

Tools Selection Guide



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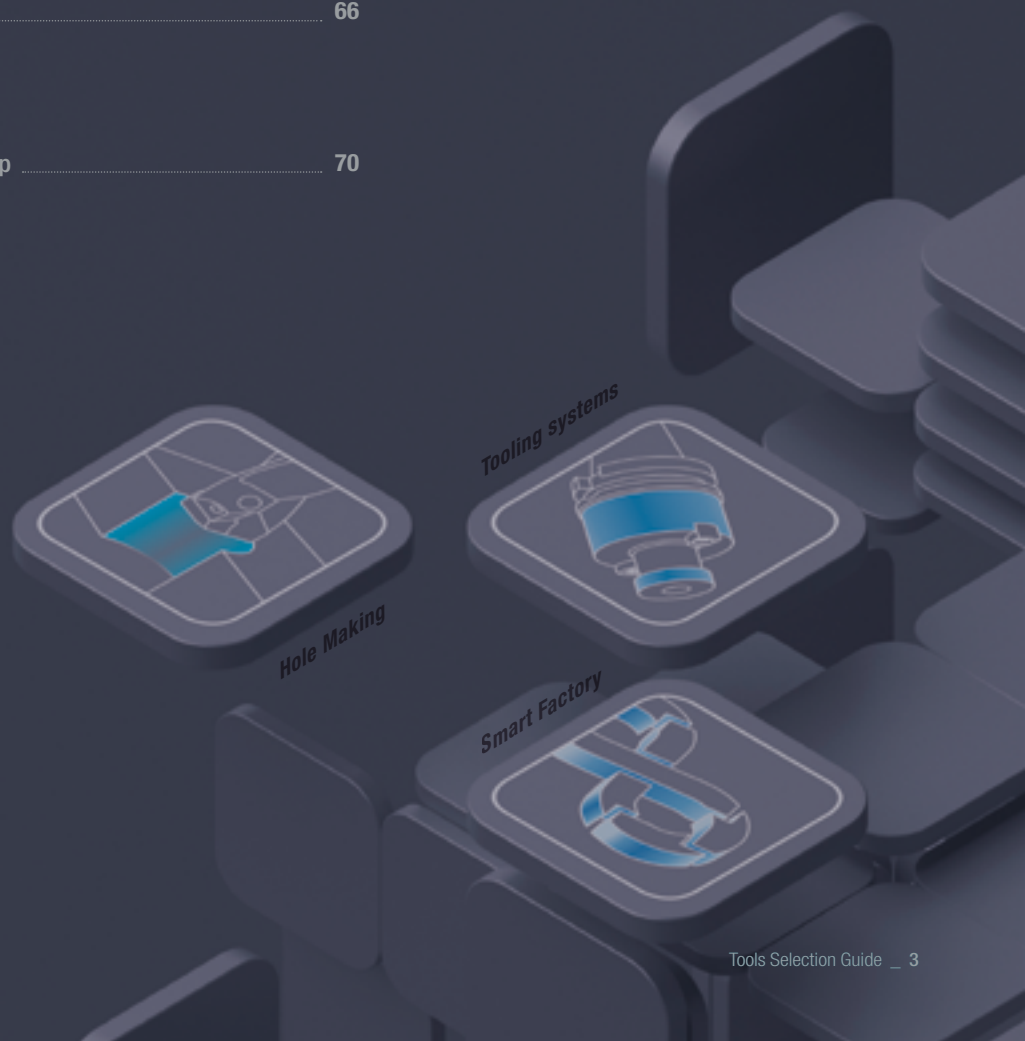
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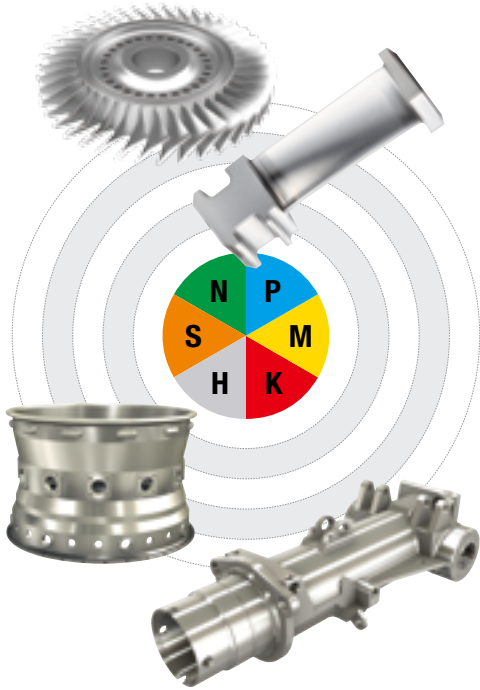
✓ Pre-Checklist for tool selection

➔ Machining operation analysis sequence



- To analyze machining operation, follow the steps above.
- From Cutting tools to Problem-solving, 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 designated sales office listed on the last page for a detail explanation.

↻ Workpieces



○ Workpiece materials

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

○ Workpiece shapes

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

○ Workpiece tolerance

Section	Recommendations or Suggestions	
Dimensional accuracy	Roughing	Apply cost-effective tools + coating material
	Finishing	Consider applying precision-grade tools + non-coated materials
Surface finish		Consider applying wipers + non-coated materials

↻ Equipment



○ Equipment

Section	Recommendations or Suggestions	
Equipment power	Low horsepower	Select low cutting resistant tools
	High horsepower	Select high-productivity tools
Equipment stability (Model year, condition)	Good	Consider using custom made tools
	Aged	Consider using ISO Tools
Number of axis	General facilities	Consider using ISO Tools
	Multiaxial equipment	Use tools with higher clamping stability
Clamping workpiece	Wrong clamping	Reassess equipment clamping status

○ Tooling System

Section	Recommendations or Suggestions	
Overhang	Short	Use general tools
	Long	Select low cutting edge angle and Anti-vibration tools
Arbor size	Small (BT30)	Apply compact tools with fewer teeth
	Large (BT50)	Select high-productivity tools, application of multiple teeth
Run-out	Defect	Check spindle condition and reviewing equipment overhaul

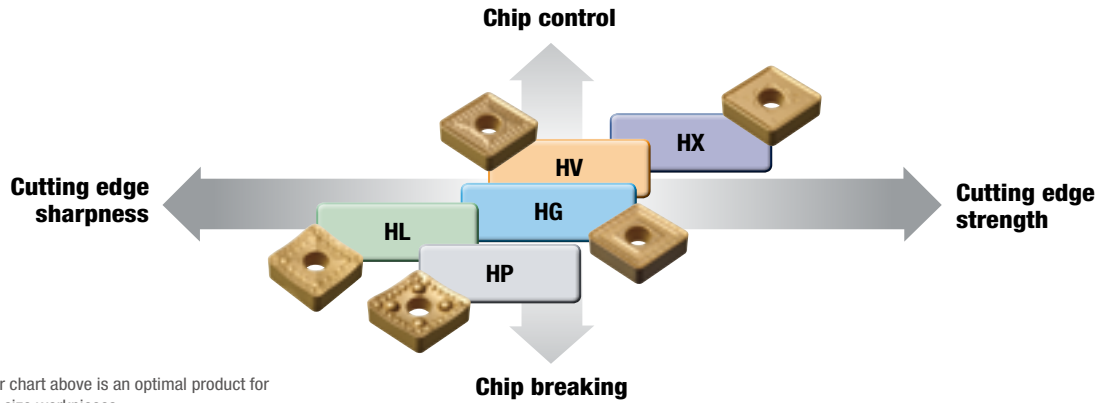
Turning

- 01) Line-up
- 02) Tool selection guide
- 03) Useful cutting tip
- 04) Troubles in cutting and solutions



01) Line-up

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



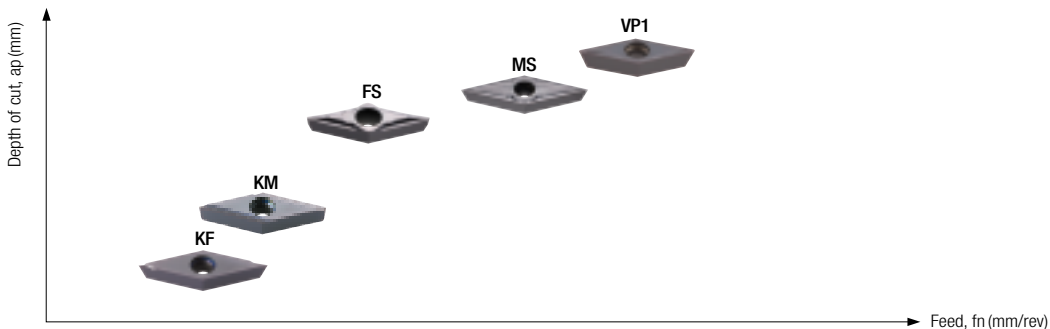
※ The chip breaker chart above is an optimal product for machining large size workpieces
 ※ Representative insert: CNMM250924

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

Workpiece	Single- sided insert (Positive)				Double- sided insert (Negative)				
	Finishing	Medium to finishing	Medium cutting	Roughing	Ultra finishing	Finishing	Medium to finishing	Medium cutting	Roughing
P Coating	FP	VL	MP	C25	FP	VL	LP	MP	GR
P Cermet	FP	VL	MP	C25		VL	VB	VQ	GM
M	FP	VL	MP	C25		FM	VP2	MM	RM
K		VL	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 chip breaker selection based on chip control or toughness issues, detail information can be found on the back page
 ※ Representative insert: CNMG120408

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



※ The chip breaker table above is Auto Tools products which is for small precision component machining.



02) Grade selection guide

Steel Turning

Workpiece	ISO	Grade - Recommended cutting speed(m/min)								
		Wear resistance ← ● →				Toughness				
		P05	P15	P20	P25	P30	P35	P40	P45	
P	VC (m/min)									
	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		VB (0.1~0.28)	VF (0.1~0.3)						
	Ultra finishing	FP (0.05~0.25)	VL (0.08~0.27)							
	wiper						VW (0.15~0.50)	LW (0.25~0.70)		
	Roughing						C25 (0.10~0.30)			
Positive	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 above is based on SM45C carbon steel.
 ※ Recommended cutting conditions may vary depending on the workpiece materials

Steel Turning (Heavy)

* Inscribed circle, 19 or greater

Workpiece	ISO	Grade - Recommended cutting speed(m/min)					
		Wear resistance ← ● →			Toughness		
		P05	P15	P20	P25	P35	P40
P	VC (m/min)						
	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 (ASTM)	Cutting conditions		
				(Cutting speed for each material was adjusted based on the reference values set at 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%	100% (Standard)
	Hardened	42CrMo4	4140(H)	78%		
	High Manganese (12~14% Mn)	22Mn6	(A128, B-2)	65%		

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



02) Grade selection guide

Steel Turning (Cermet)

Workpiece	ISO	Grade - Recommended cutting speed(m/min)					
		Wear resistance ← ● → Toughness					
		P05	P10	P15	P20	P25	P30
P	vc (m/min)						
	300		CC1015 (200~400)				
	270			CC1025 (180~350)			
	250			CN1500 (150~250)			
	220					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 (0.08~0.27)				
	Ultra finishing	FP (0.05~0.25)					
	Positive	Roughing					
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 above is based on SM45C carbon steel.
 ※ Recommended cutting conditions may vary depending on the workpiece materials

Workpiece	Workpiece materials	ISO (DIN)	AISI (ASTM)	Cutting conditions (Cutting speed for each material was adjusted based on the reference values set at 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%	100% (Standard)
	Hardened	42CrMo4	4140(H)	78%		
Sintered ferrous alloy	Fe - Cu - C (C = 0.2~1.0%)	[JIS, SMF4030]	-	70%	70%	



02) Grade selection guide

Stainless steel Turning

Workpiece	ISO	Grade - Recommended cutting speed(m/min)								
		Wear resistance ← • → Toughness								
		M05	M10	M15	M20	M25	M30	M35	M40	
M	vc (m/min)									
	250			NC9115 (220~260)						
	200		PC8105 (115~235)			NC9125 (190~230)		NC3235 (180~220)		
	150			PC8110 (105~225)	PC8115 (100~215)	PC5300 (90~190)		NC9135 (160~200)		
	125						PC9035 (75~175) PC9030 (80~180)			
	100							PC5400 (60~160)		
	Application	Chip breaker (Recommended cutting conditions)								
		Chip control ← • → Strength of cutting-edges								
	Negative	Roughing							RM (0.25~0.55)	
		Medium cutting								
Medium to finish cutting				MP (0.2~0.45)	MM (0.2~0.50)					
Finishing		FM (0.1~0.3)								
Roughing								C25 (0.10~0.30)		
Medium cutting				HMP (0.07~0.23)	MP (0.08~0.25)					
Positive	Finishing	FP (0.02~0.10)	VL (0.05~0.12)							

※ Recommended cutting speed above is for austenitic stainless steel STS304
 ※ Recommended cutting conditions may vary depending on the workpiece materials

Cast iron Turning

Workpiece	ISO	Grade - Recommended cutting speed(m/min)						
		Wear resistance ← • → Toughness						
		K05	K10	K15	K20	K25	K30	
K	vc (m/min)							
	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)
Medium cutting				MK (0.2~0.5)	B25 (0.25~0.55)			
Medium to finish cutting				MP (0.1~0.45)				
Roughing						C25 (0.10~0.30)		
Positive	Medium to finish cutting			MP (0.08~0.25)				

Workpiece	ISO (DIN)	AISI (ASTM)	Cutting conditions		
			(Cutting speed for each material was adjusted based on the reference values set at 100%)		
			Cutting speed (m/min)	Feed	Depth of cut
Austenitic	(X5CrNi 18-10)	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 (φ300 and above), CVD grades are recommended, while for small cutting materials (φ150 and below), PVD grades are recommended.

Workpiece	ISO (DIN)	AISI (ASTM)	Cutting conditions		
			(Cutting speed for each material was adjusted based on the reference values set at 100%)		
			Cutting speed (m/min)	Feed	Depth of cut
Gray cast iron	250	(A48, class35)	100% (Standard)	100% (Standard)	
	350	(A48, class50)	95%		
Ductile 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 above is based on GC250 gray cast iron.
 ※ Recommended cutting conditions may vary depending on the workpiece materials



02) Grade selection guide

Heat resisting alloy Turning

Workpiece	ISO	Grade - Recommended cutting speed(m/min)						
		Wear resistance ← • → Toughness						
		S05	S10	S15	S20	S25	S30	S35
S	vc (m/min)							
	60	PC8105 (40~80)						
	55		PC8110 (35~75)					
	50			PC8115 (30~70)				
	45				PC5300 (30~60)			
	40			NC9125 (20~60)		PC9035 (25~55)	NC9135 (20~60)	
35						PC5400 (25~50)		
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)	FM (0.1~0.3)					
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)				

Aluminium Turning

Workpiece	ISO	Grade - Recommended cutting speed(m/min)				
		Wear resistance ← • → Toughness				
		N05	N10	N15	N20	N25
N	vc (m/min)					
	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)		
	Roughing			AR (0.05~0.5)		
Positive	Medium cutting		AM (0.04~0.45)			
	Finishing	AK (0.03~0.4)				

Workpiece	ISO (DIN)	AISI (ASTM)	Cutting conditions		
			Cutting speed (m/min)	Feed	Depth of cut
Ti alloy	Ti-6Al-4V	Ti-6Al-4V	110%	110%	100% (Standard)
Ni series	(NiCr22Mo9Nb)	(B443)	100% (Standard)	100% (Standard)	
	(NiCr19Fe19Nb5Mo3)	(B637)			
Co series	Stellite	Stellite	85%	90%	
Fe series	-	Inconel909			






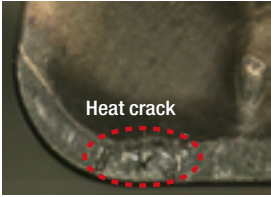

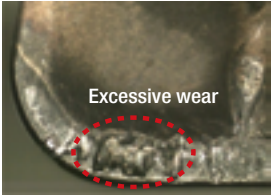
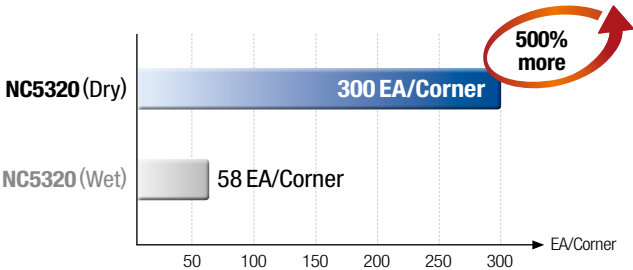
Workpiece	ISO (DIN)	AISI (ASTM)	Cutting conditions		
			Cutting speed (m/min)	Feed	Depth of cut
Graphite	Graphite	-	110%	100% (Standard)	100% (Standard)
Al alloy	G9GK0-ALLi7Mg (GD-AISI10Mg) (GD-AISI9Cu3)	-	100% (Standard)	90%	
Composite materials	CFRP	-	90%		

※ The recommended cutting speed above is based on Inconel 718, a nickel-based alloy.
 ※ Recommended cutting conditions may vary depending on the workpiece materials



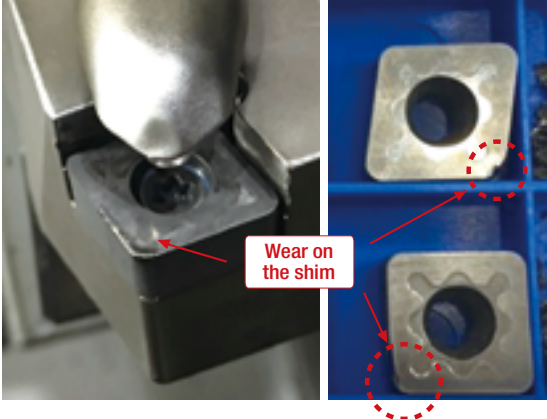

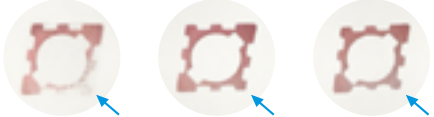

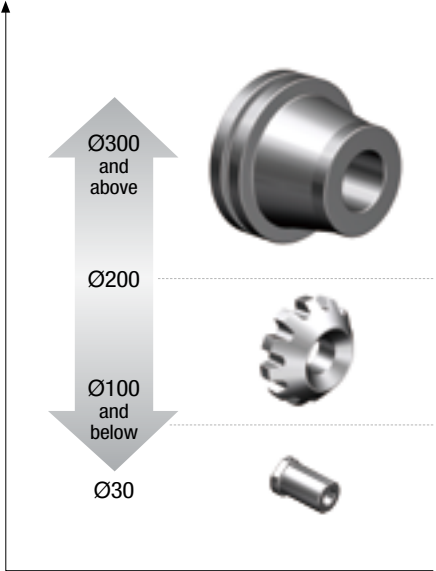
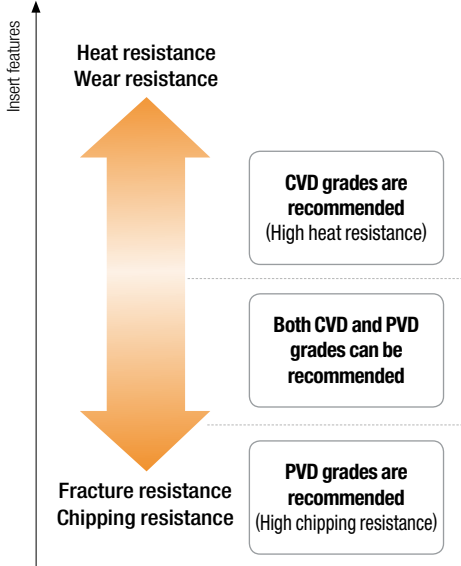
※ The recommended cutting speed above is based on A6061S Al forged alloy.
 ※ Recommended cutting conditions may vary depending on the workpiece materials



03) Useful cutting tip









Section	Contents						
<p>Hub Continuous cutting/ interrupted cutting</p>  <p>1st recommendation : NC5320</p> 	 <p>Internal/ External cutting, etc. (Continuous cutting) : NC3215</p> <p>External fins (Low interrupted cutting) : NC5320</p> <p>(Heavy interrupted cutting) : NC3225</p> <p>Wear resistance</p> <p>1st recommendation</p> <p>Toughness</p>						
<p>Difference in tool life based on the presence or absence of cutting fluid</p>  <p>Recommendation for dry machining at high interrupted cutting</p>	<p>Interrupted and wet cutting</p>  <p>Rapid heating and rapid cooling cycles on cutting tools</p>  <p>Heat crack</p>  <p>Excessive wear by heat impact</p>  <p>Excessive wear</p> <table border="1" data-bbox="464 1832 802 2051"> <tr> <td>Workpiece use</td> <td>Hub bearing</td> </tr> <tr> <td>Workpiece</td> <td>S55CR</td> </tr> <tr> <td>Cutting conditions</td> <td>vc (m/min) = 250~270 fn (mm/rev) = 0.2~0.35 ap (mm) = 1</td> </tr> </table>  <p>500% more</p> <p>NC5320 (Dry) 300 EA/Corner</p> <p>NC5320 (Wet) 58 EA/Corner</p> <p>EA/Corner</p>	Workpiece use	Hub bearing	Workpiece	S55CR	Cutting conditions	vc (m/min) = 250~270 fn (mm/rev) = 0.2~0.35 ap (mm) = 1
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
<p>Insert fracture/ defect issues during heavy interrupted machining</p>  <p>Holder shim replacement</p>	<div style="display: flex; justify-content: space-around;"> <div style="width: 45%;"> <p>1) Sudden insert fracture</p>  </div> <div style="width: 45%;"> <p>2) Cause of fracture (excessive wear on shim)</p>  </div> </div> <p>3) Analysis of fracture causes (clamping force)</p> <hr/> <p>Contact area comparison between worn shim and normal shim</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>Worn shim - Unstable clamping</p>  </div> <div style="width: 45%;"> <ul style="list-style-type: none"> - Not able to clamp 100% - Occurrence of unstable fastening </div> </div> <hr/> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>Normal shim - Stable clamping</p>  </div> <div style="width: 45%;"> <ul style="list-style-type: none"> - Ensures contact area and improving fastening stability after shim replacement - More than 95% fully secure fastening state </div> </div>
<p>In stainless steel cutting, the application areas of CVD and PVD coatings</p>  <p>For large workpieces (Ø300 and above) : CVD coating is preferred.</p> <p>For small workpieces (Ø100 and below) : PVD coating is preferred.</p>	<div style="display: flex; justify-content: space-around;"> <div style="width: 45%;"> <p>Size of workpiece (mm)</p>  </div> <div style="width: 45%;"> <p>Insert features</p>  </div> </div>








