Technical Guide Book

The Right Choice

TRIVAX

MÁQUINAS • FERRAMENTAS • EQUIPAMENTOS

- Rotating
- Non-Rotating

TaeguTec
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The Right Choice

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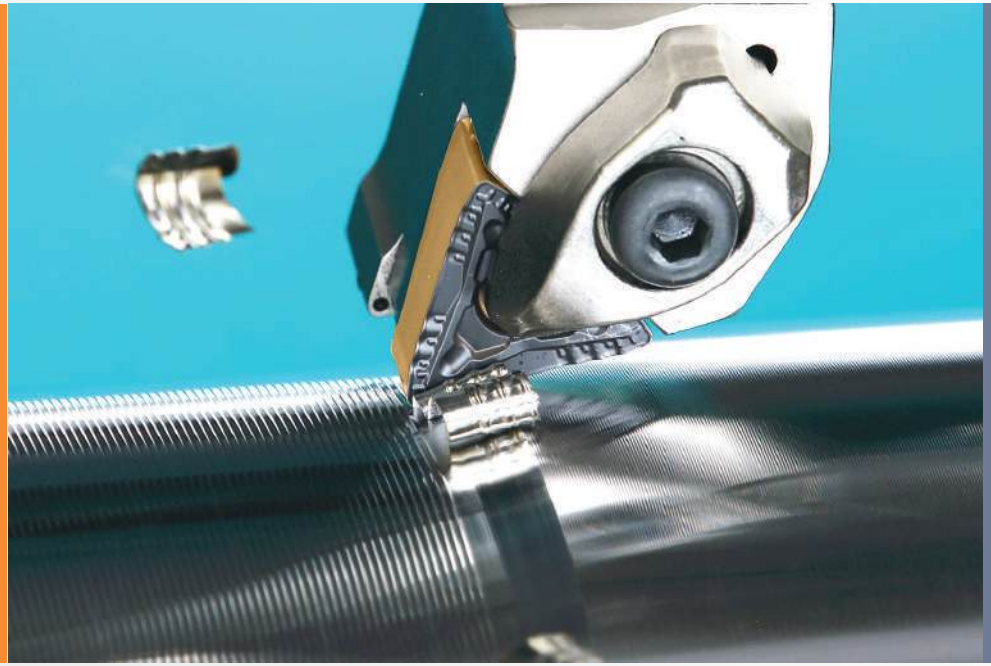
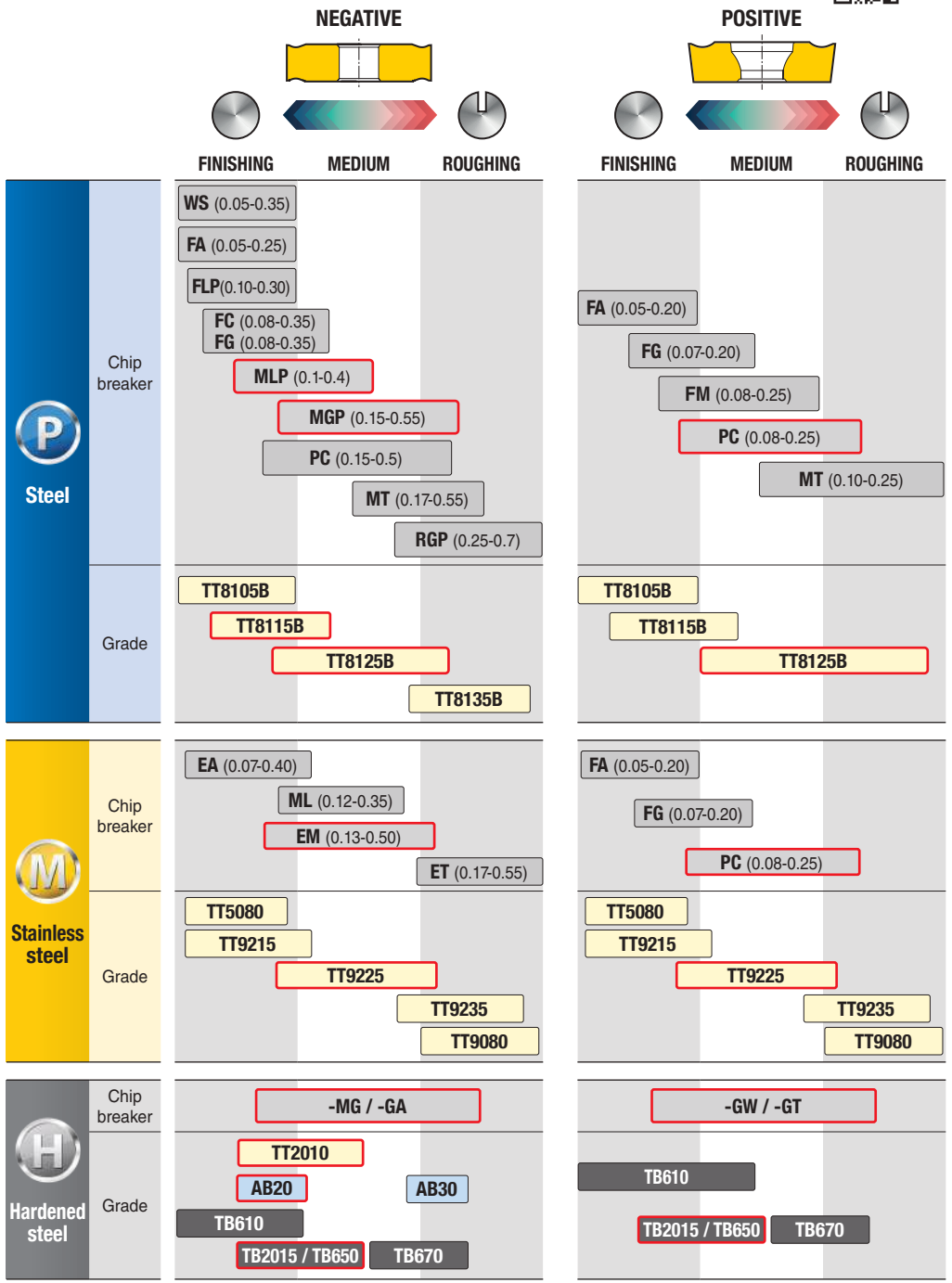
Technical Guide Book



Turning

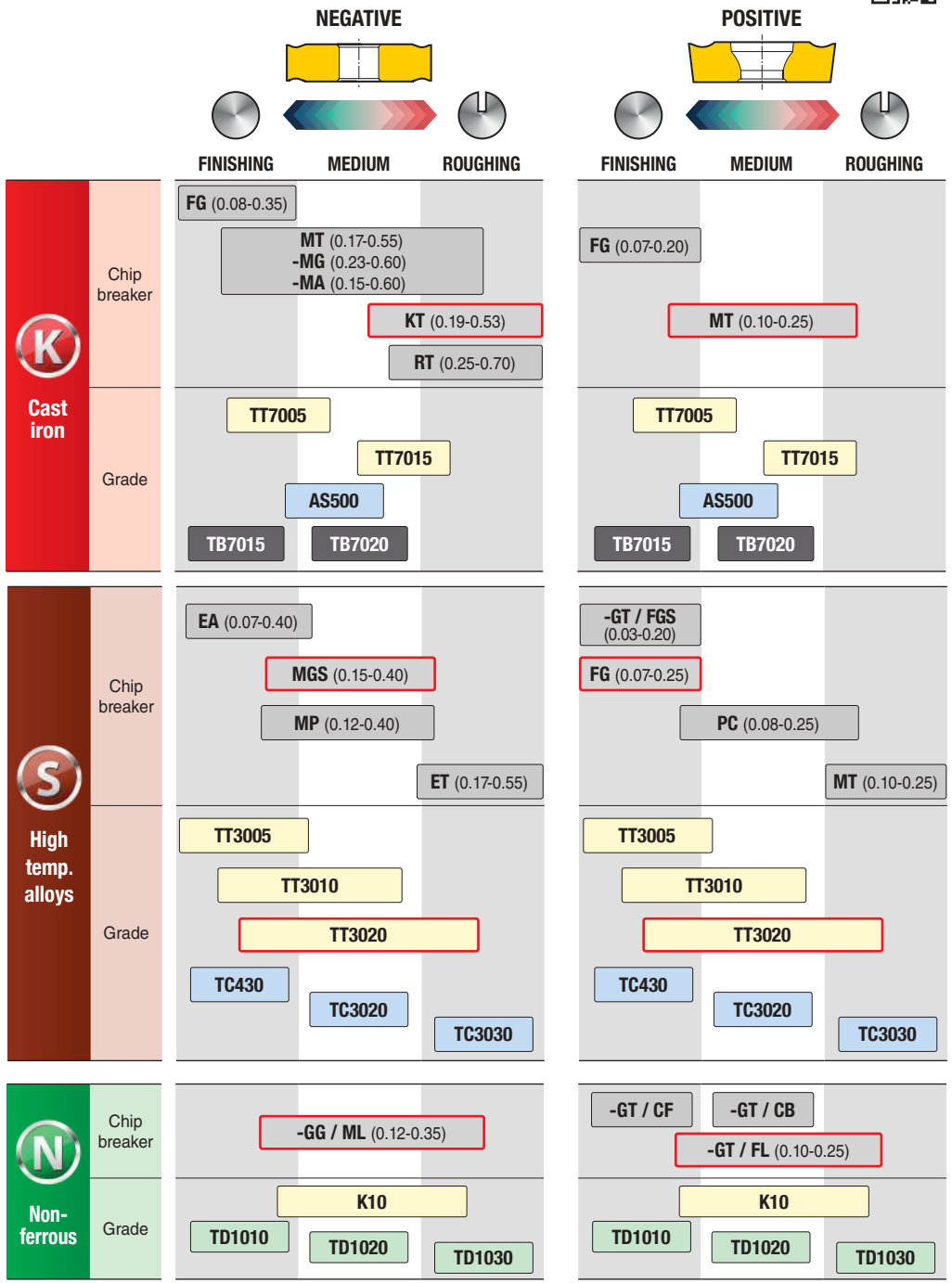
Selection Guide
Troubleshooting

Turning Homepage ➤➤➤



: 1ST Recommendation : Carbide : Ceramic : CBN : PCD (Feed rate: mm/rev)

