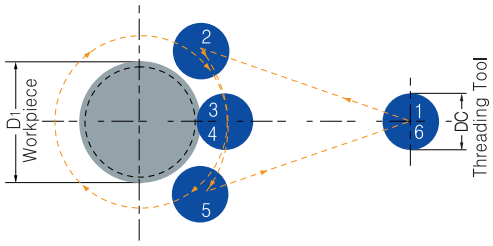
Tangential Arc Approach

- With this method, the tool enters and exits the workpiece smoothly. No marks are left on the workpiece and there is no vibration, even with harder materials. Although it requires slightly more complex programming than the radial approach (see below), this is the method recommended for machining the highest quality threads

Internal thread



External thread



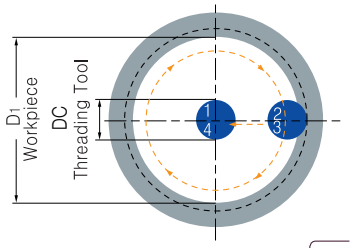
1-2 : Rapid approach
2-3 : Tool entry along tangential arc, with simultaneous feed along z-axis
3-4 : Helical movement during one full orbit (360°)
4-5 : Tool exit along tangential arc, with continuing feed along z-axis
5-6 : Rapid return

Radial Approach

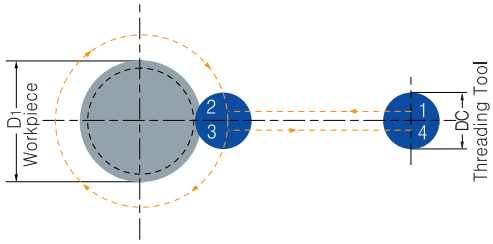
- This is the simplest method. There are two characteristics worth nothing about the radial approach:
  ① a small vertical mark may be lift at the entry (and exit) point. This is of no significance to the thread itself
  ② when using this method with very hard materials, there may be a tendency of the tool to vibrate as it approaches the full cutting depth

Note : Radial feed during entry to the full profile depth should only be 1/3 of the subsequent circular feed

Internal thread



External thread

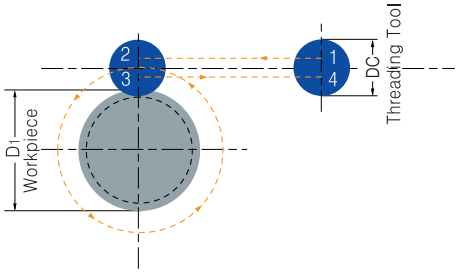


1-2 : Radial entry
2-3 : Helical movement during one full orbit (360°)
3-4 : Radial exit

Tangential Line Approach

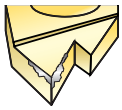
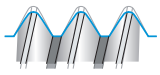
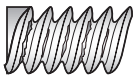
- This method is very simple, and has all of the advantages of the tangential arc method However, it is applicable only with external threads

External thread

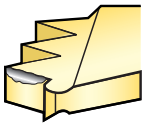
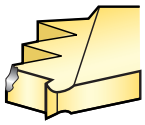
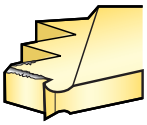
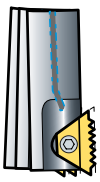
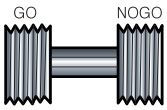


1-2 : Radial entry with simultaneous feed along z axis
2-3 : Helical movement during one full orbit (360°)
3-4 : Radial exit

04) Troubles in cutting and solutions - Thread Turning

Problem		Possible cause	Solution
	**Increased flank wear**	Too high cutting speed	Reduce cutting speed/use coated insert
		Too low depth of cut / Too many passes	Increase the depth of cut per pass
		Unsuitable carbide grade	Use a coated carbide grade
		Insufficient coolant oil	Increase coolant flow rate
	**Uneven cutting edge wear**	Incorrect helix angle	Choose the correct shim
		Wrong infeed method	Use the alternating flank infeed method
	**Extreme plastic deformation**	Too deep depth of cut	Decrease depth of cut/ increase number of passes
		Insufficient coolant	Increase coolant flow rate
		Too high cutting speed	Reduce cutting speed
		Unsuitable carbide grade	Use a tougher carbide
		Too small nose radius	Use an insert with a larger radius, if possible
	**Cutting edge breakage**	Too deep depth of cut	Decrease depth of cut/ increase number of passes
		Extreme plastic deformation	Use a tougher carbide
		Insufficient coolant oil	Increase flow rate and/ or correct flow direction
		Unsuitable carbide grade	Use a tougher carbide
		Instability	Check stability of the system
	**Built-up edge**	Incorrect cutting speed	Change the cutting speed
		Unsuitable carbide grade	Use a coated carbide
	**Thread profile is too shallow**	Tool's height is not matched with the workpiece's axial height	Change tool's height
		Thread's crest is not properly shaped	Recheck the workpiece diameter
		Worn insert	Change the insert's cutting edge immediately
	**Poor surface quality**	Too low cutting speed	Increase cutting speed
		Wrong shim	Choose correct shim
		Flank infeed method is not appropriate	Use the alternate flank or radial infeed method

04) Troubles in cutting and solutions - **Thread Milling**

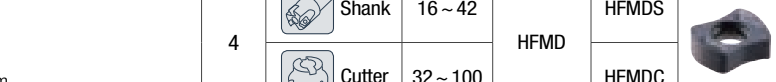
Problem		Possible cause	Solution
	**Excessive flank wear**	Too high cutting speed	Reduce cutting speed/use coated insert
		Chip is too thin	Increase feed rate
		Insufficient coolant	Increase coolant flow rate
	**Excessive chipping**	Chip is too thick	Reduce feed rate/Use the tangential arc method Increase RPM
		Vibration	Check stability
	**Built up edge**	Incorrect cutting speed	Change cutting speed
		Unsuitable carbide grade	Use a coated carbide grade
	**Chatter/ vibration**	Feed rate is too high	Reduce the feed.
		Profile is too deep	Execute two passes, each with increased cutting depth/ Execute two passes, each cutting only half the thread length
		Thread length is too long	Execute two passes, each cutting only half the thread length
	**Insufficient thread accuracy**	Tool deflection	Reduce feed rate/Execute a “zero” cut

Milling

01) Line-up

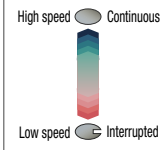
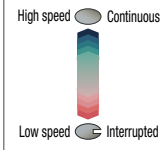
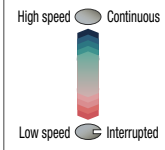
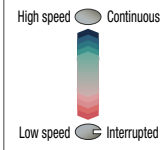
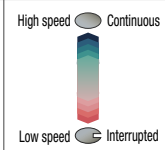
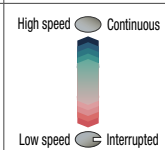
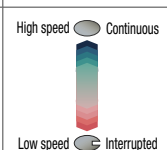
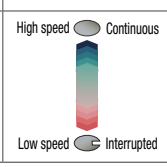
Machining types	A.A	Max. ap (mm) 5 10 15 20 25 30	Cutting -edges	Type	Cutting diameter Range (Ø)	Product name	Holder designation	Available inserts	Promotional materials Link	Sub application
 Facing	-	RNMX12 : 3.5mm	8	Shank	32 ~ 63	Rich Mill (RMR)	RMRS		INFO	-
				Cutter	50 ~ 125		RMRC			
	45°	SAGX14 : 5.5mm SNMX14 : 5.5mm	8	Shank Cutter	50 ~ 250	Rich Mill (RM8-X)	RMX8AC		INFO	-
	45°	SNM(E)X12 : 6mm SNM(E)X15 : 7.5mm	8	Shank Cutter	50 ~ 400	Rich Mill (RM8)	RM8AC		INFO	-
	45°	ONM(H)X06 : 4mm ONM(H)X08 : 5.5mm	16	Shank Cutter	50 ~ 400	Rich Mill (RM16)	RM16AC		INFO	-
	51°	XNMX06(Flat) : 4.8mm XNMX06(Helix) : 3.5mm	14	Shank Cutter	50 ~ 160	Rich Mill (RM14)	RM14XC		-	-
	75°	SNM(E)X12 : 9mm SNM(E)X15 : 11mm	8	Shank Cutter	50 ~ 400	Rich Mill (RM8)	RM8EC		INFO	-
 Shouldering	90°	ADKT10 : 9.5mm ADKT12 : 11.5mm ADKT17 : 16.5mm	2	Shank Cutter	16 ~ 40 40 ~ 125	Alpha mill-X	AMXS AMXC		INFO	Facing Slotting Plunge Ramping Helical
	90°	TNKT10 : 8mm TNKT16 : 11.5mm TNKT20 : 15.5mm	3	Shank Cutter	25 ~ 40 50 ~ 125	Triple mill	TPMS TPMC		INFO	Facing Slotting Plunge
	90°	XNK(C)T06 : 5.5mm XNK(C)T08 : 8mm XNK(C)T12 : 12mm	3	Shank Cutter	20 ~ 63 40 ~ 125	Rich Mill (RM3)	RM3PS RM3PC		INFO	Facing Slotting Plunge Ramping Helical
	90°	LNM(E)X10 : 9mm LNM(E)X15 : 14mm	4	Shank Cutter	14 ~ 63 40 ~ 160	Rich Mill (RM4)	RM4PS RM4PC		INFO	Facing Slotting Plunge Ramping Helical
	90°	WNGX04 : 4.3mm WNGX08 : 8.2mm	6	Shank Cutter	20 ~ 50 40 ~ 125	Rich Mill (RM6)	RM6PS RM6PC		INFO	Facing Slotting Plunge Ramping Helical
	90°	SOKX14 : 11mm	8	Shank Cutter	- -	Tangen-Pro (TP8P)	TP8PS TP8PC		INFO	Facing Slotting Plunge

01) Line-up

Machining types	A.A	Max. ap (mm) 5 10 15 20 25 30	Cutting -edges	Type	Cutting diameter Range (Ø)	Product name	Holder designation	Available inserts	Promotional materials Link	Sub application
High feed machining	-	LNMX04 : 0.5mm LNMX06 : 1mm LNMX10 : 1.5mm	4	Shank Cutter	16 ~ 42 32 ~ 100	HFMD	HFMDS HFMDC		INFO	Facing Shouldering Profile Ramping Helical
	13°	LPMT04 / LPM(E)W04 : 0.5mm	2	Shank Cutter	8 ~ 21	HFM	HFMS		INFO	
	14°	WNMX06 : 1mm WNMX09 : 1.5mm WNMX13 : 2mm WNMX16 : 2.5mm	6	Shank Cutter	16 ~ 63 40 ~ 315	HRMD	HRMDS HRMDC		INFO	
	15°	WDKT08 : 1mm WDKT10 : 1mm WDKT13 : 2mm WDKT15 : 2.5mm	3	Shank Cutter	20 ~ 63 50 ~ 160	HRM	HRMS HRMC		-	
Aluminum cutting	90°	LXET25 : 25mm LXET34 : 34mm	2	Shank Cutter	32 ~ 63 63	Pro-L Mill	PALS PALC		-	Facing Slotting Plunge Ramping Helical
		XEKT19 : 17mm XEKT25 : 23mm	2	Shank Cutter	20 ~ 40 40 ~ 125	Pro-X Mill	PAXS PAXC		INFO	
		XDET19 : 17mm	2	Shank Cutter	25 ~ 40 40 ~ 125	Pro-V Mill	PAVS PAVC		INFO	
		VDKT22 : 15mm VDKT11 : 8mm	2	Shank Cutter	12 ~ 40 40 ~ 100	Pro-A Mill	PAS PAC		INFO	