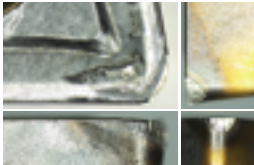



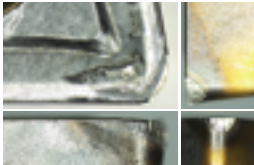



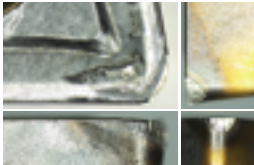


03) Useful cutting tip - Cermet

Section	Contents																																						
<p>Automotive and machinery components (carbon steel and alloy steel - continuous machining on external and internal diameter)</p>  <p>1st recommendation For continuous cutting : CC1015</p> <p>1st recommendation For interrupted cutting : CN2500</p>	 <p>External diameter (Continuous cutting) : CC1015</p>  <p>External diameter (Continuous cutting) : CN1500</p> <p>Slotting/External diameter (Interrupted cutting) : CC1025/CN2500</p>																																						
<p>Automotive components (sintered alloy - interrupted cutting)</p>  <p>1st recommendation : CC1015 CN1500</p> <p>2nd recommendation : CC1025 CN2500</p> 	 <p>Facing/External diameter (Continuous cutting) : CC1015/CN1500</p> <p>Facing/External diameter (Interrupted cutting) : CC1025/CN2500</p>																																						
<table border="1"> <thead> <tr> <th>Section</th> <th>TPMT110304</th> <th>SCMT09T308</th> <th>SNMG120408</th> <th>VNMG160408</th> </tr> </thead> <tbody> <tr> <td>Cutting speed vc (m/min)</td> <td>250</td> <td>200</td> <td>100 ~ 150</td> <td>150 ~ 180</td> </tr> <tr> <td>RPM n (rpm)</td> <td>1,650 ~ 2,500</td> <td>1,650 ~ 2,500</td> <td>1,650 ~ 2,500</td> <td>1,650 ~ 2,500</td> </tr> <tr> <td>Feed fn (mm/rev)</td> <td>0.08 ~ 0.12</td> <td>0.08 ~ 0.12</td> <td>0.2 ~ 0.25</td> <td>0.12 ~ 0.3</td> </tr> <tr> <td>Depth of cut ap (mm)</td> <td>0.2</td> <td>0.4</td> <td>0.5 ~ 2.0</td> <td>0.2 ~ 0.4</td> </tr> <tr> <td>Diameter and length of workpiece</td> <td>Smaller than 100mm</td> <td>Smaller than 100mm</td> <td>Smaller than 100mm</td> <td>Smaller than 100mm</td> </tr> <tr> <td>Coolant</td> <td>Wet</td> <td>Wet</td> <td>Wet</td> <td>Wet</td> </tr> </tbody> </table>					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
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Coolant	Wet	Wet	Wet	Wet																																			
<ul style="list-style-type: none"> Representative inserts used in sintered alloy components <ul style="list-style-type: none"> - 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. 																																							



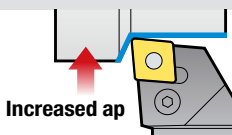

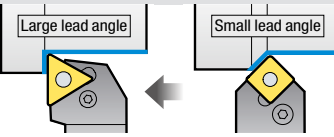

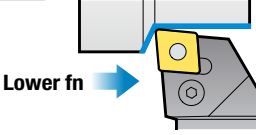
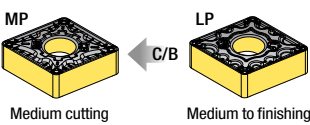
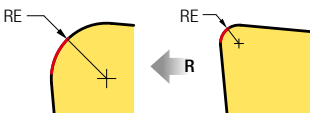

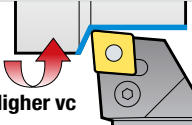

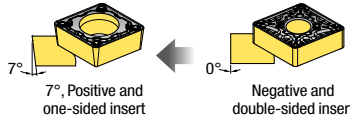
03) Useful cutting tip - Heavy cutting

Section	Contents
<p>1st recommended chip breaker for heavy cutting</p>  <p>1st recommended chip breaker for vertical machining : HV</p> <p>1st recommended chip breaker for horizontal machining : HG</p> 	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>1) In vertical cutting of a flange</p>  <p>Facing/ external diameter cutting (vertical direction of holders) : 1st recommended HV</p> </div> <div style="width: 45%; text-align: right;"> <p>[Chip breaker features]</p>  <p>Rigidity of cutting edge</p> <p>Wear resistance</p> </div> </div> <div style="margin-top: 20px;"> <p>2) In horizontal cutting of a shaft</p>  <p>External diameter cutting (horizontal direction of holders) : 1st recommended HG</p> </div>

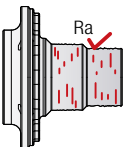
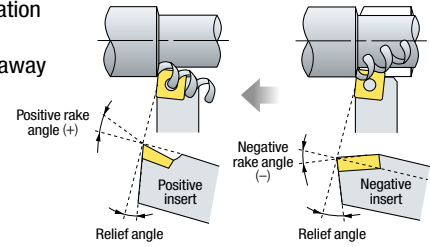
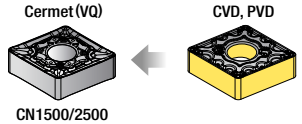
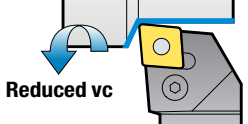
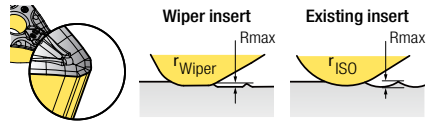
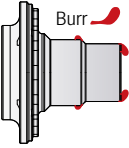
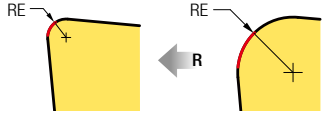
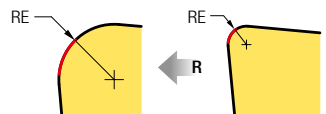
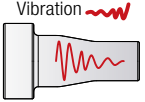
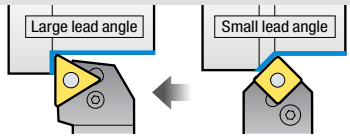
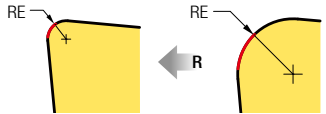
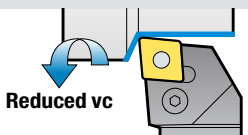
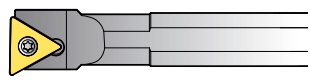
<p>Cases of insert damage caused by screw issues and solutions</p>  <p>Recommended to use genuine screws and holders</p>	<ul style="list-style-type: none"> • Checking the screw head protrusion → Suspecting the insert attachment condition → Verifying the screw size <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">  <p>Damaged holder</p> </div> <div style="text-align: center;">  <p>Genuine screw</p> </div> <div style="text-align: center;">  <p>Fracture or counterfeit screw</p> </div> </div>									
	<table border="1" style="width: 100%;"> <thead> <tr> <th style="width: 30%;">Section</th> <th colspan="2">Contents</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Undamaged holder + genuine screw</td> <td style="text-align: center;">  Stable clamping </td> <td style="text-align: center;">  Normal wear </td> </tr> <tr> <td style="text-align: center;">Damaged holder + counterfeit screw</td> <td style="text-align: center;">  Wear phenomenon (vibrations) </td> <td style="text-align: center;">  Abnormal wear/ fracture </td> </tr> </tbody> </table>	Section	Contents		Undamaged holder + genuine screw	 Stable clamping	 Normal wear	Damaged holder + counterfeit screw	 Wear phenomenon (vibrations)	 Abnormal wear/ fracture
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

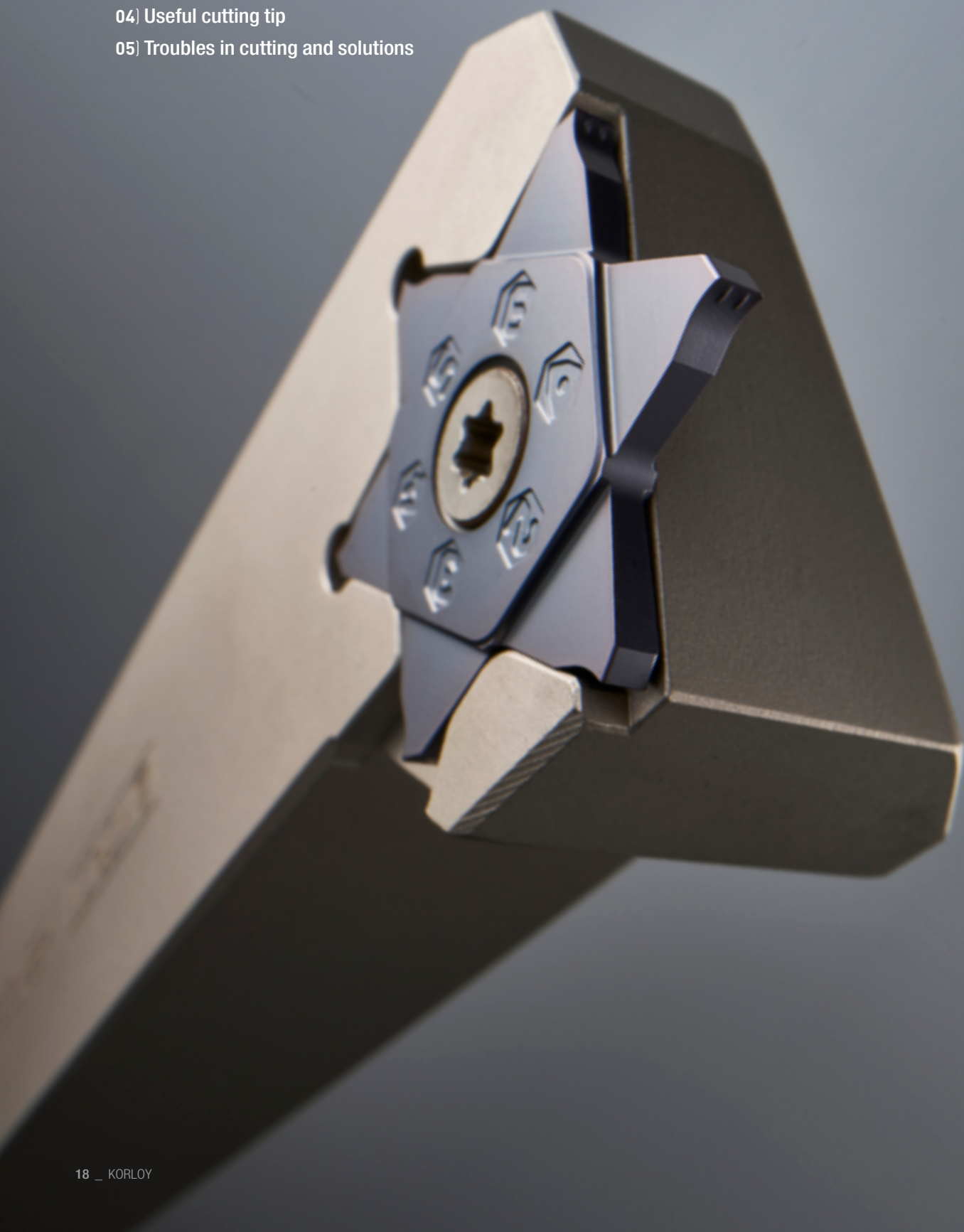
Troubles	Factors	Solutions	
<p>! Chip jamming</p> <p>Chips do not break, so the long chip tangled around the tools or a workpiece</p> 	→ Selected a wrong chip breaker for the application area	→ Select an appropriate chip breaker that matches the cutting conditions <small>that Refer to the tool selection guide p. 7</small>	
	→ 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	
<p>! Excessive chip fragmentation</p> <p>The excessive formation of very short chips due to high cutting forces, leading to shortened tool life and tool damage</p> 	→ Too high feed	→ Decreased feed 	
		→ Select a chip breaker designed for higher feed	
	→ Too small nose radius	→ Select larger nose radius	
<p>! Built-up-edge/welding</p> <p>The simultaneous occurrence of burrs and chipping, causing accumulated burrs to detach along with the insert material, resulting in damage</p> 	→ 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
<p>! Surface roughness defect</p> <p>Rough surface finish and fail to meet the tolerance requirements</p> 	<p>→ Leaving marks on the surface as chips break towards the workpiece</p>	<p>→ Choose a chip evacuation configuration that discharges chips far away</p> 
	<p>→ Rough surface due to notch wear</p>	<p>→ Select a cermet grade</p>  <p>→ Reduce cutting speed</p> 
	<p>→ High feed and too small cutting radius</p>	<p>→ Select a wiper insert or larger nose radius</p> <p>→ Lower feed</p> 
<p>! Burr formation</p> <p>The formation of burrs at the end of cutting when the cutting edge deviates from the workpiece</p> 	<p>→ Dull cutting edge</p>	<p>→ Use a sharp insert</p> 
	<p>→ Notch wear on the part of depth of cut</p>	<p>→ Select larger nose radius</p> 
<p>! Vibration</p> <p>Tool scratched the workpiece due to chattering</p> 	<p>→ Improper lead angle</p>	<p>→ Use larger lead angle</p> 
	<p>→ Too large nose radius</p>	<p>→ Select smaller nose radius</p> 
	<p>→ Excessive front wear of the cutting edge</p>	<p>→ Reduce cutting speed or select a better wear resistance grade</p> 
	<p>→ Vibration caused by excessive overhang during steel boring bar usage</p>	<p>→ Use carbide boring bar which has better rigidity than steel boring bar and minimizes vibration during deep machining</p> 

Grooving

- 01) Line-up
- 02) Grade selection guide
- 03) Tool selection guide
- 04) Useful cutting tip
- 05) Troubles in cutting and solutions



01) Line-up

↻ Tool-specific cutting width, depth of cut, and recommended machining by tool

Division	Tools	No. of corners	Recommended cutting conditions														INFO Link	
			For external machining							For external machining					Face grooving			
			Grooving	Parting	Turning	Back turning	Copying	Relieving	Threading	Grooving	Boring	Back Boring	Copying	Relieving	Threading	Grooving		Turning
Basic	 Saw Man-X	1	<input type="checkbox"/>	<input type="checkbox"/>													<ul style="list-style-type: none"> • Tool for external diameter cutting, deep hole cutting • For high speed and high feed 	
Basic	 Saw Man	1	<input type="checkbox"/>	<input type="checkbox"/>													<ul style="list-style-type: none"> • Tool for external diameter cutting, deep hole cutting 	-
Precision (Cutting edge sharpness)	 Fine Tools	1							<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>			<ul style="list-style-type: none"> • For precision boring of internal diameters up to 16 	-
Precision (Cutting edge sharpness)	 Auto Tools (MSB Plus)	1							<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>	<input type="checkbox"/>		<ul style="list-style-type: none"> • For premium precision boring of internal diameters up to 10 • Internal coolant, precision clamping 	
Precision (Cutting edge sharpness)	 Auto Tools (MSB)	1, 2							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<ul style="list-style-type: none"> • For precision boring of internal diameters up to 10 	
Precision (Cutting edge sharpness)	 K-Notch	2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>										<ul style="list-style-type: none"> • For precision external machining 	
Basic, Precision (C/B type)	 KGT	1, 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<ul style="list-style-type: none"> • For multi-functional machining of external, internal, and face 	
Basic, Precision (C/B type)	 MGT	2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<ul style="list-style-type: none"> • Multi-functional tool capable of various operations such as external diameter, inner diameter, cross-section, and more 	
Basic	 MGT Plus	2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<ul style="list-style-type: none"> • Multi-functional tool capable of various operations such as external diameter, inner diameter, cross-section, and more • Inserts compatible with MGT Holders 	
Precision (Cutting edge sharpness)	 Auto Tools (Blade)	2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>									<ul style="list-style-type: none"> • Tool for external diameter machining on automatic lathes. • Small-sized parting off operations with a diameter of Ø16 or less 	
Precision (Cutting edge sharpness)	 Auto Tools (Multi utility)	2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>									<ul style="list-style-type: none"> • Tool for external diameter machining on automatic lathes • Capable to apply various inserts for multiple purposes onto a single holder 	
Precision (Cutting edge sharpness, C/B type)	 TB	3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>										<ul style="list-style-type: none"> • Cutting tool for external diameter • 3 corner grooving 	
Precision (Cutting edge sharpness, C/B type)	 Hexa Blade	6	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>												<ul style="list-style-type: none"> • Tool for external diameter machining • Economical 6-corner groove machining 	



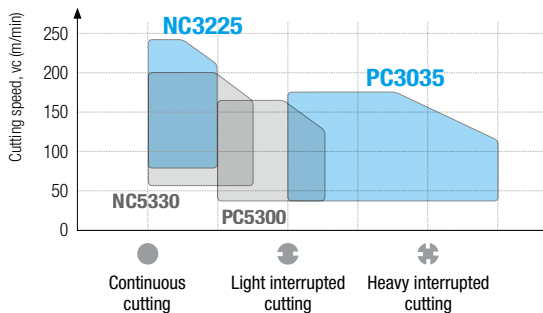
02) Grade selection guide

Features

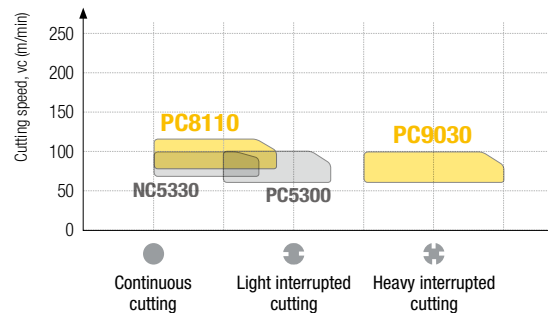
Grade	Recommended workpiece	ISO Grade									Features
		Wear resistance ←					•	→ Toughness			
		5	10	15	20	25	30	35	40	45	
CVD	NC3225	P				P20~25					• Steel, mild steel general purpose grade
	NC5330	P						P30~35			• Universal grade • Stable in high speed machining
		M						M25~35			
		K				K15~25					
		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

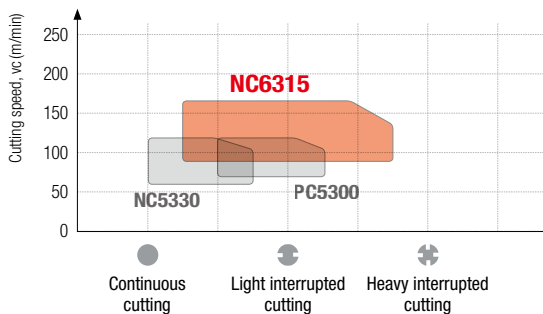
P Steel



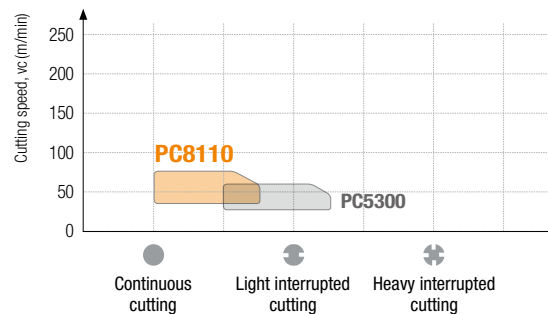
M Stainless steel



K Cast iron

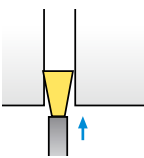






S HRSA






































03) Tool selection guide

↪ External Grooving and Turning

Usage	Processing type and Recommended tool			
	General external diameter grooving (CDX 36 mm and below)	Shallow external diameter grooving (CDX 4 mm and below)	Deep external diameter grooving (CDX 36 mm over)	Precision external diameter grooving (CWTOL: ±0.025)
	KGT 	Hexa Blade 	Saw Man-X 	K-Notch 

*CWTOL: Cutting width tolerance

Tools	No. of corners	shank size (mm)	Width of cutting edge (CW, mm)				Recommended inserts by workpiece material				
			2	4	6	8	P	M	K	S	N
			5	10	20	60	Max. Depth of cut (CDX, mm)				
Saw Man-X KSPH 	1	16 20 25	2	6	38	KSP-N PC3035 	KSP-S PC8110 	KSP-N PC5300 	KSP-S PC8110 	-	
Saw Man-X KSEHR 	1	20 25	2	6	25	KSP-N PC3035 	KSP-S PC8110 	KSP-N PC5300 	KSP-S PC8110 	-	
Saw Man SPH SPH-S 	1	16 20 25	3	5	35	SP PC5300 	SP PC5300 	SP PC5300 	-	SP A30 	
K-Notch KNSR 	2	10 12 16, 20 25, 32	0.79	6.35	6.35	KNG PC5300 	KNGP PC8110 	KNG PC5300 	KNGP PC8110 	-	
KGT KGEHR 	1, 2	12 16 20 25, 32	1.5	8	36	KGMN-T PC5300 	KGMN-TL PC5300 	KGMN-R PC5300 	KGMN-TL SPC810 	KGGN-A H01 	
MGT MGEHR 	2	16 20 25 32	1.5	8	32	MGMN-M PC5300 	MGMN-L PC5300 	MGMN-M PC5300 	-	MGGN-A H01 	
MGT Plus MGEHR 	2	16 20 25 32	1.5	8	32	PGMN-MM PC3035 	PGMN-MM PC9030 	PGMN-MM PC5300 	-	-	



03) Tool selection guide

External Grooving and Turning

Usage	Processing type and Recommended tool			
	General external diameter grooving (CDX 36 mm and below)	Shallow external diameter grooving (CDX 4 mm and below)	Deep external diameter grooving (CDX 36 mm over)	Precision external diameter grooving (CWTOL: ±0.025)
	KGT 	Hexa Blade 	Saw Man-X 	K-Notch