Turning E-Catalog ➤➤➤



: 1ST Recommendation : Carbide : Ceramic : CBN : PCD (Feed rate: mm/rev)

FINISHING → ROUGHING

		FS	FM	FT	
P Steel (HB 200-220)	RHINOTURN	 CNMG 090404 FS TT8115B Vc : 300-250 fn : 0.07-0.30 ap : 0.25-1.5	 CNMG 090408 FM TT8115B Vc : 300-230 fn : 0.10-0.35 ap : 0.3-2.0	 CNMG 090408 FT TT8115B Vc : 280-220 fn : 0.10-0.40 ap : 0.5-3.0	
	T-TURN	FLP  CNMG 120404 FLP TT8115B Vc : 300-250 fn : 0.08-0.30 ap : 0.2-2.0	MLP  CNMG 120408 MLP TT8115B Vc : 300-230 fn : 0.10-0.40 ap : 0.5-3.5	MGP  CNMG 120408 MGP TT8115B Vc : 280-220 fn : 0.15-0.55 ap : 0.5-5.0	RGP  CNMG 120412 RGP TT8125B Vc : 250-200 fn : 0.25-0.70 ap : 2.5-6.0

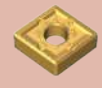
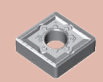
FINISHING → ROUGHING

		EA	MK	EM	
M Stainless steel (HB 160-180)	RHINOTURN	 CNMG 090404 EA TT5080 / TT9215 Vc : 200-130 fn : 0.05-0.30 ap : 0.2-1.5	 CNMG 090408 MK TT9225 Vc : 170-130 fn : 0.20-0.50 ap : 1.0-3.0	 CNMG 090408 EM TT9225 Vc : 120-60 fn : 0.13-0.40 ap : 0.5-3.0	
	T-TURN	EA  CNMG 120404 EA TT5080 / TT9215 Vc : 200-130 fn : 0.05-0.30 ap : 0.15-1.5	MP  CNMG 120408 MP TT9225 Vc : 170-130 fn : 0.12-0.40 ap : 1.0-4.0	EM  CNMG 120408 EM TT9080 / TT9225 Vc : 120-60 fn : 0.13-0.50 ap : 0.5-5.0	ET  CNMG 120412 ET TT8080 / TT9235 Vc : 120-60 fn : 0.20-0.60 ap : 1.2-5.5

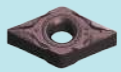
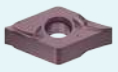
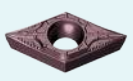
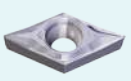
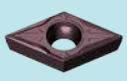
: 1ST Recommendation

• Vc cutting speed : m/min • fn feed rate : mm/rev • ap depth of cut : mm

FINISHING → ROUGHING

		EA	MGS	ET	-GX / -GN
S High temp. alloys (HB 300-350)	Ni Nickel based Super alloys	 CNMG 120408 EA TT3010 / TT3020 Vc : 90-30 85-30 fn : 0.07-0.40 0.07-0.40 ap : 0.15-1.5 0.15-1.5	 CNMG 120408 MGS TT3020 Vc : 40-20 fn : 0.15-0.40 ap : 1.0-4.0	 CNMG 120412 ET TT9080 Vc : 40-20 fn : 0.17-0.45 ap : 1.2-5.5	 RCGX & RNGN 1207 TC3020 / TC3030 Vc : 350-250 250-150 fn : 0.05-0.30 0.05-0.30 ap : 0.1-4.0 0.1-4.0
	Ti Titanium alloys	MK  CNMG 090408 MK TT3010 Vc : 90-30 fn : 0.05-0.20 ap : 1.0-3.0	MGS  CNMG 120408 MGS TT3010 Vc : 80-50 fn : 0.15-0.40 ap : 1.0-4.0	MGS  CNMG 120412 MGS K10 Vc : 70-45 fn : 0.17-0.50 ap : 1.5-4.0	

LOW DEPTH → Small Parts Turning → HIGH DEPTH

			For medical parts FS-F	FU-F	ST-R-F
Miniature industry (G tolerance)	RHINOTURN Negative Insert		 VNGX 130402M FS-F TT4430 Vc : 120-100 fn : 0.04-0.12 ap : 0.2-1.0	 DNGG 130502M FU-F TT4430 Vc : 120-100 fn : 0.04-0.12 ap : 0.2-2.5	 DNGX 130504M ST-R-F TT4430 Vc : 120-100 fn : 0.05-0.12 ap : 0.7-5.0
	TOPMINI Positive Insert	SL-F  DCGT 11T302M SL-F TT4410/TT4430 Vc : 120-100 fn : 0.02-0.10 ap : 0.02-0.25	SA  DCGT 11T302 SA TT9020 Vc : 120-100 fn : 0.02-0.15 ap : 0.1-2.5	SM-F  DCGT 11T302M SM-F TT4430 Vc : 120-100 fn : 0.02-0.12 ap : 0.2-1.5	ST-F  DCGT 11T304M ST-F TT4430 Vc : 120-100 fn : 0.05-0.12 ap : 0.7-5.0

: 1ST Recommendation

• Vc cutting speed : m/min • fn feed rate : mm/rev • ap depth of cut : mm

LOW SPEED → HIGH SPEED

Cast iron (HB 220-250)

Carbide Grade

MA-	KT	MT
CNMA 120412 TT7025 Vc : 280-220 fn : 0.15-0.70 ap : 1.5-6.0	CNMG 120408 KT TT7015 Vc : 300-250 fn : 0.19-0.53 ap : 0.38-7.0	CNMG 120408 MT TT7005 Vc : 330-280 fn : 0.17-0.55 ap : 1.2-5.0

CBN & Ceramic Grade

CNGA 120412 AS10	CNGX-CH 120712 T7 AS500	RNGN 120400 SD TB7020	CNGX 120412 DA TB7020
Vc : 800-250 fn : 0.05-0.25 ap : 0.1-3.0	1000-300 0.05-0.30 0.1-3.5	Vc : 1200-200 fn : 0.05-0.30 ap : 0.1-3.0	Vc : 1200-300 fn : 0.05-0.40 ap : 0.1-4.0

LOW SPEED → HIGH SPEED

Hardened steel

Carbide & Ceramic Grade (HRc ≥ 40)

CNMG 120408 TT2010	CNGA 120408 AB30	CNGA 120408 AB20 / AB2010
Vc : 200-50 fn : 0.15-0.55 ap : 0.5-3.0	Vc : 170-120 fn : 0.10-0.20 ap : 0.5-1.5	Vc : 200-150 fn : 0.10-0.18 ap : 0.4-1.2

CBN Grade (HRc ≥ 50)

CNGA 120408 TB670	CNGA 120408 TB2015	CNGA 120412 TB650	CNGA 120412 TB610
Vc : 200-100 fn : 0.10-0.20 ap : 0.1-0.7	Vc : 250-150 fn : 0.08-0.15 ap : 0.1-0.6	Vc : 250-150 fn : 0.08-0.15 ap : 0.1-0.6	Vc : 300-200 fn : 0.10-0.20 ap : 0.1-0.5

: 1ST Recommendation

• Vc cutting speed : m/min • fn feed rate : mm/rev • ap depth of cut : mm

Trouble

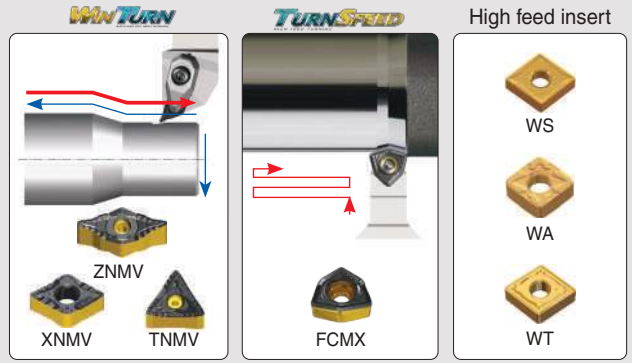
Productivity

Solutions

1 Use high-speed grades

TT81xxB CVD grades SPEEDRUSH

2 Use high feed and high productivity inserts



Multidirectional and high feed back turning

Bi-directional high feed turning

Double-feed at the same surface finish

3 Use high-pressure coolant (Max. 70bar)

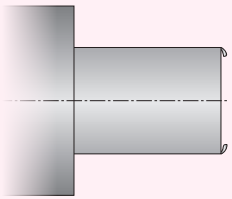
-TB Holder (2x speed up) COOLBURST

4 Use high stability holder

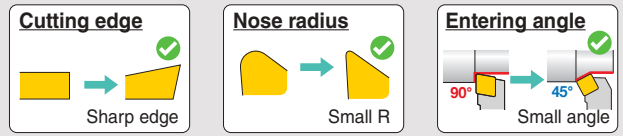
QH- / QS- Head and Shank

7xD, 10xD, 12xD, 14xD

Burr



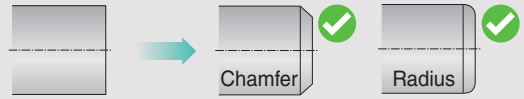
1 Change insert geometry



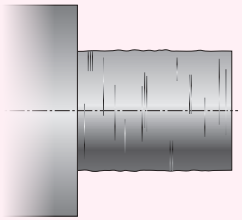
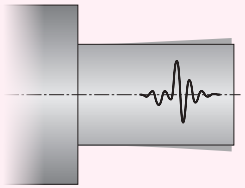
2 Use PVD grade or ground insert at low feed

TT5080, TT8020, TT9080, TT3010, TT3020... PVD grade

3 Pre-machine of chamfer or round at start / end of workpiece



Trouble	Solutions
 Tangled Chip	**1 Change cutting conditions** FEED UP SPEED DOWN Depth: High depth **2 Change insert geometry** Nose radius: Small R Chip breaker: Narrow groove Entering angle: 45° → 90° Large angle **3 Use high-pressure coolant (Max. 70bar)** -TB Holder COOLBURST
 Over Breaking Chip	**1 Change cutting conditions** FEED DOWN SPEED UP Depth: Low depth **2 Change insert geometry** Nose radius: Big R Chip breaker: Wide groove Entering angle: 90° → 45° Small angle **3 Use external coolant**