Continuous

02) Grade selection guide

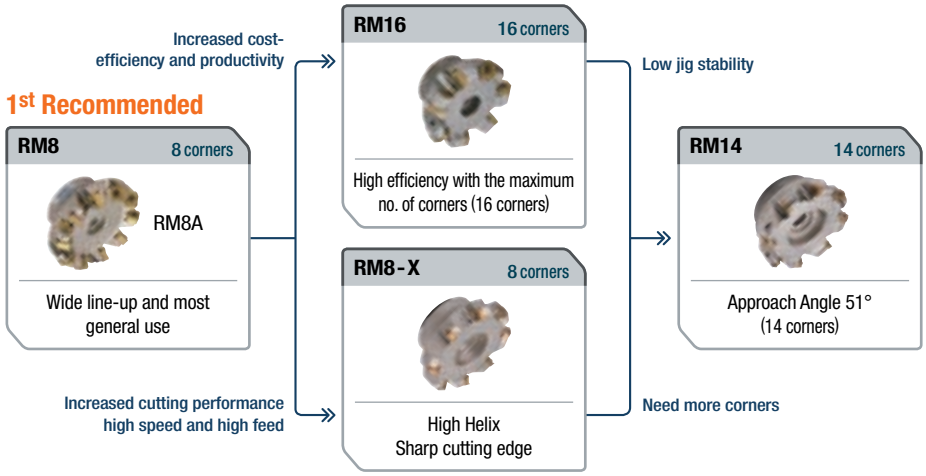
Machining types	Type	Product	Machining Features	Application range					
				P	M	K	S	H	N
				MM/MF	ML/MM	MF/MM	ML/MM	MM/MF	MA
 Facing	For high rigidity flat surface	RM8 RM8-X RM14 RM16 RMR		NCM535 PC3700 PC5300 PC5535 PC5400	NC5330 PC5300 PC5535 PC9530 PC5400 PC9540	PC6510 NCM535 PC5300 PC5535 PC5400	PC5300 PC5535 PC5400 PC9540	-	H01
	For high rigidity flat surface	Mill max heavy Power buster		NCM535 PC3700 PC5300	PC5300	NCM535 PC5300	PC5300	-	-
	For wiper finishing	RM8 RM16		PC3700 PC5300	PC5300	PC6510	PC5300	-	-
 Shouldering	For perpendicularity and flat surface	Alpha mill-X Alpha mill RM3 RM4 Triple mill RM6		NCM535 PC3700 PC5300 PC5535 PC5400	NC5330 PC5300 PC5535 PC9530 PC5400 PC9540	PC6510 NCM535 PC5300 PC5535 PC5400	PC5300 PC5535 PC5400 PC9540	PC2505 PC2510	H01 H05
	For thin and sagging shouldering	TP2P TP8P RM4 RM6		NCM535 PC3700 PC5300 PC5535 PC5400	NC5330 PC5300 PC5535 PC9530 PC5400 PC9540	PC6510 NCM535 PC5300 PC5535 PC5400	PC5300 PC5535 PC5400 PC9540	PC2505 PC2510	H01
	For edge cutting	Mono - Tool Alpha mill Multi - edge		NCM535 PC3700 PC5300 PC5535 PC5400	NC5330 PC5300 PC5535 PC9530 PC5400 PC9540	PC6510 NCM535 PC5300 PC5535 PC5400	PC5300 PC5535 PC5400 PC9540	PC2505 PC2510	H01
 High feed machining		HRMD HRM HFMD HFM		PC3700 PC5300 PC5535 PC5400	PC5300 PC5535 PC9530 PC5400 PC9540	PC5300 PC5535 PC5400	PC5300 PC5535 PC5400 PC9540	PC2505 PC2510	H01
Aluminum cutting		Pro-L Mill Pro-X Mill Pro-V Mill Pro-A Mill		-	-	-	-	-	H01 H05

Chip Breaker selection

MA	ML	MF	MM
Aluminum	Hard-to-cut materials	Light cutting	General cutting
Sharp cutting edge type	Low cutting resistance type	Low cutting resistance type	Strengthened edge
			

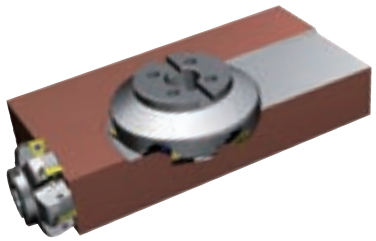
03 Tool selection guide - Facing

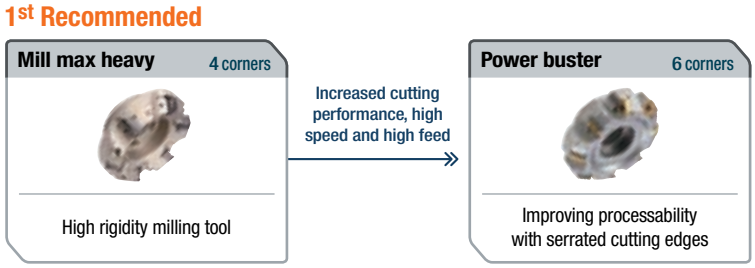
General flat surface milling



Item	Cutting load	Max. Depth of cut	Cutting quality	Versatility	Cost-effectiveness	No. of corners
RM8-X	★★★★★	★★★★★	★★★★	★★★	★★★	★★★
RM8	★★★	★★★★	★★★★★	★★★★	★★★★	★★★
RM14	★★★★	★★★	★★★★	★★★★★	★★★★	★★★★
RM16	★★★	★★★	★★★	★★	★★★★★	★★★★★

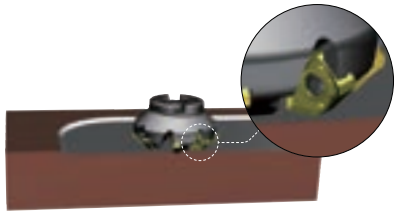
High rigidity flat surface milling

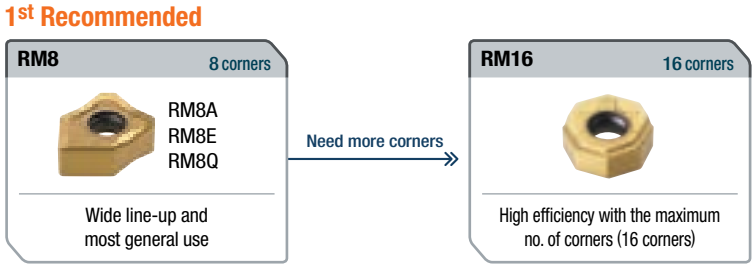




Item	Cutting load	Max. Depth of cut	Cutting quality	Versatility	Cost-effectiveness	No. of corners
Mill max heavy	★★★	★★★	★★★★★	★★★	★★★★	★★★
Power buster	★★★★★	★★★★★	★★★	★★★★★	★★★★	★★★★★

Finishing with wiper





Item	Cutting load	Max. Depth of cut	Cutting quality	Versatility	Cost-effectiveness	No. of corners
RM8	★★★	★★★★★	★★★★★	★★★★	★★★★	★★★
RM16	★★★	★★★★	★★★	★★★	★★★★	★★★★★

03) Tool selection guide - Facing

General flat surface milling

★ 1st recommended ☆ 2nd recommended ○ Available

System	Rich Mill - RM8A/E/Q									Rich Mill - RM8A/E/Q									Rich Mill - RM8-X							
A.A	45º ~ 88º									45º ~ 88º									45º							
Max.ap	6.0 ~ 11.5									6.0 ~ 11.5									5.5							
Diameter(ØD)	50 ~ 400									80 ~ 315									50 ~ 125							
Material	P		M		K		S		N	P		M		K		S		N	P		M		K		S	
C/B	MM	MF	MM	ML	MM	MF	MM	ML	MA	MM	MF	MM	ML	MM	MF	MM	ML	MA	MM	ML	MM	ML	MM	ML	MM	ML
PC6510					★	☆								★	☆								★			
PC3700	★	○								★	☆								★							
PC5300	☆	○	○	☆	○	○	○	☆											☆		○	☆	☆	○	○	☆
PC5535	○	○	○		○	○	○																			
PC9530			○																							
PC5400	○	○	○	○	○	○	○	○																		
PC9540			★				★														○	★			○	★
NC5330	○		○		○		○																			
NCM535	○	○			○	○																				
H01									★																	
H05																										

★ 1st recommended ☆ 2nd recommended ○ Available

System	Rich Mill - RM14				Rich Mill - RM16								Rich Mill - RMR							
A.A	51º				45º								-							
Max.ap	3.0				4.0 ~ 5.5								3.5							
Diameter(ØD)	80 ~ 315				80 ~ 400								32 ~ 125							
Material	M		K		P		M	K			S	N	P		M		K		S	
C/B	N	XNR	N	XNR	MM	MF	MM	MM	MF	MM	ML	MA	MM	ML	MM	ML	MM	ML	MM	ML
PC6510			○	○				★	☆								★	○		
PC3700					★	○							★							
PC5300	○	○	○	○	☆	○	☆	○	○	○	☆		☆	○	○	○	☆	○	○	○
PC5535	○	○	○	○	○	○	○	○	○	○										
PC9530							○													
PC5400	○	○	○	○	○	○	○	○	○	○	○		○	○	○	○	○	○	○	○
PC9540	☆	★					★			★					☆	★				
NC5330																				
NCM535	○	○	☆	★	○	○		○	○											
H01												★								
H05																				

03) Tool selection guide - Facing

High rigidity flat surface milling

★ 1st recommended ☆ 2nd recommended ○ Available

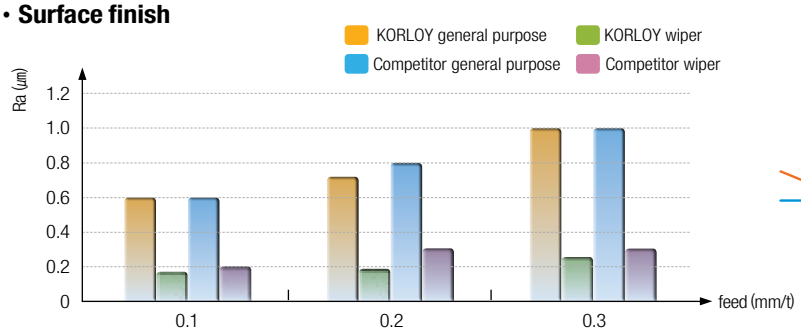
System	Mill Max - Heavy			Power Buster - PBP		Power Buster - PBA		Power Buster - PBZ	
									
A.A	55º			90º		45º		80º	
Max.ap	14.5			20		12		18	
Diameter(ØD)	125 ~ 315			80 ~ 315		80 ~ 315		80 ~ 315	
Material	P	M	K	P	K	P	K	P	K
C/B	MM	MM	MM	NM	NM	NM	NM	NM	NM
PC3700	★					★		★	
PC5300	☆	★	☆			☆	★	☆	★
PC9530									
PC5400						○	○	○	○
NCM535	○	○	★			○	☆	○	☆

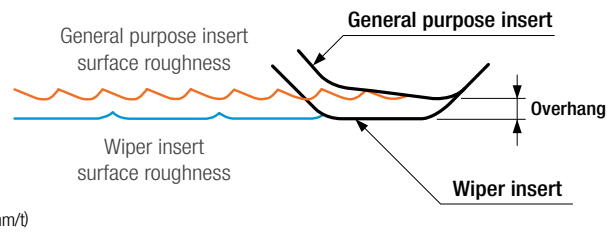
Finishing with wiper

★ 1st recommended ☆ 2nd recommended ○ Available

System	Rich Mill - RM8A				Rich Mill - RM16			
								
A.A	45º				45º			
Max.ap	6				4.0 ~ 5.5			
Diameter(ØD)	50 ~ 400				80 ~ 400			
Material	P	M	K	S	P	M	K	S
C/B	W	W	W	W	W	W	W	W
PC6510			★				★	
PC3700	★							
PC9530						○		
PC5300	○	★	○	★	★	★	○	★

• Surface finish

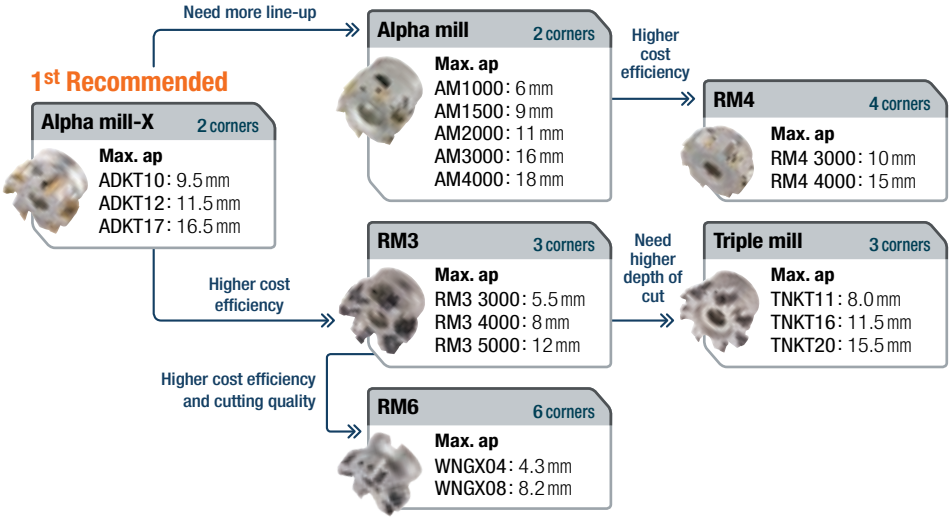




- **Insert** : ONMX080608-MM (General purpose) / ONHX080608-W (Wiper)
- **Grade** : PC3700
- **Material** : SM45C
- **Depth of cut** : vc = 200m/min
- **Cutting depth** : ap = 3.0mm