*CWTOL: Cutting width tolerance

Tools	No. of corners	shank size (mm)	Width of cutting edge (CW, mm)				Recommended inserts by workpiece material				
			2	4	6	8	P	M	K	S	N
			5	10	20	60					
Max. Depth of cut (CDX, mm)											
Auto Tools (Blade) SBHR 	2	10	0.5	2.5							
		12									
		16	7.5								
Auto Tools (Multi utility) SXGNR 	2	10	1	3							
		12									
		16									
		20	9								
TB TBH 3/4 	3	20	1.25	4.5							
		25	5								
TB TBH 5 	3	10	0.5	3.18							
		12									
		16									
		20, 25	6.5								
Hexa Blade HBEHR -27 	6	16	1.78	4							
		20									
		25	5								
Hexa Blade HBEHR -19 	6	12	0.5	3.18							
		16									
		20	4								

03) Tool selection guide

External Parting

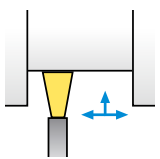

Usage	Processing type and Recommended tool			
	General external diameter parting off (CUTDIA Ø70 and below)	Shallow external diameter parting off (CUTDIA Ø16 and below)	Deep external diameter parting off (CUTDIA Ø70 over Ø120 and below)	Pipe external diameter parting off (CUTDIA Ø120 and below)
	Saw Man-X 	Auto Tools (Blade) 	Saw Man-X 	Saw Man-X






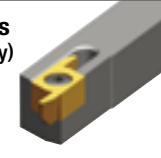

Tools	No. of corners	shank size (mm)	Width of cutting edge (CW, mm)				Recommended inserts by workpiece material					
			2	4	6	8	P	M	K	S	N	
			5	10	20	60	Max. Depth of cut (CDX, mm)					
Saw Man-X KSPB 	1	26 32	2	6			60	KSP-D-N PC3035	KSP-D-N PC8110	KSP-D-N PC5300	KSP-D-N PC8110	-
Saw Man SPB SPB-S 	1	26 32 52.6	2	6			60	SP-R/L PC5300	SP-R/L PC5300	SP-R/L PC5300	-	SP-R/L A30
Auto Tools (KGT) KGEHR -D00A/B 	1, 2	10 12 16	2	3			16	KGMR-RP PC5300	KGMR-LP PC5300	KGMR-RP PC5300	KGMR-TL SPC810	KGGN-A H01
KGT KGTB 	1, 2	26 32	1.5	8			60	KGMR-RP PC5300	KGMR-LP PC5300	KGMR-RP PC5300	KGMR-TL SPC810	KGGN-A H01
Auto Tools (MGT) MGEHR -X00A 	2	10 12 16	1.5	2.5			12.5	MGMN-M PC5300	MGMN-M PC5300	MGMN-M PC5300	-	MGGN-A H01
Auto Tools (MGT Plus) MGEHR -X00A 	2	10 12 16	1.5	2.5			12.5	PGMN-MM PC3035	PGMN-MM PC9030	PGMN-MM PC5300	-	-
Auto Tools (Blade) SBHR 	2	10 12 16	0.7	2			7.5	SBCR PC5300	SBCR PC8110	SBCR PC5300	SBCR PC8110	-
Auto Tools (Multi utility) SXGNR 	2	10 12 16 20	1	3			9	-	SCR PC9030	-	-	-
TB TBH 5 	3	10 12 16 20, 25	1	2			6.5	TB5-DR PC5300	TB5-DR PC5300	TB5-DR PC5300	-	-



03) Tool selection guide

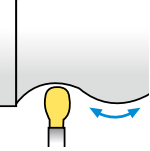


↻ External Back Turning





Usage	Processing type and Recommended tool	
	General external back turning	
	<p>Auto Tools (Blade)</p> 	

Tools	No. of corners	shank size (mm)	Max. Depth of cut (APMX, mm)				Recommended inserts by workpiece material				
			2	4	6	8	P	M	K	S	N
			5	10	20	60					
Major cutting edge angle (KRINS, °)											
Auto Tools (Blade) SBHR 	2	10	4								-
		12									
		16	59								
Auto Tools (Multi utility) SXGNR 	2	10	5.5				-		-	-	-
		12									
		16	70								
		20									

03) Tool selection guide

↻ External Copying and Relief

Usage	Processing type and Recommended tool	
	General external diameter machining	General external diameter relief (CDX = 3.3 mm)
	KGT 	KGT 

Tools	No. of corners	shank size (mm)	Width of cutting edge (CW, mm)				Recommended inserts by workpiece material				
			2	4	6	8	P	M	K	S	N
			5	10	20	60					
Max. Depth of cut (CDX, mm)											
K-Notch KNSR 	2	10 12 16, 20 25, 32	1.57 6.35				KNR PC5300 	KNRP PC8110 	KNR PC5300 	KNRP PC8110 	-
KGT KGEHR 	2	12 16 20 25 32	2 36		8		KRMN-C PC5300 	KRGN-CM PC5300 	KRMN-C PC5300 	KRGN-CM SPC810 	KRGN-A H01 
KGT KGEUR 	2	16 20 25	3.3		3 8		KRMN-C PC5300 	KRGN-CM PC5300 	KRMN-C PC5300 	KRGN-CM SPC810 	KRGN-A H01 
MGT MGEHR 	2	16 20 25 32			2 8		MRMN-M PC5300 	MRMN-M PC5300 	MRMN-M PC5300 	-	MRGN-A H01 
MGT MGEUR 	2	20 25	5		3 8		MRMN-M PC5300 	MRMN-M PC5300 	MRMN-M PC5300 	-	MRGN-A H01 
MGT Plus MGEUR 	2	20 25	5		3 8		PRMN-RM PC3035 	PRMN-RM PC9030 	PRMN-RM PC5300 	-	-
TB TBH 5 	3	16 20 25	1.57 6.5	3			TB5-P PC5300 	TB5-P PC5300 	TB5-P PC5300 	TB5-P PC5300 	-



03) Tool selection guide

External Threading

Usage	Processing type and Recommended tool	
	General external thread	
	<p>K-Notch</p>	

Tools	No. of corners	shank size (mm)	Profile X-direction distance (PDX, mm)				Recommended inserts by workpiece material					
			2	4	6	8	P	M	K	S	N	
			5	10	20	60						
K-Notch KNSR 	2	10 12 16, 20 25, 32	3.25				60	KNT PC5300	KNT PC8110	KNT PC5300	KNT PC8110	-
Auto Tools (Blade) SBHR 	2	10 12 16	1.59				60	SBTR PC5300	SBTR PC8110	SBTR PC5300	SBTR PC8110	-
Auto Tools (Multi utility) SXGNR 	2	10 12 16 20	1.6				60	-	STR PC9030	-	-	-

03) Tool selection guide

↪ Internal Grooving and Boring

Usage	Processing type and Recommended tool			
	General internal grooving, boring (DMIN Ø20mm)	Small internal grooving, boring (DMIN Ø8 ~ Ø16mm)	Micro internal grooving (DMIN Ø3.2 ~ Ø10.2mm)	Micro internal boring (DMIN Ø3.2~10.2mm)
	KGT 	Fine Tools 	Auto Tools (MSB Plus) MSB 	Auto Tools (MSB Plus) MSB

*DMIN : Minimum bore diameter

Tools	No. of corners	Min. Cutting dia (Ø)	Width of cutting edge (CW, mm)				Recommended inserts by workpiece material														
			2	4	6	8	P	M	K	S	N										
			5	10	20	60	Max. Depth of cut (CDX, mm)														
Fine Tools NFTIH 	1	8 11 14 16	0.75 4.6	4.02																	
Auto Tools (MSB Plus) MBCR (Boring) 	1	1.0	0.5																		
Auto Tools (MSB Plus) MGSR (Grooving) 	1	7.2	0.6 2.5	2																	
Auto Tools (MSB) MGR (Square) 	1, 2	3.2	1 3.5	3																	
Auto Tools (MSB) MGRR (Round) 	1, 2	3.2	1 5	4.5																	
Auto Tools (MSB) MBR (Boring) 	1, 2	3.2	0.8																		
Auto Tools (MSB) MBBR (Back Boring) 	1, 2	3.2	1.5 1.9	2																	
KGT KGIVR 	2	20 25 32 40, 45	1.5 8.5	8																	
MGT MGIVR 	2	20 25 29,31 37,45	1.5 10.2	8																	
MGT Plus MGIVR 	2	20 25 29,31 37,45	2 10.2	8																	



03) Tool selection guide

↻ Internal Copying and Relief

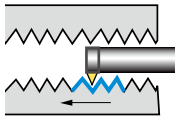
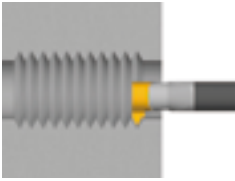
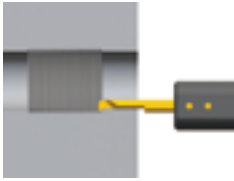
Usage	Processing type and Recommended tool			
	General internal copying (DMIN Ø20mm)	Small internal copying (DMIN Ø8 ~ Ø16mm)	Micro internal copying (DMIN Ø4.2 ~ Ø6.2mm)	General internal relief (DMIN Ø35mm)

*DMIN: Minimum bore diameter


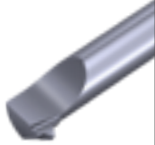

Tools	No. of corners	Min. Cutting dia (Ø)	Width of cutting edge (CW, mm)				Recommended inserts by workpiece material				
			2	4	6	8	P	M	K	S	N
			5	10	20	60					
Fine Tools NFTIH 	1	8 11 14 16	0.75	4.02			NFTF PC5300 	NFTF PC5300 	NFTF PC5300 	-	-
			4.6								
Auto Tools (MSB) MBCR (Copying) 	1, 2	4.2	1	3			MBCR PC30M 	MBCR PC30M 	MBCR PC30M 	-	-
			3.5								
KGT KGIVR 	2	20 25 32 40, 45	1.5			8	KRMN-C PC5300 	KRGN-CM PC5300 	KRMN-C PC5300 	KRGN-CM UPC810 	KRGN-A H01
			8.5								
KGT KGIUR 	2	35 40 50	1.5			8	KRMN-C PC5300 	KRGN-CM PC5300 	KRMN-C PC5300 	KRGN-CM UPC810 	KRGN-A H01
			10.2								
MGT MGIVR 	2	20 25 29, 31 37, 45	2			8	MRMN-M PC5300 	MRMN-M PC5300 	MRMN-M PC5300 	-	MRGN-A H01
			10.2								
MGT MGIUR 	2	35 40 50	3			8	MRMN-M PC5300 	MRMN-M PC5300 	MRMN-M PC5300 	-	MRGN-A H01
			8								
MGT Plus MGIVR 	2	20 25 29, 31 37, 45	2			8	PRMN-RM PC3035 	MRMN-RM PC9030 	MRMN-RM PC5300 	-	-
			10.2								
MGT Plus MGIUR 	2	35 40 50	3			8	PRMN-RM PC3035 	MRMN-RM PC9030 	MRMN-RM PC5300 	-	-
			8								

03) Tool selection guide

↪ Internal Threading

Usage	Processing type and Recommended tool	
	General internal thread (DMIN Ø8 ~ Ø16 mm)	Micro internal thread (DMIN Ø3.3 ~ Ø6.2 mm)
	Fine Tools 	Auto Tools (MSB) 

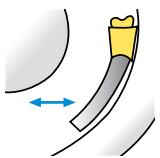
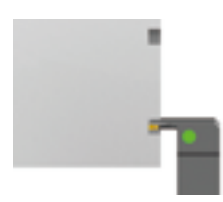
*DMIN : Minimum bore diameter










Tools	No. of corners	Min. Cutting dia (Ø)	Profile X-direction distance (PDX, mm)				Recommended inserts by workpiece material												
			1	2	3	4	P	M	K	S	N								
			5	10	20	60													
Fine Tools NFTIH 	1	8 11 14 16	1.8				60												
Auto Tools (MSB Plus) MTHR (Threading) 	1	0.73	0.9				60												
Auto Tools (MSB) MTR (Threading) 	1, 2	3.3	1.59				60												



03) Tool selection guide

↻ Face Grooving and Turning

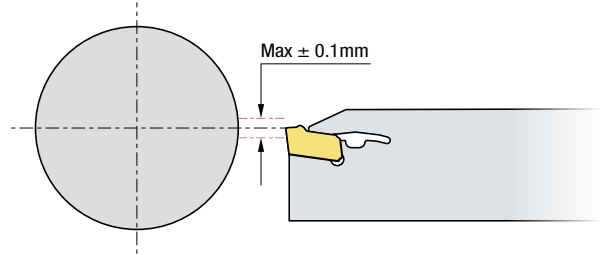
Usage	Processing type and Recommended tool	
	General face grooving, turning	
	KGT 	

Tools	No. of corners	shank size (mm)	Width of cutting edge (CW, mm)				Recommended inserts by workpiece material				
			2	4	6	8	P	M	K	S	N
			5	10	20	60					
Auto Tools (MSB Plus) MFGR 	1	-	1 3.18				MFGR PC3030T	MFGR PC3030T	MFGR PC3030T	-	-
Auto Tools (MSB) MGFR 	1, 2	-	1 4.5				MGFR PC30M	MGFR PC30M	MGFR PC30M	-	-
KGT KGEVR-T00 	1, 2	16 20 25	1.5 8				KGMMN-T PC5300	KGMMN-TL PC5300	KGMMN-R PC5300	KGMMN-TL SPC810	KGGMN-A H01
KGT KGFHR 	1, 2	25	3 6			25	KGMMN-T PC5300	KGMMN-TL PC5300	KGMMN-R PC5300	KGMMN-TL SPC810	KGGMN-A H01
KGT KGFVR 	1, 2	20 25	3 6			20	KGMMN-T PC5300	KGMMN-TL PC5300	KGMMN-R PC5300	KGMMN-TL SPC810	KGGMN-A H01
MGT MGFHR (CW=3) 	2	25	3 15				MFMN-M NC5330	MFMN-M PC5300	MFMN-M NC5330	-	-
MGT MGFHR (CW=4) 	2	25	4 15				MGMN-M PC5300	MGMN-L PC5300	MGMN-M PC5300	-	MGMN-A H01
MGT MGFVR (CW=3) 	2	25	3 15				MFMN-M NC5330	MFMN-M PC5300	MFMN-M NC5330	-	-
MGT MGFVR (CW=4) 	2	25	4 15				MGMN-M PC5300	MGMN-L PC5300	MGMN-M PC5300	-	MGMN-A H01

04) Useful cutting tip

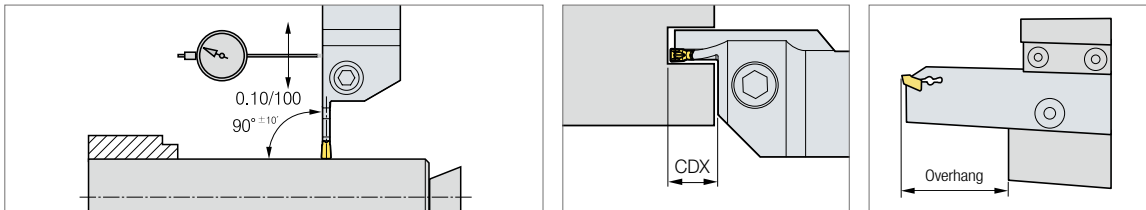
↪ Insert cutting edge height setting

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



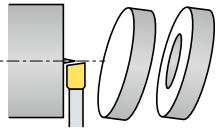
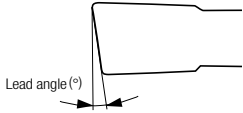
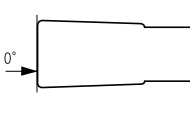
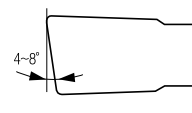
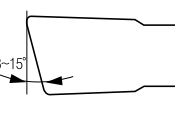
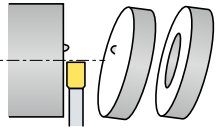
↪ Holder setting method

- 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

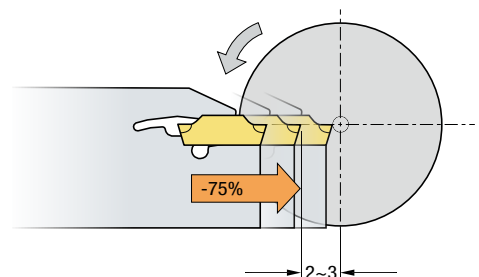
- It is possible to minimize chip (PIP) and burr formation by choosing a proper lead angled insert.
- If there is minimal chip and burr formation, it is recommended to use inserts without a positive lead angle.

	Applicable workpieces per insert's lead angle	Lead angle 0° (N-type)	Lead angle 4° ~ 8°	Lead angle 8° ~ 15°
 <p>Hand-type insert</p>	 <p>Lead angle (°)</p>	 <p>0°</p>	 <p>4~8°</p>	 <p>8~15°</p>
 <p>Insert without hand</p>	<ul style="list-style-type: none"> • 4° - Hollow (pipe) • 6° - Pipe and solid bar • 8° - Solid bar • 15° - Solid bar with small diameter 	<ul style="list-style-type: none"> • For parting off solid bar shaped workpiece • Center stub can be occurred after parting off • Prevents deflection of the parting off direction during machining • Optimized for deep cutting depth machining 	<ul style="list-style-type: none"> • For parting off solid bar shaped workpiece, reduce center stub • For machining applications with hollow bar inserts to minimize burr formation 	<ul style="list-style-type: none"> • For parting off hollow bars with thin cross-sectional thickness • For parting off small diameter workpieces to minimize burr and center stub

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

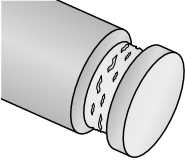
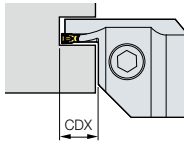
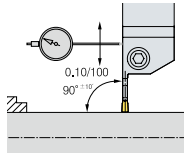
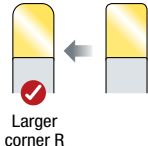
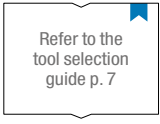
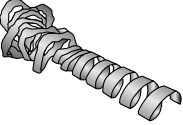

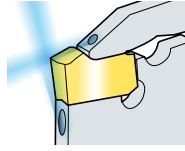
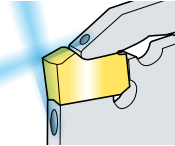
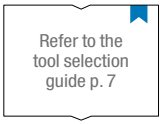
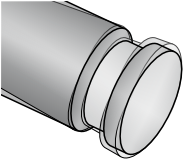
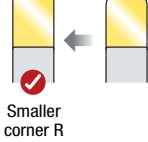
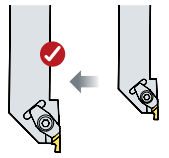
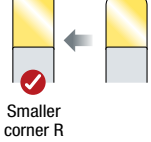
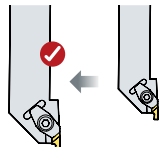
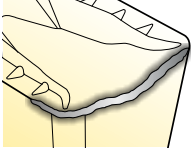
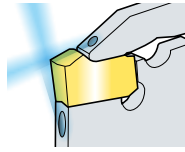
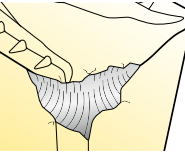
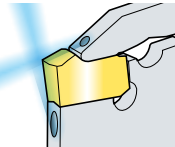
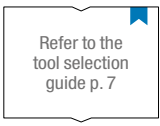
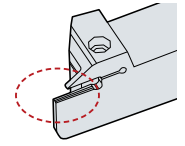
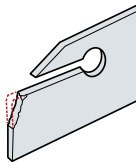
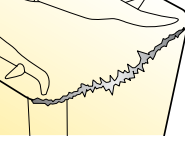
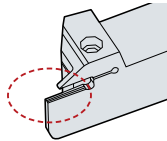
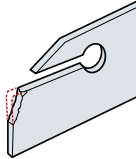
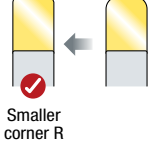
↪ Reducing feed before parting off the center of workpiece

- 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.