Trouble	Solutions
 Bad Surface Finish	**1 Change cutting conditions** FEED DOWN SPEED UP Depth: Low depth **2 Use wiper or bigger nose radius insert** Standard: Ra Wiper: Ra, Big R **3 Use high-pressure coolant (Max. 70bar)** -TB Holder COOLBURST
 Vibration	**1 Change cutting conditions** FEED DOWN SPEED DOWN Depth: High depth (Larger than insert nose R) **2 Change insert geometry** Nose radius: Small R Rake angle: Positive rake Entering angle: 45° → 90° Large angle **3 Use strong holder and anti-vibration bar** T-holder HUSH-BORE and Carbide shank HUSHBORE 7xD, 10xD, 12xD, 14xD

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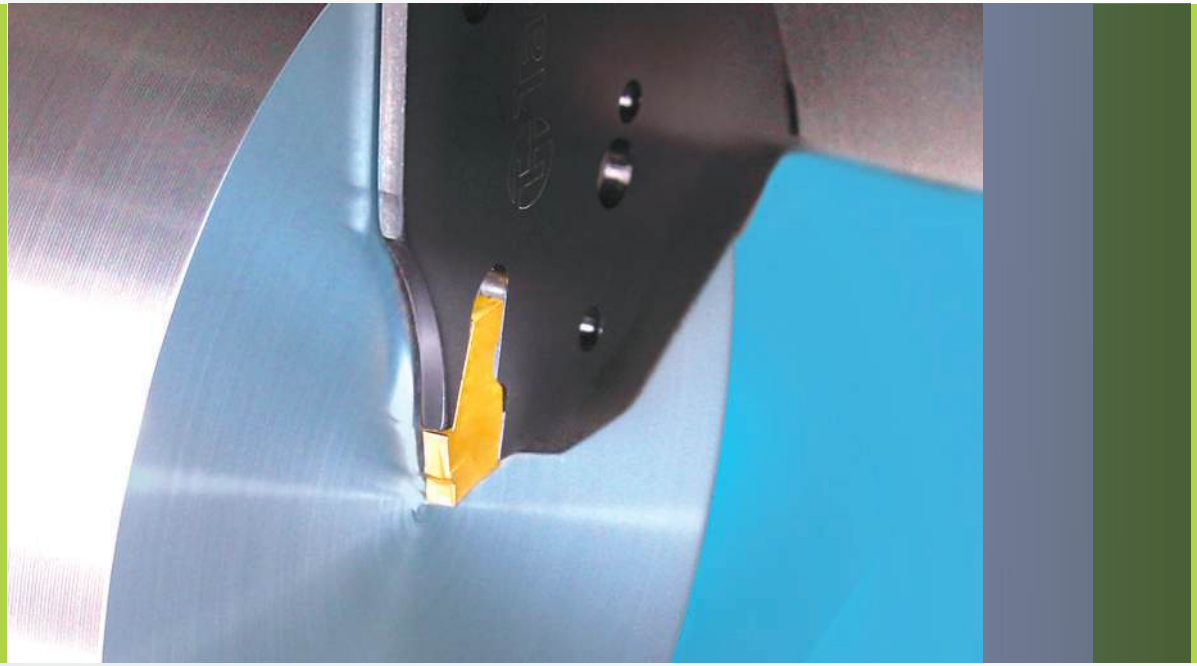
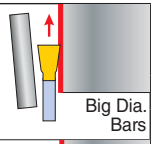
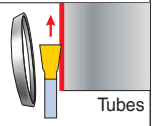
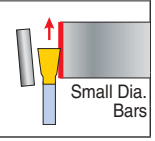
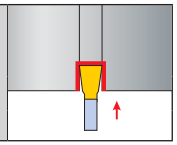
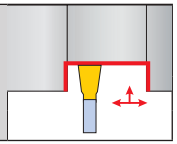
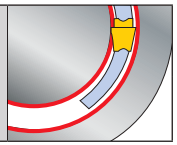
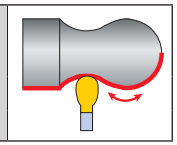
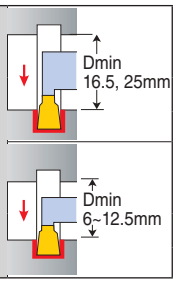


Parting & Grooving

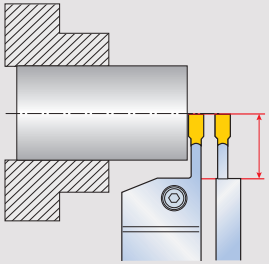
Selection Guide
Technical Tips
Troubleshooting

		P Steel (HB 200-220)	K Cast iron (HB 220-250)	M Stainless steel (HB 180-200)	S High temp. alloys (HB 300-350)	N Non-ferrous	H Hardened steel
Parting	Deep Parting Deep Grooving	 Big Dia. Bars SFC TT9080 TDC TT9080 (Vc 150-100, fn 0.1-0.4)	TDC TT9080 TDCT TT6080 (Vc 180-120, fn 0.1-0.4)	SFC TT9080 TDC TT9080 (Vc 120-80, fn 0.1-0.15)	SFJ TT9080 TDJ TT9080 (Vc 60-30, fn 0.08-0.12)	TDJ K10 (Vc 330-150, fn 0.1-0.5)	TSG-H TB2015 (Vc 60-120, fn 0.02-0.16)
	Tube Parting	 Tubes SFC TT9080 TDC TT9080 (Vc 150-100, fn 0.1-0.4)	TDC TT9080 TDCT TT6080 (Vc 180-120, fn 0.1-0.4)	SFJ TT9080 TDJ TT9080 (Vc 120-80, fn 0.1-0.15)	SFJ TT9080 TDJ TT9080 (Vc 60-30, fn 0.08-0.12)	TDJ K10 (Vc 330-150, fn 0.1-0.5)	TSG-H TB2015 (Vc 60-120, fn 0.02-0.16)
	Shallow Parting Shallow Grooving Precision Grooving	 Small Dia. Bars TQC TT9080 TQS TT4430 (Vc 150-100, fn 0.06-0.15)	TQC TT9080 (Vc 180-120, fn 0.1-0.4)	TQJ TT9080 TQJ TT4430 (Vc 120-80, fn 0.05-0.13)	TQJ TT9080 TQJ TT4430 (Vc 60-30, fn 0.08-0.12)	TQS TT4430 (Vc 330-150, fn 0.1-0.5)	TSG-H TB2015 (Vc 60-120, fn 0.02-0.16)
Grooving		 TDC TT9080 TDXU TT9080 (Vc 150-100, fn 0.1-0.4)	TDCT TT6080 TDXT TT6080 (Vc 180-120, fn 0.1-0.4)	TDJ TT9080 TDXU TT9080 (Vc 120-80, fn 0.1-0.15)	TDCT TT9080 TDXU TT3010 (Vc 60-30, fn 0.08-0.12)	TDJ K10 TDXU K10 (Vc 330-150, fn 0.1-0.5)	TSG-H TB2015 (Vc 60-120, fn 0.02-0.16)
Groove Turning		 TDXU TT9080 TDCT TT9080 Vc 150-100, fn 0.1-0.4)	TDCT TT6080 TDXT TT6080 (Vc 180-120, fn 0.1-0.4)	TDCT TT9080 TDXU TT9080 (Vc 120-80, fn 0.1-0.15)	TDCT TT9080 TDXU TT3010 (Vc 60-30, fn 0.1-0.15)	TDCT K10 TDXU K10 (Vc 330-150, fn 0.1-0.5)	TSG-H TB2015 TSG-HF TB2015 (Vc 60-120, fn 0.08-1.20)
Face Grooving		 TDCT TT9080 TDFX TT9080 (Vc 150-100, fn 0.1-0.4)	TDCT TT6080 TDXT TT6080 (Vc 180-120, fn 0.1-0.3)	TDCT TT9080 TDFX TT9080 (Vc 120-80, fn 0.1-0.15)	TDCT TT9080 TDFX TT9080 (Vc 60-30, fn 0.1-0.15)	TDCT K10 TDXU K10 (Vc 330-150, fn 0.1-0.4)	TSG-H TB2015 (Vc 50-100, fn 0.02-0.14)
Profiling		 TDT-RU TT9080 TDT-RS TT9080 (Vc 150-100, fn 0.1-0.4)	TDT-RU TT6080 (Vc 180-120, fn 0.1-0.4)	TDT-RS TT9080 TDT-RU TT9080 (Vc 120-80, fn 0.1-0.15)	TDT-RS TT3010 TDT-RU TT3010 (Vc 60-30, fn 0.1-0.15)	TDA K10 (Vc 330-150, fn 0.1-0.4)	TSG-H TB2015 (Vc 60-120, fn 0.03-0.30)
Internal Grooving		 Dmin 16.5, 25mm Dmin 6~12.5mm TQIS TT9080 TDXU TT9080 (Vc 150-100, fn 0.1-0.4) TMIR/L TT4430 TDIM TT9080 (Vc 50-100, fn 0.01-0.1)	TQIS TT9080 TDCT TT6080 (Vc 180-120, fn 0.1-0.3) TDIM TT9080 TDIP TT9080 (Vc 70-110, fn 0.02-0.1)	TQIS TT9080 TDXU TT9080 (Vc 120-80, fn 0.1-0.15) TMIR/L TT4430 TDIM TT9080 (Vc 40-70, fn 0.01-0.1)	TDCT TT9080 TDXU TT3010 (Vc 60-30, fn 0.1-0.15) TMIR/L TT4430 TDIP TT9080 (Vc 20-40, fn 0.01-0.1)	TDCT K10 TDXU K10 (Vc 330-150, fn 0.1-0.4) TMIR/L TT4430 TDIP TT9080 (Vc 100-300, fn 0.01-0.1)	TSG-H TB2015 (Vc 60-120, fn 0.02-0.16)

