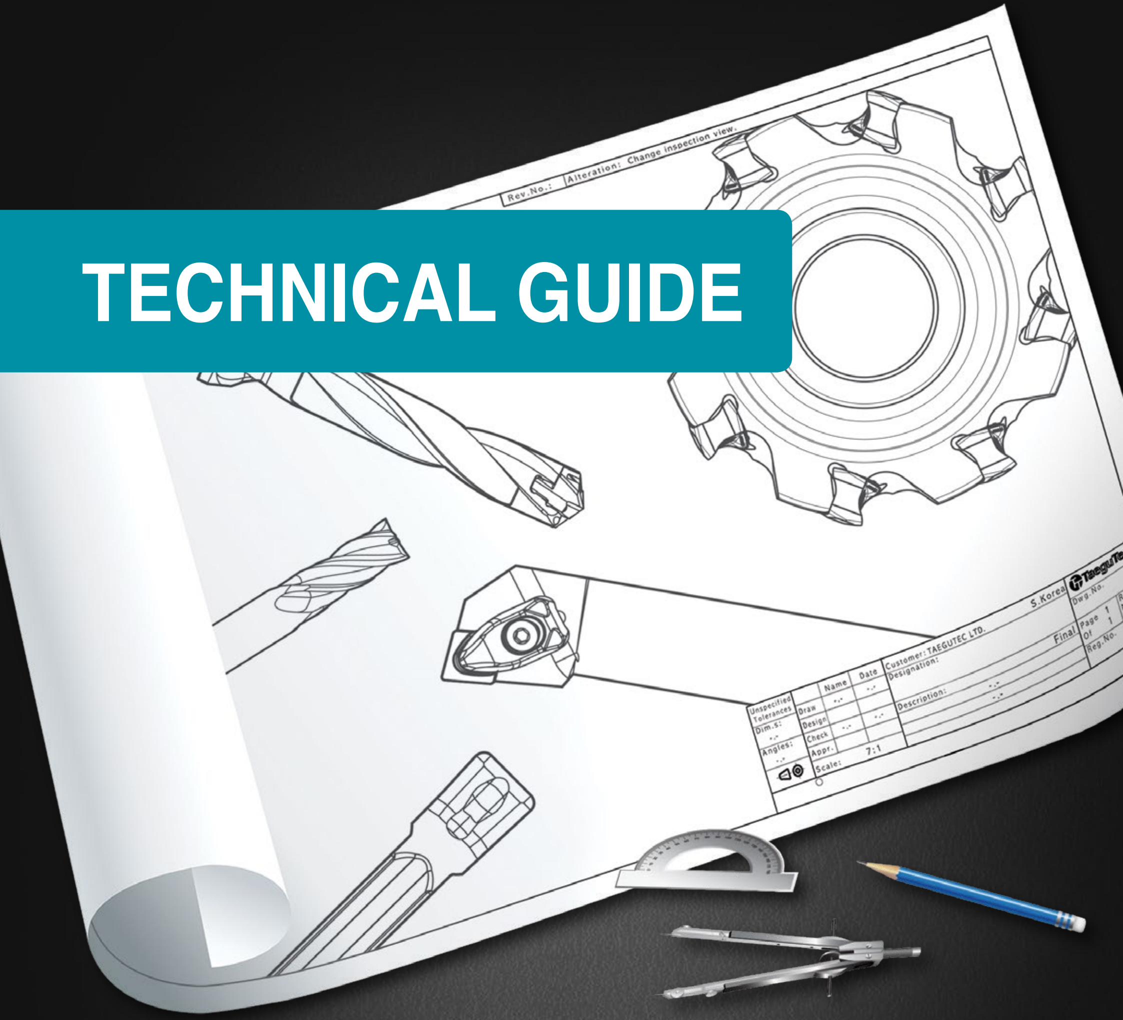
TECHNICAL GUIDE



Contents

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TECHNICAL GUIDE

-Turning

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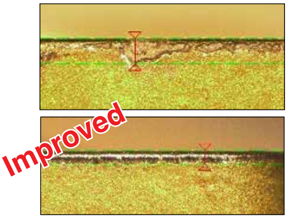
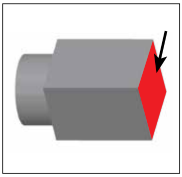
GOLDRUSH grades

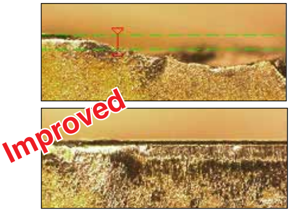
- Improved chipping resistance and insert breakage
- High surface finish on the work pieces
- Stable and extended tool life in continuous and interrupted cutting operations
- Reduced cutting friction and minimized built-up edge on exotic materials

Beneficial influence of new technology

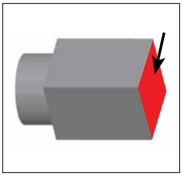


Material: Low carbon steel (HB145-160)
Insert: CNMG 120408 TT8115
Cutting condition
V=100m/min
f=0.10mm/rev
d=3.0mm
Face interrupted cut