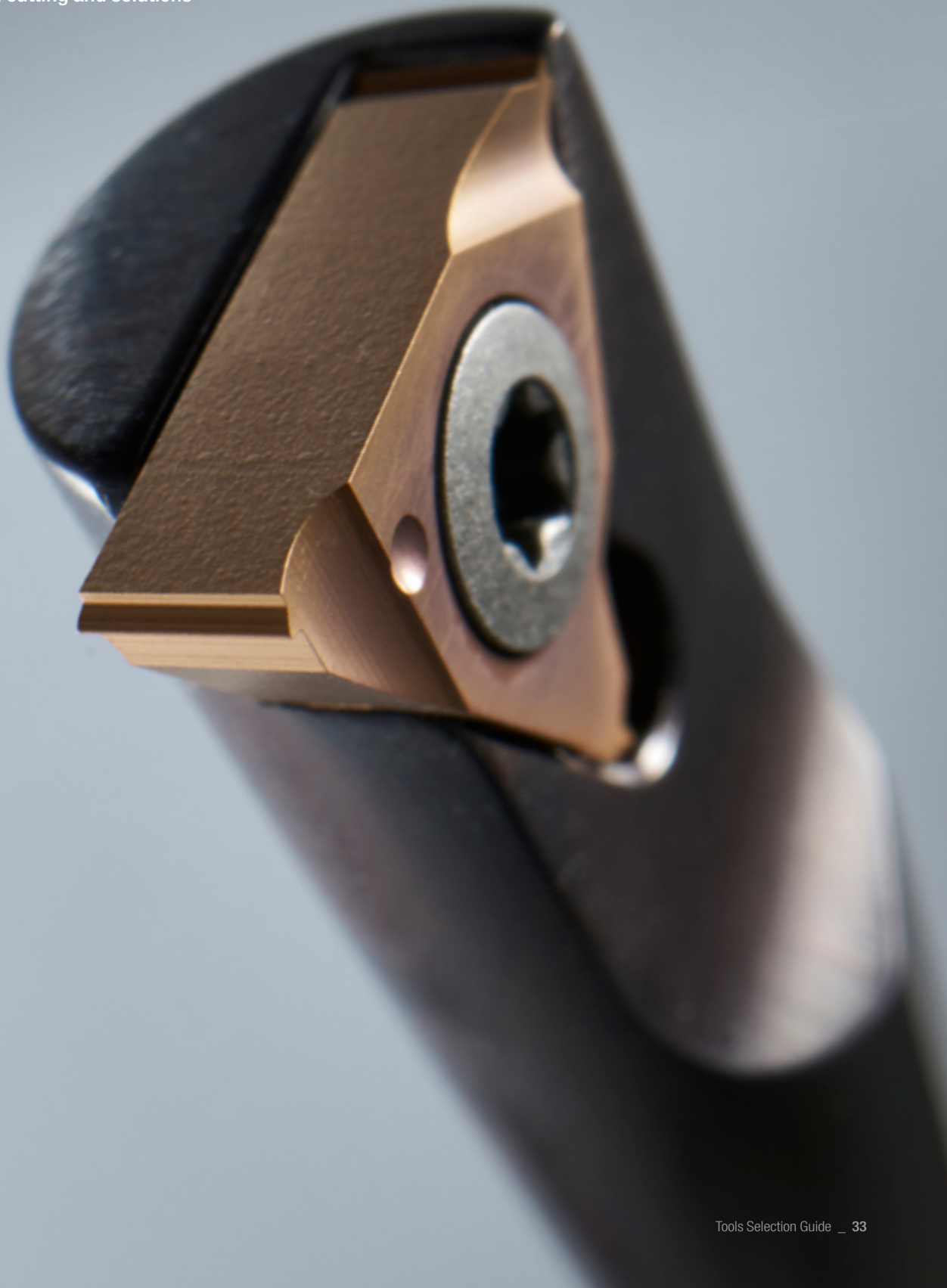


05) Troubles in cutting and solutions

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  Larger corner R	Change to another chip breaker <div style="border: 1px solid black; padding: 5px; text-align: center;"> Refer to the tool selection guide p. 7 </div>
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 <div style="border: 1px solid black; padding: 5px; text-align: center;"> Refer to the tool selection guide p. 7 </div>
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  Smaller corner 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 <div style="border: 1px solid black; padding: 5px; text-align: center;"> Refer to the tool selection guide p. 7 </div>
Fracture of insert 	Putting 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  Smaller corner R	Change to another chip breaker <div style="border: 1px solid black; padding: 5px; text-align: center;"> Refer to the tool selection guide p. 7 </div>

Threading

- 01) Line-up
- 02) Tool selection guide
- 03) Useful cutting tip
- 04) Troubles in cutting and solutions





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	Application	Geometries	Unit	Grinding	M-type	U-type	Division	Application	Geometries	Unit	Grinding	M-type	U-type
Partial profile (55°)	General threading		TP	0.5~6.0	0.5~5.0	0.5~3.0	American ACME (ACME)	Power transfer (feed screw)		TP	-	-	-
			TPI	48~4	48~5	48~8				TPI	16~4	-	-
Partial profile (60°)	General threading		TP	0.5~6.0	0.5~5.0	0.5~3.0	Stub ACME (STACME)	Power transfer (thin shape)		TP	-	-	-
			TPI	48~4	48~5	48~8				TPI	16~3	-	-
ISO metric	General industry		TP	0.35~6.0	1.0~3.0	1.5~2.0	UNJ	Aero-space industry		TP	-	-	-
			TPI	-	-	-				TPI	48~4	-	-
American UN (UN, UNC)	General industry		TP	-	-	-	American buttress (ABUT)	One direction		TP	-	-	-
			TPI	72~4	-	-				TPI	20~6	-	-
Withworth (BSW, BSF)	Industrial pipe		TP	-	-	-	British buttress (BBUT)	One direction		TP	-	-	-
			TPI	72~4	19~11	14~11				TPI	16~8	-	-
British standard pipe (BSPT)	Gas and water pipe (55°)		TP	-	-	-	Metric buttress (SAGE)	One direction (DIN513)		TP	2.0~4.0	-	-
			TPI	28~11	-	-				TPI	-	-	-
National pipe (NPT)	Gas and water pipe		TP	-	-	-	API	Oil and gas industry		TP	-	-	-
			TPI	27~8	-	-				TPI	6~4	-	-
National pipe (NPTF) _Dryseal	Gas and water pipe		TP	-	-	-	API buttress casing (BUT)	Oil and gas industry (tube, casing)		TP	-	-	-
			TPI	27~8	-	-				TPI	5	-	-
Round DIN405 (RD)	Fire-fighting and food industry		TP	-	-	-	API round casing (APIRD)	Oil and gas industry		TP	-	-	-
			TPI	10~4	-	-				TPI	10~8	-	-
Trapez DIN103 (TR)	Power transfer		TP	1.5~6.0	-	-	Extreme line casing (EL)	Oil and gas industry (tube, casing)		TP	-	-	-
			TPI	-	-	-				TPI	6~5	-	-

※ Unit : TP(mm), TP(tp)

01) Line-up

↻ Milling line-up

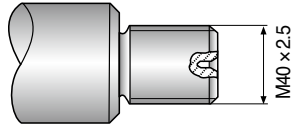
Division	Application	Geometries	Unit	Indexable	Internal coolant Helical	Internal coolant Helical, drill/chamfer	Deep drilling	External coolant Helical	External coolant straight
									
ISO metric	General industry		TP	0.5~6.0	0.5~3.0	1.0~1.75	0.25~2.5	0.5~3.0	0.5~6.0
American UN (UN, UNC)	General industry		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		TP	-	-	-	0.5~2.0	-	-

※ Unit : TP(mm), TP(tpi)



02) Tool selection guide - Thread Turning

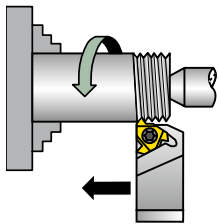
➤ Thread turning steps



Application

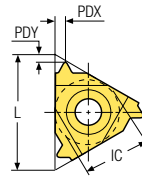
- Thread : External right hand ISO metric M40 × 2.5
- Material : 4140 (25 HRC)

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.

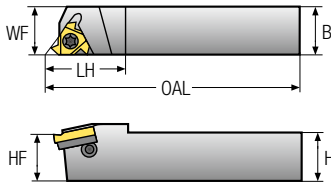
2 Choose the insert size



• 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

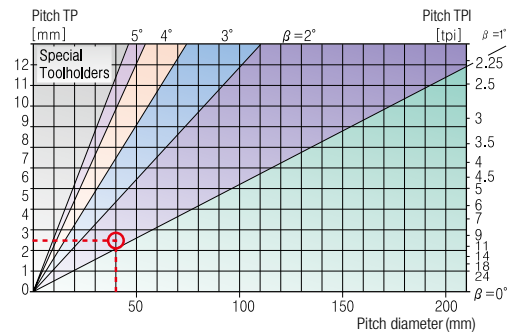
3 Choose the tool holder



• 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

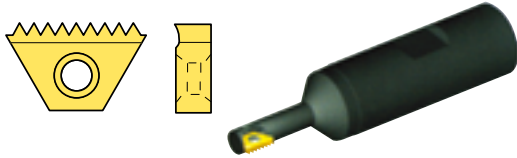
8 Summary

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

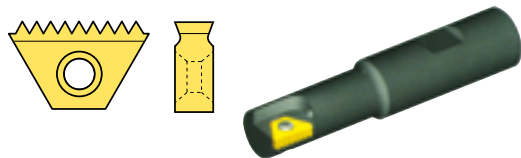
↪ The right tool for the job

Small diameter type



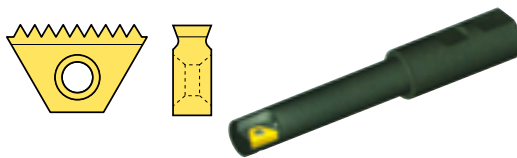
- Tool holder : TMSR • Insert : TM (L = 10.4 mm)
- For small bore diameters down to 9.5 mm

Standard type



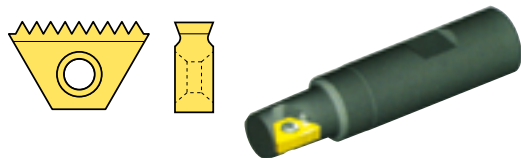
- Tool holder : TMSR • Insert : TM2
- For standard length threads

Long type



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

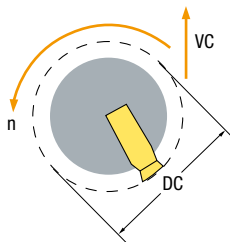
Tapered type



- 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]



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

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

$$F_1 = n \times z \times f_n$$

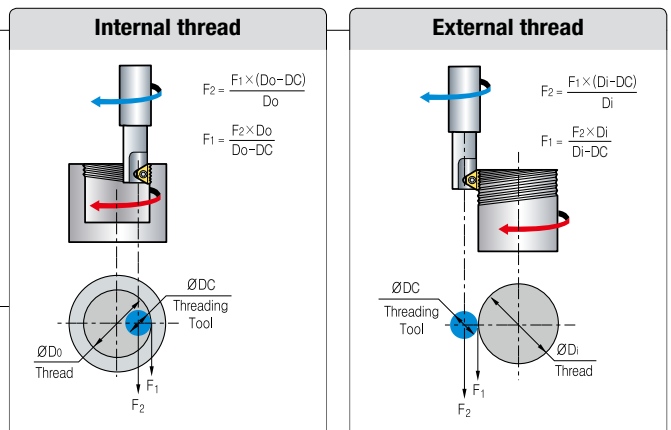
- n – Rotational Velocity (min⁻¹)
- vc – Cutting Speed (m/min)
- DC – Tool holder Cutting Dia. (mm)
- F₁ – Real Feed rate at the Cutting Edges(mm/min)
- z – No. of Cutting Edges
- f_n – Feed per Tooth per Rotation (mm/rev)

[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 at the tool's center-line.

[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

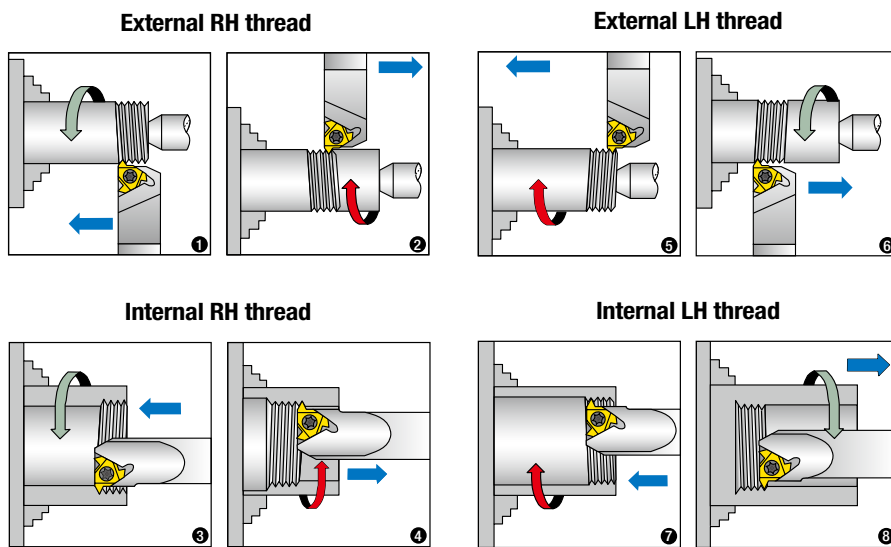




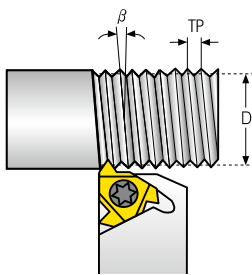
03) Useful cutting tip - Thread Turning

↻ Thread turning method

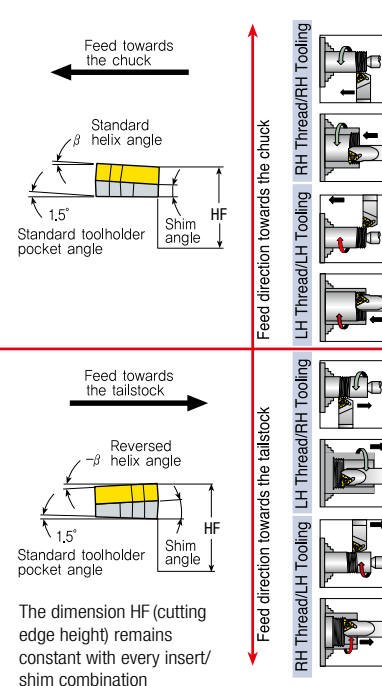
Thread	Inserts & Tool holder	Rotation	Feed direction	Helix method	Drawing no.
Right Hand External	EX RH	Counter clockwise	Towards chuck	Regular	❶
	EX LH	Clockwise	Outwards chuck	Reversed	❷
Right Hand Internal	EX RH	Counter clockwise	Towards chuck	Regular	❸
	IN LH	Clockwise	Outwards chuck	Reversed	❹
Left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



↻ Calculating the helix angle (β)



(Helix angle diagram)

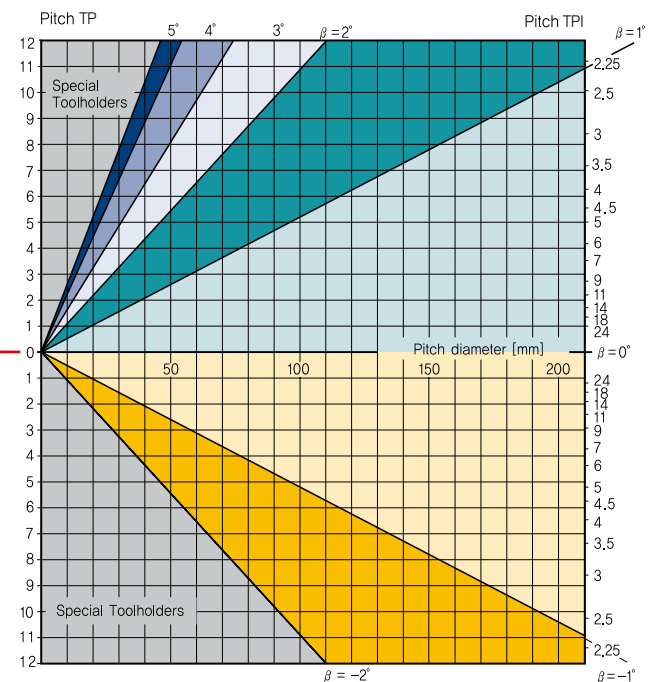


• The helix angle is calculated by the following formula

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

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

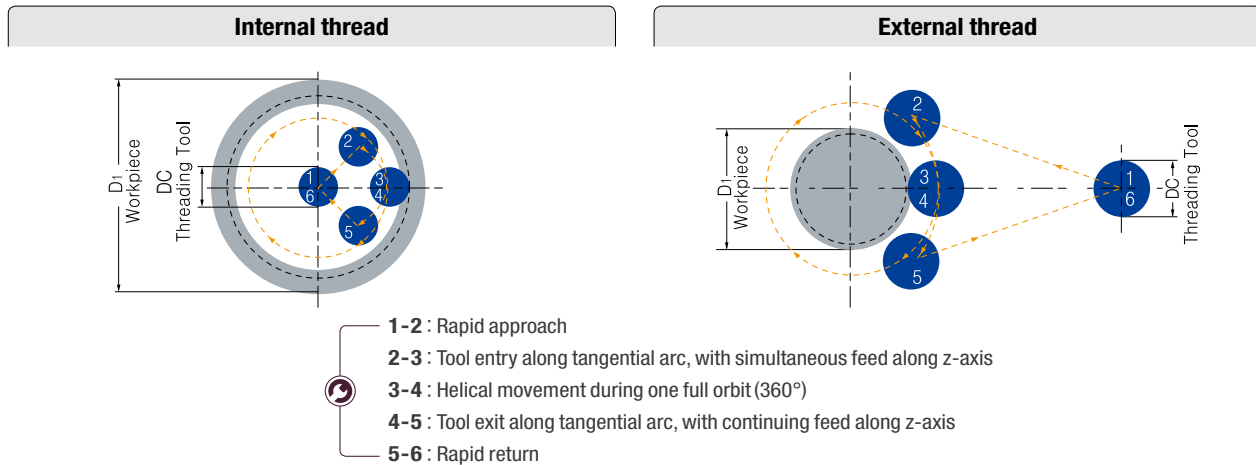
• The helix angle can also be found from the diagram below



03) Useful cutting tip - Thread Milling

↪ Tangential Arc Approach

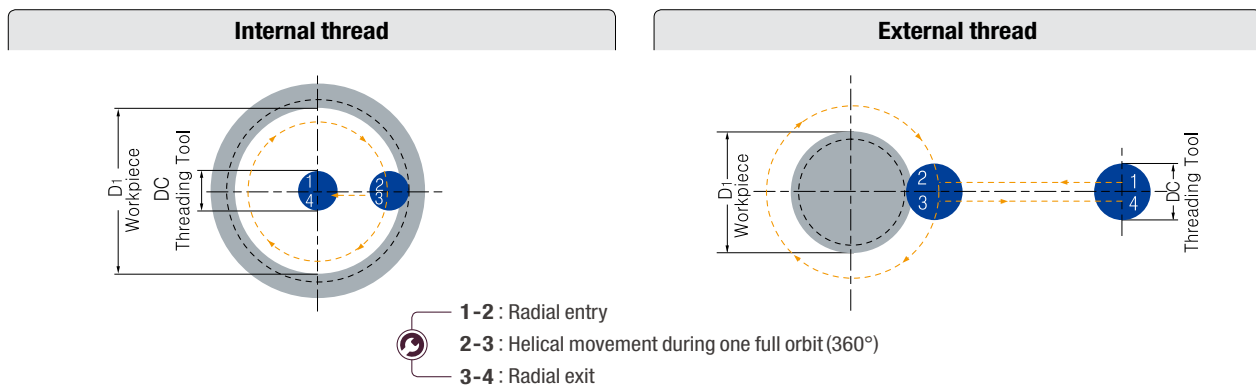
- With this method, the tool enters and exits the workpiece smoothly. No marks are left on the workpiece and there is no vibration, even with harder materials. Although it requires slightly more complex programming than the radial approach (see below), this is the method recommended for machining at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



↪ Radial Approach

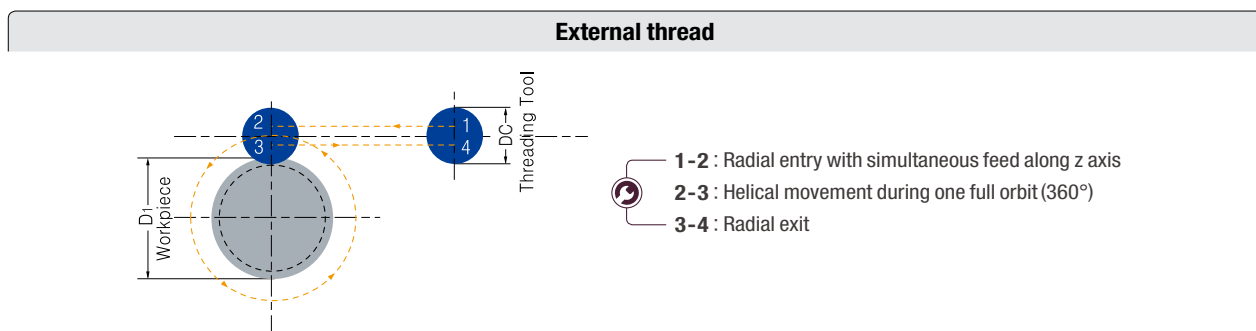
- It is the simplest method and there are two properties to consider:
 - ① a small vertical mark may be left at the entry (and exit) point. This is of no significance to the thread itself
 - ② when using this method with very hard materials, there may be a tendency of the tool to vibrate as it approaches the full cutting depth

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








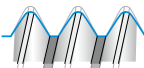

↪ Tangential Line Approach

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

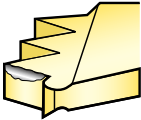
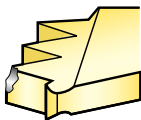
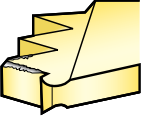
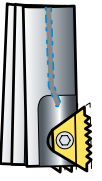
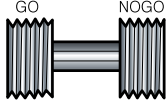




04) Troubles in cutting and solutions - Thread Turning

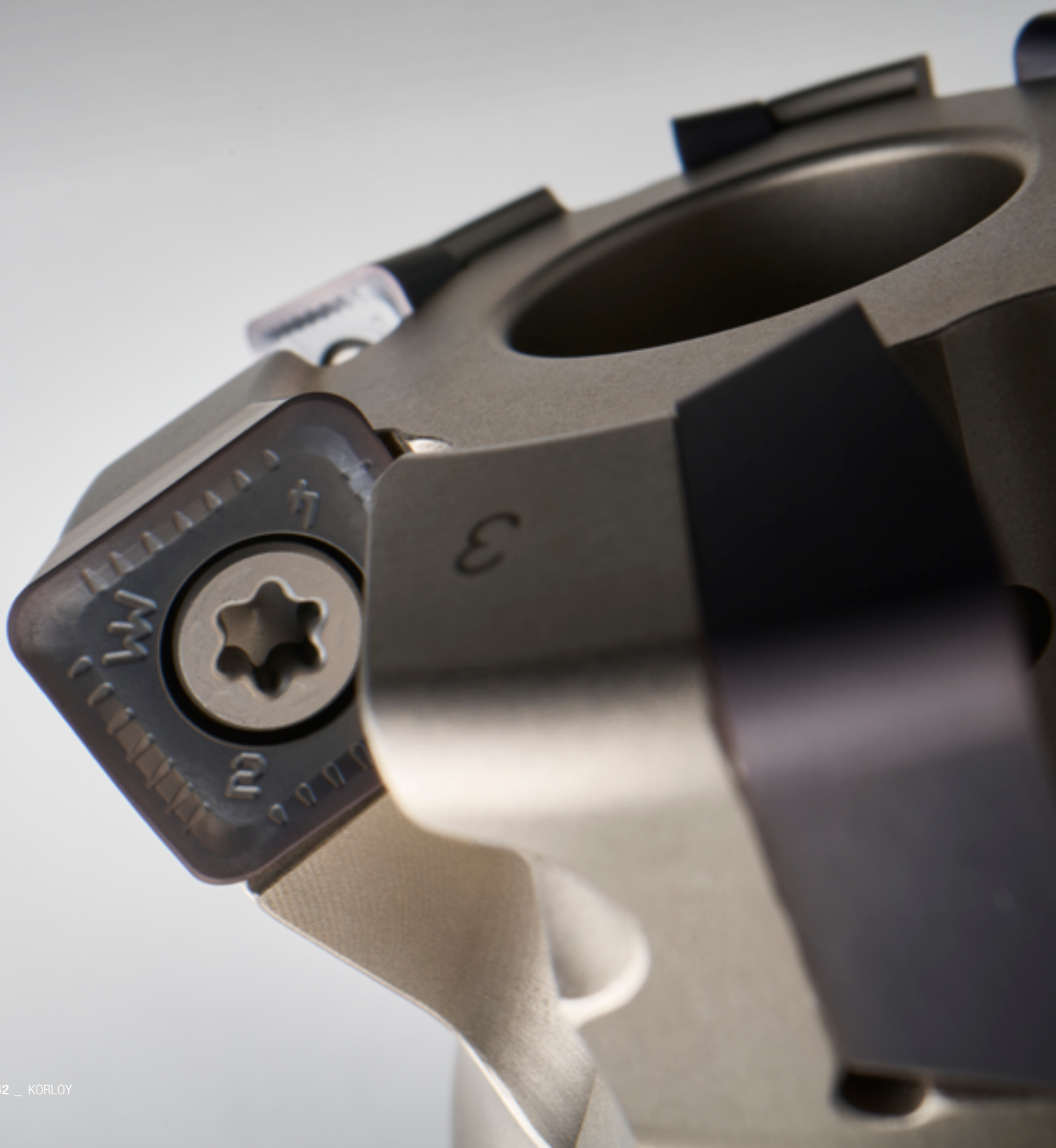
Problem	Possible cause	Solution
 Increased flank wear	Too high cutting speed	Reduce cutting speed/use coated insert
	Too low depth of cut / Too many passes	Increase the depth of cut per pass
	Unsuitable carbide grade	Use a coated carbide grade
	Insufficient coolant oil	Increase coolant flow rate
 Uneven 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