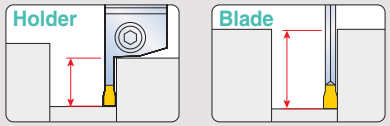
(Vc cutting speed: m/min, fn feed rate: mm/rev)

Holder and Blade Size Selection

: To minimize vibration and deflection



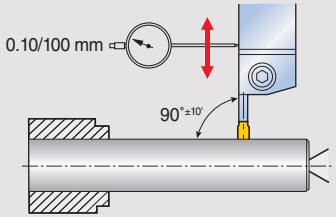
- Blade or tool holder with the smallest possible overhang (CDX)
- Tool holder with the maximum shank size
- Blade or tool holder with the maximum width of insert seat size



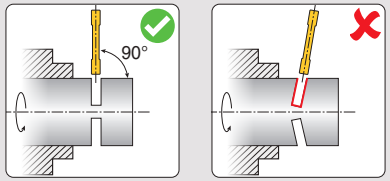
For short overhang For long overhang

90° Mounting of Tool Holder

: To get perpendicular surface and minimize vibration

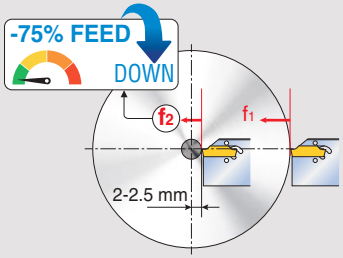


- Insert must be mounted **90°** to the workpiece
- Mounting the holder as close to the chuck as possible



Recommended Feed Rate for Parting-off

: To increase tool life and productivity

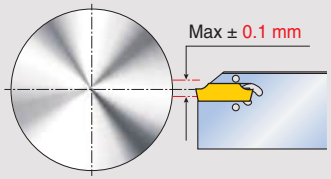


- Reduce feed up to **70-80%** before 2.0-2.5 mm from the center
- Recommended feed rate f2 = f1 x 0.2 ~ 0.3 (mm/rev)

$f_2 = f_1 \times 0.2$ $f_2 = f_1$

Cutting Edge Height Set-up

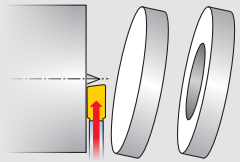
: To prevent over wear and breakage of insert and short tool life



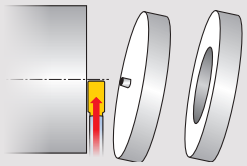
- Cutting edge height set-up within maximum **± 0.1 mm**
- Parting-off should be as close to the chuck as possible
- When machining long overhang, set the cutting edge height **+0.1 mm** higher to compensate for tool deflection

Handed Type Insert with Lead Angle

: To minimize pips or burrs



Handed insert



Neutral insert

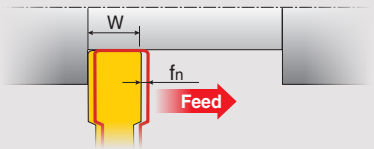
- Use lead angle insert only to reduce burrs
- Recommended lead angle by application
  4°: Tube and hollow bar **6°**: Tube and solid bar
  8°: Solid bar **15°**: Small diameter solid bar
- Neutral type inserts are recommended for parts that allow burrs

	Tool Life	Burr Size	Straightness	Surface Finish	Chip Flow
Neutral	✓		✓	✓	✓
Handed		✓			

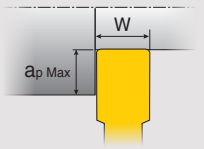
Maximum Feed and Depth in Turning

- Max. feed rate and depth of cut depends on insert width W in turning

Max. Feed rate
fn = W x 0.075 (mm/rev)

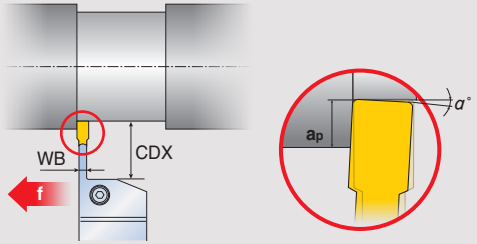


Max. Depth of cut
ap = W x 0.8 (mm)



Principles of Turning with Groove-Turn Tools

The basic principle in turning with groove-turn tools is the deflection of the cutting tool, which results in a frontal clearance angle α° between the insert and the workpiece. The clearance angle α° is a function of the side cutting forces and is not constant, as is the case with ISO inserts.



※ In very light machining, such as super finishing, there is not enough deflection, which can cause chatter and vibration.

Influenced factors of deflection:

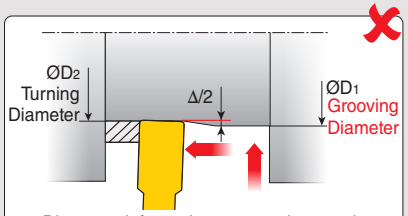
- ✓ Feed **f**
- ✓ Depth of Cut **ap**
- ✓ Overhang of Insert Support **CDX**
- ✓ Width of Insert Support **WB**
- ✓ Cutting Speed **Vc**
- ✓ Workpiece Materials

When all of the above factors remain constant during turning, a high degree of accuracy with a tolerance up to ±0.01 mm can be achieved.

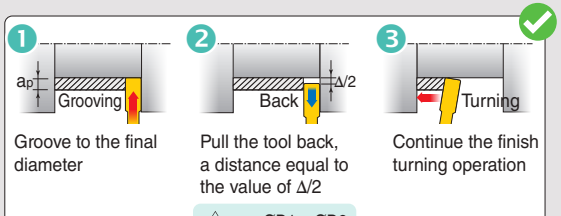
Groove-Turning with Compensation Factor

: To eliminate the difference in the workpiece diameter when groove-turning

• Compensation factor must be used in the final finishing groove-turn operation



Diameter deformation occurs when turning immediately after grooving

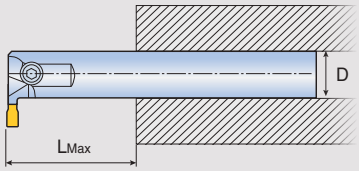


1. Groove to the final diameter
2. Pull the tool back, a distance equal to the value of Δ/2
3. Continue the finish turning operation

$$\frac{\triangle}{2} = \frac{ØD1 - ØD2}{2}$$

Recommended Overhang for Internal Machining

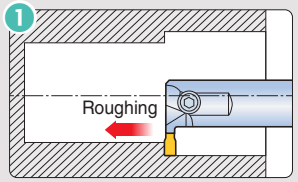
: To minimize vibration and good surface finish



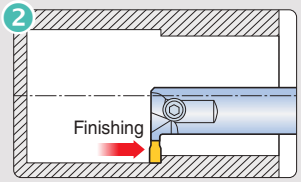
Shank Type	Recommended Overhang (LMax)
Steel Shank	LMax ≤ 3D
Tungsten Carbide Shank	LMax ≤ 5D
Anti-vibration bar	LMax ≤ 7D

Efficient Use of Insert Corner

: To reduce machining time and improve tool life

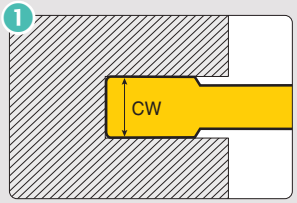


The first corner is used for roughing

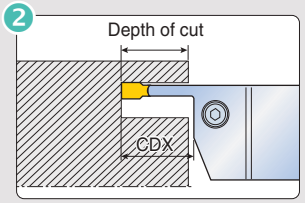


The other corner is used on the return path for finishing

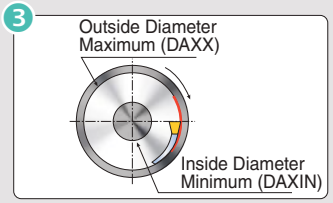
Tool Selection for Face Turning and Face Grooving



Choose the widest possible insert and tool, according to the cutting width and geometry to be machined



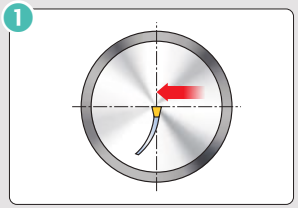
Choose the shortest tool overhang, according to the maximum depth required



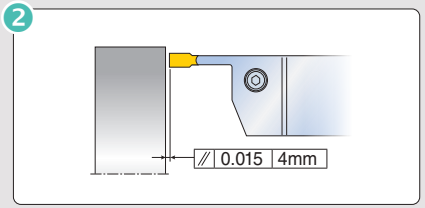
Choose the tool range with the largest diameter, depending on the initial grooving diameter required in the application

Facing Tool Adjustment

: Prior to machining, check and adjust the following tool positions



Check the cutting edge height at the center line, machine in light turning down to the center and check for burrs



Check the parallelism of the cutting edge and machined surface. The correct position can guarantee good surface quality when face turning in both directions.