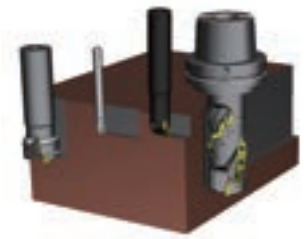
03) Tool selection guide - **Shouldering**

Perpendicularity and flat surface milling



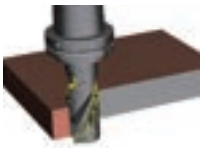
Item	Unit price per corner	No. of corners	Versatility	Cutting load	Max. Depth of cut
RM3	★★★★★	★★½	★★★★	★★★★	★★★
RM4	★★★	★★★	★★★	★★★	★★★★
RM6	★★★★	★★★★	★★★★	★★★	★★★
Alpha mill	★★	★★	★★★★★	★★★½	★★★★★
Alpha mill-X	★★	★★	★★★★★	★★★★★	★★★★★
Triple mill	★★★	★★½	★★	★★★★★	★★★★

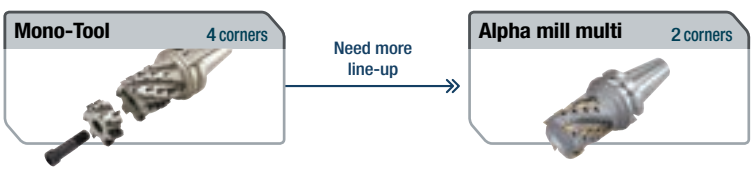
Perpendicular milling on a thin wall



Item	No. of corners	Cutting stability	Max. Depth of cut	Surface roughness	Line-up
TP8P	★★★★★	★★★★★	★★★★	★★	★★
TP2P	★★	★★★★★	★★★★★	★★★★	★★★★
RM4	★★★	★★	★★★★	★★★	★★★★★
RM6	★★★★	★★★	★★★	★★★★★	★★★★★

Edge cutting- peripheral milling





Item	No. of corners	Cutting stability	Max. Depth of cut	Surface roughness	Line-up
Mono-Tool	★★★★	★★★★★	★★★★★	★★★★★	★★
Alpha mill	★★	★★★	★★★★★	★★★	★★★★★

03) Tool selection guide - Shouldering

Perpendicularity and flat surface milling

★ 1st recommended ☆ 2nd recommended ○ Available

System	Alpha mill-X									Alpha mill									Rich Mill - RM3									
																												
A.A	90°									90°									90°									
Max.ap	9.5 ~ 16.5									6.0 ~ 18.0									5.5 ~ 12.0									
Diameter(ØD)	16 ~ 125									10 ~ 200									20 ~ 125									
Material	P		M		K		S		N	P		M		K		S		H	N	P		M		K		S		H	N
C/B	MM	ML	MM	ML	MM	ML	MM	ML	MA	MM	MF	MM	ML	MM	MF	MM	ML	MM	MA	MM	ML	MM	ML	MM	ML	MM	ML	MM	MA
PC6510					★	☆								★	☆									★	☆				
PC2505																		○										○	
PC2510																		★										★	
PC3700	★	○								★	○									★	○								
PC5300	○	○	○	○	○	○	○	○		○	○	○	☆	○	○	○	☆			○	○	○	○	○	○	○	○		
PC5535	☆	○	○	☆	○	○	○	☆		☆	○	○		○	○	○				☆	○	○	☆	○	○	○	☆		
PC9530												○																	
PC5400	○	○	○	○	○	○	○	○		○	○	○	○	○	○	○	○			○	○	○	○	○	○	○	○		
PC9540			○	★			○	★				★				★						○	★			○	★		
NC5330										○	○	○		○	○	○													
NCM535	○	○			○	○				○				○						○	○			○	○				
H01																			★										★
H05																													

★ 1st recommended ☆ 2nd recommended ○ Available

System	Rich Mill - RM4									Triple mill									Rich Mill - RM6									
																												
A.A	90°									90°									90°									
Max.ap	10.0 ~ 15.0									8.0 ~ 15.5									18.0									
Diameter(ØD)	14 ~ 160									25 ~ 125									25 ~ 125									
Material	P		M		K		S		N	P		M		K		S			P		M		K		S			
C/B	MM	MF	MM	MF	MM	MF	MM	MF	MA	MM	ML	MM	ML	MM	ML	MM	ML		MM	ML	MM	ML	MM	ML	MM	ML		
PC6510					★	☆								★									★	☆				
PC2505																												
PC2510																												
PC3700	★	○								★	○								★	○								
PC5300	○	○	○		○	○	○	○		○	○	○	○	○	○	○	○		○	○	○	○	○	○	○	○		
PC5535	☆	○	★	☆	○	○	★	☆		☆	○	○	☆	☆	○	○	☆		☆	○	○	☆	○	○	○	☆		
PC9530			○																									
PC5400	○	○	○	○	○	○	○	○											○	○	○	○	○	○	○	○		
PC9540													★				★				○	★			○	★		
NC5330																												
NCM535	○		○		○		○												○	○			○	○				
H01									★																			★
H05																												

03) Tool selection guide - Shouldering

Perpendicular milling on a thin wall

★ 1st recommended ☆ 2nd recommended ○ Available

System	Tangential TP2P									Tangential TP8P		Rich Mill - RM4								Rich Mill - RM6								
																												
A.A	90º									90º		90º								90º								
Max.ap	8.0 ~ 16.5									12.0		10.0 ~ 15.0								18.0								
Diameter (ØD)	16 ~ 125									32 ~ 125		14 ~ 160								25 ~ 125								
Material	P		M		K		S		N	P	K	P		M		K		S		N	P		M		K		S		N
C/B	MM	ML	MM	ML	MM	ML	MM	ML	MA	ML	ML	MM	MF	MM	MF	MM	MF	MM	MF	MA	MM	ML	MM	ML	MM	ML	MM	ML	MA
PC6510						★										★	☆								★	☆			
PC3700												★	○								★	○							
PC5300	★	☆	○	★	○	☆	☆	★		★	★	○	○	○		○	○	○	○		○	○	○	○	○	○	○	○	
PC5535												☆	○	★	☆	○	○	★	☆		☆	○	○	☆	○	○	☆	★	
PC9530														○															
PC5400	○	○	○	☆	○	○	○	○				○	○	○	○	○	○	○	○		○	○	○	○	○	○	○	○	
PC9540																							○	★					
NC5330																													
NCM535												○				○					○	○		○	○				
H01																				★									★
H05																													

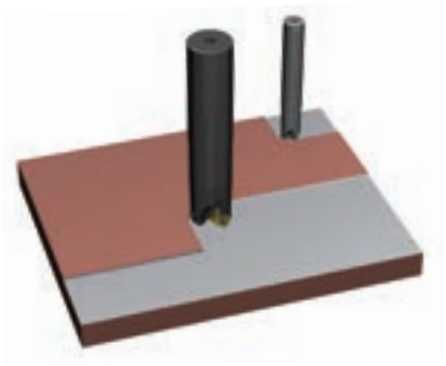
Edge cutting- peripheral milling

★ 1st recommended ☆ 2nd recommended ○ Available

System	Mono - Tool		Alpha mill multi - edge									
												
A.A	90º		90º									
Max.ap	94 ~ 114		15 ~ 76									
Diameter (ØD)	50 ~ 80		16 ~ 100									
Arbor	BT		BT, SK, HSK									
Material	P	K	P		M		K		S		H	N
C/B	MM	MM	MM	MF	MM	ML	MM	MF	MM	ML	MM	MA
PC6510							★	☆				
PC2505											☆	
PC2510											★	
PC3700	★		★	○								
PC5300	☆	★	☆	○	○	☆	○	○	○	☆		
PC5535			○	○	○	○	○	○	○	○		
PC9530												
PC5400			○	○	○	○	○	○	○	○		
PC9540					○	★			○	★		
NC5330			○	○	○	○	○	○	○	○		
NCM535			○	○			○	○				
H01												★
H05												

03) Tool selection guide - High feed machining

High feed milling



1st Recommended

HRMD 6 corners

General use / High efficiency

Lack of line-up on small diameter

HFMD 4 corners

Smallerization possible
Economic

Lack of line-up on High hardness

HFM 2 corners

High hardness specialized
Positive

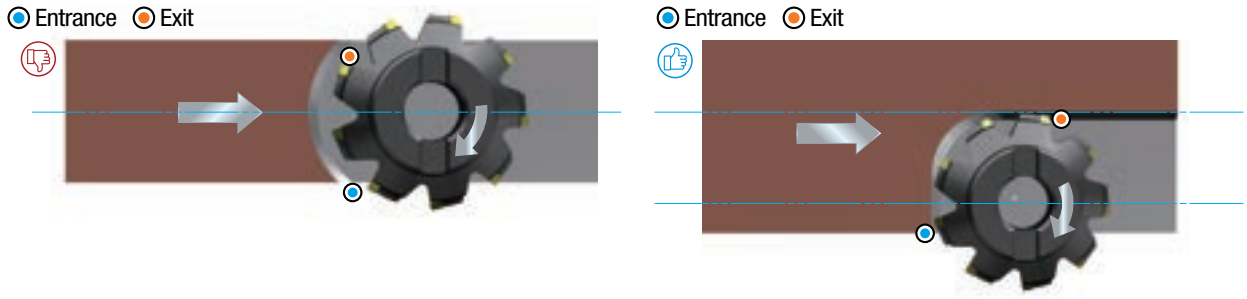
Item	Cost-effectiveness	Cutting resistance	Max. Depth of cut	No. of corners	Min. Cutting dia
HFMD	★★★★	★★★★	★★★★	★★★★	★★★★★
HFM	★★	★★★★★	★★	★★	★★★★★
HRMD	★★★★★	★★★	★★★★★	★★★★★	★★★
HRM	★★★	★★★	★★★★★	★★★	★★

★ 1st recommended ☆ 2nd recommended ○ Available

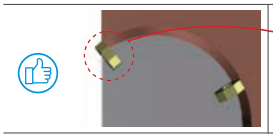
System	HRM					HRMD									HFM									HFMD									
																																	
A.A	15°					14°									13°									-									
Max.ap	1.0 ~ 2.5					1.0 ~ 2.5									0.4 ~ 0.5									0.4 ~ 1.5									
Diameter(ØD)	20 ~ 160					16 ~ 315									8 ~ 21									8 ~ 100									
Material	P	M	K	S	H	P		M		K		S		H	P		M		K		S		H	P		M			K		S		H	
C/B	MH	MH	MH	MH	MH	MM	MF	MM	ML	MM	MF	MM	ML	MM	MF	-	MF	-	MF	-	MF	-	-	MM	MF	MM	MF	ML	MM	MF	MM	ML	MM	MF
PC6510			★																														
PC2505					☆									☆									☆										
PC2510					★									★									★										
PC3700	★				○	★	○								★									★	○							★	☆
PC5300	☆	☆	☆	☆	○	☆	○	○	☆	★	○	○	☆		☆	○	★	☆	★	☆	☆	★	○	☆	○	○	○	☆	★	○	☆	★		
PC5535						○	○	○		☆	○	○												○	○	○	○	○	☆	○	○	○		
PC5400	○	○	○	○	○	○	○	○	○	○	○	○	○		○		○		○		○			○	○	○	○	○	○	○	○	○		
PC9530		★		★				○	○																								
PC9540								○	★			○	★													○	○	★						

04) Useful cutting Tip

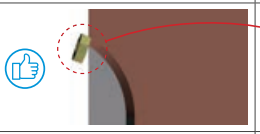
Cutter position : Do not align the cutter center with the center of the workpiece!



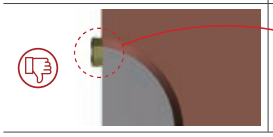
Optimal ae Selection : Maximize tool life by selecting the optimal ae!



ae > 75% of ØD
- Optimal cutting conditions
- Offset the initial impact along the direction of rotation when entering the cut



ae < 25% of ØD
- Form positively when entering.
- Absorb the impact during entry by the outermost part of the insert, gradually offset by the tool



ae = 50% of ØD
- Not recommended.
- Very high impact and load on the tool during a tool's entering

Downward milling : Reduce heat and minimize work hardening tendencies!