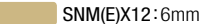


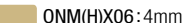



























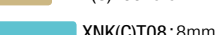

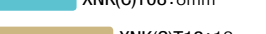










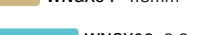











Problem	Possible cause	Solution	
	Excessive flank wear	<p>Too high cutting speed Reduce cutting speed/use coated insert</p> <p>Chip is too thin Increase feed rate</p> <p>Insufficient coolant Increase coolant flow rate</p>	
		Excessive chipping	<p>Chip is too thick Reduce feed rate/Use the tangential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

Milling

- 01) Line-up
- 02) Grade selection guide
- 03) Tool selection guide
- 04) Useful cutting tip
- 05) Troubles in cutting and solutions



01) Line-up




























Machining types	KAPR	APMX (mm)					Cutting-edges	Holder				Available inserts	INFO Link	Sub Application	
		5	10	15	20	25		30	Type	Cutting diameter Range (Ø)	Product name				Designation
 <p>Facing</p>	-						8	 Shank	32 ~ 63	Rich Mill (RMR)	RMRS			-	
		 Cutter	50 ~ 125	RMRC											
	 <p>45°</p>	 SAGX14: 5.5mm  SNMX14: 5.5mm					8		50 ~ 250	Rich Mill (RM8-X)	RMX8AC			-	
		 SNM(E)X12: 6mm  SNM(E)X15: 7.5mm									8				
		 ONM(H)X06: 4mm  ONM(H)X08: 5.5mm					16		50 ~ 400	Rich Mill (RM16)		RM16AC			
		 XNM(X)06(Flat): 4.8mm  XNM(X)06(Helix): 3.5mm									14				50 ~ 160
	 SNM(E)X12: 9mm  SNM(E)X15: 11mm					8		50 ~ 400	Rich Mill (RM8)	RM8EC					
	 <p>Shouldering</p>	-	 ADKT10: 9.5mm  ADKT12: 11.5mm  ADKT17: 16.5mm							2	 Shank	16 ~ 40			Alpha Mill-X
			 Cutter	40 ~ 125	AMXC										
			 TNKT11: 8mm  TNKT16: 11.5mm  TNKT20: 15.5mm					3	 Shank	25 ~ 40	Triple Mill	TPMS			Facing Slotting Plunge
 Cutter		50 ~ 125	TPMC												
 <p>90°</p>		 XNK(C)T06: 5.5mm  XNK(C)T08: 8mm  XNK(C)T12: 12mm					3	 Shank	20 ~ 63	Rich Mill (RM3)	RM3PS			Facing Slotting Plunge Ramping Helical	
		 Cutter	40 ~ 125	RM3PC											
		 LNM(E)X10: 9mm  LNM(E)X15: 14mm					4	 Shank	14 ~ 63	Rich Mill (RM4)	RM4PS			Facing Slotting Plunge Ramping Helical	
		 Cutter	40 ~ 160	RM4PC											
		 WNGX04: 4.3mm  WNGX08: 8.2mm					6	 Shank	20 ~ 50	Rich Mill (RM6)	RM6PS			Facing Slotting Plunge Ramping Helical	
		 Cutter	40 ~ 125	RM6PC											
 LNKT08: 8mm  LNKT14: 12.7mm  LNKT17: 16.5mm					2	 Shank	25 ~ 40	Tangen-Pro (TP2P)	TP2PS			Facing Slotting Plunge			
 Cutter		40 ~ 125	TP2PC												







01) Line-up

Machining types	KAPR	APMX (mm)						Cutting-edges	Holder				Available inserts	INFO Link	Sub Application
		5	10	15	20	25	30		Type	Cutting diameter Range (Ø)	Product name	Designation			
Shouldering	90°	LNGX13:12mm						4	Shank	25 ~ 40	Tangen-Pro (TP4P)	TP4PS		INFO	Facing Slotting Plunge
		Cutter	40 ~ 125	TP4PC											
		SOKX14:11mm						8	Shank	32 ~ 40	Tangen-Pro (TP8P)	TP8PS		INFO	
		Cutter	50 ~ 125	TP8PC											
High feed machining	10°	SQMT12:1.5mm						4	Shank	32 ~ 40	HQM	HQMS		INFO	Facing Shouldering Profile Ramping Helical
		SQMT14:2.0mm							Cutter	50 ~ 100		HQMC			
	-	LNMX04:0.5mm						4	Shank	16 ~ 42	HFMD	HFMS		INFO	
		LNMX06:1mm							Cutter	32 ~ 100		HFMC			
	13°	LPMX04/LPM(E)W04:0.5mm						2	Shank	8 ~ 21	HFM	HFMS		INFO	
		LNMX10:1.5mm							Cutter						
	14°	WNMX06:1mm						6	Shank	16 ~ 63	HRMD	HRMS		INFO	
		WNMX09:1.5mm							Cutter	40 ~ 315		HRMC			
		WNMX13:2mm													
		WNMX16:2.5mm													
15°	WDKT08:1mm						3	Shank	20 ~ 63	HRM	HRMS		-		
	WDKT10:1.5mm							Cutter	50 ~ 160		HRMC				
	WDKT13:2mm														
	WDKT15:2.5mm														
Aluminum cutting	90°	LXET25:25mm						2	Shank	32 ~ 63	Pro-L Mill	PALS		-	
		LXET34:34mm							Cutter	63		PALC			
		XEKT19:17mm						2	Shank	20 ~ 40	Pro-X Mill	PAXS		INFO	
		XEKT25:23mm							Cutter	40 ~ 125		PAXC			
		XDET19:17mm						2	Shank	25 ~ 40	Pro-V Mill	PAVS		INFO	
									Cutter	40 ~ 125		PAVC			
		VDKT11:8mm						2	Shank	12 ~ 40	Pro-A Mill	PAS		INFO	
		VDKT22:15mm							Cutter	40 ~ 100		PAC			

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	General flat surface milling	RM8 RM8-X RM14 RM16 RMR	High speed  Continuous  Low speed  Interrupted	NCM535 PC3700 PC5300 PC5535 PC5400	NC5330 PC5300 PC5535 PC9530 PC5400 PC9540	PC6100 NCM535 PC5300 PC5535 PC5400	PC5300 PC5535 PC5400 PC9540	-	H01
	High rigidity flat surface milling	Mill Max Heavy Power Buster	High speed  Continuous  Low speed  Interrupted	NCM535 PC3700 PC5300	PC5300	NCM535 PC5300	PC5300	-	-
	Finishing with wiper	RM8 RM16	High speed  Continuous  Low speed  Interrupted	PC3700 PC5300	PC5300	PC6100	PC5300	-	-
 Shouldering	Perpendicularity and flat surface milling	Alpha Mill-X Alpha Mill RM3 RM4 Triple Mill RM6	High speed  Continuous  Low speed  Interrupted	NCM535 PC3700 PC5300 PC5535 PC5400	NC5330 PC5300 PC5535 PC9530 PC5400 PC9540	PC6100 NCM535 PC5300 PC5535 PC5400	PC5300 PC5535 PC5400 PC9540	PC2505 PC2510	H01 H05
	Perpendicular milling on a thin wall	TP4P TP2P TP8P RM4 RM6	High speed  Continuous  Low speed  Interrupted	NCM535 PC3700 PC5300 PC5535 PC5400	NC5330 PC5300 PC5535 PC9530 PC5400 PC9540	PC6100 NCM535 PC5300 PC5535 PC5400	PC5300 PC5535 PC5400 PC9540	PC2505 PC2510	H01
	Edge cutting-peripheral milling	Mono - Tool Alpha Mill Multi - Edge	High speed  Continuous  Low speed  Interrupted	NCM535 PC3700 PC5300 PC5535 PC5400	NC5330 PC5300 PC5535 PC9530 PC5400 PC9540	PC6100 NCM535 PC5300 PC5535 PC5400	PC5300 PC5535 PC5400 PC9540	PC2505 PC2510	H01
 High feed machining		HQM HRMD HRM HFMD HFM	High speed  Continuous  Low speed  Interrupted	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	High speed  Continuous  Low speed  Interrupted	-	-	-	-	-	H01 H05 PD1005 PD1010

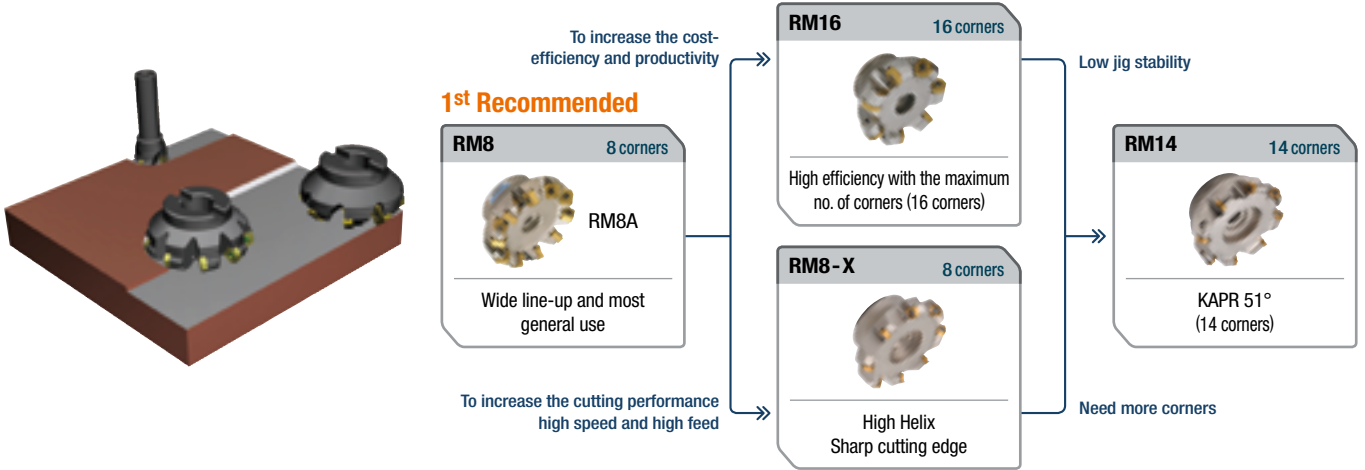
➔ Chip Breaker selection

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
			



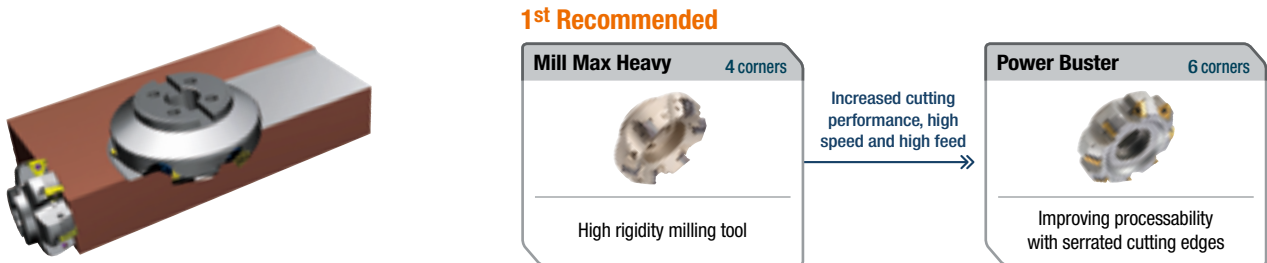
03) Tool selection guide - Facing

General flat surface milling



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

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								
																													
KAPR	45° ~ 88°										45° ~ 88°										45°								
APMX	6 ~ 11.5										6 ~ 11.5										5.5								
DC	50 ~ 400										80 ~ 315										50 ~ 125								
ISO	P		M		K		S		N		P		M		K		S		N		P		M		K		S		
Chip breaker	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	MM	ML	
PC6100					★	☆									★	☆											★		
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										
																							
KAPR	51°				45°								-										
APMX	3.5				4 ~ 5.5								3.5										
DC	80 ~ 315				80 ~ 400								32 ~ 125										
ISO	M		K		P		M		K		S		N		P		M		K		S		
Chip breaker	N	XNR	N	XNR	MM	MF	MM	MM	MF	MM	ML	MA	MM	ML	MM	ML	MM	ML	MM	ML	MM	ML	
PC6100			○	○				★	☆					★				★	○				
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

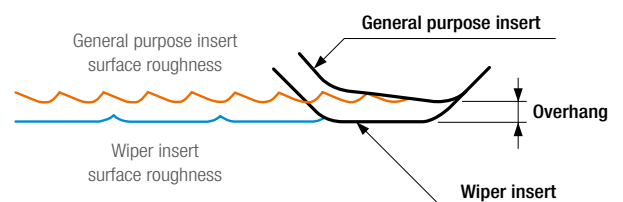
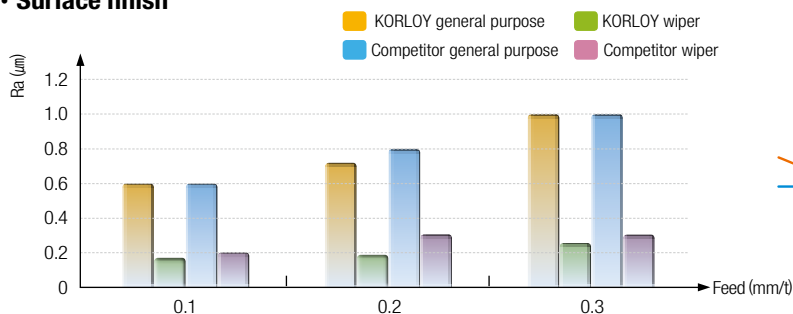
System	Mill Max - Heavy			Power Buster - PBP		Power Buster - PBA		Power Buster - PBZ	
KAPR	55°			90°		45°		80°	
APMX	14.5			20		12		18	
DC	125 ~ 315			80 ~ 315		80 ~ 315		80 ~ 315	
ISO	P	M	K	P	K	P	K	P	K
Chip breaker	MM	MM	MM	NM	NM	NM	NM	NM	NM
PC3700	★					★		★	
PC5300	☆	★	☆			☆	★	☆	★
PC9530									
PC5400						○	○	○	○
NCM535	○	○	★			○	☆	○	☆

Finishing with wiper

★ 1st recommended ☆ 2nd recommended ○ Available

System	Rich Mill - RM8A				Rich Mill - RM16			
KAPR	45°				45°			
APMX	7.5				4 ~ 5.5			
DC	50 ~ 400				80 ~ 400			
ISO	P	M	K	S	P	M	K	S
Chip breaker	W	W	W	W	W	W	W	W
PC6100			★				★	
PC3700	★							
PC9530						○		
PC5300	○	★	○	★	★	★	○	★

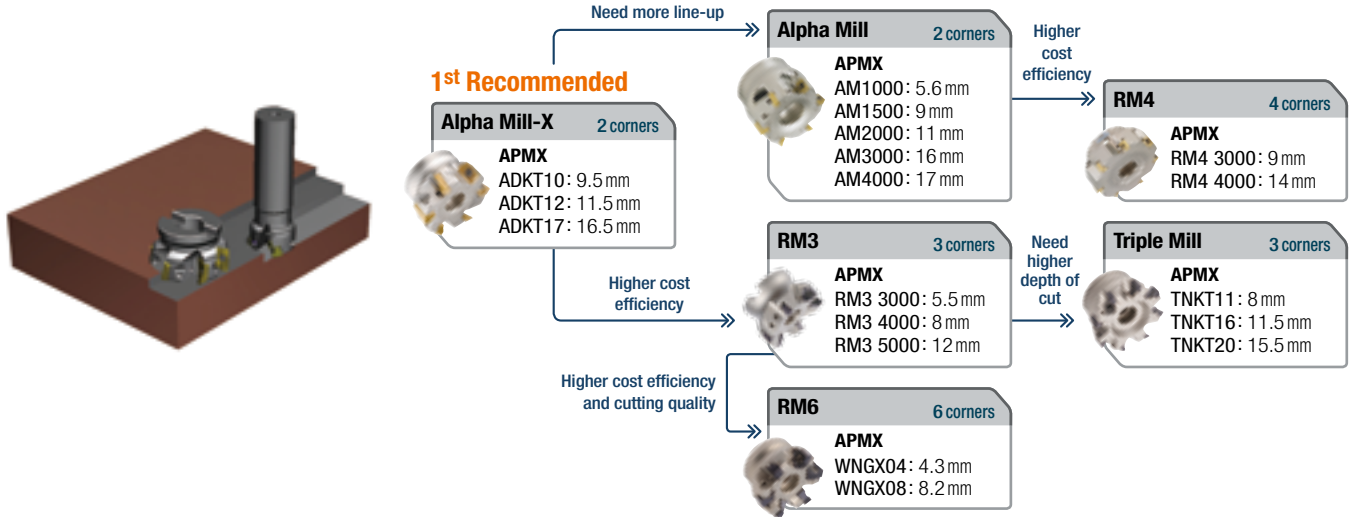
• Surface finish



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

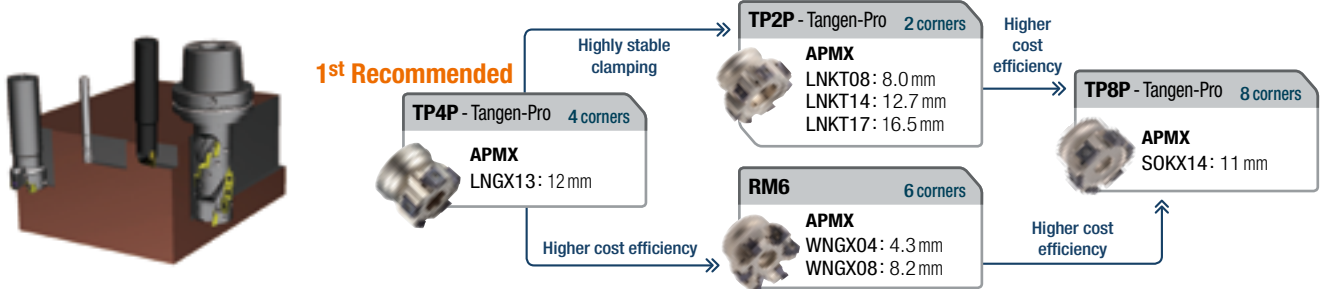
03) Tool selection guide - Shouldering

↪ Perpendicularity and flat surface milling



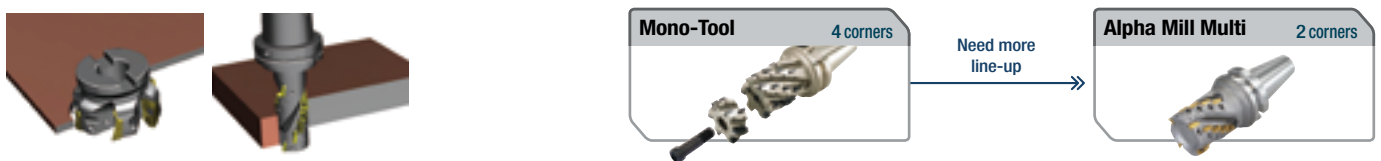
Item	Unit price per corner	No. of corners	Versatility	Cutting load	Max. Depth of cut
RM3	★★★★★	★★★	★★★★	★★★★	★★★
RM4	★★★	★★★	★★★	★★★	★★★★
RM6	★★★★	★★★★	★★★★	★★★	★★★
Alpha Mill	★★	★★	★★★★★	★★★★☆	★★★★★
Alpha Mill-X	★★	★★	★★★★★	★★★★★	★★★★★
Triple Mill	★★★	★★★	★★	★★★★★	★★★★
TP8P	★★	★★★★★	★★	★★★★	★★★★

↪ Perpendicular milling on a thin wall



Item	Stable clamping	No. of corners	Surface roughness	Line-up	Max. Depth of cut
TP2P	★★★★★	★★	★★★★★	★★★	★★★★★
TP4P	★★★★	★★★	★★★	★★★★	★★★★
TP8P	★★★★	★★★★★	★★★	★★	★★★
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													
KAPR	90°										90°										90°													
APMX	9.5 ~ 16.5										5.6 ~ 17										5.5 ~ 12													
DC	16 ~ 125										10 ~ 200										20 ~ 125													
ISO	P		M		K		S		N		P		M		K		S		H		N		P		M		K		S		H		N	
Chip breaker	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	ML	MM	MA			
PC6100					★	☆								★	☆											★	☆							
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									
KAPR	90°										90°										90°									
APMX	9 ~ 14										8 ~ 15.5										4.3 ~ 8.2									
DC	14 ~ 160										25 ~ 125										25 ~ 125									
ISO	P		M		K		S		N		P		M		K		S		P		M		K		S		N			
Chip breaker	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	MM	ML	MA		
PC6100					★	☆										★									★	☆				
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	TP4P - Tangen-Pro					TP8P - Tangen-Pro					Rich Mill - RM4					Rich Mill - RM6													
																													