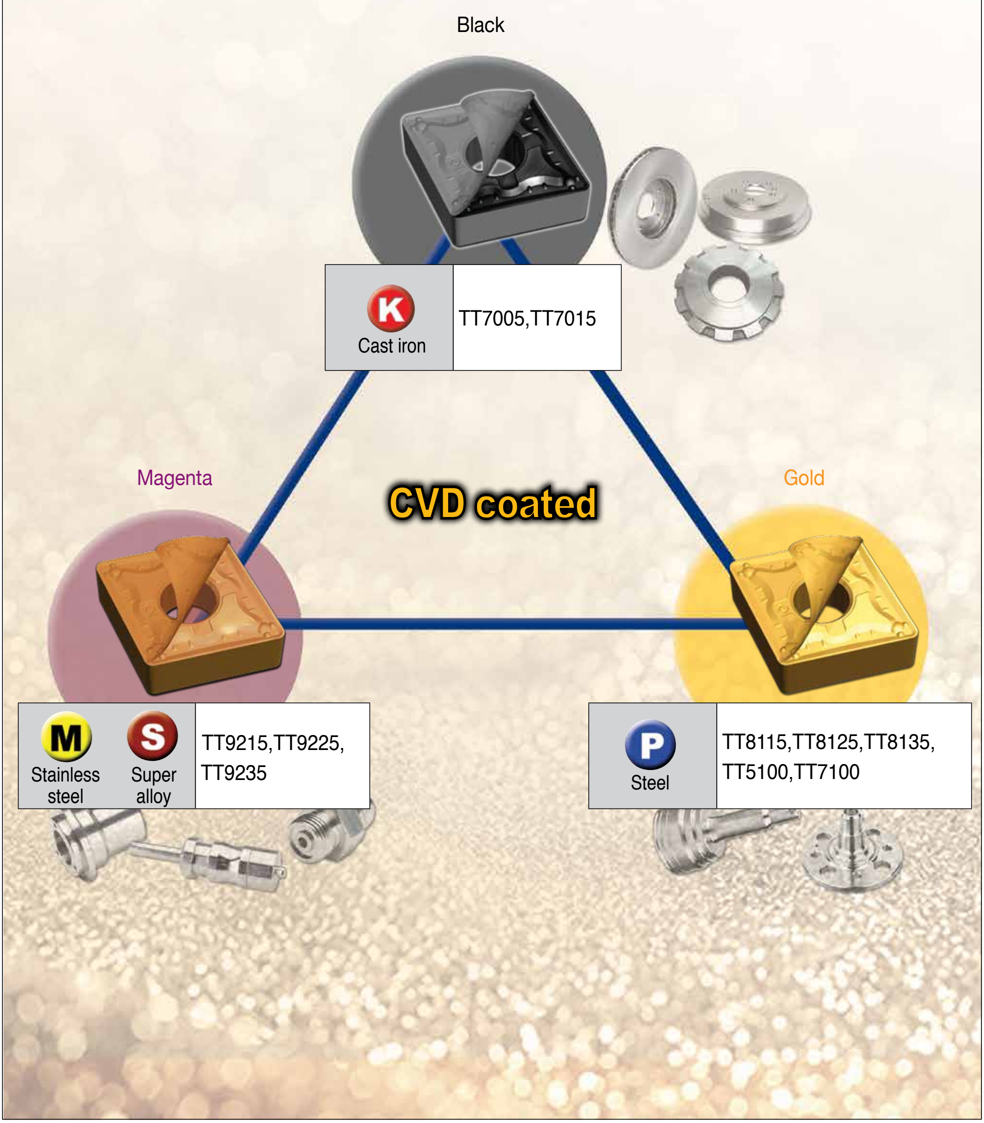




Meterial: Cold working tool steel (HB170-190)
Insert: CNMG 120408 TT8115
Cutting condition
V = 100m/min
f = 0.20mm/rev
d = 2.0mm
Face interrupted cut

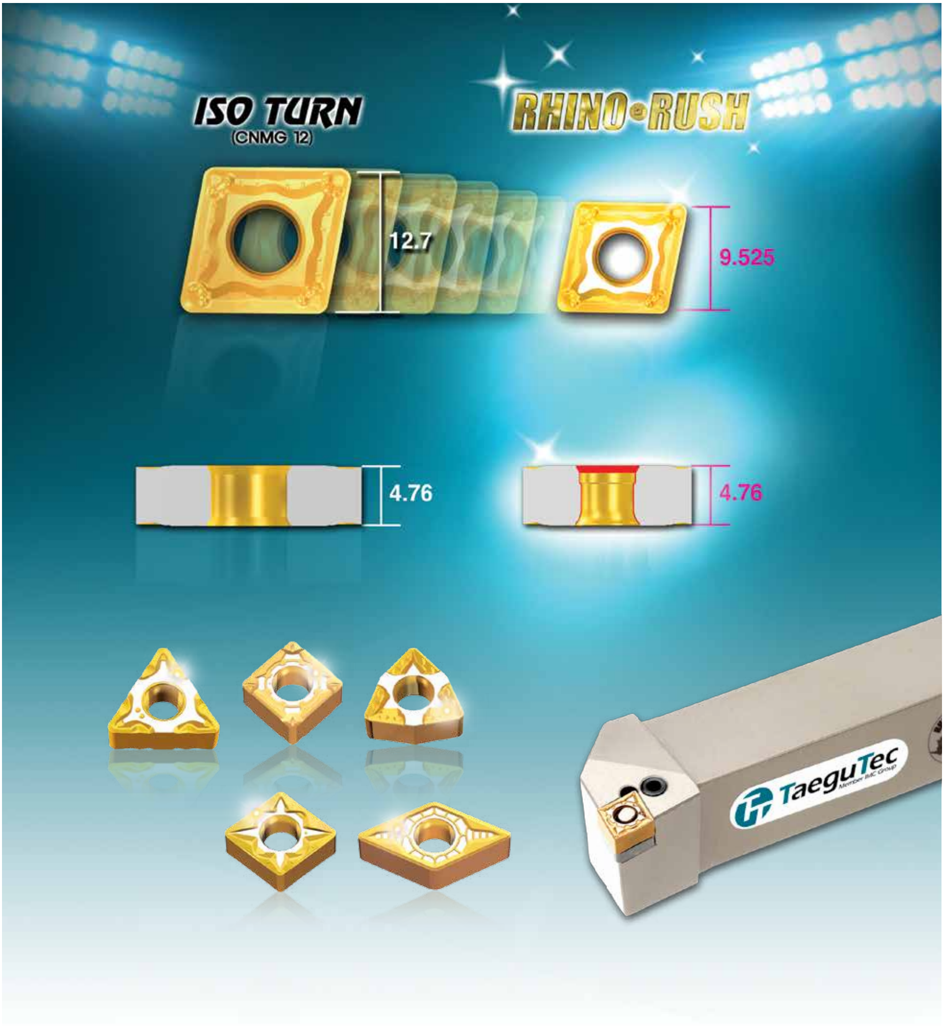


▶ Easy to select insert color in CVD insert by workpiece material



RHINORUSH insert

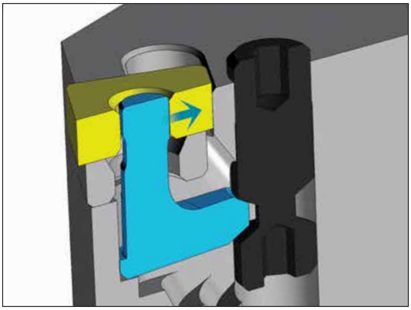
- Small inserts with superior durability and the same thickness as ISO inserts
- Stronger clamping force because of hook lever system
- Stable tool life due to insert's smaller size
- Stable tool life in interrupted or high feed machining
- Suitable for mass production manufacture



▶ RHINORUSH clamping system

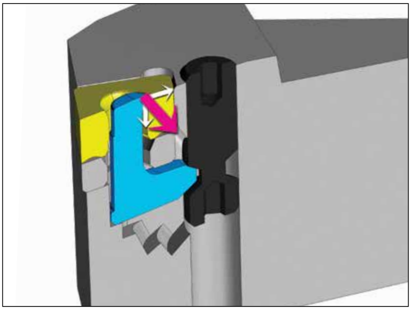
RHINORUSH hook lever lock system helps insert stable clamping on holder due to the two directional force

ISO TURN



One directional force

RHINO•RUSH



Two directional force

The hook lever system pushes the insert into the holder's pocket creating two directional force that improves insert rigidity during machining compare to ISO straight lever.