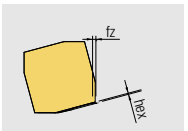
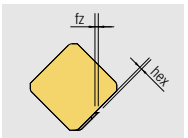
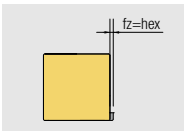
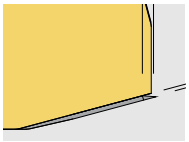
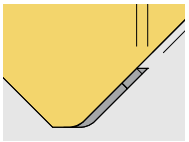
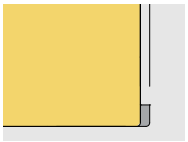
Optimal no. of tooth determination : Select the appropriate No. of tooth based on the application!

No sign (Coarse)
- Minimal no. of inserts
- Limited stability
- Long overhang
- Small machine/ limited power
- Deep pocket slot machining
- Uneven pitch

M (Close)
- General use
- Proper for multi-variety production
- Small to medium machine
- 1st recommended in general

H (Extra Close)
- Maximal no. of inserts to maximize productivity
- Stable cutting conditions
- Short chip material
- Heat-resistant alloy material

Optimal feed rate determination : Chip thickness varies upon the tool's approach angle so maximum feed rate also varies.

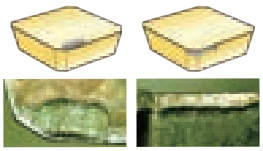
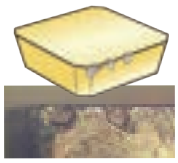
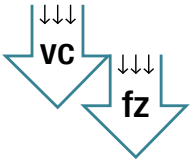
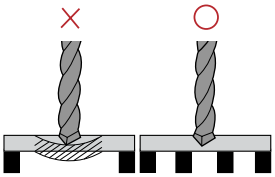
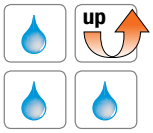
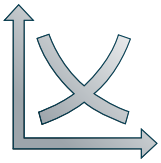
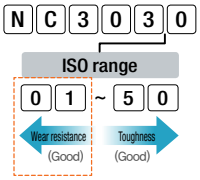
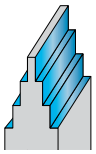
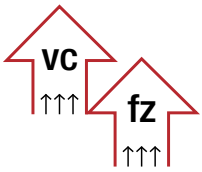
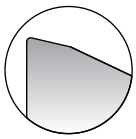
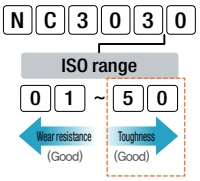
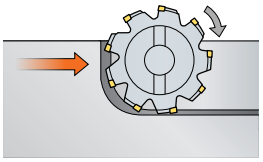
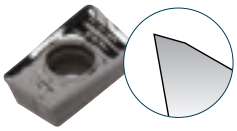
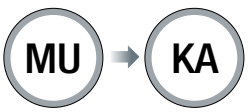
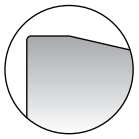
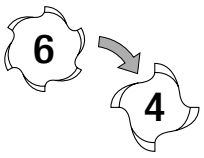
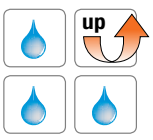
15°	45°	95°
		
		
		
$5.76 \times f_z$	$1.414 \times f_z$	f_z

→ **Main formula**

$$h_{ex} = f_z * \cos(AA)$$

$$f_z = \frac{h_{ex}}{\cos(AA)}$$

05 Troubles in cutting and solutions

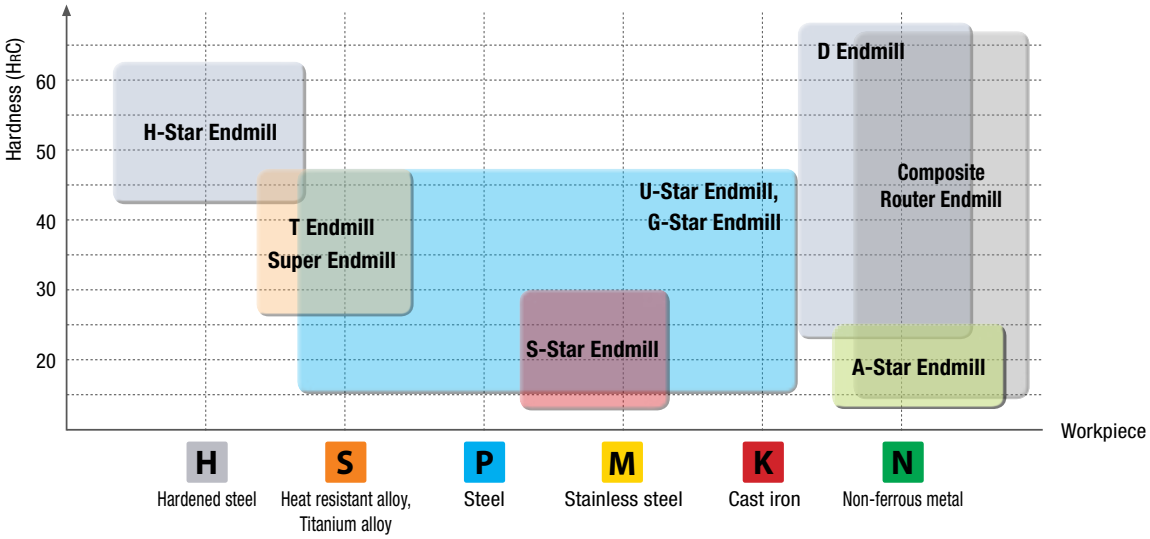
	Excessive wear	Chipping / fracture	Wrong chip evacuation (chip jamming)	Built-up edge / welding
Troubles				
Factors	• Excessive cutting speed/ excessive feed • Dull cutting edge • Low precision of tools	• Excessive feed • Weak jig • Long overhang	• Fracture on the corner • Chipping on the cutting edge and fracture • Re-cutting of chips	• Low cutting speed/ low feed • Negative shape • High adhesiveness material
Solutions	Cutting speed down, feed down 	Accurate clamping of workpiece 	Use more coolant and increase its pressure 	Check the cutting conditions 
	Use higher grade 	Feed down 	Multiple pass division of deep machining 	Cutting speed up, feed up 
	Applying C/B for low cutting load 	Use lower grade 	Upward cutting 	Positive I/S, Using polished inserts 
	Use high precision class inserts (higher tolerance) 	Applying a C/B for strong cutting edge 	Applying fewer teeth (pitches) 	Use more coolant and increase its pressure 

Endmill

01 Line-up

Workpiece	Use	Product name	Type	No. of tooth	Diameter (mm)	Picture / No. of standard items	Features	Promotional materials Link
H	High hardness (~HRC65)	cBN Endmill	B, R	2	0.4~2	 33 Items	• Higher productivity and surface finish in high speed cutting • Stable tool life and surface from high precision Endmill	INFO
H	High hardness (~HRC63)	H-Star Endmill	F, B, R	2~6	0.1~20	 3,007 Items	• Economical tools for high speed and high hardness machining • Available for various shapes of workpiece as long-neck	INFO
P K	Hardness (~HRC50)	U-Star Endmill	F, B, R, Ro	2~6	0.1~25	 4,585 Items	• Economical tools for general machining with high performance • For various workpiece machining (carbon steel, alloy steel, cast iron, pre-hardened, etc.)	INFO
P K	General (~HRC30)	G-Star Endmill	F, B, R	2~4	1.0~20	 456 Items	• For general machining with high performance and high quality • For various workpiece machining (carbon steel, alloy steel, cast iron, pre-hardened, etc.)	INFO
M	Stainless steel	S-Star Endmill	F, B, R, Ro	2~7	1.0~20	 187 Items	• Optimal performance in stainless machining • Enhanced oxidation resistance	INFO
S	HRSA	Super Endmill for HRSA	F, R	4	3.0~20	 162 Items	• Endmill for HRSA machining • Optimal for machining of Ni based HRSA such as Inconel, Hastelloy, Waspaloy, etc.	INFO
S	Titanium	Super Endmill for Ti	F, B, R	2/4	1.0~20	 64 Items	• Optimal edge design for stainless steel machining ensures stable machining by minimizing a sudden breakage • New coating with better oxidation resistance and higher surface hardness is applied and shows better performance on stainless steel series, titanium, Ni based and etc.	INFO
N	Non-ferrous metal, Aluminum	A-Star Endmill	F, B, Ro	2~3	1.0~20	 330 Items	• Effective chip evacuation in high feed machining with U-shape • Double relief angle (Stronger cutting edge hardness)	INFO
N	Non-ferrous metal, Aluminum	SSEA	F, B	2~3	1.0~20	 128 Items	• Good welding resistance and chip evacuation • Minimized cutting load and built-up-edge and good surface finish	INFO
N	Composite materials	Composite Router Endmill	F	2~8	4.0~12	 44 Items	• Router for composite material machining • High performance due to Nano-Crystalline dia-coating	INFO
N	Graphite, Ceramics	D Endmill	F, B, R	2~4	0.5~12	 280 Items	• Longer tool life due to high hardness dia-coating • Applying one-pass grinding and good surface finish	INFO
N	Dental, metal, wax, Zirconia	T Endmill	F, B	2	0.3~7.5	 214 Items	• Endmill for machining materials for stooping teeth, Zirconia, Titanium, Co-Cr, Wax, PMMA, etc. • Applicable to dental milling machine and various materials for stooping teeth	INFO
For general machining with special function	Roughing	R+ Endmill	Ro	2~4	5.0~25	 204 Items	• Endmill with a shape minimizing cutting load for roughing	INFO

02) Tool selection guide



Tool selection guideline by functions

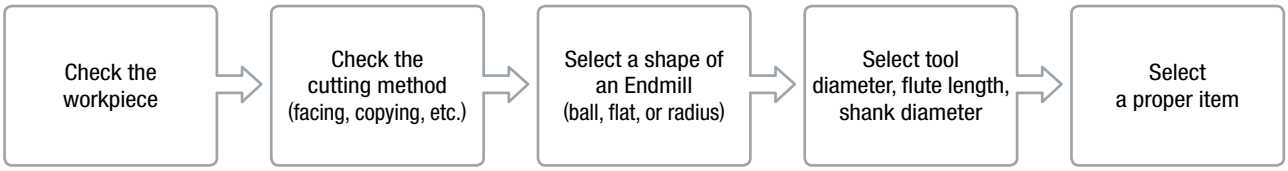
★ 1st recommended ☆ 2nd recommended

Type	No. of tooth		Precise finishing	Finishing	Roughing	Slotting	Plunging	Copying	Trochoidal milling
Flat/ Radius	2 teeth				☆	★	★		
	3 teeth			☆	☆	★	☆		
	4 teeth		★	★	★	★			★
	6 teeth or over		★	★					★
Ball	2 teeth					★		★	
	4 teeth					☆		★	

※ It is recommended to choose the shortest length tool in every application as possible.
※ Stable machining actualizes long tool life and enhanced surface finish.