KAPR	90°					90°					90°					90°													
APMX	12					11					10 ~ 15					4.3 ~ 8.2													
DC	25 ~ 125					32 ~ 125					14 ~ 160					25 ~ 125													
ISO	P		M		K		S		N	P		K		P		M		K		S		N							
Chip breaker	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
PC6100					★	☆					☆					★	☆								★	☆			
PC3700	★	○								☆				★	○						★	○							
PC5300	☆	○	☆	☆	○	○	☆	★		★	★	☆	○	○	☆	○	○	☆	★	☆	○	○	☆	○	○	☆	★		
PC5535	○	○	★	○	○	○	○	○				○	○	○	○	○	○	○	○		○	○	○	○	○	○	○	○	
PC5400	○	○	○	○	○	○	○	○		○	○	○	○	○	○	○	○	○	○		○	○	○	○	○	○	○	○	
PC9540														○	★								○	★					
NC5330												○	○	○	○	○	○	○	○		○	○	○	○	○	○	○	○	
NCM535												○	○	○	○	○	○	○	○		○	○	○	○	○	○	○	○	
H01																				★								★	
H05									★											☆								☆	

↻ Edge cutting- peripheral milling

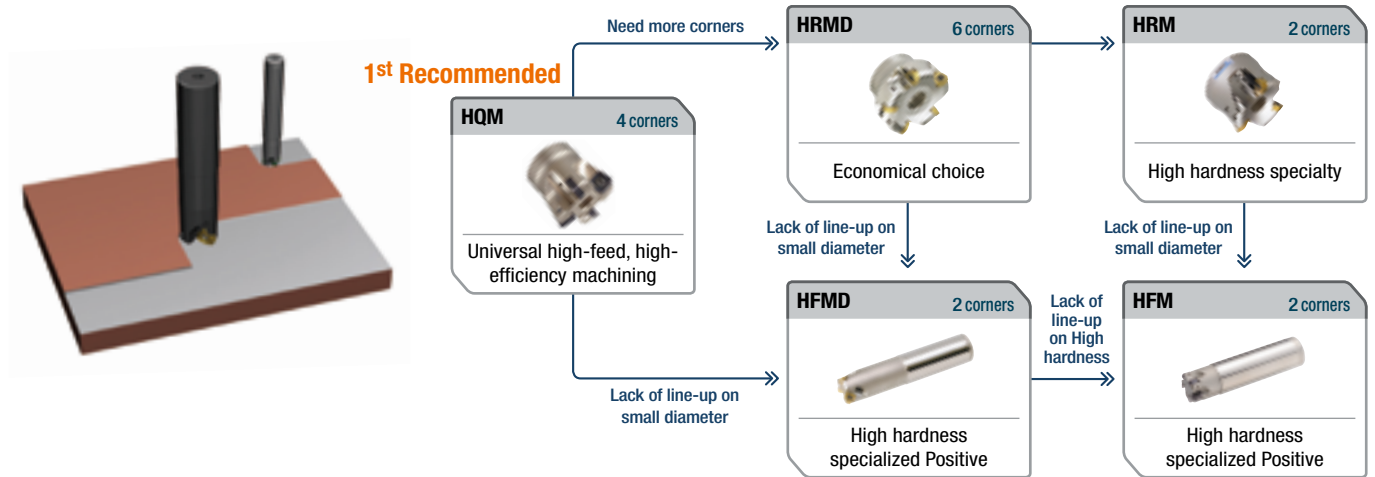
★ 1st recommended ☆ 2nd recommended ○ Available

System	Mono - Tool					Alpha Mill Multi - Edge									
															
KAPR	90°					90°									
APMX	94 ~ 114					15 ~ 76									
DC	50 ~ 80					16 ~ 100									
Arbor	BT					BT, SK, HSK									
ISO	P		K			P		M		K		S		H	N
Chip breaker	MM		MM			MM	MF	MM	ML	MM	MF	MM	ML	MM	MA
PC6100										★	☆				
PC2505														☆	
PC2510														★	
PC3700	★					★	○								
PC5300	☆					☆	○	○	☆	○	○	○	☆		
PC5535						○	○	○	○	○	○	○	○		
PC9530															
PC5400						○	○	○	○	○	○	○	○		
PC9540								○	★			○	★		
NC5330						○	○	○	○	○	○	○	○		
NCM535						○	○			○	○				
H01															★
H05															



03) Tool selection guide - High feed machining

↻ High feed milling



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

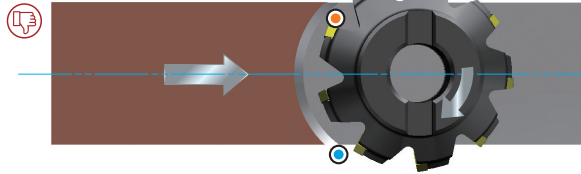
★ 1st recommended ☆ 2nd recommended ○ Available

System	HQM					HRMD					HFM					HFMD				
	MM	MF	ML	MM	MF	MM	MF	ML	MM	MF	MM	MF	ML	MM	MF	MM	MF	ML	MM	MF
KAPR	10°					14°					13°					-				
APMX	1.5 ~ 2					1.0 ~ 2.5					0.4 ~ 0.5					0.5 ~ 1.5				
DC	32 ~ 100					16 ~ 315					8 ~ 21					8 ~ 100				
ISO	P	M	K	S	H	P	M	K	S	P	M	K	S	H	P	M	K	S		
Chip breaker	MM	MF	ML	MM	MF	MM	MF	ML	MM	MF	MM	MF	ML	MM	MF	MM	MF	ML	MM	MF
PC6100				★	☆									★	☆				★	☆
PC3700	★	○				★	○				★	○				★	○			
PC5300	☆	○	○	○	○	☆	○	○	☆	○	☆	○	○	☆	○	☆	○	○	☆	○
PC5535																				
PC5400	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
PC9530																				
PC9540		☆	★						○	★				★	○				○	★
PC2505																				
PC2510						★	○													

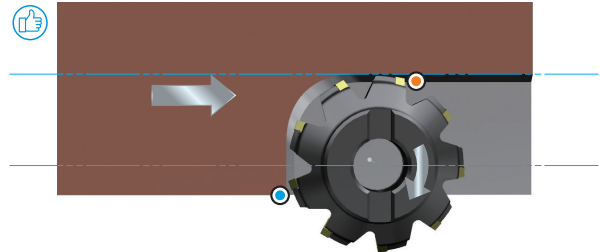
04) Useful cutting Tip

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

👍 Entrance 🚫 Exit



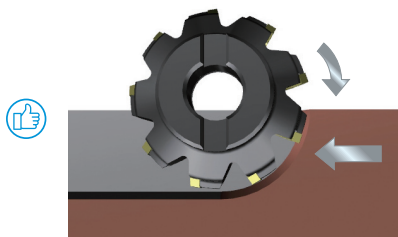
👍 Entrance 🚫 Exit



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

		<p>ae > 75% of ØD</p> <ul style="list-style-type: none"> Optimal cutting conditions Offset the initial impact along the direction of rotation when entering the cut
		<p>ae < 25% of ØD</p> <ul style="list-style-type: none"> Form positively when entering. Absorb the impact during entry by the outermost part of the insert, gradually offset by the tool
		<p>ae = 50% of ØD</p> <ul style="list-style-type: none"> Not recommended. Very high impact and load on the tool during a tool's entering

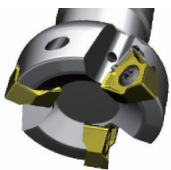
➔ Downward milling: Reduce heat and minimize work hardening tendencies!



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

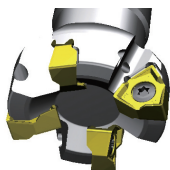
15°	45°	90°
$5.76 \times f_z$	$1.414 \times f_z$	f_z

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



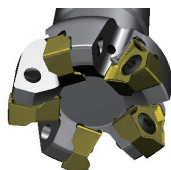
No sign (Coarse)

- 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






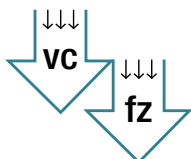
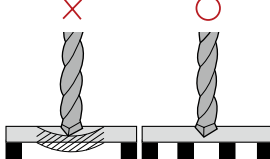
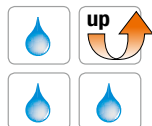
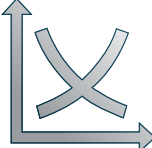

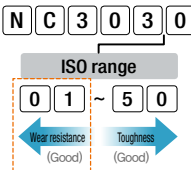

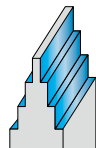
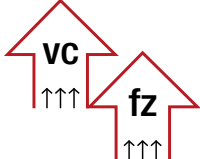
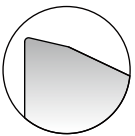

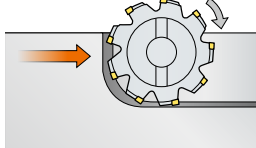
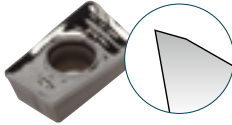
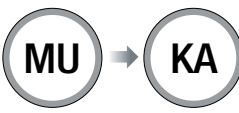
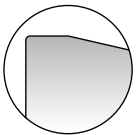
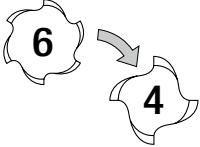
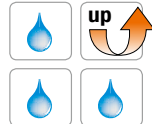
➔ Main formula

$$h_{ex} = f_z * \sin(KAPR)$$

$$f_z = \frac{h_{ex}}{\sin(KAPR)}$$

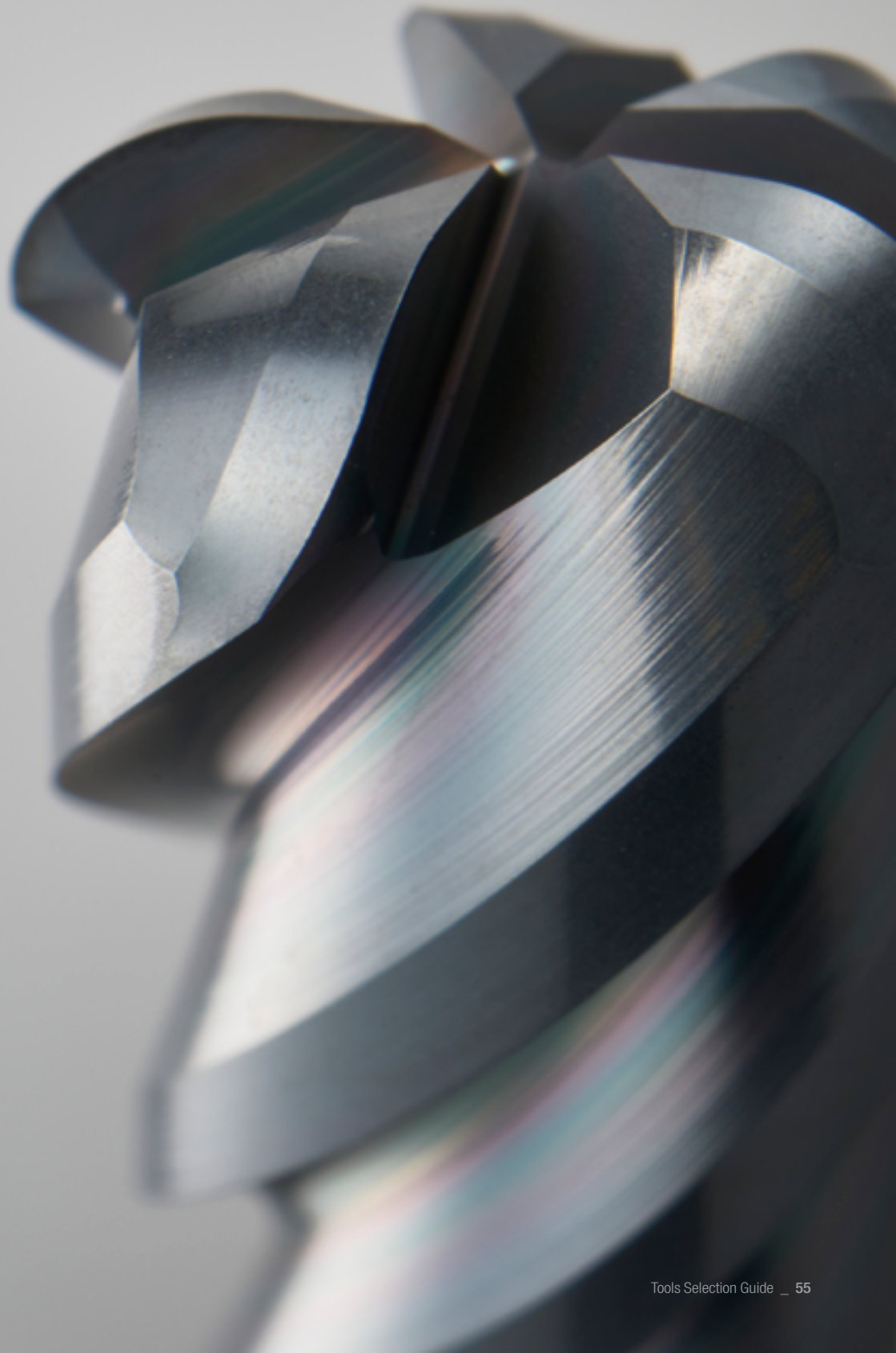


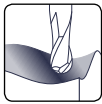
05) Troubles in cutting and solutions

 Troubles	<p>Excessive wear</p> 	<p>Chipping / fracture</p> 	<p>Wrong chip evacuation (chip jamming)</p> 	<p>Built-up edge / welding</p> 
<p>Factors</p> <ul style="list-style-type: none"> • Excessive cutting speed/ excessive feed • Dull cutting edge • Low precision of tools 	<ul style="list-style-type: none"> • Excessive cutting speed/ excessive feed • Dull cutting edge • Low precision of tools 	<ul style="list-style-type: none"> • Excessive feed • Weak jig • Long overhang 	<ul style="list-style-type: none"> • Fracture on the corner • Chipping on the cutting edge and fracture • Re-cutting of chips 	<ul style="list-style-type: none"> • Low cutting speed/ low feed • Negative shape • High adhesiveness material
	<p>Cutting speed down, feed down</p> 	<p>Accurate clamping of workpiece</p> 	<p>Use more coolant and increase its pressure</p> 	<p>Check the cutting conditions</p> 
<p>Solutions</p> 	<p>Use higher wear resistance grade</p> 	<p>Feed down</p> 	<p>Multiple pass division of deep machining</p> 	<p>Cutting speed up, feed up</p> 
	<p>Applying C/B for low cutting load</p> 	<p>Use tougher grade</p> 	<p>Upward cutting</p> 	<p>Positive I/S, Using polished inserts</p> 
	<p>Use high precision class inserts (higher tolerance)</p> 	<p>Apply strong cutting edge C/B</p> 	<p>Apply fewer teeth (pitches)</p> 	<p>Use more coolant and increase its pressure</p> 

Endmill

- 01) Line-up
- 02) Tool selection guide
- 03) Useful cutting tip
- 04) Troubles in cutting and solutions

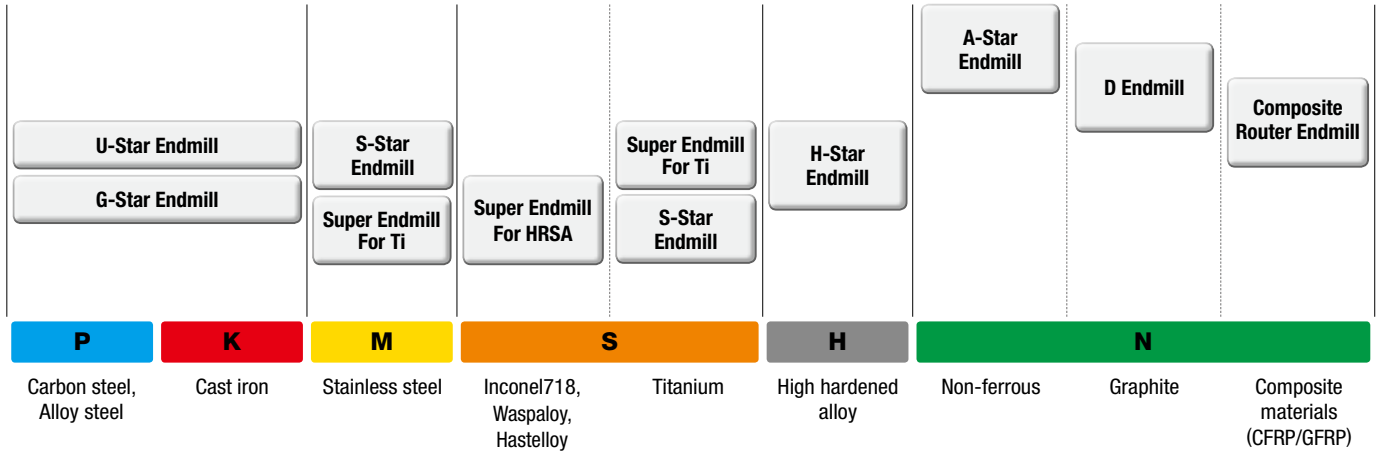




01) Line-up

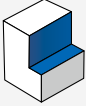

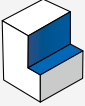




Workpiece	Use	Product name	Type	No. of tooth	Diameter (mm)	Picture	Features	INFO Link
						No. of standard items		
H	High hardness (~HrC65)	The Mirror Endmill (PCD)		-	0.3~2	 6 Items	<ul style="list-style-type: none"> Optimal surface finish by PCD ball Endmill with no edge Nano-level surface finish due to its ultra-fine Endmill 	
	High hardness (~HrC65)	The Mirror Endmill (cBN)		2	0.4~2	 9 Items	<ul style="list-style-type: none"> Higher productivity and surface finish in high speed cutting Stable tool life and surface from high precision Endmill 	
	High hardness (HrC50~63)	H-Star Endmill		2~6	1.0~20	 3,007 Items	<ul style="list-style-type: none"> Suitable for high speed machining of hardened workpieces (HrC50~63) Improved initial chipping resistance and good wear resistance with optimized edge treatment for high hardness steel cutting 	
P K	General (medium hardness) (HrC30~50)	U-Star Endmill		2~6	0.1~25	 4,585 Items	<ul style="list-style-type: none"> Suitable for machining medium hardness workpieces (HrC30~50) made of alloy steel, carbon steel, die steel, etc. 	
	General (~HrC30)	G-Star Endmill		2~4	1.0~20	 456 Items	<ul style="list-style-type: none"> For general machining with high performance and high quality For various workpiece machining (carbon steel, alloy steel, cast iron, pre-hardened, etc.) 	
M	Stainless steel	S-Star Endmill		2~7	1.0~20	 218 Items	<ul style="list-style-type: none"> Optimal performance in stainless machining Enhanced oxidation resistance Neck application and trochoidal machining 	
S	HRSA	Super Endmill		4/6	3.0~20	 251 Items	<ul style="list-style-type: none"> Endmill for HRSA machining Optimal for machining of Ni based HRSA such as Inconel, Hastelloy, Waspaloy, etc. 	
	Titanium	Super Endmill		2/4/5	1.0~20	 132 Items	<ul style="list-style-type: none"> Endmill for titanium and stainless steel cutting Longer tool life : high toughness substrate and high lubrication coating layer 	
N	Non-ferrous metal, Aluminum	A-Star Endmill		2~3	1.0~20	 187 Items	<ul style="list-style-type: none"> Effective chip evacuation in high feed machining with U-shape Double relief angle (Stronger cutting edge hardness) 	
	Composite materials (GFRP, GFRP)	Composite Router Endmill		2~8	4.0~12	 44 Items	<ul style="list-style-type: none"> Router for composite material machining High performance due to Nano-Crystalline dia-coating 	
	Graphite, Ceramics	D Endmill		2~4	0.6~12	 280 Items	<ul style="list-style-type: none"> Longer tool life due to high hardness dia-coating Applying one-pass grinding and good surface finish 	
	Dental, metal, wax, Zirconia	T Endmill		2	0.6~3	 214 Items	<ul style="list-style-type: none"> 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 	
	Copper, Copper alloy	C-Max Endmill		2	0.5~12	 94 Items	<ul style="list-style-type: none"> Application of K-Silver Coating(wear resistance, chipping resistance) Optimal for copper and non-ferrous metal machining 	-
For general machining with special function	Roughing	R+ Endmill		2~4	5.0~25	 204 Items	<ul style="list-style-type: none"> Endmill with a shape minimizing cutting load for roughing 	

02) Tool selection guide

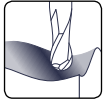


↻ Tool selection guideline by functions

● 1st recommended ● 2nd recommended ○ Not recommended

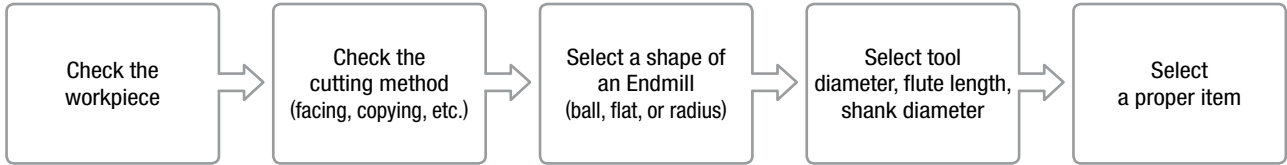
Type	No. of tooth							
		Precise finishing	Finishing	Roughing	Slotting	Plunging	Copying	Trochoidal milling
Flat/ Radius	2 teeth	○	○	◐	●	●	○	○
	3 teeth	○	◐	◐	●	◐	○	○
	4 teeth	●	●	●	●	○	○	●
	6 teeth or over	●	●	○	○	○	○	●
Ball	2 teeth	○	○	○	●	○	●	○
	4 teeth	○	○	○	◐	○	●	○

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



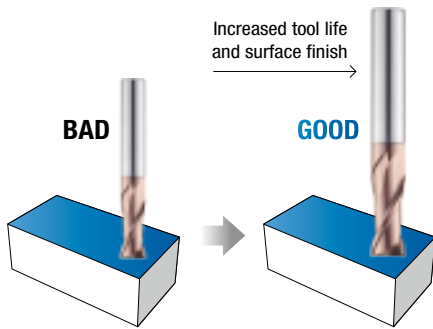
03) Useful cutting Tip

How to select an Endmill

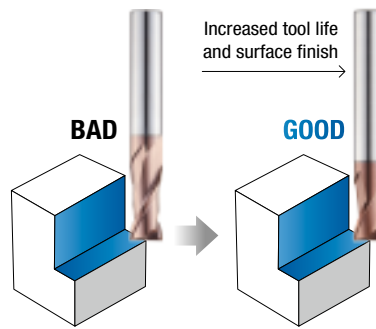


How to use an Endmill

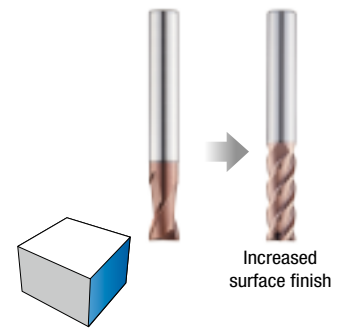
1) Use a larger diameter in case of no issues during machining