▶ Recommended clamping torque

Use torque gauge or adjustable torque driver					
Lever designation	Screw designation	Thread size	Allen key size	Remark	Recommended clamping torque
LCL 08-NX	LCS 3-NX	M6 X 1.0	2.5mm	External	3.0Nm
LCL 09-NX	LCS 3	M6 X 1.0	2.5mm	External	3.0Nm
LCL 08B-NX LCL 09B-NX	LCS 3B	M5 X 0.8	2.0mm	Internal	2.5Nm
LCL 11-NX	LCS 4	M8 X 1.0	3.0mm	External	4.0Nm
	LCS 4S			Internal	

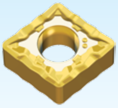
Note: Caution is recommended when clamping RHINORUSH inserts on to the holder.
Follow the recommended torque values posted above due to the smaller RHINORUSH components' size.

▶ Chip breaker selection according to workpiece material

P


FG


FM


FT


PC


MT

FG: Low cutting force for finishing
FM: For semi-finishing to semi-medium
FT: Excellent chip breaking on variable depth of cut
PC: For semi finishing to medium
MT: Tough rake angle for general use

M

S

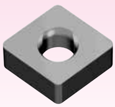

EA


EM


MM

EA: Excellent chip control at low feeds rate on exotic materials
EM: Sharp land design for low cutting force
MM: For general roughing machining

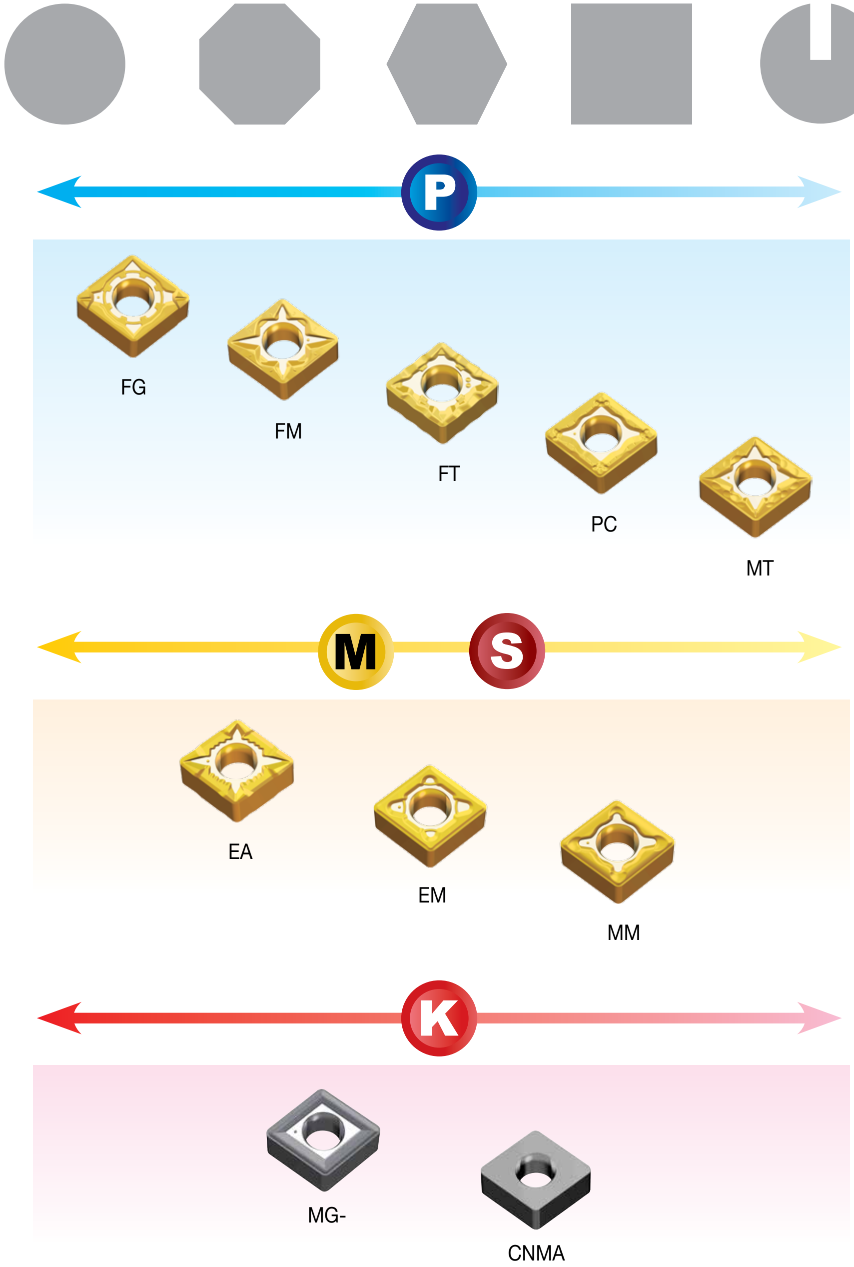
K


CNMA


MG-

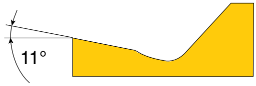
CNMA: For cast iron without chip breaker
MG-: Strong rake angle for medium roughing

Chip breaker selection according to workpiece shape



DNUX insert

▪ Chip breaker geometry

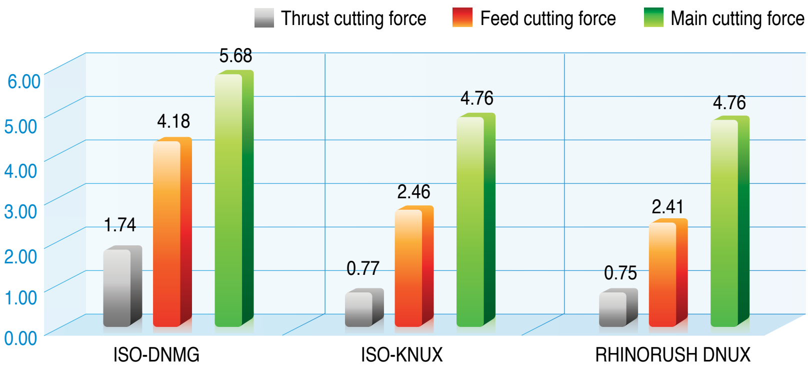
Insert	Edge geometry
	

▪ Features

- 4 cutting edges for productivity and economy
- For medium light to medium applications
- Steel and stainless steel machining
- Decreased cutting forces due to high positive rake angle geometry
- Suitable for machining slender bar, thin-wall components