Trouble

Productivity

Solutions

1 Use high feed and high productivity inserts

WinCut — For parting & deep grooving — SFC, SFJ
High feed and extraordinarily stable machining

FaceRush — For face grooving — TDFXR/L
High feed machining. Reinforced insert geometry

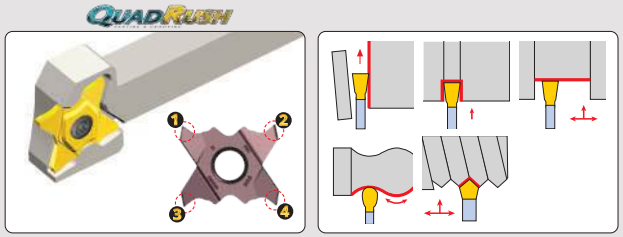
T-Clamp — For turning — TSG-HF
CBN insert for high feed finish turning on hardened steel

2 Use high-pressure coolant (Max. 70bar)

-TB Holder (2x speed up) CoolBurst

Parting and deep grooving | Parting and deep grooving | Face grooving | Shallow grooving | Turn-grooving

3 Use of multiple application tools with multiple cutting edges



Strong 4-cutting edges | Various applications

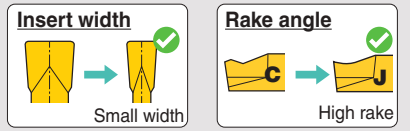
Trouble

Tangled Chip

Solutions

1 Change cutting conditions

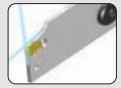
2 Change insert geometry



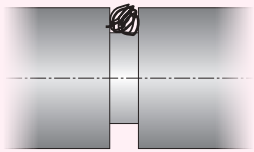
3 Use pecking (dwelling)

4 Use high-pressure coolant (Max. 70bar)

-TB Holder CoolBurst



Trouble

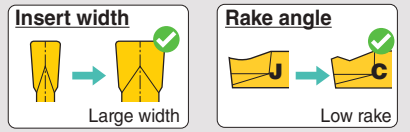


Chip Jamming

Solutions

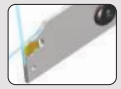
1 Change cutting conditions

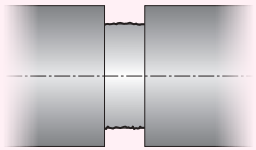
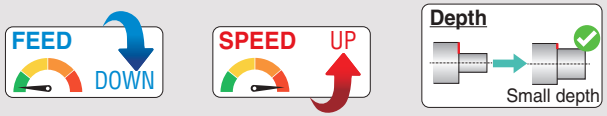
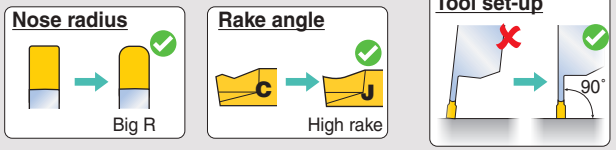
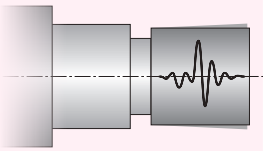
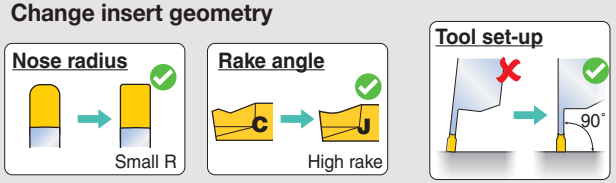
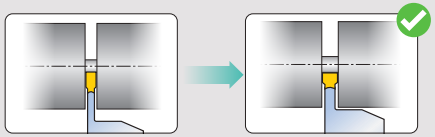
2 Change insert geometry

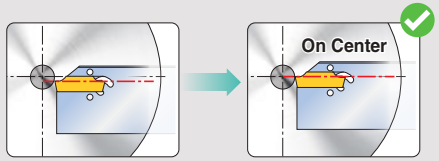
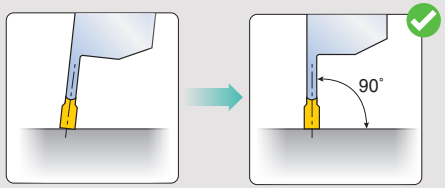
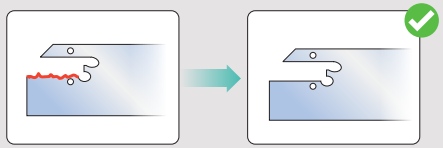
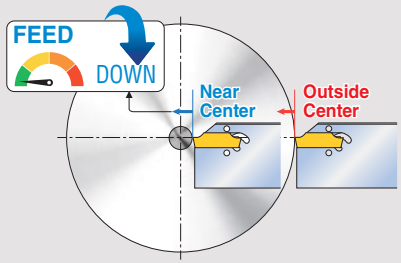


3 Use high-pressure coolant (Max. 70bar)

-TB Holder CoolBurst



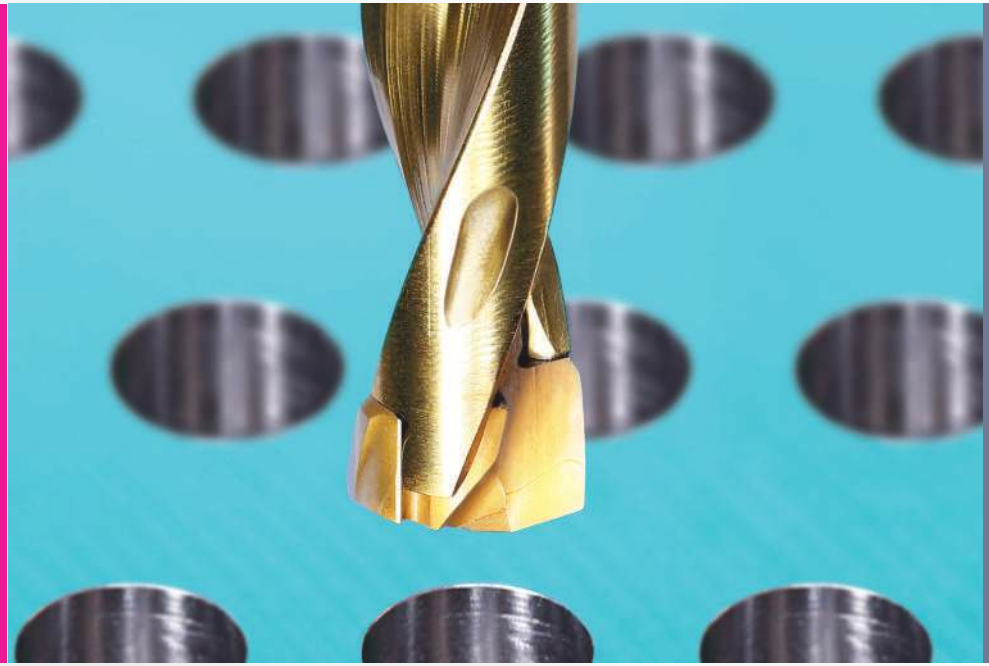
Trouble	Solutions
 Bad Surface Finish	1 Change cutting conditions  2 Change insert geometry  3 Improve stability of the tool and workpiece 4 Use high-pressure coolant (Max. 70bar) -TB Holder COOLBURST 
 Vibration	1 Change cutting conditions  2 Change insert geometry  3 Use strong holder and short overhang tool 

Trouble	Solutions
 Shorter Tool Life	1 Check the cutting edge height  2 Check the angle between tool and workpiece  3 Check the damage of the insert seat located in the tool  4 Decrease the feed rate near the center in parting operations  5 Machining with recommended speed and feed 6 Increase the coolant volume or use high-pressure coolant

The Right Choice

Technical Guide Book

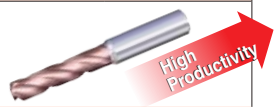
The Right Choice



Drilling

Selection Guide
Technical Tips
Troubleshooting

	Hole tolerance (mm)	Application	Recommended drill series	Diameter range
Rough	+0.4 -0.1	S M L Medium to large	TOP DRILL TOP 2/3/4/5D	Direct mounting Ø12.0 - Ø50.0 mm Cartridge type Ø51.0 - Ø80.0 mm
	+0.25 -0.1	S M L Medium to large	MODU DRILL TNDH (Head) MDB-3/5/7D (Body)	Ø26.0 - Ø50.0 mm
General	+0.1 0	S M L Medium to large	SPADE RUSH LCD-3/5/8D	Ø20.0 - Ø41.0 mm
	+0.1 0	S M L Small to medium	DRILL RUSH TCD-1.5/3/5/8/12D	Ø4.0 - Ø25.9 mm
High Productivity	+0.1 0	S M L Small to medium	DRILL SPEED 3ED-3/5/8D	Ø12.0 - Ø25.9 mm
	+0.1 0	S M L Small hole drilling	SOLID 3 DRILL 3HD-PI3/PI5/PI8 3HD-CI2	Ø4.0 - Ø12.0 mm

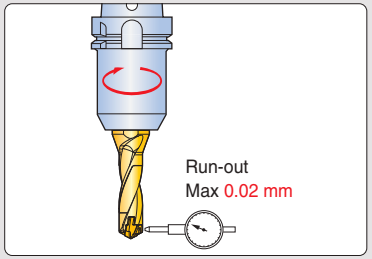
ISO materials	P	M	K
P M K N S *N: SOMT-DA	 for Alloy steel  for Low carbon steel **SOMT-DP TT9080** **SOMT-DL TT9080** Vc 180 - **160** - 140 fn 0.08 - **0.12** - 0.14	 **SOMT-DP TT9080** Vc 220 - **180** - 160 fn 0.06 - **0.08** - 0.10	 **SOMT-DK TT6080** Vc 200 - **160** - 140 fn 0.10 - **0.15** - 0.20
P K	  **TCD-P-CO+** **SPGX-DW TT9080** Vc 180 - **140** - 100 fn 0.20 - **0.25** - 0.35	-	  **TCD-P-CO+** **SPGX-DW TT9080** Vc 200 - **160** - 120 fn 0.20 - **0.30** - 0.50
P M K	 **LCD-P/P+ TT9080** Vc 200 - **100** - 80 fn 0.20 - **0.25** - 0.30	 **LCD-P TT9080** Vc 80 - **60** - 70 fn 0.12 - **0.20** - 0.25	 **LCD-P/P+ TT9080** Vc 150 - **120** - 100 fn 0.20 - **0.35** - 0.50
P M K N *N: TCD-N	 **TCD-P/P+ TT9080** Vc 200 - **100** - 70 fn 0.20 - **0.25** - 0.30	 **TCD-M TT9080** Vc 70 - **60** - 50 fn 0.12 - **0.18** - 0.25	 **TCD-K TT9080** Vc 150 - **120** - 100 fn 0.20 - **0.27** - 0.35
P K	 **3ED-P+ TT5130** Vc 140 - **100** - 70 fn 0.30 - **0.40** - 0.55	-	 **3ED-P+ TT5130** Vc 160 - **120** - 80 fn 0.40 - **0.50** - 0.60
P K	 **3HD TT5130** Vc 140 - **100** - 70 fn 0.20 - **0.35** - 0.55	-	 **3HD TT5130** Vc 140 - **100** - 80 fn 0.25 - **0.45** - 0.60