2) Use the shortest available flute length



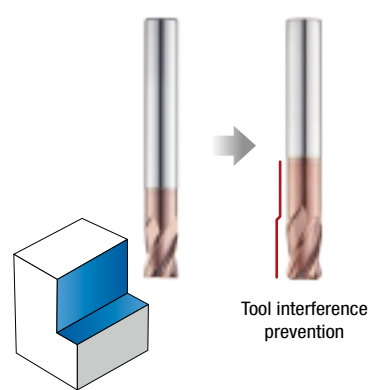
3) Use a tool with more flutes as possible for finishing



4) Maintain a short end mill overhang from arbor



5) Use a necked tool for deep machining depths




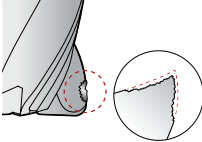
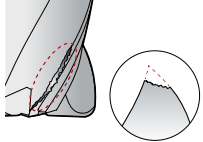
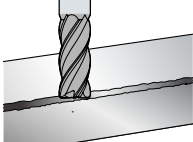
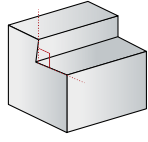


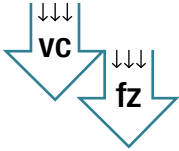
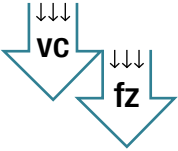
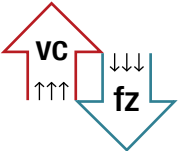
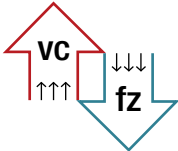
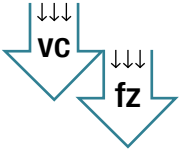
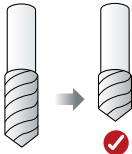
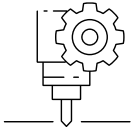
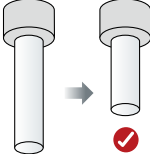
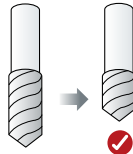
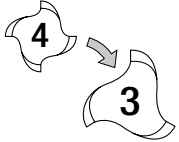
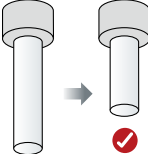
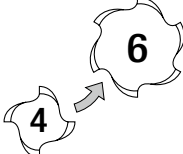
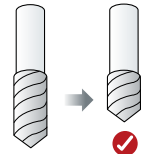
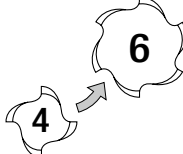
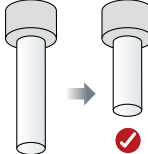
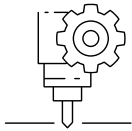
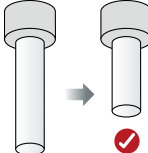
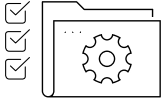
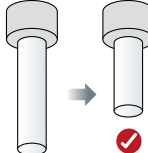
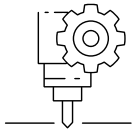
※ In case you already have existing tools in use



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



04) Troubles in cutting and solutions

 Trouble	Chipping on the tool 	Excessive wear on the tool 	Bad surface finish 	Defective dimensional accuracy, perpendicularity 	Fracture in while cutting 
Factor	<ul style="list-style-type: none"> • High speed/high feed • Long flute length, overhang 	<ul style="list-style-type: none"> • High speed/high feed • Long overhang 	<ul style="list-style-type: none"> • Vibration • Built-up edge 	<ul style="list-style-type: none"> • Improper cutting conditions • Long flute length, overhang 	<ul style="list-style-type: none"> • Improper cutting conditions • Long overhang
 Solution	<p>Cutting speed down, feed down</p> 	<p>Cutting speed down, feed down</p> 	<p>Cutting speed up, feed down</p> 	<p>Cutting speed up, feed down</p> 	<p>Cutting speed down, feed down</p> 
<p>Use a tool with short flute length</p> 	<p>Check the item (shape and grade)</p> 	<p>Select short overhang</p> 	<p>Use a tool with short flute length</p> 	<p>Enlarge the space for chip flowing (Decrease the no. of tooth)</p> 	
<p>Select short overhang</p> 	<p>Increase the no. of effective tooth</p> 	<p>Use a tool with short flute length</p> 	<p>Increase the no. of effective tooth</p> 	<p>Select short overhang</p> 	
<p>Check the item (shape and grade)</p> 	<p>Select short overhang</p> 	<p>Check the clamping of the facility, arbor and workpiece</p> 	<p>Select short overhang</p> 	<p>Check the item (shape and grade)</p> 	

Hole Making

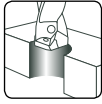
- 01) Line-up
- 02) Tool selection guide
- 03) Useful cutting tip
- 04) Troubles in cutting and solutions



01) Line-up

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

Work-piece	Machining type	Tolerance of hole	Drills dia.	Product	Depth of cut	holder		Insert		Grade	Recommended cutting condition		INFO 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	 (External)	SPMT□-PD XOMT□-PD SPMT□-LD XOMT□-LD (For mild steel)	PC3700 PC5335	120 ~ 170	0.16 ~ 0.06	
	Through-hole	0~+0.1	Ø8~Ø11.9	TPDC Plus Drill (TPDX)	3D, 5D, 8D		TPDX□D		TPD□XP	PC325U	40 ~ 140	0.35 ~ 0.12	
	Through-hole	0~+0.1	Ø10~Ø32.9	1st (recommended) TPDB Plus Drill	3D, 5D, 8D 10D, 12D		TPDB□-P		TPD□B	PC5300	40 ~ 140	0.43 ~ 0.18	
	Through-hole	0~+0.1	Ø33~Ø39.9	1st (recommended) TPDB Plus Drill	3D, 5D, 8D		TPDB□-P		TPD□B-DS	PC5300	50 ~ 140	0.45 ~ 0.2	
	Through-hole	0~+0.1	Ø12~Ø30.9	2nd (recommended) TPDC Plus Drill	1.5D, 3D 5D, 8D 10D, 12D		TPDC□D		TPD□CP	PC5335	50 ~ 140	0.45 ~ 0.2	
	Flat / Blind hole	0~+0.1	Ø12~Ø30.9	1st (recommended) TPDC Plus Drill	1.5D, 3D 5D, 8D 10D, 12D		TPDC□D		TPD□CP-FC	PC5335	50 ~ 110	0.33 ~ 0.18	
	Flat / Blind hole	0~+0.1	Ø14~Ø30.9	2nd (recommended) TPDB Plus Drill	1.5D		TPDB□-F		TPD□B-F	PC5400	40 ~ 100	0.32 ~ 0.2	
	H-Beam, Plate	0~+0.3	Ø14~Ø32.9	TPDB Plus Drill	3D, 4D, 5D, 8D		TPDBP□-H		TPD□BP-H	PC340UL	60 ~ 75	0.3 ~ 0.15	
	Through-hole	0~+0.1 (Highly precise)	Ø2.5~Ø20	MSD Plus	3D, 5D, 7D (Internal coolant)		MSDPH□P	-	-	PC325U	40 ~ 150	0.4 ~ 0.05	
	Through-hole	0~+0.1 (Highly precise)	Ø1~Ø20	W-Star Drill	5D, 7D (External coolant)		WSDP□	-	-	PC325W	40 ~ 120	0.32 ~ 0.06	
	Through-hole	0~+0.1 (Highly precise)	Ø3~Ø10	MLD Plus	10D ~ 25D (External coolant, MQL)		MLD□N□	-	-	PC315G	60 ~ 90	0.25 ~ 0.1	
	Flat / Blind hole	0~+0.1 (Highly precise)	Ø2.5~Ø16	MSFD	2D (External coolant) 3D (Internal coolant)		MSFD(H)□	-	-	PC325U	50 ~ 90	0.2 ~ 0.03	
M	Through-hole	-0.15 ~ +0.4	Ø12~Ø60.5 Ø61~Ø100 (Cartridge type)	1st (recommended) KING Drill	2D, 3D 4D, 5D		K□D	 (External)	SPMT□-LD XOMT□-LD (For carbon steel)	PC5335	80 ~ 140	0.08 ~ 0.04	
	Through-hole	-0.15 ~ +0.4	Ø12~Ø60.5 Ø61~Ø100 (Cartridge type)	2nd (recommended) KING Drill	2D, 3D 4D, 5D		K□D	 (External)	SPMT□-PD XOMT□-PD	PC9540	60 ~ 120	0.08 ~ 0.04	
	Through-hole	0~+0.1	Ø12 Ø30.9	2nd (recommended) TPDC Plus Drill	1.5D, 3D 5D, 8D 10D, 12D		TPDC□D		TPD□CM	PC330N	50 ~ 90	0.35 ~ 0.05	



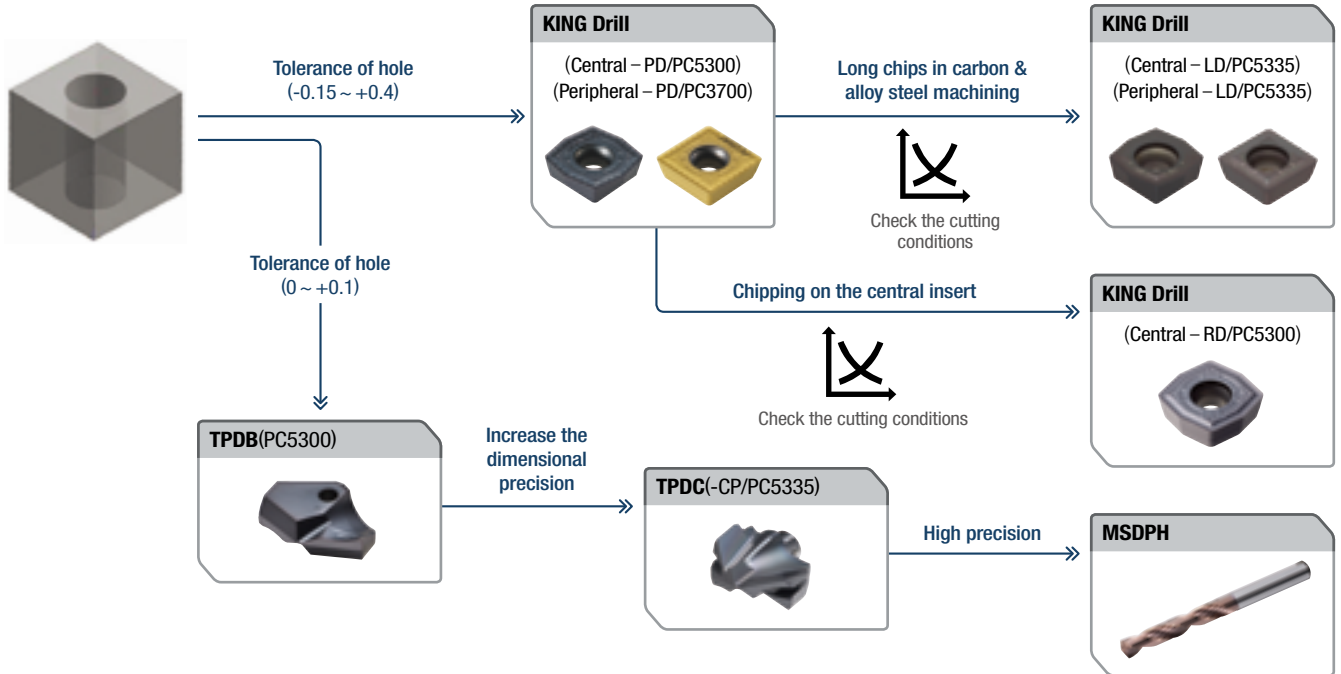
01) Line-up

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

Work-piece	Machining type	Tolerance of hole	Drills dia.	Product	Depth of cut	holder		Insert		Grade	Recommended cutting condition		INFO Link
						Picture	Designation	Picture	Designation		vc	fn	
M	Through-hole	0~+0.1	Ø10~Ø32.9	1 st (recommended) TPDB Plus Drill	3D, 5D, 8D 10D, 12D		TPDB□-P		TPD□BM	PC340UL	40 ~ 80	0.22 ~ 0.1	
	Through-hole	0~+0.1 (Highly precise)	Ø2.5~Ø20	MSD Plus	3D, 5D, 7D (Internal coolant)		MSDPH-□M	-	-	PC325U	25 ~ 80	0.3 ~ 0.15	
	Through-hole	0~+0.1 (Highly precise)	Ø1~Ø20	W-Star Drill	5D, 7D (External coolant)		WSDP-□	-	-	PC325W	20 ~ 64	0.24 ~ 0.04	
K	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	PC6100 PC5300	100 ~ 250	0.26 ~ 0.04	
	Through-hole	-0.15 ~ +0.4	Ø10~Ø32.9	1 st (recommended) TPDB Plus Drill	3D, 5D, 8D 10D, 12D		TPDB□-P		TPD□B	PC5300	100 ~ 140	0.45 ~ 0.18	
	Through-hole	0~+0.1	Ø33~Ø39.9	TPDB Plus Drill	3D, 5D, 8D		TPDB□-P		TPD□B-DS	PC5300	50 ~ 140	0.45 ~ 0.2	
	Through-hole	0~+0.1	Ø12~Ø30.9	2 nd (recommended) TPDC Plus Drill	1.5D, 3D 5D, 8D 10D, 12D		TPDC□D		TPD□CP	PC5300	70 ~ 140	0.55 ~ 0.2	
	Through-hole	0~+0.1 (Highly precise)	Ø2.5~Ø20	MSD Plus	3D, 5D, 7D (Internal coolant)		MSDPH-□K	-	-	PC325U	70 ~ 150	0.4 ~ 0.1	
	Through-hole	0~+0.1 (Highly precise)	Ø1~Ø20	W-Star Drill	5D, 7D (External coolant)		WSDP-□	-	-	PC325W	56 ~ 120	0.32 ~ 0.08	
	Through-hole	-0.15 ~ +0.4	Ø12~Ø60.5 Ø61~Ø100 (Cartridge type)	KING Drill	2D, 3D 4D, 5D		K□D	 	SPMT□-ND XOMT□-ND	H01 H01	200 ~ 400	0.25 ~ 0.05	
	Through-hole	0~+0.1	Ø12~Ø30.9	TPDC Plus Drill	1.5D, 3D 5D, 8D 10D, 12D		TPDC□D		TPD□CN	H01	70 ~ 220	0.55 ~ 0.28	
	Through-hole	0~+0.1 (Highly precise)	Ø1~Ø13	SSD-N	- (External coolant)		SSD□□□-N	-	-	H01	65 ~ 120	0.18 ~ 0.05	
N	Through-hole	0~+0.1 (Highly precise)	Ø2.5~Ø20	MSD Plus	3D, 5D, 7D (Internal coolant)		MSDPH-□N	-	-	FG2	40 ~ 150	0.4 ~ 0.05	
	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	PC9540 PC9540	30 ~ 100	0.16 ~ 0.04	
S	Through-hole	0~+0.1 (Highly precise)	Ø2.5~Ø20	MSD Plus	3D, 5D (Internal coolant)		MSDPH-□S	-	-	PC325T	20 ~ 50	0.23 ~ 0.045	

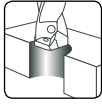
02) Tools selection guide

↻ Through-hole machining



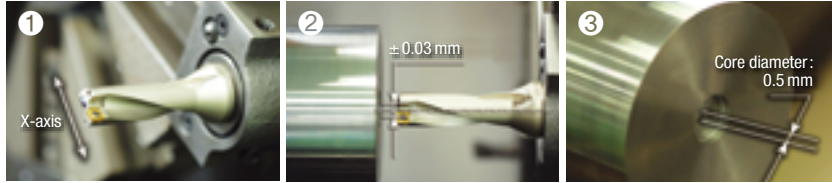
↻ Application products

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	-



03) Useful cutting Tip

Notice for setting the drill in the lathe

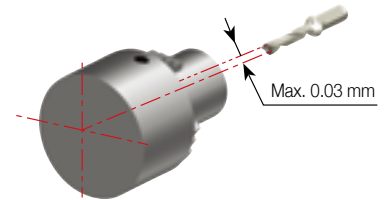


- Set the peripheral insert parallel to the X axis (based on the side lock)
- If the machined core is about 0.5 mm after machining 5 mm, that is the proper setting
- ※ Please make sure that the location of the side lock could be different depending on manufacturers of machine

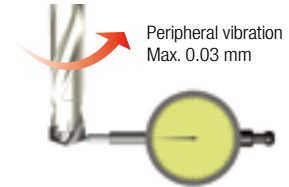
Notice for setting the top solid indexable drill

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)

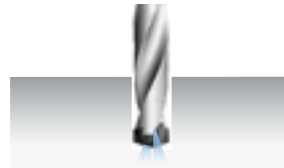
Using a pilot drill (Recommended)

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]




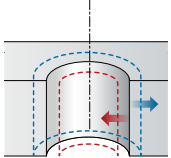

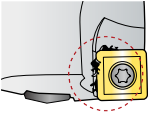
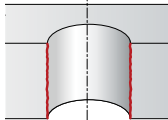


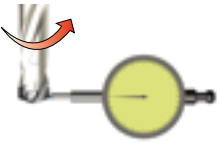
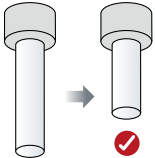
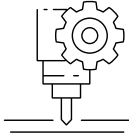
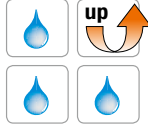
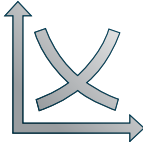

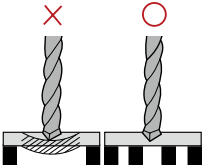
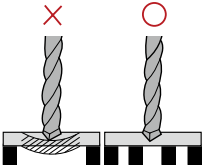
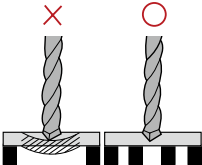
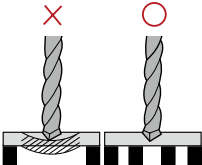
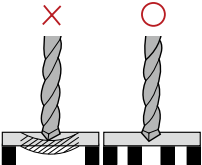

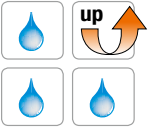
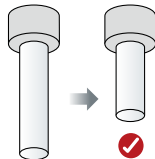
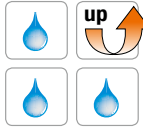
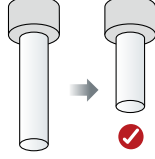
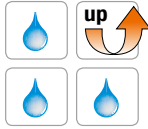

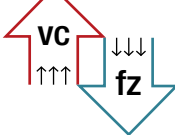
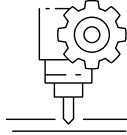
[External coolant]



[Non-dry processing]



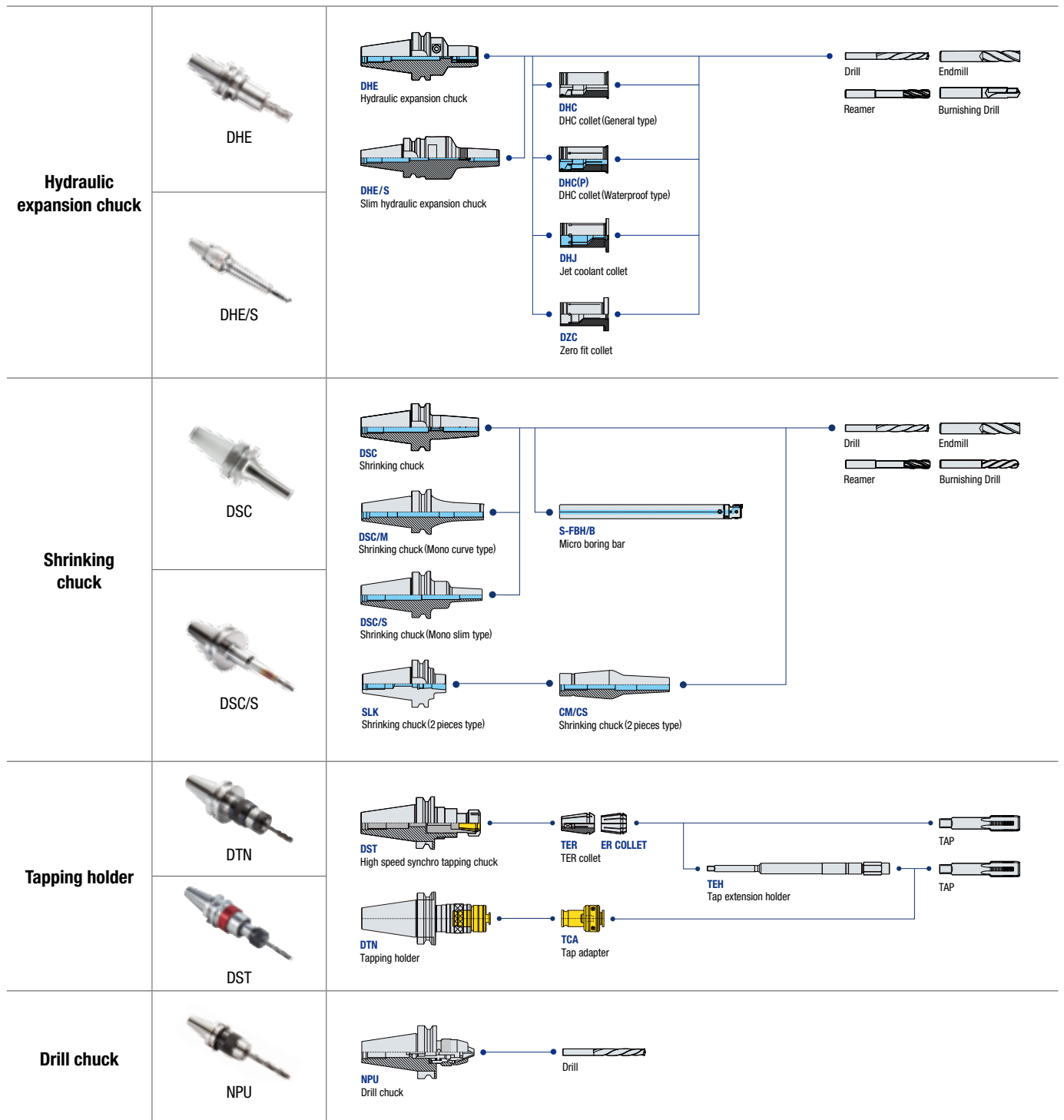
04) Troubles in cutting and solutions

 Trouble	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 
Factor	<ul style="list-style-type: none"> • Wrong setting • Lack of coolant 	<ul style="list-style-type: none"> • Long overhang • Weak jig 	<ul style="list-style-type: none"> • Fracture of corner • Lack of coolant 	<ul style="list-style-type: none"> • Lack of coolant • Weak jig 	<ul style="list-style-type: none"> • High speed / high feed • Weak jig
 Solution	<p>Check the status of drill run-out</p> 	<p>Select short overhang</p> 	<p>Check the item (shape and grade)</p> 	<p>Use more coolant and increase its pressure</p> 	<p>Check the cutting conditions</p> 
	<p>Accurate clamping of workpiece</p> 	<p>Accurate clamping of workpiece</p> 	<p>Use more coolant and increase its pressure</p> 	<p>Accurate clamping of workpiece</p> 	<p>Accurate clamping of workpiece</p> 
	<p>Use more coolant and increase its pressure</p> 	<p>Check the clamping of the facility, arbor and workpiece</p> 	<p>Cutting speed up, feed down</p> 	<p>Select short overhang</p> 	<p>Use more coolant and increase its pressure</p> 
	<p>Cutting speed up, feed down</p> 	<p>Cutting speed down, feed down</p> 	<p>Select short overhang</p> 	<p>Cutting speed up, feed down</p> 	<p>Check the item (shape and grade)</p> 