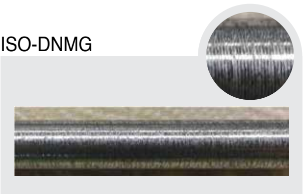
▪ Comparison of cutting force

Workpiece	Vc(m/min)	f(mm/rev)	Cutting depth	Coolant	Remark
0.45% Carbon steel (Ø20mm)	200 m/min	0.3 mm/rev	3.0 mm	Dry	External continuous

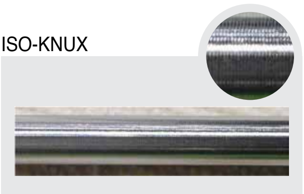


▪ Surface roughness

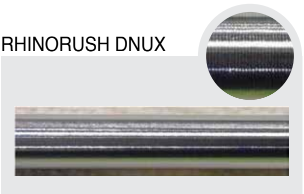
ISO-DNMG



ISO-KNUX



RHINORUSH DNUX

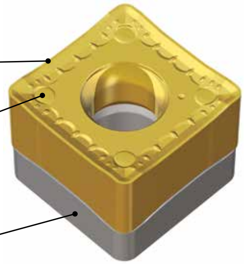


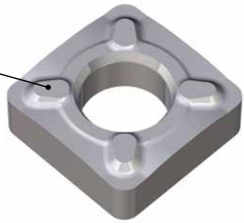
HB chip breaker

▪ Double-sided semi-heavy turning insert
- Low cutting force
- An optimized chip breaker suitable for semi heavy machining

▪ Stable contact surface with seat
- Unique contact surface with large convex

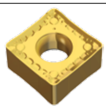
▪ Exclusive seat
- 3 dimensional geometry
- Exchangeable with the ISO standard holder





▪ Replacement seats for ISO lever turning holder

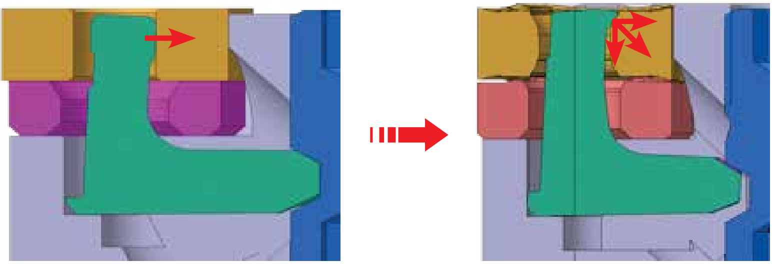
TaeguTec offers several replacement seats that are exchangeable with the ISO lever turning holder. However, it is recommended the HB insert be used with its exclusive holder to maximize tool life

Designation	Shape	Seat for H-holder	Seat for ISO Lever holder
CNMX 16		LSC 54-NX	LSC 53-NX LSC 53-NXS
SNMX 15		LSS 54-NX	LSS 53-NX LSS 53-NXS

• LSC 53-NX: Same size with IC of insert
• LSC 53-NXS: Smaller size than IC of insert

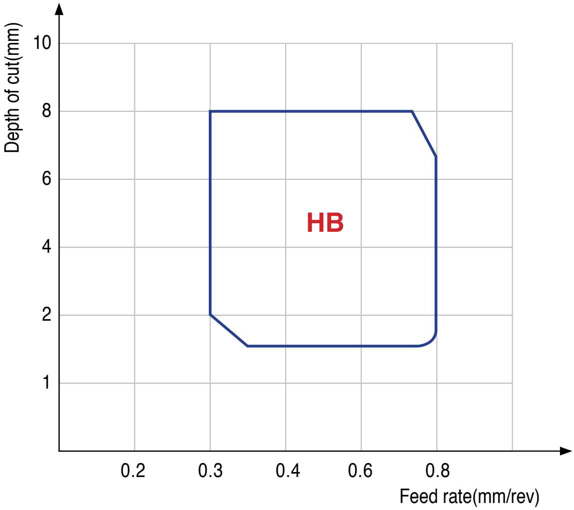
Clamping structure and features

- Quick change and rigid clamping force
  (Increased clamping force due to hooked lever design)



Conventional lever type   Hook lever type

Chip breaking range

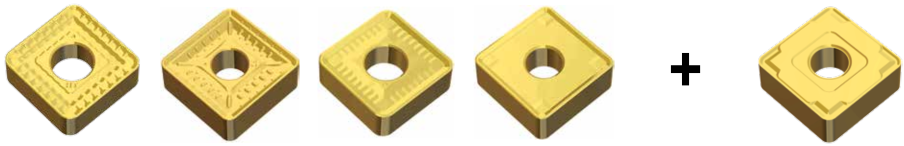


- Insert: CNMX 160712 HB
- Cutting speed: 150 m/min
- Material: 0.45% Carbon steel

▶ Double sided H series chip breaker

CNMD / SNMD

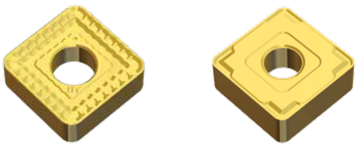
HT HD HY HZ



Top face Bottom face

■ Features
- Utilizes both sides to improve economy & cost reduction
- Offers a variety of sizes and chip breakers to meet customers specific heavy rough machining requirements
- Economy is further improved by using one tool holder for rough to finish machining

■ Guideline for finish machining
- Commence operation on finish machining first with the bottom face of insert
- Operate rough machining with the top face when required, after four corners of the bottom face are worn-out