(Vc, m/min, fn, mm/rev)

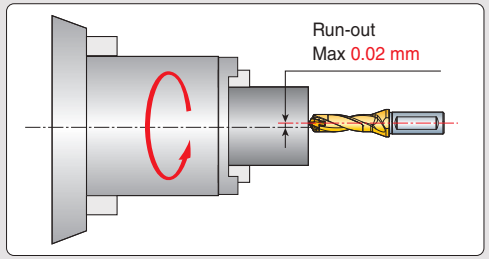
Solid Carbide Drill and Head Changeable Drill Set-up

- The drilling run-out should not exceed **0.02 mm**
- Use a drill with as short an overhang as possible

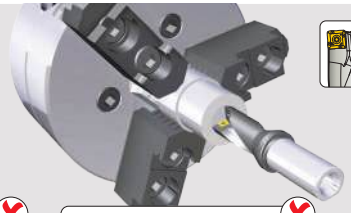
Rotating drill: for machining center



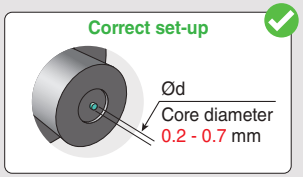
Stationary drill: for lathe

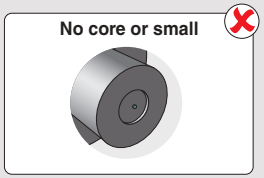


Indexable Drill Set-up on the Lathe

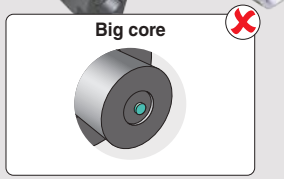


- On first hole
  - Retract the drill after drilling to a depth of **3-6** mm
  - Check if it has produced a small core within **0.2-0.7** mm



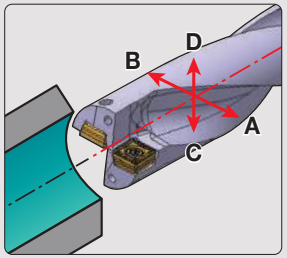


Causes insert breakage and vibration. Adjust the drill body after rotating 180 degrees.



Causes overload and vibration. Adjust offsets to bring core to correct size.

- Tool eccentric position by machined hole condition (Ø47 TOP-DRILL)

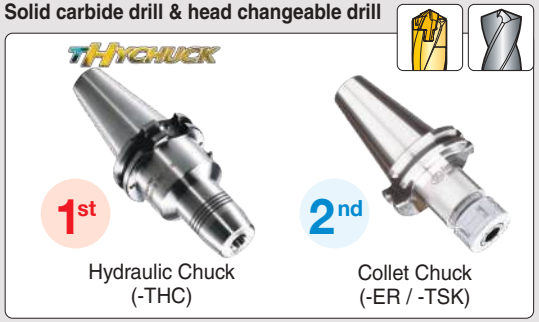


Tool Position	Core Size	Hole Diameter	Problem
Correct	0.2 mm	47 mm	Correct performance and diameter
A	0.2 mm	48 mm	Hole diameter incorrect
B	0.2 mm	46 mm	Holder interferes with work piece
C	1.2 mm	47.2 mm	Vibration
D	None	46.8 mm	Insert breakage and vibration

Recommended Drill Holder

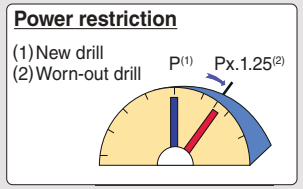
Indexable drill

Solid carbide drill & head changeable drill

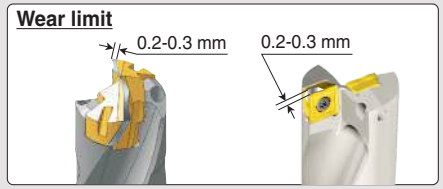


Indication of Tool Life

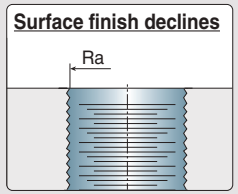
: Tool life is judged based on the following



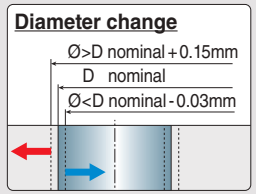
25% more cutting load than initial



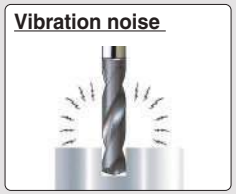
Frank wear on the head or insert cutting edge 0.2-0.3 mm



Poor hole surface roughness



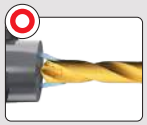
Unstable hole diameter



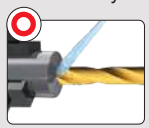
Vibration noise drastically increases

Coolant Supply

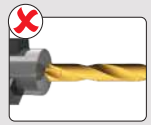
For Stationary Drill



Internal coolant



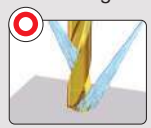
External coolant (up to 2xD)



Dry cutting

For Rotating Drill

Internal coolant



External coolant (up to 2xD)

Dry cutting

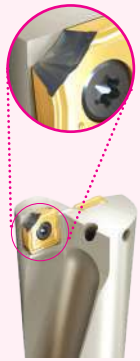
Trouble	Solutions
Productivity	**1 Use high productivity drill** DrillSpeed: Head changeable 3-flute drill Solid3Drill: Solid carbide 3-flute drill **2 Use self-centering drill head (no-pilot drill)** TCD-P+ / 3ED-P+ / LCD-P+
Bad Surface Finish	**1 Increase coolant pressure and volume** **2 Change cutting conditions** FEED DOWN / SPEED UP Overhang → Short overhang **3 Use self-centering drill head (no-pilot drill)** TCD-P+ / 3ED-P+ / LCD-P+ **4 Check alignment and drill runout** Rotating (90°) / Non-rotating (90°) / Run-out

DRILLING TROUBLESHOOTING

Drilling E-Catalog ➤➤➤

Trouble	Solutions
Oversized Hole	**1 Check alignment and drill runout** Rotating (90°) / Non-rotating (90°) / Run-out **2 Increase coolant pressure and volume**
Undersized Hole	**3 Change to tougher grade** P M K N S H Tougher: TT8020 → TT9030 → TT9080 TT6080 → TT9300 → TT7400 → TT5130 → TT9080 **4 Change cutting conditions** FEED DOWN / SPEED UP Overhang → Short overhang

Trouble	Solutions
 Chip Jamming	1 Check the cutting conditions and geometry FEED & SPEED P M K N S H 2 Change coolant conditions Supply method: External / Internal Pressure and Volume: Increase coolant 3 Change cutting conditions FEED DOWN, SPEED UP Overhang: Short overhang
 Vibration	1 Improve rigidity and stability Overhang: Short overhang Clamping 2 Check the cutting conditions and geometry FEED & SPEED P M K N S H 3 Change cutting conditions FEED DOWN, SPEED DOWN

Trouble	Solutions
 Insert Breakage	1 Change to tougher grade P M K N S H Tougher: TT8020, TT9030 TT6080 → TT9300 → TT7400 → TT5130 → TT9080 2 Change cutting conditions FEED DOWN Overhang: Short overhang 3 Check alignment and clamping Alignment: 90° Clamping
 Shorter Tool Life	1 Increase coolant pressure and volume 2 Check the cutting conditions and insert grade FEED & SPEED P M K N S H 3 Check alignment and clamping Alignment: 90° Clamping

The Right Choice

Technical Guide Book

The Right Choice

Milling

Section Guide
Troubleshooting

Tool Selection by Application

			P TT9080 (TT8080)	M TT8080 (TT8020)	K TT6080 (TT7515)	N K10 (PCD)	S TT8080 (TT8020)	H TT2510 (CBN)
Shouldering	End mill	1st	AVKT-M	AVKT-EL	LPKU-M	4NHT-AL	AVKT-EL	LPKU-M
		2nd	CVKT-M	CVK(H)T-M/L	SQKU-M	AVCT-AL	3PK(H)T-ML	4NKT-M
	Face mill	1st	SQKU-M	4NHT-ML	LPKU-M	4NHT-AL	3PK(H)T-ML	LPKU-M
		2nd	LPKU-M	3PKT-ML	SQK(H)U-M/MM	3PHT-AL	3PK(H)T-ML	SQKU-M
Slotting	End mill (Roughing)	1st	4NKT-M	AVKT-M/L	LPKU-M	4NHT-AL	AVKT-EL	LPKU-M
		2nd	CVKT-M	CVK(H)T-M/L	4NKT-M	XEVT-AL	3PK(H)T-ML	4NKT-M
Facing	Roughing	1st	HXKU	7EMT	HXHU-MM	4NHT-AL	7EMT-ML	PTKU-M
		2nd	XNMU-M	HXKU-ML	XNHU-MM	3PHT-AL	HXKU-ML	RYHX-MR
	Finishing	1st	4WHU-ML CT7000	SNGX-ML	4WHU-ML, CBN	4WHU-AL, PCD	SNGX-ML	4WHU-CBN

1st : First recommendation
2nd : Second recommendation

Tool Selection by Application

			P TT9080 (TT8080)	M TT8080 (TT8020)	K TT6080 (TT9080, TT2510)	N K10 (PCD)	S TT8080 (TT8020)	H TT2510 (CBN)
HF High Feed Milling	End mill	1st	BLMV-M	AVKT-HF	PTKU-M	Big R XEVT-AL	SBMT-ML	BLMV-M
		2nd	AVKT-HF	BLMV-MM	BLMV-M	-	BLMV-ML	4NKT-HF
	Face mill	1st	BLMV-M	BLMV-MM	PTKU-M	Big R XEVT-AL	SBMT-ML	BLMV-M
		2nd	PTKU-M	PTKU-ML	BLMV-M	-	BLMV-ML	PTKU-M