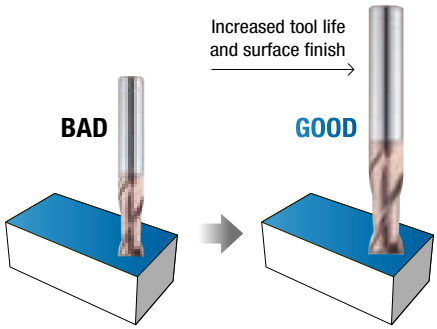
03 Useful cutting tip

How to select an Endmill

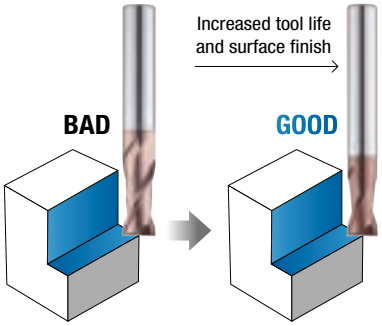


How to use an Endmill

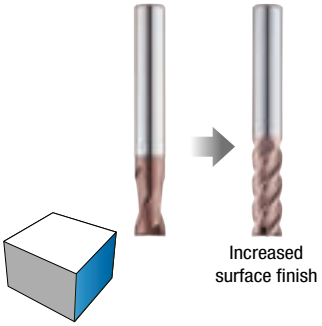
1) Using a larger diameter in case of no issues during machining



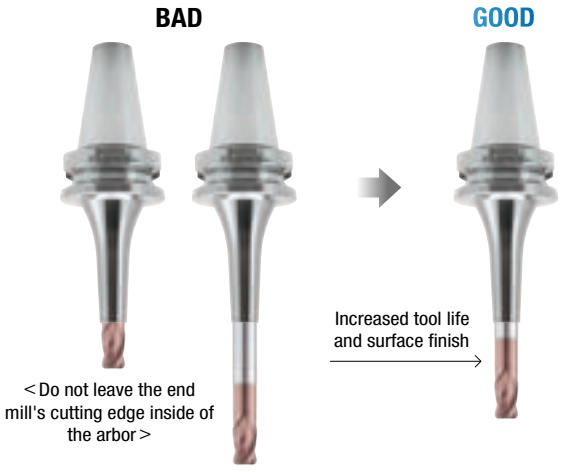
2) Use the shortest available flute length



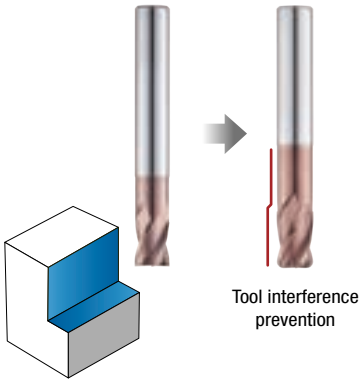
3) Use a tool with more flutes as possible for finishing



4) Maintain a short end mill overhang from arbor



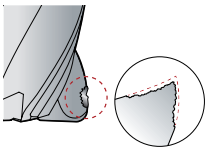
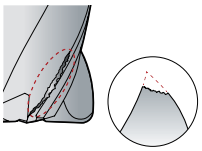
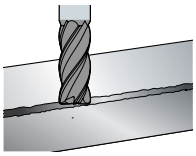
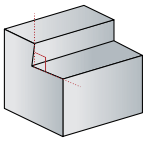
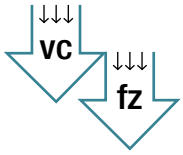
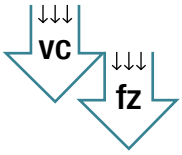
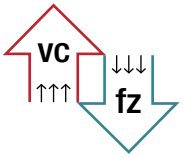
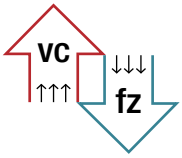
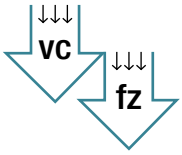
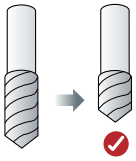
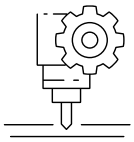
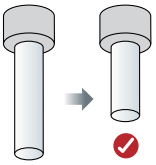
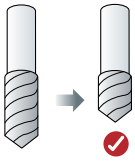
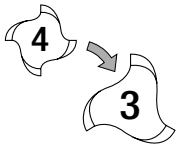
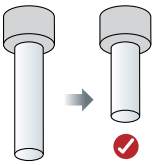
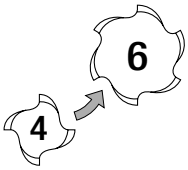
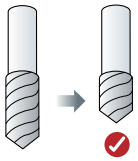
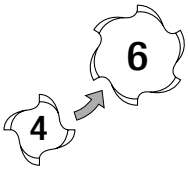
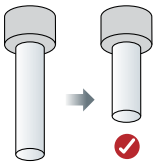
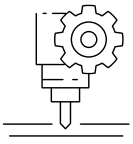
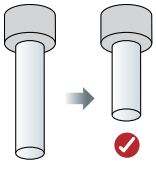
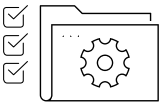
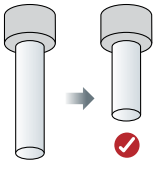
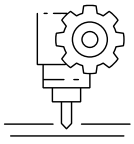
5) Use a necked tool for deep machining depths



※ In case you already have existing tools in use

Please install the KORLOY KTS app from Play Store or App store and utilize the Solid Tool Converter to select recommended tools. [App Store Link]

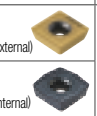
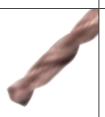
04) Troubles in cutting and solutions

	Chipping on the tool	Excessive wear on the tool	Bad surface finish	Defective dimensional accuracy, perpendicularity	Fracture in while cutting
Troubles					
Factors	• High speed / high feed • Long flute length, overhang	• High speed / high feed • Long overhang	• Vibration • Built-up edge	• Improper cutting conditions • Long flute length, overhang	• Improper cutting conditions • Long overhang
Solutions	Cutting speed down, feed down 	Cutting speed down, feed down 	Cutting speed up, feed down 	Cutting speed up, feed down 	Cutting speed down, feed down 
	Use a tool with short flute length 	Check the item (shape and grade) 	Select short overhang 	Use a tool with short flute length 	Enlarge the space for chip flowing (Decrease the no. of tooth) 
	Select short overhang 	Increase the no. of effective tooth 	Use a tool with short flute length 	Increase the no. of effective tooth 	Select short overhang 
	Check the item (shape and grade) 	Select short overhang 	Check the clamping of the facility, arbor and workpiece 	Select short overhang 	Check the item (shape and grade) 

Hole Making

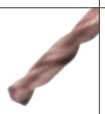
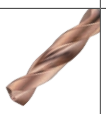
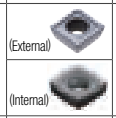
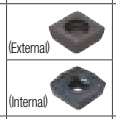
01) Line-up

(**vc** : m/min, **fn** : mm/rev)

ISO Work-piece	Machining types	Tolerance of hole	Drills dia.	Product	Depth of cut	holders		Inserts		Grade selection	Recommended cutting condition		Promotional materials Link
						Picture	Designation	Picture	Designation		vc	fn	
P	Through-hole	-0.15 ~ +0.4	Ø12~Ø60.5 Ø61~Ø100 (Cartridge type)	KING Drill	2D, 3D 4D, 5D		K□D		SPMT□-PD XOMT□-PD SPMT□-LD XOMT□-PD (For mild steel)	PC3700 PC5335 PC5335 PC5300	70 ~ 180	0.18 ~ 0.04	INFO
	Through-hole	0.0 ~ +0.1	Ø8.0 ~ Ø11.9	TPDX	3D, 5D, 8D		TPDX□D		TPD□XP	PC325U	50 ~ 140	0.35 ~ 0.12	INFO
	Through-hole	0.0 ~ +0.1	Ø10.0 ~ Ø32.9	TPDB Plus 1st (recommended)	3D, 5D, 8D 10D, 12D		TPDB□-P		TPD□B	PC5300	60 ~ 110	0.4 ~ 0.15	INFO
	Through-hole	0.0 ~ +0.1	Ø12.0 ~ Ø30.9	TPDC Plus 2nd (recommended)	1.5D 3D, 5D, 8D 10D, 12D		TPDC□D		TPD□CP	PC5335	40 ~ 120	0.48 ~ 0.1	INFO
	Flat / Blind hole	0.0 ~ +0.1	Ø12.0 ~ Ø30.9	TPDC Plus 1st (recommended)	1.5D 3D, 5D, 8D 10D, 12D		TPDC□D		TPD□CP-FC	PC5335	70 ~ 90	0.33 ~ 0.18	INFO
	Flat / Blind hole	0.0 ~ +0.1	Ø14.0 ~ Ø30.9	TPDB Plus 2nd (recommended)	1.5D		TPDB□-F		TPD□B-F	PC5400	60 ~ 80	0.32 ~ 0.2	INFO
	H-Beam, Plate	0.0 ~ +0.3	Ø14.0 ~ Ø30.9	TPDB-H	3D, 4D, 8D		TPDB□-H		TPD□B-H	PC340Q	60 ~ 75	0.3 ~ 0.15	INFO
	Through-hole	0.0 ~ +0.1 (Highly precise)	Ø2.5 ~ Ø20.0	MSD Plus	3D, 5D, 7D (Internal coolant)		MSDPH-□P	-	-	PC325U	50 ~ 120	0.4 ~ 0.08	INFO
	Through-hole	0.0 ~ +0.1 (Highly precise)	Ø1.0 ~ Ø20.0	W-Star Drill 1st (recommended)	5D, 7D (External coolant)		NDPG50□	-	-	PC325W	40 ~ 120	0.32 ~ 0.06	INFO
	Through-hole	0.0 ~ +0.1 (Highly precise)	Ø1.0 ~ Ø20.0	ESD Plus 2nd (recommended)	3D, 5D, 7D (External coolant)		ESDP-□	-	-	PC325U	40 ~ 120	0.32 ~ 0.06	INFO
	Through-hole	0.0 ~ +0.1 (Highly precise)	Ø3.0 ~ Ø10.0	MLD Plus	10D ~ 25D (External coolant, MQL)		MLD□N-□	-	-	PC315G	60 ~ 90	0.25 ~ 0.08	INFO
	Flat / Blind hole	0.0 ~ +0.1 (Highly precise)	Ø2.5 ~ Ø16.0	MSFD	2D (External coolant) 3D (Internal coolant)		MSFD(H)□	-	-	PC325U	50 ~ 90	0.20 ~ 0.03	INFO
M	Through-hole	-0.15 ~ +0.4	Ø12~Ø60.5 Ø61~Ø100 (Cartridge type)	KING Drill 1st (recommended)	2D, 3D 4D, 5D		K□D		SPMT□-LD XOMT□-LD (For carbon steel)	PC5335 PC5335	80 ~ 140	0.08 ~ 0.04	INFO
	Through-hole	-0.15 ~ +0.4	Ø12~Ø60.5 Ø61~Ø100 (Cartridge type)	KING Drill 2nd (recommended)	2D, 3D 4D, 5D		K□D		SPMT□-PD XOMT□-PD	PC9540 PC9540	60 ~ 120	0.08 ~ 0.04	INFO
	Through-hole	0.0 ~ +0.1	Ø12.0 ~ Ø30.9	TPDC Plus	1.5D 3D, 5D, 8D 10D, 12D		TPDC□D		TPD□CM	PC330N	50 ~ 90	0.35 ~ 0.05	INFO

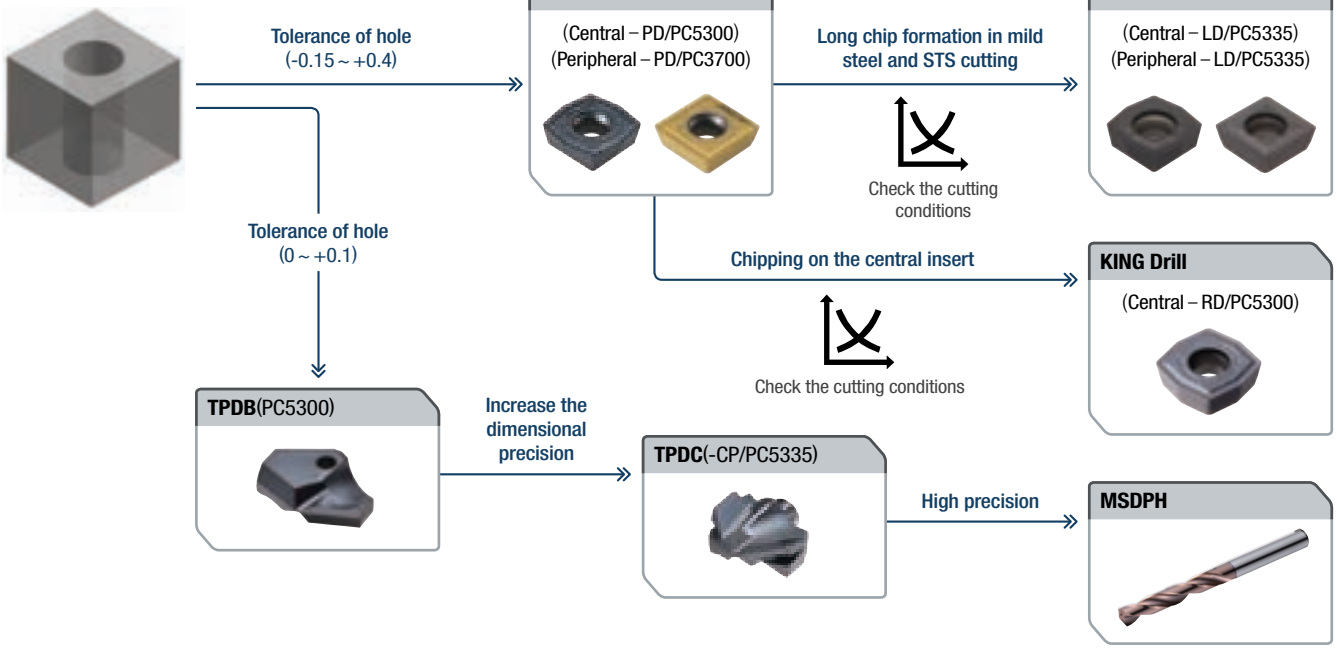
01) Line-up

(**vc**:m/min, **fn**:mm/rev)