Top face
Rough machining

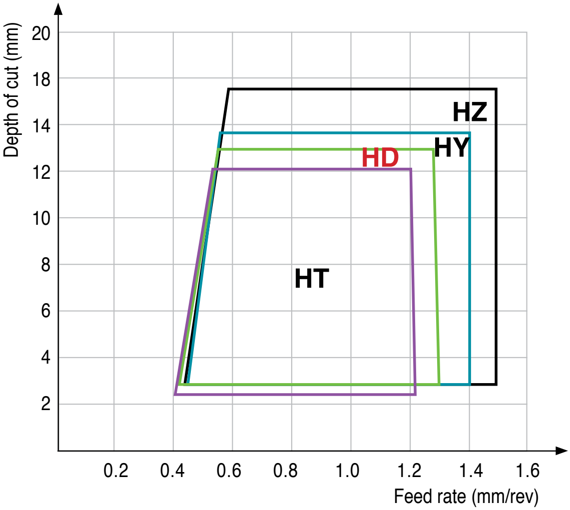
Bottom face
Finish machining

Storage

Bottom face

Top face

Chip breaking range

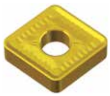


- Insert: CNMD 250924 HD
- Cutting speed: 100 m/min
- Material: 0.45% Carbon steel

The top face finish machining conditions

Details	Depth of cut (mm)	Feed rate (mm/rev)
Cutting condition	3.0 (2.0-5.0)	0.6 (0.4-0.8)

Chip breaking features

Chip breaker	Appearance	Features	Priority of performance		
			Chip-control	Cutting edge toughness	Cutting force
HT		• Low cutting force for low horse power machines • Excellent chip control due to changeable land and a flexible chip breaker	O		O
HD		• For all kinds of shafts, connecting-rods and ship building components • Flexible chip breaker offers excellent chip evacuation	O		O
HY		• For large depth of cut and high feed • Strong cutting edge credit to a wide land and large land angle	O	O	
HZ		• For large depth of cut and high feed • Extremely strong cutting edge credit to a wide land and large land angle • Suitable for high cutting conditions	O	O	

Double sided insert with 32mm cutting edge

■ Features
- The top face has a negative chip breaker type that is suitable for heavy machining
- The bottom face is designed to minimize the cutting load and break chips effectively when machining depths of cut less than 5mm
- Strong clamping force due to hooked lever system

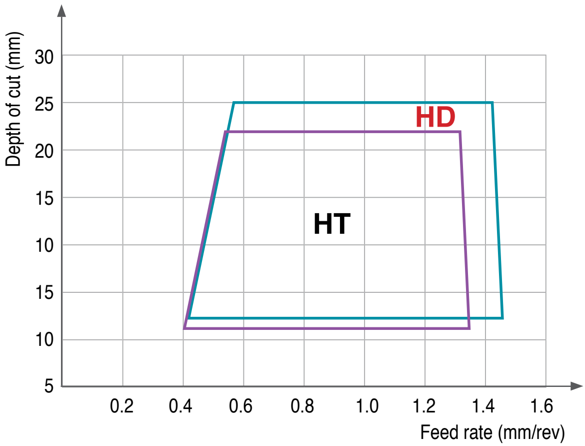
■ The top face (rough machining) conditions

Designation	Feed rate (mm/rev)	Depth of cut (mm)
SNMD 310924 HD	0.60 - 1.50	7.0 - 25.0
SNMD 310924 HT	0.50 - 1.40	6.0 - 22.0

■ The bottom face (finish machining) conditions

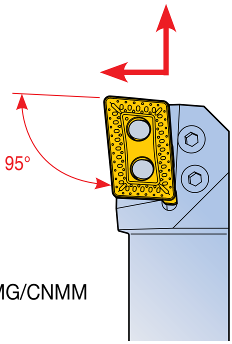
Details	Feed rate (mm/rev)	Depth of cut (mm)
Cutting condition	0.40 - 0.80	2.0 - 5.0

Chip breaking range (The top face rough machining range)



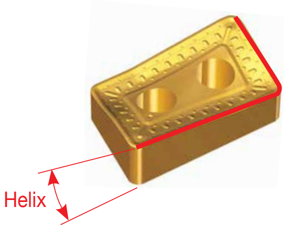
- Insert: SNMD 310924
- Cutting speed: 100 m/min
- Material: 0.45% Carbon steel

HX chip breaker



- 40mm helix cutting edge
  - Double lever clamping for maximum clamping stability
  - Unique geometry gives low cutting force
  - Enhanced productivity with 40mm cutting edge
  - Suitable for low-powered machines
  - Facing and external turning possible & available in R & L types

- Versatile usage
  - 80 degree corner angle allows it to be used for the same purpose as CNMG/CNMM
  - 95 degree entrance angle permits facing and external machining



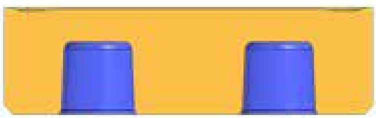
HD, HY chip breaker

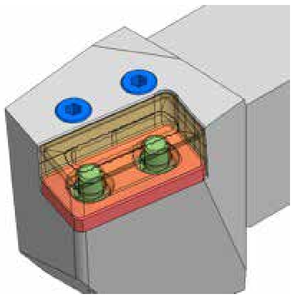
- 50mm cutting edge enables cutting up to 45mm depth of cut
- Rectilinear shaped cutting edge ideal for heavy roughing on high powered machines
- The HD insert is suitable for continuous machining and the HY insert is for interrupted operations

LNMX 501432 HY

LNMX 501432 HD

- Two blind holes and lever clamping system provide simple but strong clamping forces without lowering the rigidity of the insert