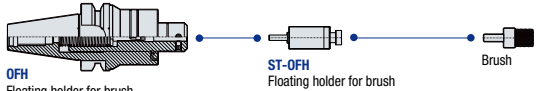


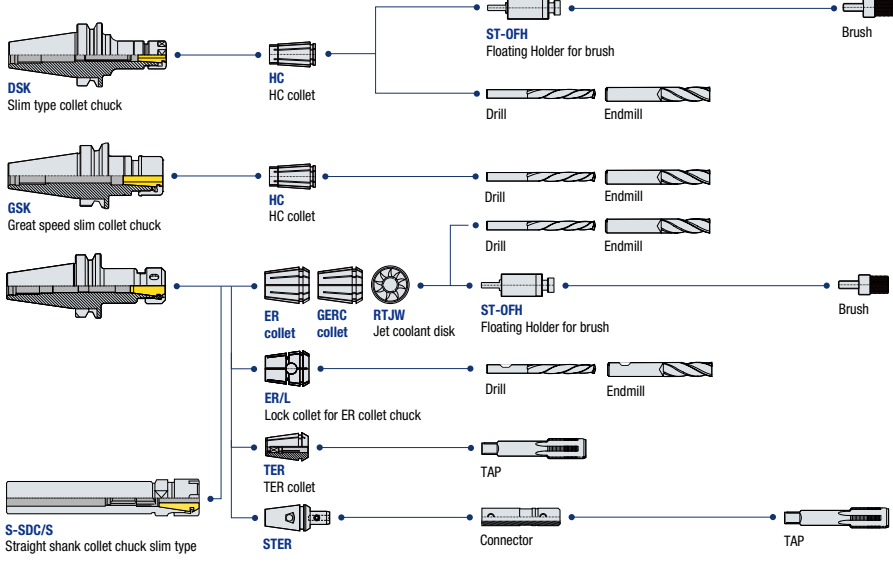

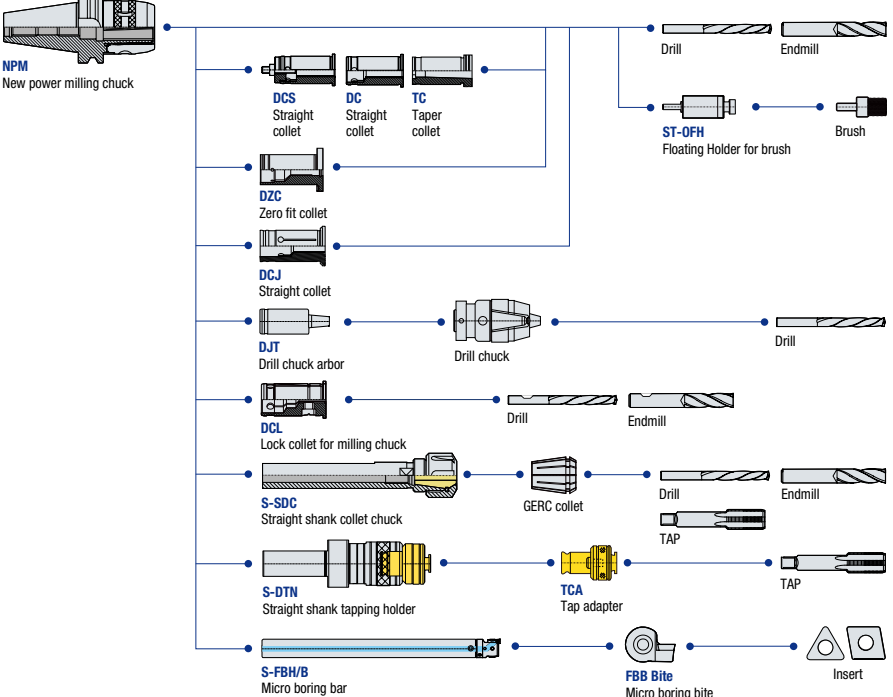

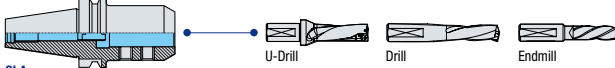


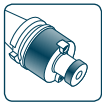
DINOX Map

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	★★★	★★★★	★★



DINOX Map


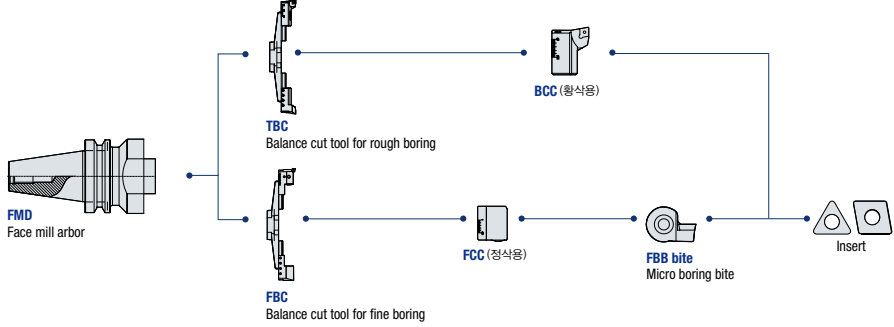

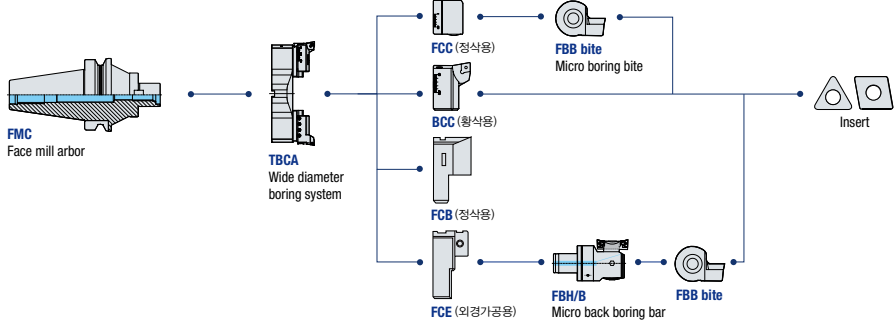

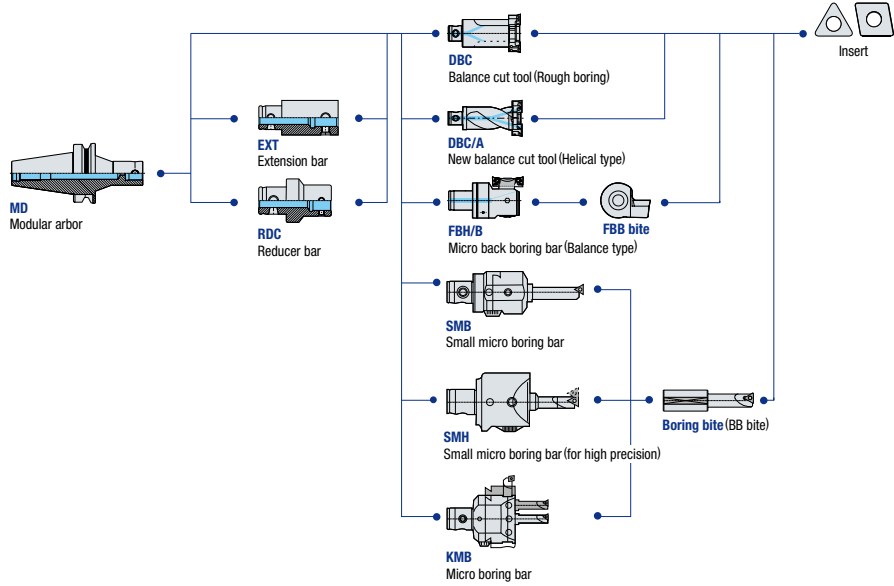

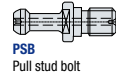
<p>Floating holder for brush</p>	 <p>OFH</p>	 <p>OFH Floating holder for brush</p> <p>ST-OFH Floating holder for brush</p> <p>Brush</p>
<p>Collet chuck</p>	 <p>SDC/P</p>  <p>GSK</p>	 <p>DSK Slim type collet chuck</p> <p>GSK Great speed slim collet chuck</p> <p>ER collet</p> <p>GERC collet</p> <p>RT.JW Jet coolant disk</p> <p>ER/L Lock collet for ER collet chuck</p> <p>TER TER collet</p> <p>S-SDC/S Straight shank collet chuck slim type</p> <p>ST-OFH Floating Holder for brush</p> <p>Drill</p> <p>Endmill</p> <p>Brush</p> <p>TAP</p> <p>Connector</p> <p>TAP</p>
<p>Milling chuck</p>	 <p>NPM</p>	 <p>NPM New power milling chuck</p> <p>DCS Straight collet</p> <p>DC Straight collet</p> <p>TC Taper collet</p> <p>DZC Zero fit collet</p> <p>DCJ Straight collet</p> <p>DJT Drill chuck arbor</p> <p>Drill chuck</p> <p>DCL Lock collet for milling chuck</p> <p>S-SDC Straight shank collet chuck</p> <p>S-DTN Straight shank tapping holder</p> <p>S-FBH/B Micro boring bar</p> <p>ST-OFH Floating Holder for brush</p> <p>Brush</p> <p>Drill</p> <p>Endmill</p> <p>GERC collet</p> <p>Drill</p> <p>Endmill</p> <p>TAP</p> <p>TAP</p> <p>TCA Tap adapter</p> <p>FBB Bite Micro boring bite</p> <p>Insert</p>
<p>Side lock arbor</p>	 <p>SLA</p>	 <p>SLA Side lock arbor</p> <p>U-Drill</p> <p>Drill</p> <p>Endmill</p>



DINOX Map

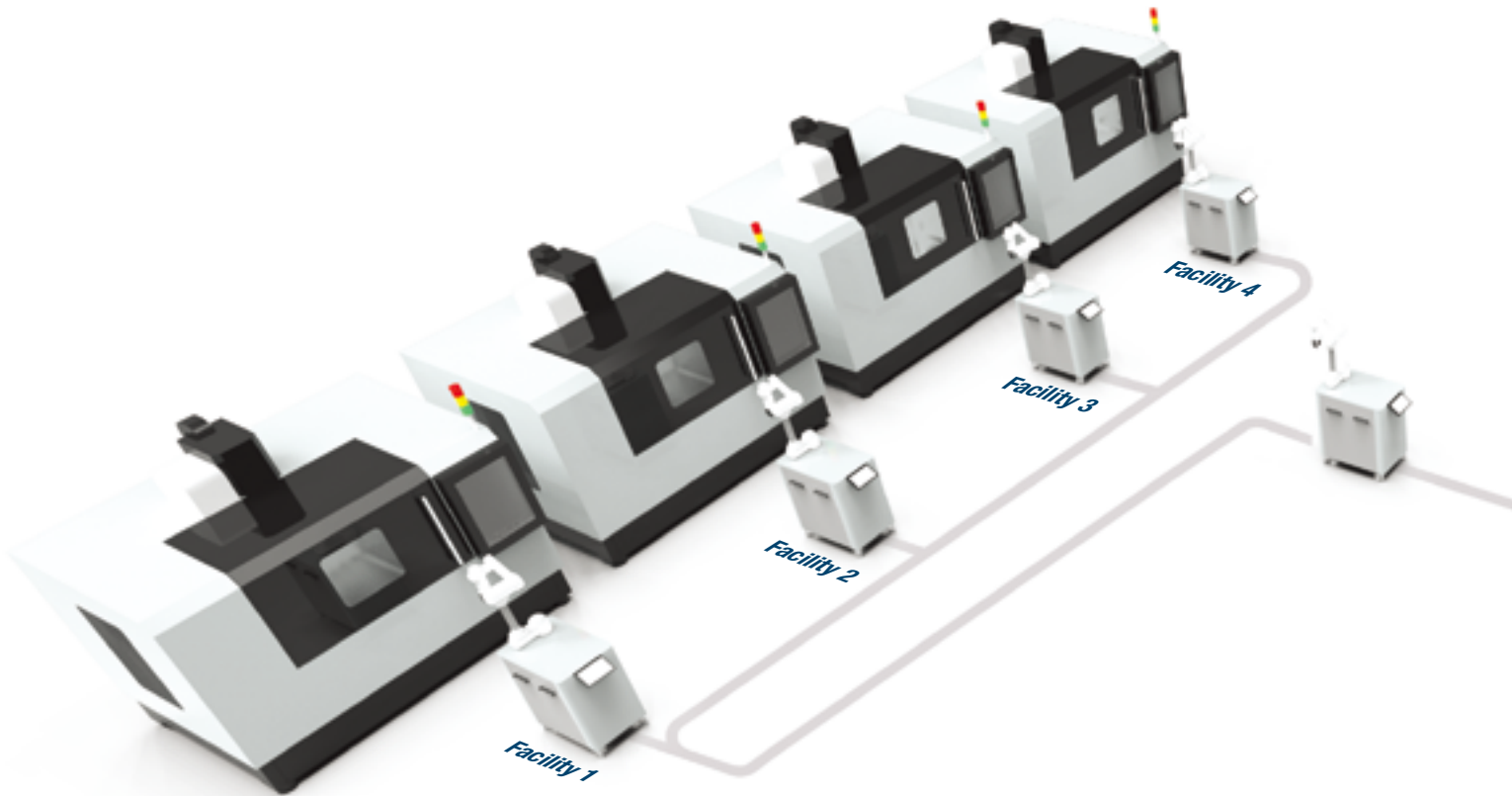
<p>Morse taper arbor</p>	<p>MTA</p>	<p>MTA Morse taper arbor</p> <p>Drill Reamer</p>
<p>Face mill arbor</p>	<p>FMA</p>	<p>FMA Face mill arbor</p> <p>Cutter</p>
<p>Air spindle</p>	<p>ATM</p>	<p>ATM Air turbine machine</p> <p>HC HC collet</p> <p>Drill Endmill</p> <p>Air regulator</p>
<p>Angular head</p>	<p>KAH</p> <p>MAH</p> <p>KAH</p> <p>KAC</p> <p>SAH</p>	<p>KHU Free angle type angular head</p> <p>GERC collet</p> <p>Drill Endmill</p> <p>MAH Free angle type angular head</p> <p>Drill Endmill</p> <p>HRAG/KAG Attachment type angular head</p> <p>NT shank</p> <p>BT shank</p> <p>Drill Endmill Reamer TAP Cutter</p> <p>KAH 90° Angle type angular head</p> <p>GERC collet</p> <p>Drill Endmill</p> <p>KAC 45° Angle type angular head</p> <p>GERC collet</p> <p>Endmill</p> <p>SAH Slim angular head</p> <p>SAH collet</p> <p>Drill Endmill</p>
<p>Boring series</p>	<p>BT-FBH/B</p>	<p>BSA Square boring bar</p> <p>BH Square boring bite for BSA</p> <p>BKA FZ micro boring bar</p> <p>FF unit Inclined mounting type</p> <p>BCF Micro boring bar</p> <p>FF unit Micro boring bar</p> <p>Insert</p>

DINOX Map

	 <p>BCF</p>	
<p>Boring series</p>	 <p>TBC, FBC</p>	
	 <p>KMB</p>	
<p>Pull stud bolt</p>	 <p>PSB</p>	



Smart Factory Solution Map



Collaborative Robot

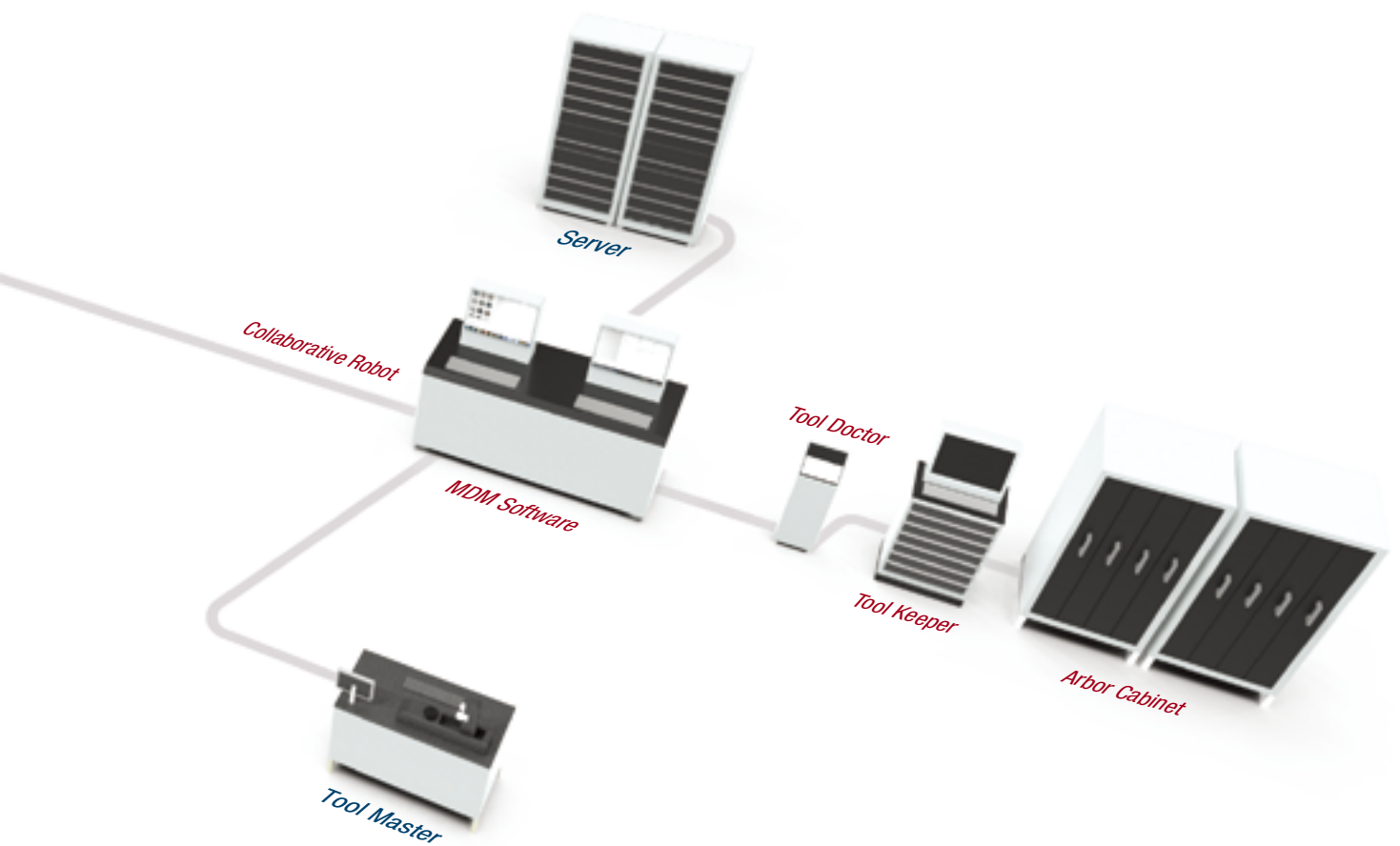
- Optimal for repeated work in small place
- Effective on works with heavy weight materials

Tool Master (Tool pre-setter)

- Measuring the offset of tool length in advance
- Reduced tool setting time and downtime

MDM (Tool management S/W)

- Managing the tool holder information
→ Cutting diameter, overall length, storage location
- Integrated management of tool, production, CAM, etc.



**Tool Doctor
(Monitoring system)**

- Managing poor quality product manufacturing in mass production
→ Tool breakage, unprocessed item check, and re-processing
- Managing tool life trends

**Tool Keeper
(Tool management equipment)**

- Managing tool releases day and night
- Systemic management of stock and inventory backup order
- Transparent tool usage results management

**Arbor Cabinet
(Storage box exclusive for Arbors)**

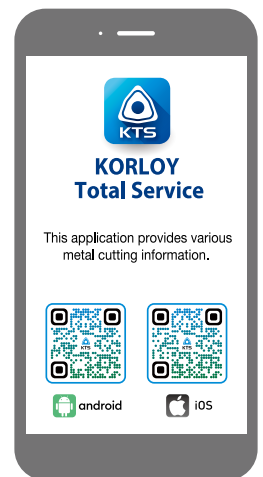
- Enhancing space efficiency and protecting tools (from damage or pollution of tools due to debris of work sites)
- Capable for running virtual warehouse with Tool Keeper (Managing position and quantity of tools)

⚠ For the safe metalcutting

- Use safety supplies such as protective gloves to prevent possible injury while touching the edge of tools.
- Use safety glasses 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 tools can be pulled out due to centrifugal force while high speed machining.



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