ISO Work-piece	Machining types	Tolerance of hole	Drills dia.	Product	Depth of cut	holders		Inserts		Grade selection	Recommended cutting condition		Promotional materials Link
						Picture	Designation	Picture	Designation		vc	fn	
M	Through-hole	0.0 ~ +0.1 (Highly precise)	Ø2.5 ~ Ø20.0	MSD Plus	3D, 5D, 7D (Internal coolant)		MSDPH-□M	-	-	PC325U	25 ~ 80	0.3 ~ 0.05	INFO
	Through-hole	0.0 ~ +0.1 (Highly precise)	Ø1.0 ~ Ø20.0	W-Star Drill	5D, 7D (External coolant)		NDPG50□	-	-	PC325U	20 ~ 64	0.24 ~ 0.04	INFO
P M K	Through-hole	0.0 ~ +0.1 (Highly precise)	Ø3.0 ~ Ø20.0	P-Star	3D, 5D, 8D		(H)P(I)50□	-	-	-	40 ~ 120	-	INFO
	Through-hole	0.0 ~ +0.1 (Highly precise)	Ø1.0 ~ Ø20.0	W-Star Drill	5D, 7D		NDPG50□	-	-	-	40 ~ 120	-	INFO
K	Through-hole	-0.15 ~ +0.4	Ø12~Ø60.5 Ø61~Ø100 (Cartridge type)	KING Drill	2D, 3D 4D, 5D		K□D	 (External) (Internal)	SPMT□-PD XOMT□-PD	PC6510 PC5300	100 ~ 250	0.26 ~ 0.04	INFO
	Through-hole	0.0 ~ +0.1	Ø10.0 ~ Ø32.9	TPDB Plus 1st (recommended)	3D, 5D, 8D 10D, 12D		TPDB□-P		TPD□B	PC5300	70 ~ 140	0.45 ~ 0.18	INFO
	Through-hole	0.0 ~ +0.1	Ø12.0 ~ Ø30.9	TPDC Plus 2nd (recommended)	1.5D 3D, 5D, 8D 10D, 12D		TPDC□D		TPD□CP	PC5300	70 ~ 140	0.55 ~ 0.2	INFO
	Through-hole	0.0 ~ +0.1 (Highly precise)	Ø2.5 ~ Ø20.0	MSD Plus	3D, 5D, 7D (Internal coolant)		MSDPH-□K	-	-	PC325U	70 ~ 150	0.4 ~ 0.1	INFO
	Through-hole	0.0 ~ +0.1 (Highly precise)	Ø1.0 ~ Ø20.0	W-Star Drill	5D, 7D (External coolant)		NDPG50□	-	-	PC325W	56 ~ 120	0.32 ~ 0.08	INFO
N	Through-hole	-0.15 ~ +0.4	Ø12~Ø60.5 Ø61~Ø100 (Cartridge type)	KING Drill	2D, 3D 4D, 5D		K□D	 (External) (Internal)	SPMT□-ND XOMT□-ND	H01 H01	200 ~ 400	0.25 ~ 0.05	INFO
	Through-hole	0.0 ~ +0.1	Ø12.0 ~ Ø30.9	TPDC Plus	1.5D 3D, 5D, 8D 10D, 12D		TPDC□D		TPD□CN	H01	70 ~ 220	0.55 ~ 0.28	INFO
	Through-hole	0.0 ~ +0.1 (Highly precise)	Ø1.0 ~ Ø13.0	SSD-N	-		SSD□□□-N	-	-	H01	65 ~ 120	0.18 ~ 0.03	INFO
	Through-hole	0.0 ~ +0.1 (Highly precise)	Ø2.5 ~ Ø20.0	MSD Plus	3D, 5D, 7D (Internal coolant)		MSDPH-□N	-	-	FG2	40 ~ 150	0.4 ~ 0.05	INFO
S	Through-hole	-0.15 ~ +0.4	Ø12~Ø60.5 Ø61~Ø100 (Cartridge type)	KING Drill	2D, 3D 4D, 5D		K□D	 (External) (Internal)	SPMT□-PD XOMT□-PD	PC5300 PC5300	30 ~ 100	0.16 ~ 0.04	INFO
	Through-hole	0.0 ~ +0.1 (Highly precise)	Ø2.5 ~ Ø20.0	MSD Plus	3D, 5D (Internal coolant)		MSDPH-□S	-	-	PC325T	20 ~ 50	0.23 ~ 0.045	INFO

02) Tool selection guide

Through-hole machining

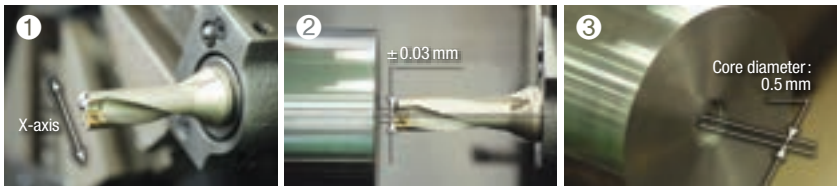


Application products

Machining convex side	Machining concave side	Boring	Ramping	Machining cross holes	Machining overlapped holes
					
KING Drill	KING Drill	KING Drill	KING Drill	KING Drill	KING Drill
TPDB Plus	TPDB Plus	-	TPDB - F	TPDB Plus	TPDB - F
TPDC Plus	TPDC Plus	-	TPDC - FC	TPDC Plus	TPDC - FC
MSDPH	MSDPH	-	MSFD	MSDPH	MSFD
W-Star Drill	W-Star Drill	-	W-Star Drill	W-Star Drill	-
ESD Plus	ESD Plus	-	ESD Plus	ESD Plus	-

03 Useful cutting tip

Notice for setting the drill in the lathe

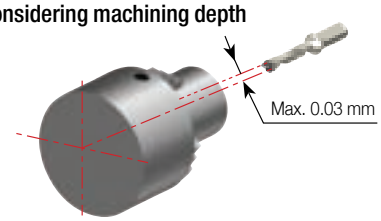


- Set the peripheral insert parallel to the X axis (based on the side lock)
- If the machined core is about 0.5 mm after machining 5 mm, that is the proper setting

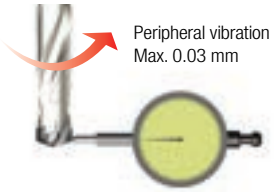
※ Please make sure that the location of the side lock could be different depending on manufacturers of machine

Notice for setting the top solid indexable drill

Use the shortest drill as possible after considering machining depth



[Setting of the horizontal equipment]



[Setting of the vertical equipment]

How to drill a deep hole (10D/12D)

Using a pilot drill (Recommended)

1. Drilling a pilot hole (with a pilot drill)

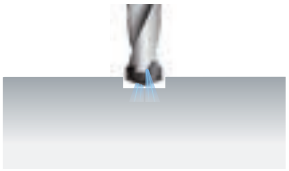
- Drill a 0.5D pilot hole in 70% lower cutting speed with 1.5D drill or 3D drill

2. Start drilling

- Start drilling in recommended cutting conditions after replacing the drill

Without pilot drill

1. Drilling a pilot hole (without a pilot drill)



- After drill 0.5D with 70% lower cutting speed, stop drilling for 2-3 seconds putting the drill in the hole

2. Stop drilling

- Stop supplying the coolant and completely take out the drill from the hole. Then, stop drilling for 2-3 seconds

3. Ready to drill

- After putting the drill in the hole to 2-3 mm upper than the bottom of the pilot hole, start supplying the coolant. Then, be ready to start drilling

4. Stop drilling

- Start drilling in recommended cutting conditions

Cautions when drilling

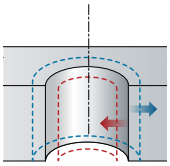
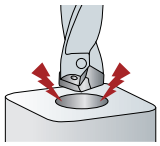
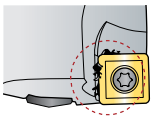
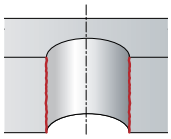
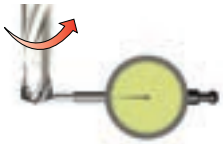
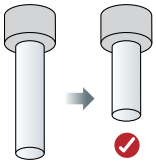
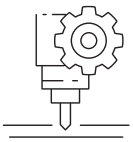
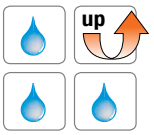
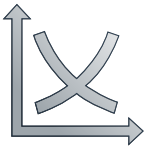
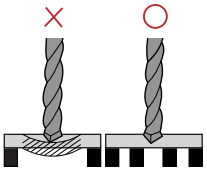
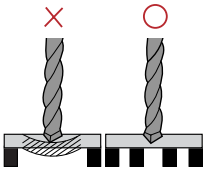
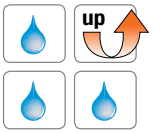
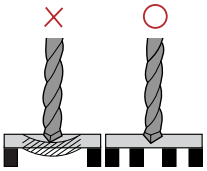
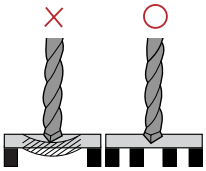
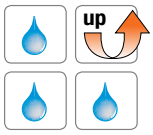
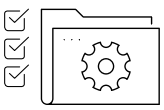
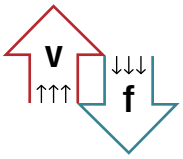
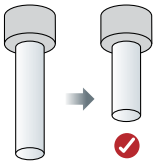
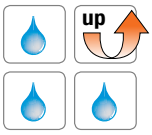
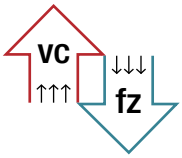
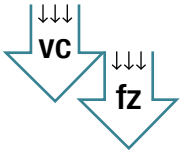
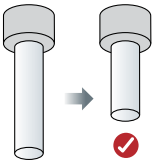
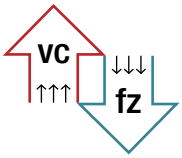
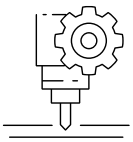
- Supply enough coolant to the beginning of the hole
- Minimum pressure of oil coolant : 5 bar
- Minimum flow of coolant : 1.321 gal/min

[Internal coolant]

[External coolant]

[Non-dry processing]

04) Troubles in cutting and solutions

	Wrong hole size : Both shrunken or enlarged	**Chattering in cutting**	**Wrong chip evacuation** (chip jamming)	**Bad surface finish of hole**	**Short tool life of insert**
Troubles					
Factors	• Wrong setting • Lack of coolant	• Long overhang • Weak jig	• Fracture of corner • Lack of coolant	• Lack of coolant • Weak jig	• High speed / high feed • Weak jig
Solutions	Check the status of drill run-out 	Select short overhang 	Check the item (shape and grade) 	Use more coolant and increase its pressure 	Check the cutting conditions 
	Accurate clamping of workpiece 	Accurate clamping of workpiece 	Use more coolant and increase its pressure 	Accurate clamping of workpiece 	Accurate clamping of workpiece 
	Use more coolant and increase its pressure 	Check the clamping of the facility, arbor and workpiece 	Cutting speed up, feed down 	Select short overhang 	Use more coolant and increase its pressure 
	Cutting speed up, feed down 	Cutting speed down, feed down 	Select short overhang 	Cutting speed up, feed down 	Check the item (shape and grade) 