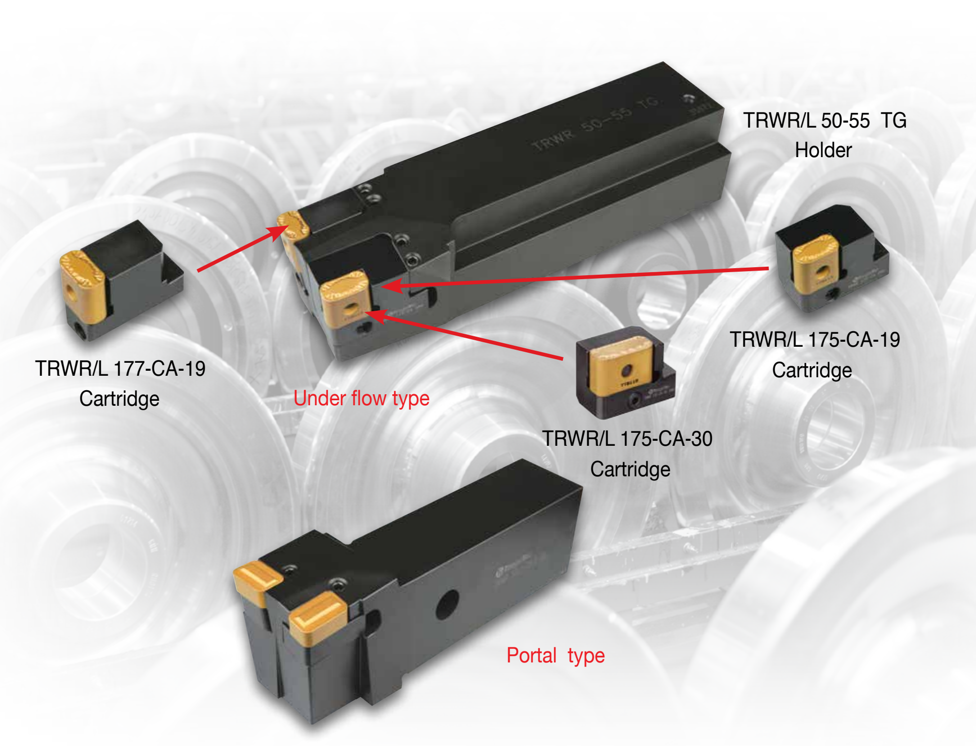




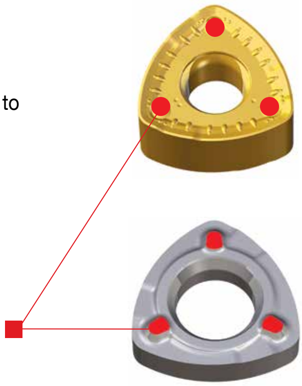
For rail wheel profiling

LNMX 30-TWR — For roughing
LNMX 30-TWM — For medium
LNMX 19-TWM
LNMX 19-TWF — For finishing
SSR-TX

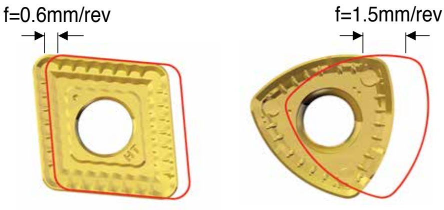
■ Features
- Tangential inserts are suitable for radius and rough machining of wheel profiles
- Economical and productive inserts are specified for individual cutting conditions
- Post assembly under floor lathe machining is possible via cartridge holders designed for easy assembly/disassembly



New HF chip breaker doubles your feed rate

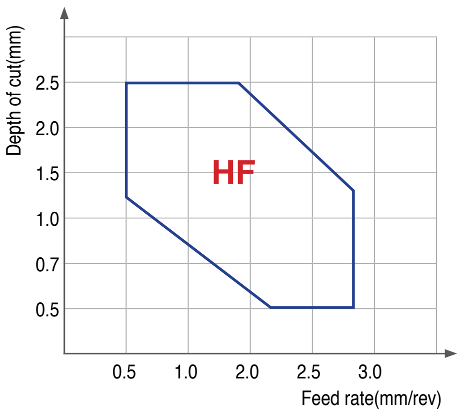


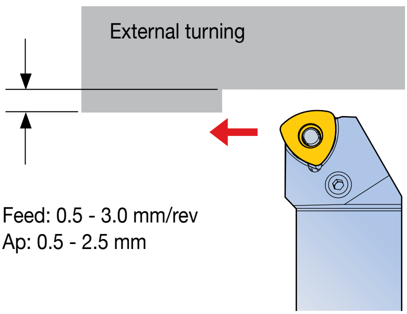
- Economical - Improved productivity with double-sided configuration
  - Employs double-sided structure with 6 cutting edges
  - Double-sided structure offers economical advantages when compared to competitors inserts
  - Remarkable feed rates achieve significant productivity improvements
- Optimized chip breaker geometry
  - Structure designed for high feed machining
  - Reduced cutting forces due to positive cutting edge
  - Prolonged tool life due to innovative cutting edge geometry
  - Clamping stability due to 3 dimensional shim design that differentiates from the competition
- Insert design has been configured for ultra high feed machining conditions
  - Maximum feed rate =3.0mm/rev , Maximum machining depth = 2.5mm



Feed rate = ISO Insert X 2.5 times
= same roughness

Chip breaking range: External turning





Feed: 0.5 - 3.0 mm/rev
Ap: 0.5 - 2.5 mm

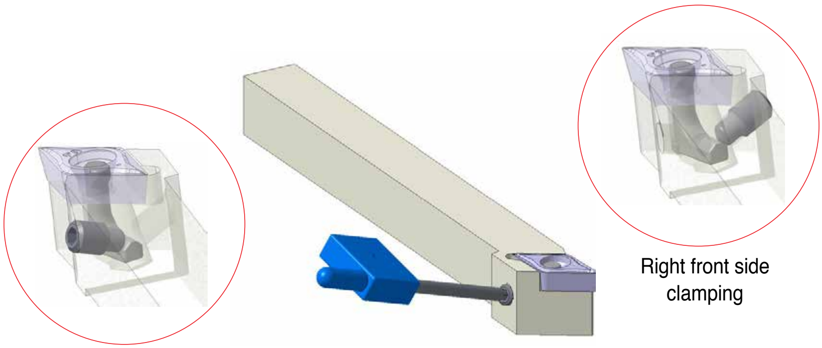
- Insert: BNMX 150720 R-HF
- Cutting speed: 150 m/min
- Material: 0.45% Carbon steel

SA chip breaker

- Ground positive ISO inserts for high precision turning
- High precision is guaranteed with the peripherally ground geometry
- Low cutting forces due to the dynamically inclined sharp cutting edge with a wide groove geometry

Back clamping holder

- Quick change holders for swiss type inserts
- Quick insert changeover with simple lever clamp design
- Both front and side clamping is available



Left front side clamping

Right front side clamping

Boring bars and inserts for small component machining

- New range of inserts and boring bars suitable for the turning of small workpieces

- TOPMINI insert
- Produced in two insert types - ground & pressed-to-size
- Micro size insert (IC=3.97, 4.76mm)

- TOPMINI boring bar
- Bore machining as small as 6mm diameter possible
- Special design near the joints ensures improved durability

Features

- Auto-centering and excellent durability due to detachable triangular shape anti-rotator
- Strong adjoining force and high precision even after repeated head exchange
- Internal coolant system
- ISO turning head
- Shank diameter size Ø25mm and Ø32mm

Modular head and shank

■ Various modular head type

e.g.)