1st : First recommendation
2nd : Second recommendation

			P TT9080	M TT8080	K TT9080 (TT2510)	S TT8080	H TT2510
Profiling	Roughing	Ø16-Ø32	2FB-M	2FB-ML	2FB-M	2FB-ML	2FB-M
		Ø32, Ø50	3FB-M	3FB-M	3FB-M	3FB-M	3FB-M
		Ø50	6RBE	6RBE	6RBE	6RBE	6RBE
	Medium		BRHU	BRHU	BRHU	BRHU	BRHU
	Finishing		NFB TT5515	NFLB NFCB	NFB TT5515	NFLB NFCB	NFLB NFCB

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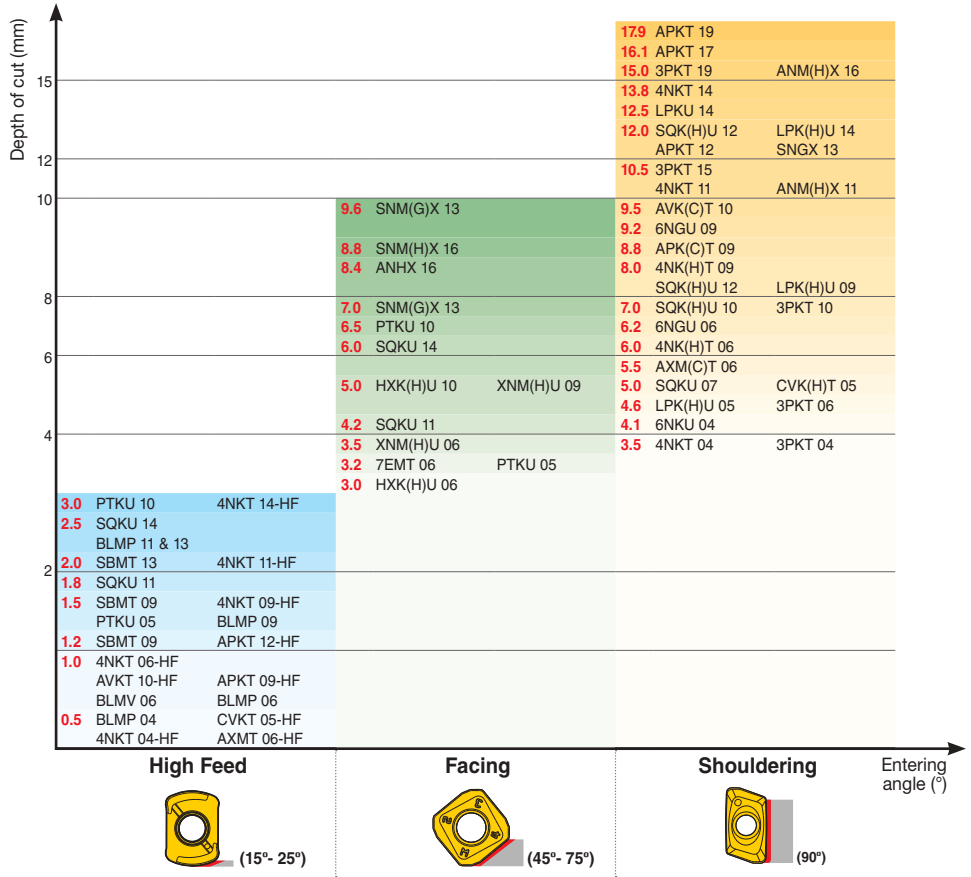
Tool Selection by Entering Angle and Depth of Cut



High Feed			Facing			Shouldering		
						17.9	APKT 19	
						16.1	APKT 17	
						15.0	3PKT 19	ANM(H)X 16
						13.8	4NKT 14	
						12.5	LPKU 14	
						12.0	SQK(H)U 12	LPK(H)U 14
							APKT 12	SNGX 13
						10.5	3PKT 15	
							4NKT 11	ANM(H)X 11
			9.6	SNM(G)X 13		9.5	AVK(C)T 10	
						9.2	6NGU 09	
			8.8	SNM(H)X 16		8.8	APK(C)T 09	
			8.4	ANHX 16		8.0	4NK(H)T 09	
							SQK(H)U 12	LPK(H)U 09
			7.0	SNM(G)X 13		7.0	SQK(H)U 10	3PKT 10
			6.5	PTKU 10		6.2	6NGU 06	
			6.0	SQKU 14		6.0	4NK(H)T 06	
						5.5	AXM(C)T 06	
			5.0	HXK(H)U 10	XNM(H)U 09	5.0	SQKU 07	CVK(H)T 05
						4.6	LPK(H)U 05	3PKT 06
			4.2	SQKU 11		4.1	6NKU 04	
			3.5	XNM(H)U 06		3.5	4NKT 04	3PKT 04
			3.2	7EMT 06	PTKU 05			
			3.0	HXK(H)U 06				
3.0	PTKU 10	4NKT 14-HF						
2.5	SQKU 14							
	BLMP 11 & 13							
2.0	SBMT 13	4NKT 11-HF						
1.8	SQKU 11							
1.5	SBMT 09	4NKT 09-HF						
	PTKU 05	BLMP 09						
1.2	SBMT 09	APKT 12-HF						
1.0	4NKT 06-HF							
	AVKT 10-HF	APKT 09-HF						
	BLMV 06	BLMP 06						
0.5	BLMP 04	CVKT 05-HF						
	4NKT 04-HF	AXMT 06-HF						

Low	Radial cutting force	High
High	Productivity	Low
Low	Entering shock	High
Less	Burr	More
Thin	Chip thickness	Thick

Properties by Cutter Pitch

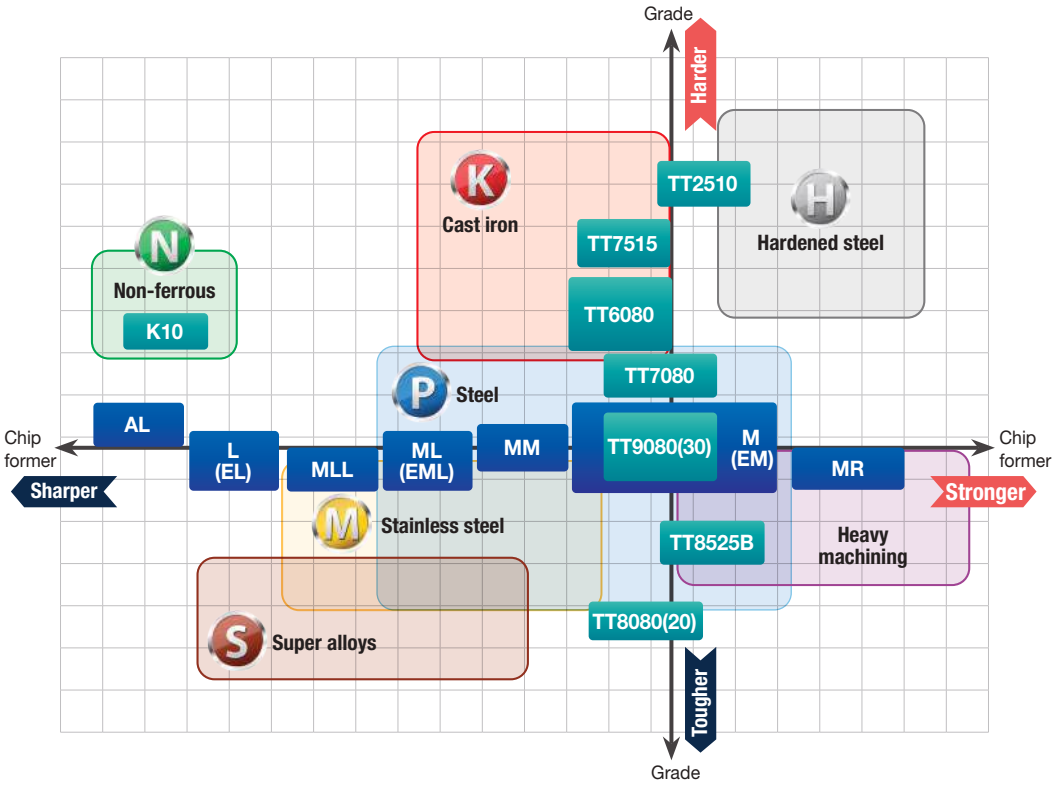
Low	Table feed	High
Low	Cutting force	High
Big	Chip gullet	Small
Good	Anti-vibration	Bad
Weak	Machine Power	Strong

Milling E-Catalog ➤➤➤

Chip Former and Grade Selection Map

AL	L	MLL	ML	MM	M	MR
Aluminum & non-ferrous alloy	Difficult-to-cut materials (HRSA)	Difficult-to-cut materials (HRSA) with high feed	Light cutting, SUS300 series	Light cutting, SUS400 series	General operation	Hardened steel & Interrupted cutting

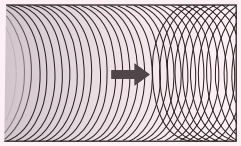
Soft	Material hardness	Hard
Low	Cutting edge strength	High
Low	Cutting force	High



Trouble	Solutions
Productivity	**1 Use high feed and high productivity insert** WIN4FEED BLMV — "V" Shape Bottom Design CHASE4FEED BLMP — Double-sided 4-corner CHASEFEED SBMT — Single-sided 4-corner CHASE2FEED BLMP 13 — Double-sided 6-corner WINMILL AVKT -HF CHASE10MILL PTKU — For high feed — Double-sided 10-corner CERAMICSPEED BNGX — For super alloys — Ceramic insert 4/6-corner WINMILL CVKT -HF CHASE4MILL 4NKT -HF **2 Use chip splitter insert (-SM)** CHASEMILL APKT -SM CHASE2MILL ANHX -SM MILLRUSH 3PKT -SM • More suitable for extended flute cutters **3 Use fine pitch cutter (more teeth, same diameter)** CHASE3MILL Ø125 mm Z=18 teeth CHASE2MILL Ø100 mm Z=11 teeth WINMILL Ø10 mm Z=3 teeth