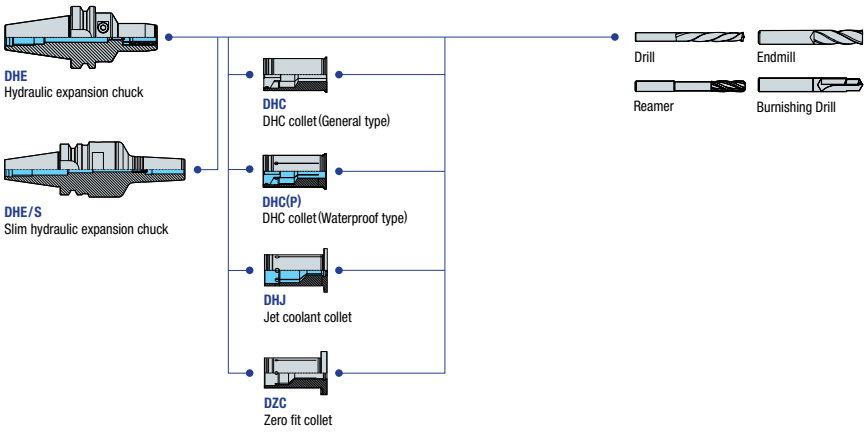
DINOX map

Division	Milling chuck	Hydraulic expansion chuck	Shrinking chuck
Use	Low to medium speed machining/ general machining	High speed finishing/ precision machining	High speed finishing for narrow and deep shape
Maintaining clamping force	★★★★	★★	★★★
Precision	★★	★★★	★★★★
High speed machining	★	★★★★	★★★★
Easy to use	★★★	★★★★	★★