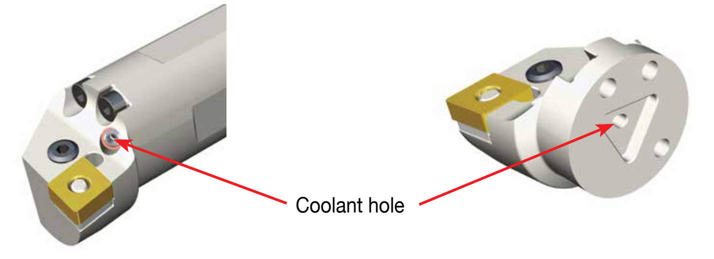
HE-PCLNR/L

HE-PDUNR/L

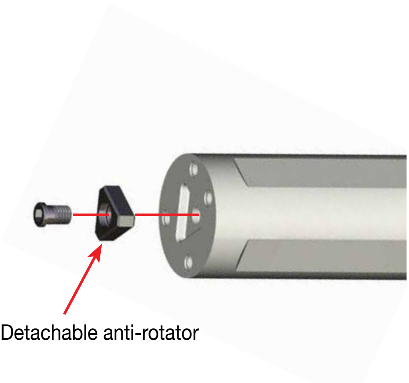
HE-SCLCR/L

HE-SDUCR/L

■ Internal coolant system



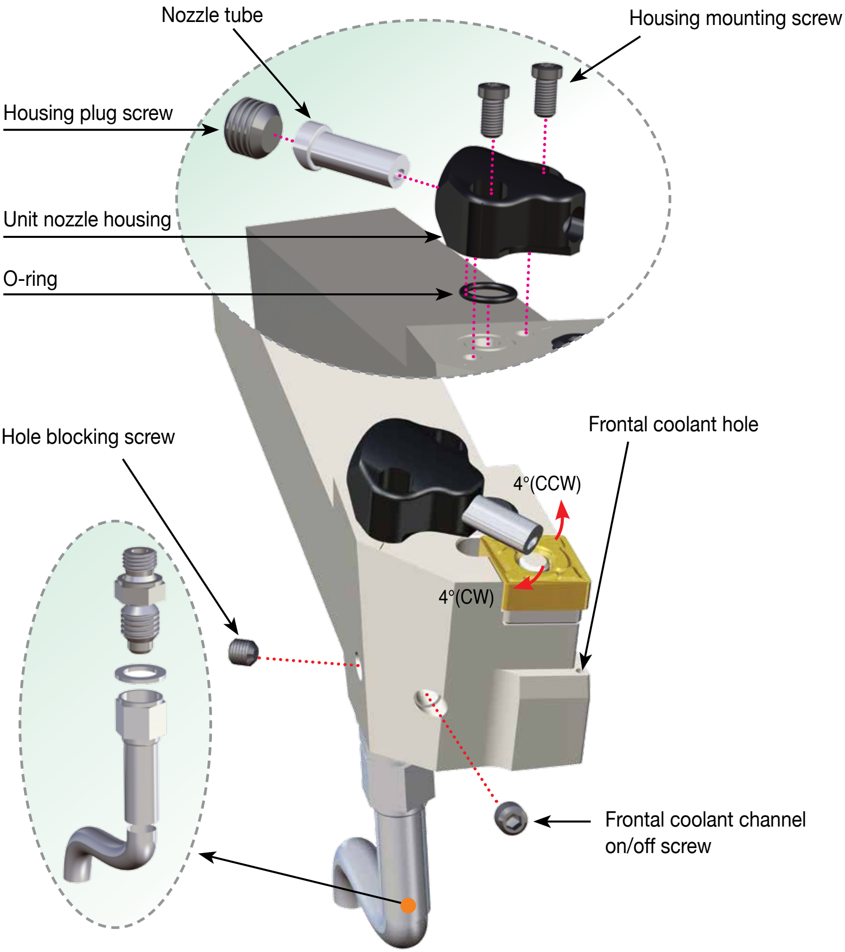
■ Shank



Features

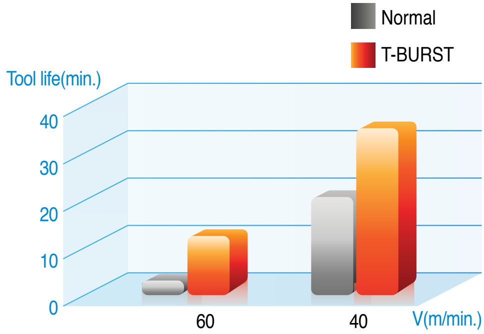
- Effective cooling down of the cutting edge
- Excellent chip control
- Increased tool life when machining titanium, heat resistant and alloy steel
- Can be used with RHINORUSH holder
- Nice performance on difficult-to-cut materials such as titanium, inconel and other heat resistant alloys

Component designation



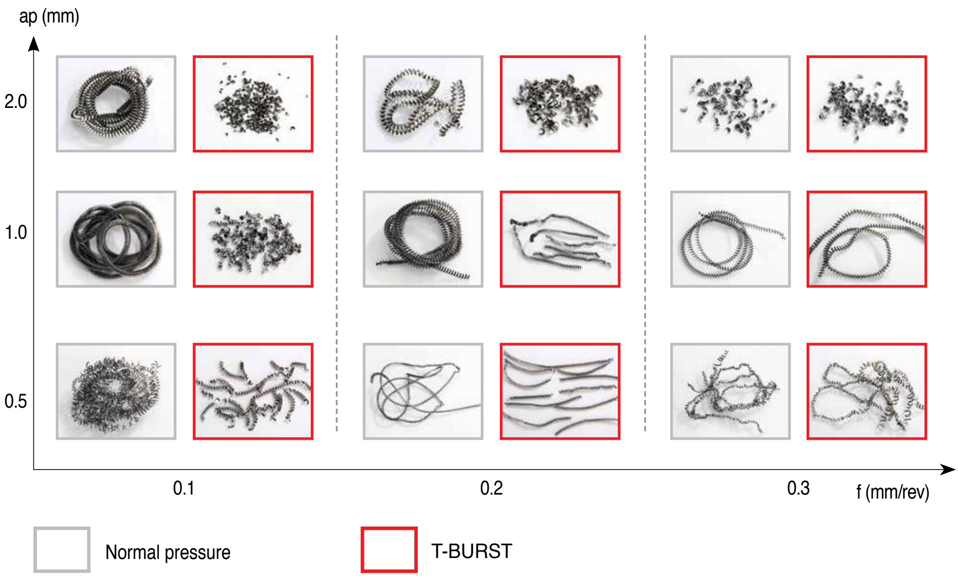
Tool life test between normal pressure & T-BURST