Trouble	Solutions
Bad Surface Finish	**1 Change cutting conditions** SPEED UP FEED OPTIMAL — Apply feed with optimum chip thickness Depth — Low depth **2 Change insert and holder geometry** Chip former — Sharper Tolerance M,K → H,G — Precise insert Overhang — Short overhang **3 Use wiper insert and combination cutter** Wiper insert Wiper — Combination cutter **4 Use carbide shank or reinforced shank** Solid carbide
Burr	**1 Change insert and holder geometry** Corner radius — Small R Tolerance M,K → H,G — Precise insert Entering angle 90° → 45° — Small angle **2 Use down milling** Down milling **3 Chamfering at start/end of workpiece**

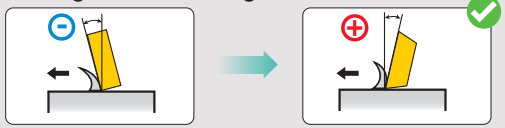
Trouble



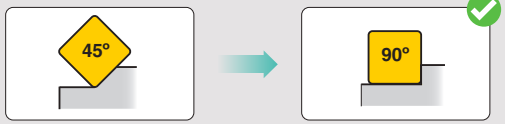
Back Cutting

Solutions

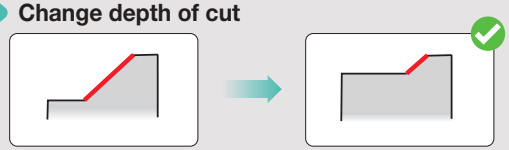
1 Change axial rake angle



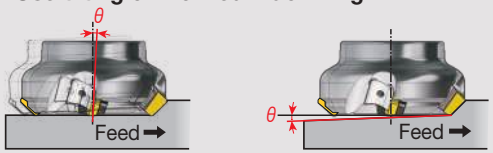
2 Change cutter entering angle

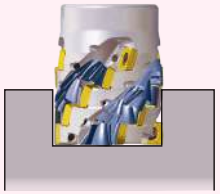


3 Change depth of cut



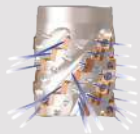
4 Use tilting or inclined machining





Chip Jamming
(full slotting or
extended cutter)

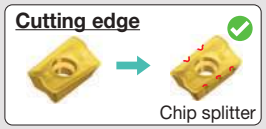
1 Use internal coolant cutter

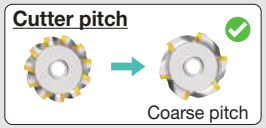


2 Change cutting conditions

Apply feed with
optimum chip thickness

3 Change insert and cutter geometry



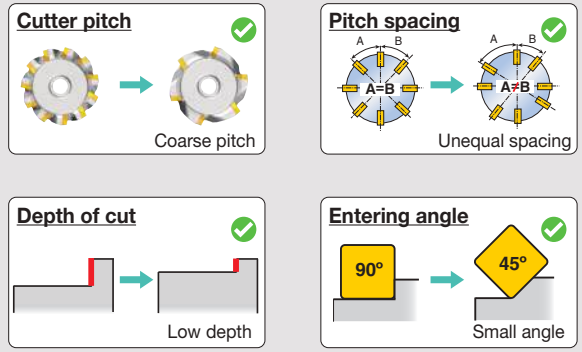


Trouble

Vibration

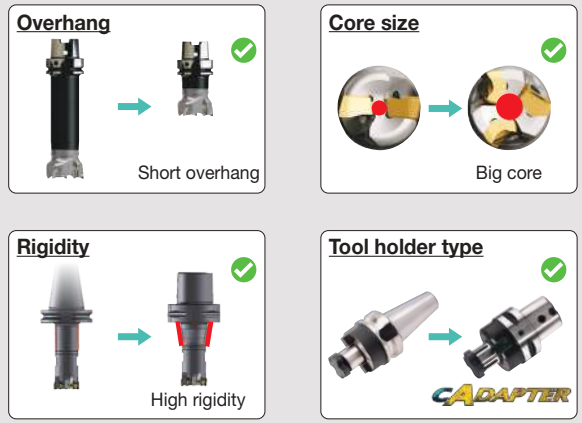
Solutions

1 Reduce cutting forces



Apply feed with
optimum chip thickness

2 Improve rigidity and stability



The Right Choice

Technical Guide Book

Solid End Mills

Selection Guide
Recommended Cases
Troubleshooting

Solid End Mills Homepage ➤➤➤

Tool Selection by Material

	General Purpose		Special Purpose	
	Geometry	1st Recommendation	Special purpose	1st Recommendation
P K M	Flat	UHP	High feed	HFM
	Corner R	UHP	Chamfering	CEM ECEM
	Ball	SBE	Roughing	REL
M S	Flat Corner R	SED	Roughing	SER
	Ball	SBT		
N	Flat Corner R	AES	Waved cutting edge	AWE
	Ball	AEB	Roughing	REA
H P K	Flat	HSF	CBN Ball	HSB 2CBN
	Corner R	HSR		
	Ball	HSB		

	For Trochoidal		For Inconel	
S	Corner R	SED 7 TT5515	Ceramic end mill corner R	CRF TC3030
			Ceramic end mill high feed	CRH TC3030

Solid End Mills E-Catalog ➤➤➤

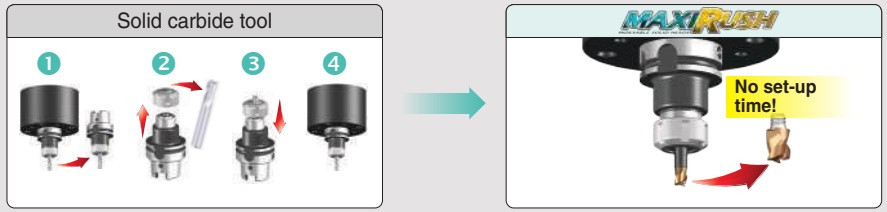
Tool Selection by Application

		P K M	M S	H P K	N
Shouldering	Flat	UHP	SED 4/7	HSF 4/6	AES 3
	Corner R	UHP		HSR 4/6	
Slotting	Flat	UHP	SED 4/7	HSF 2	AES 2/3
	Corner R	UHP	Only for trochoidal	HSR 2	
Profiling	Ball	SBE 2/4	SBT	HSB	AEB

Tool Selection by Application - MAXI-RUSH

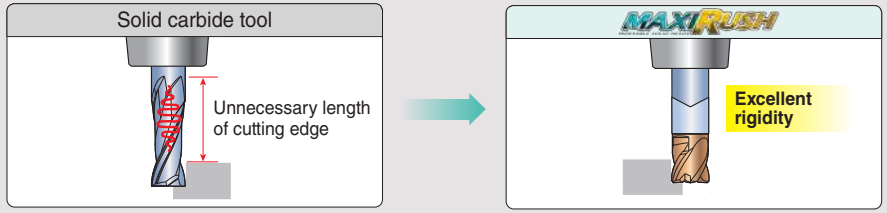
	P M H	K S	N	P K S M H	
Shouldering	MXES	MXED	MXEE-A03	High feed end milling (HF)	MXFX
Slotting	MXES		MXEE-A02	Chamfering	MXC_
Profiling (finishing)	MXRD / MXBD(E)		MXBE-BGA02	Threading	TTRD
Profiling (5-axis)	MXCSO (barrel) / MXCSL (Lens)		Ta-C Coating	Side slotting	TST/TTB

In case of many tool changes



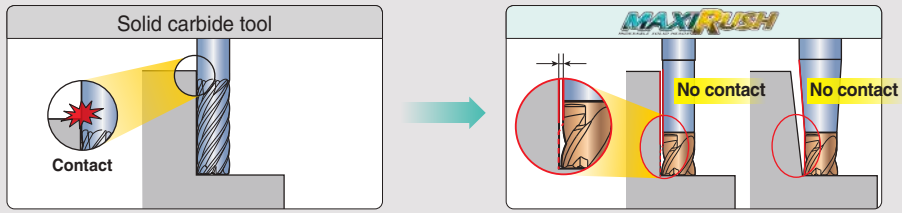
Long tool change time — Quick head change on machine

In case of lower axial depth of cut with long overhang



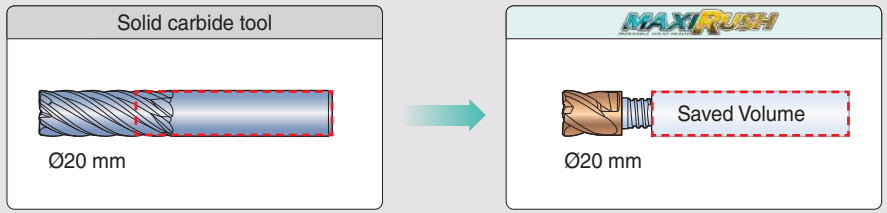
Long cutting edge — Short cutting edge

In case of deep cavity machining without interference



Tool and workpiece contact — Optimized for cavity machining

In case of bigger cutter diameter with high tool cost



High tool material cost — Low tool material cost

Trouble	Solutions
Productivity	**1 Use high productivity and high feed end mill** MAXIRUSH: Minimize tool change time and machine down time MAXIRUSH SOLIDFEED: High feed machining **2 Change machining method** : In case of hardened material or super alloys Conventional slotting → Trochoidal milling (High Depth Wide Width)
Tool Breakage	**1 Reduce number of flutes** 6z: Narrow chip space → 4z / 3z: Less number of flute (More space for chip evacuation) **2 Minimize tool overhang** Long overhang → Short overhang (Reduced vibration) **3 Change cutting conditions** SPEED DOWN, FEED OPTIMAL

SOLID END MILL TROUBLESHOOTING

Trouble	Solutions
Pull out of the tool	**1 Change the holder with strong gripping power** ER collet chuck, Hydraulic chuck: Normal gripping power → Milling chuck, Shrink chuck: Strong gripping power **2 Change tool helix angle** High helix angle → Low helix angle **3 Change cutting conditions** SPEED DOWN, FEED OPTIMAL
Rough Surface Finish	**1 Change cutting conditions** SPEED UP, FEED OPTIMAL **2 Change tool holder** ER collet chuck, End mill holder: Normal run out accuracy → Hydraulic chuck, Shrink chuck: Excellent run out accuracy **3 Minimize tool overhang** Long overhang → Short overhang (Reduced vibration)

TRIVAX

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