Hydraulic expansion chuck

DHE

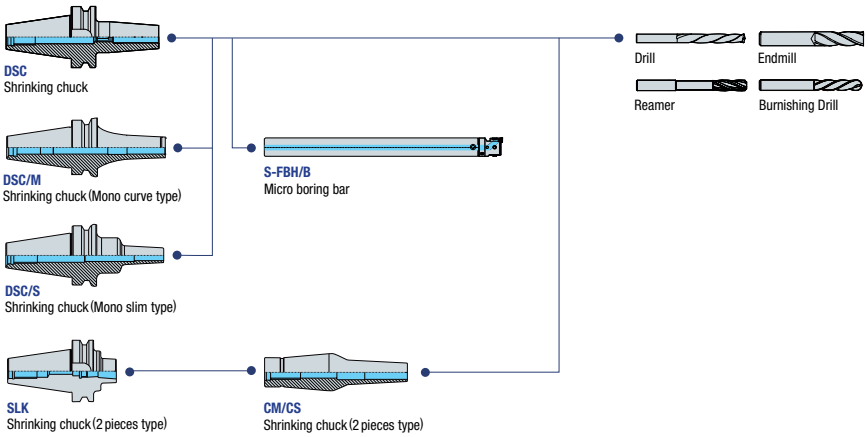
DHE/S



Shrinking chuck

DSC

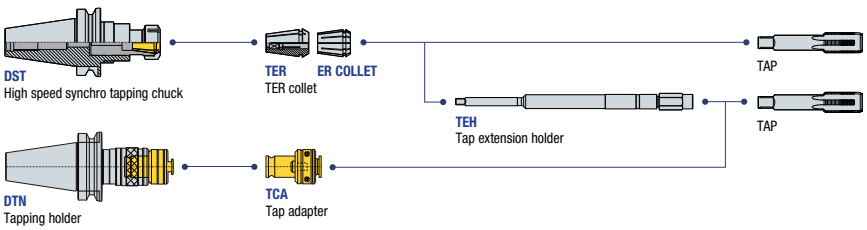
DSC/S



Tapping holder

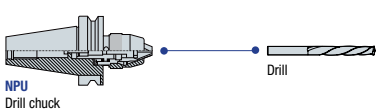
DTN

DST



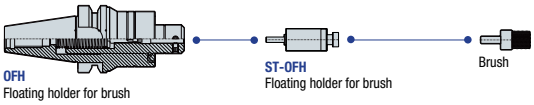
Drill chuck

NPU



Floating holder for brush

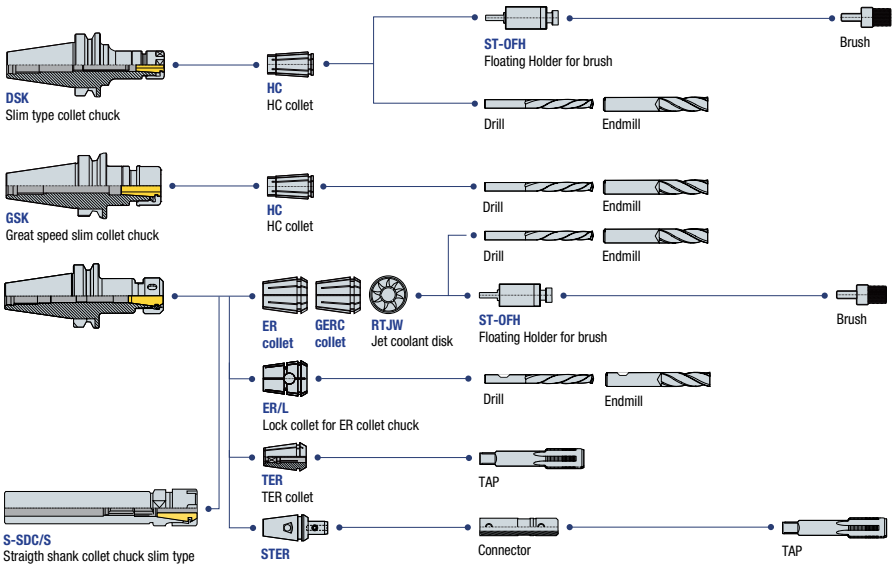
OFH



Collet chuck

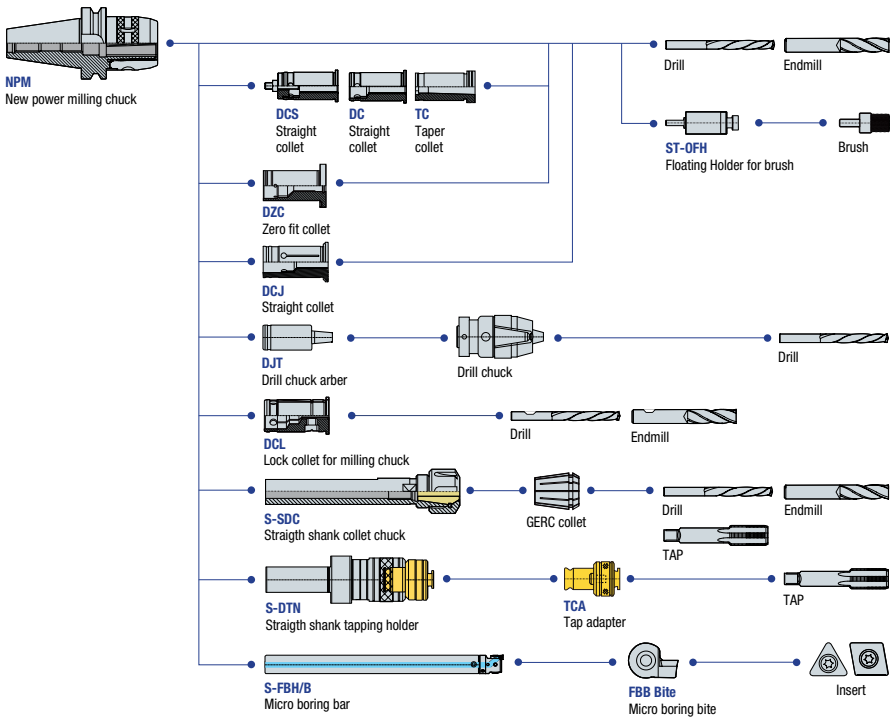
SDC/P

GSK



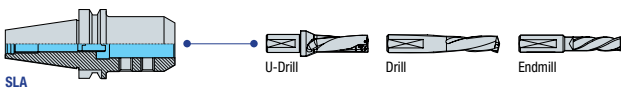
Milling chuck

NPM



Side lock arbor

SLA

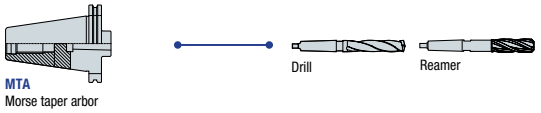


Tooling systems

DINOX map

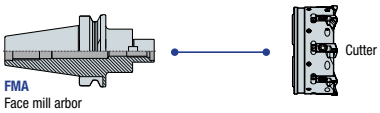
Morse taper arbor

MTA



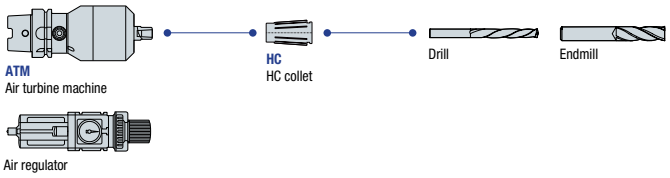
Face mill arbor

FMA



Air spindle

ATM

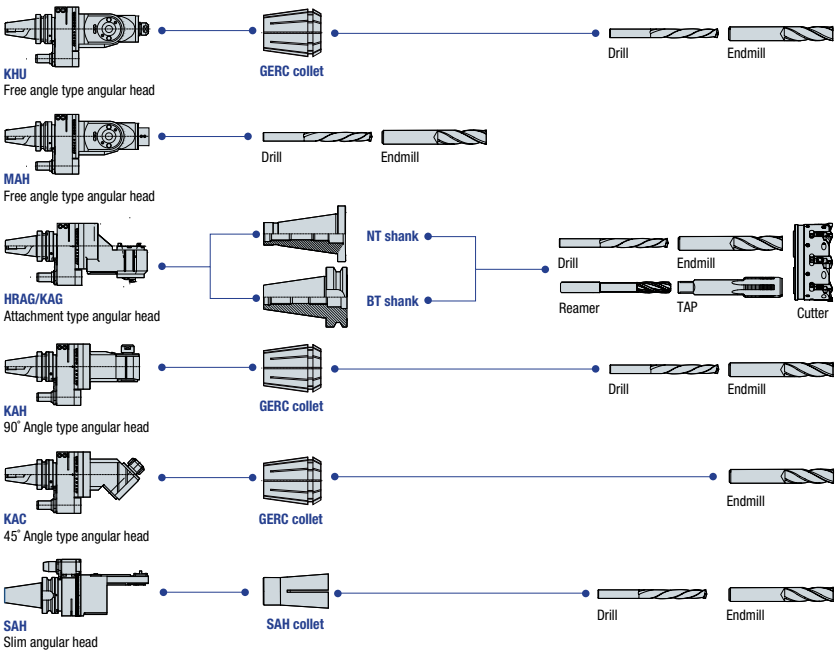


Angular head

KAH

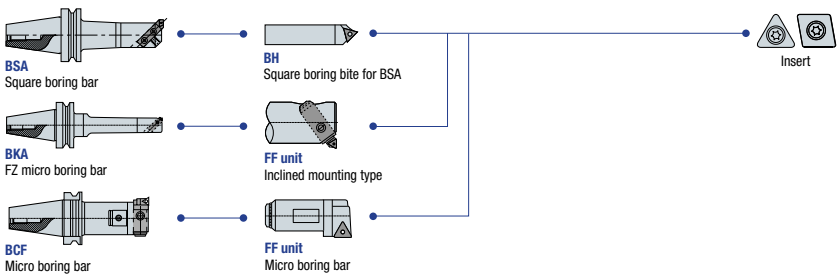
MAH

KAG



Boring series

BT-FBH/B

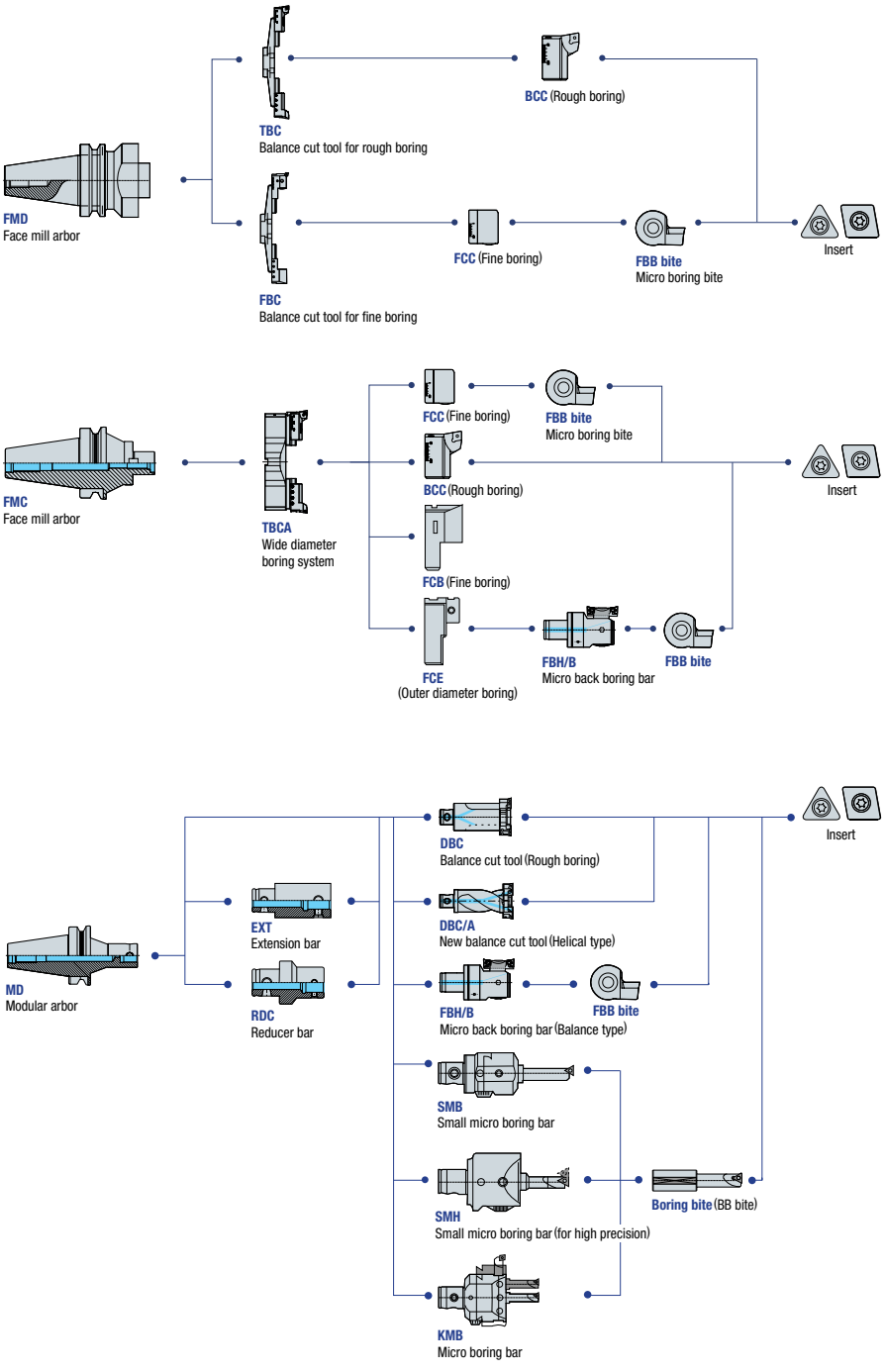


Boring series

BCF

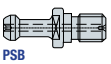
TBC, FBC

KMB

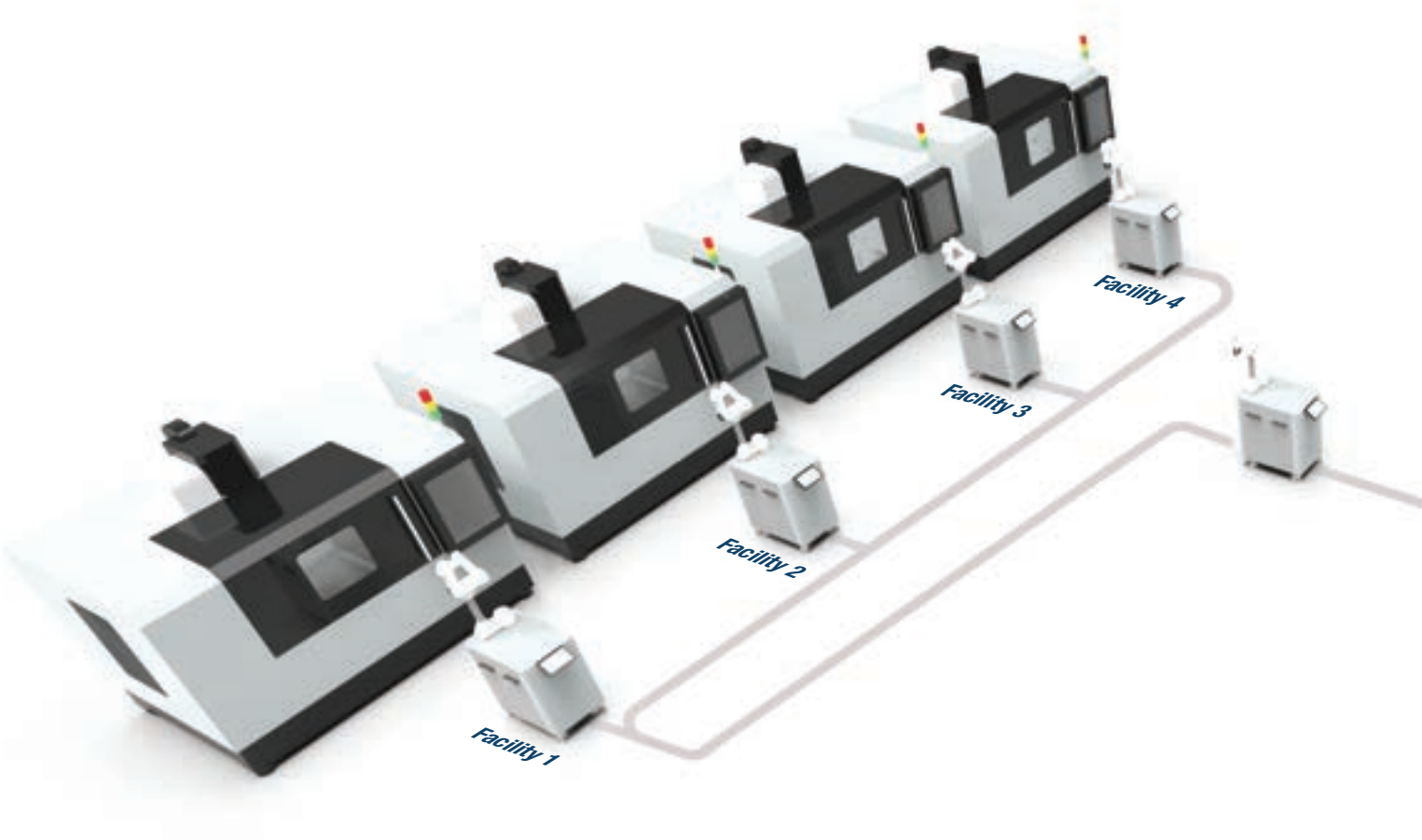


Pull stud bolt

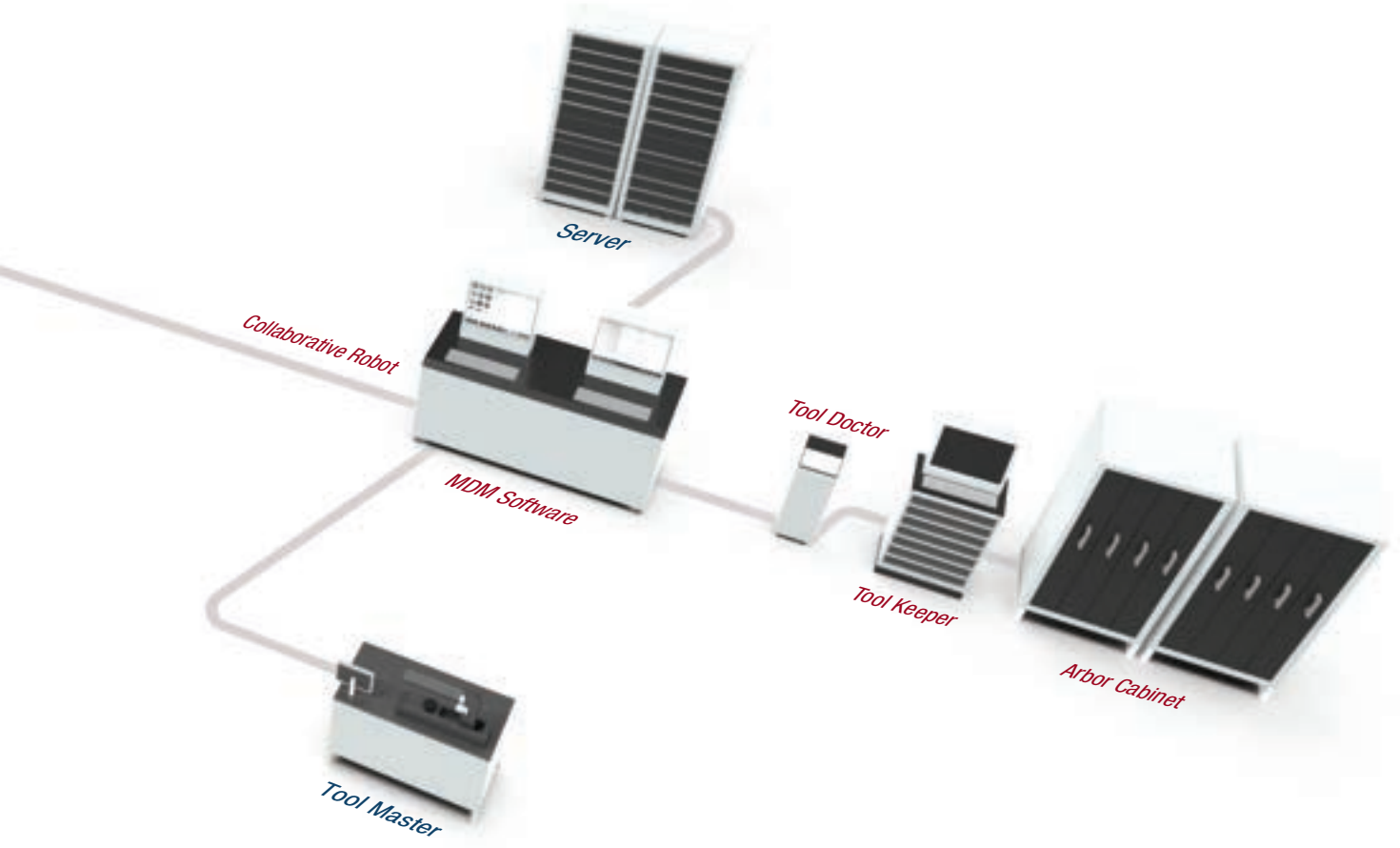
PSB



Smart factory solution map



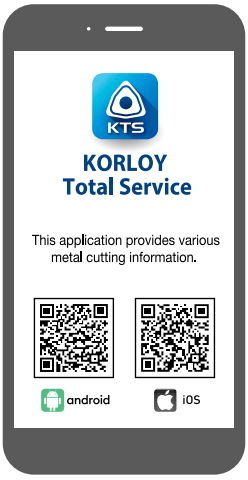
Collaborative Robot	Tool Master (Tool pre-setter)	MDM (Tool management S/W)
• Optimal for repeated work in small place • Effective on works with heavy weight materials	• Measuring the offset of tool length in advance • Reduced tool setting time and downtime	• Managing the tool holder information → Cutting diameter, overall length, storage location • Integrated management of tool, production, CAM, etc.



Tool Doctor (Monitoring system)	Tool Keeper (Tool management equipment)	Arbor Cabinet (Storage box exclusive for Arbors)
• Managing poor quality product manufacturing in mass production → Tool breakage, unprocessed item check, and re-processing • Managing tool life trends	• Managing tool releases day and night • Systemic management of stock and inventory backup order • Transparent tool usage results management	• Enhancing space efficiency and protecting tools (from damage or pollution of tools due to debris of work sites) • Capable for running virtual warehouse with Tool Keeper (Managing position and quantity of tools)

⚠ For the safe metalcutting

- Use safety supplies such as protective gloves to prevent possible injury while touching the edge of tools.
- Use safety glasess or safety cover to hedge possible dangers. Inappropriate usage or excessive cutting condition may lead tool's breakage or even the fragment's scattering.
- Clamp the workpiece tightly enough to prevent its movement while its machining.
- Properly manage the tool change phase because the inordinately used tool can be easily broken under the excessive cutting load or severe wear, and it may threat the operator's safety.
- Use safety cover because chips evacuated during cutting are hot and sharp and may cause burns and cuts. To remove chips safely, stop machining, put on protective gloves, and use a hook or other tools.
- Prepare for fire prevention measures as the use of the non-water soluble cutting oil may cause fire.
- Use safety cover and other safety supplies because the spare parts or the inserts can be pulled out due to centrifugal force while high speed machining.



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