Workpiece material	Inconel 718
Feed rate(f)	0.2 mm/rev
Depth of cut(ap)	2.0 mm
Operation	Ext, Wet
TaeguTec	CNMG 120408 MP TT5080
Test coolant pressure	69 bar



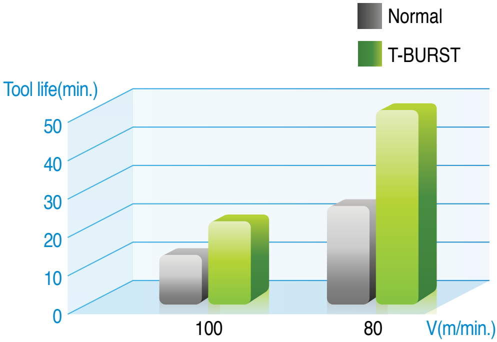
Chip breaking test between normal pressure & T-BURST

- V=60m/min



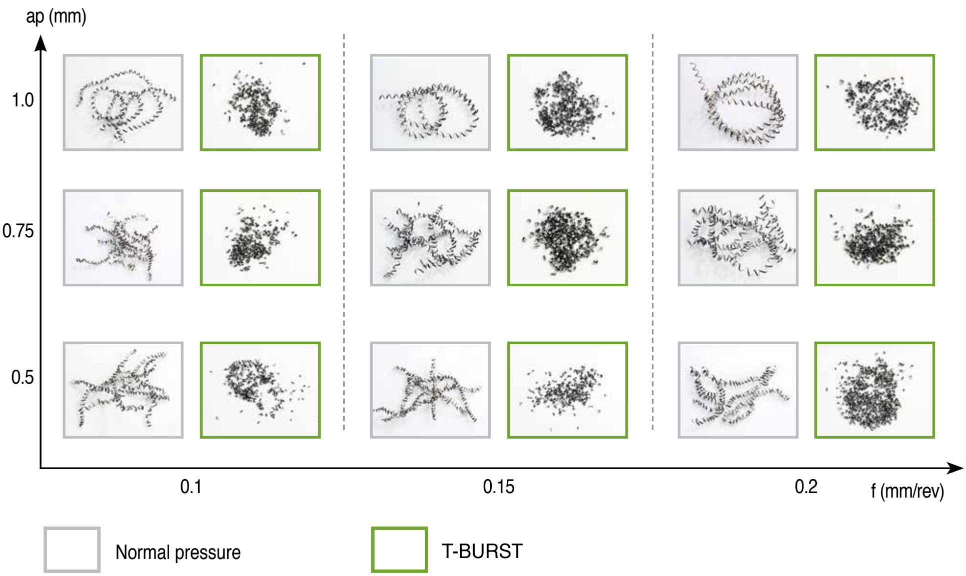
Tool life test between normal pressure & T-BURST

Workpiece material	Ti-6Al-4V
Feed rate(f)	0.15 mm/rev
Depth of cut(ap)	1.0 mm
Operation	Ext, Wet
TaeguTec	CNMG 120408 MP K10
Test coolant pressure	69 bar

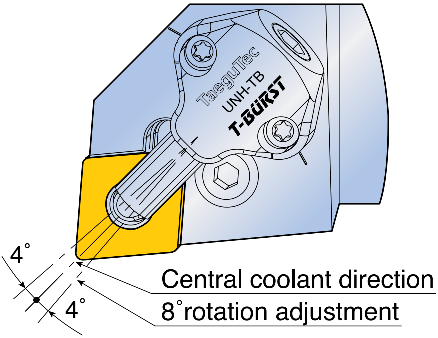


Chip breaking test between normal pressure & T-BURST

- V=100m/min



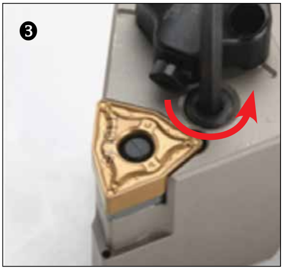
The housing unit can be rotated total 8°(4°: CW+4°: CCW) for adjustment



Insert indexing

Push the telescopic tube backward

Push the telescopic tube backward

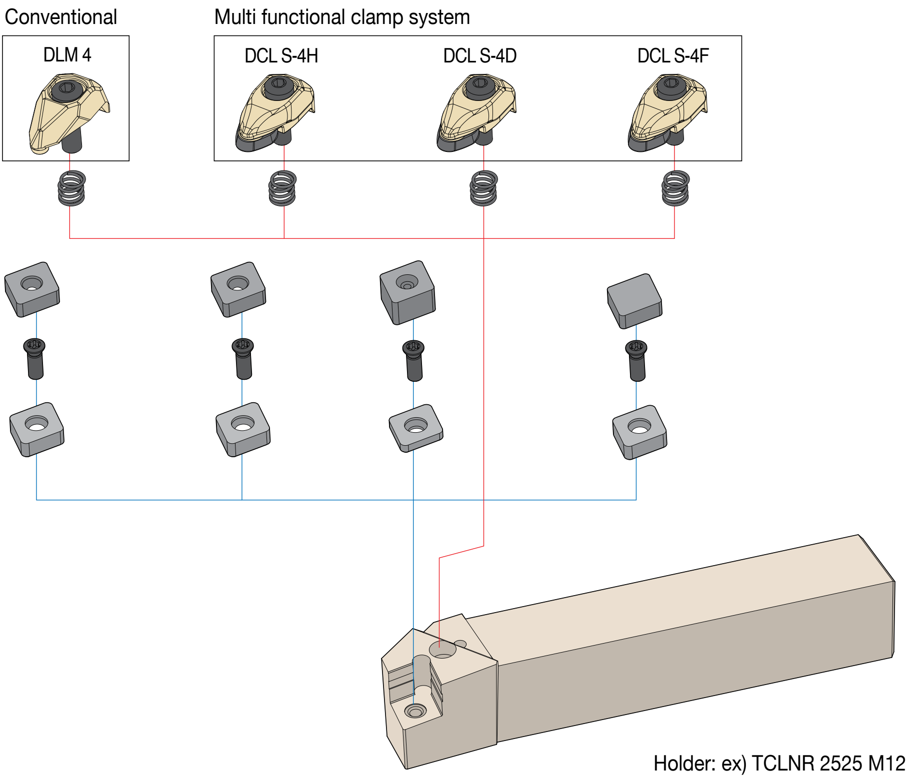


Using the screwdriver, turn counterclockwise to loosen the lever screw

Take out the insert

Features

- Compatibility: Applicable to the existing T-holders when clamp is changed
- Versatility: 3 different insert types for one T-holder
- Durability: The new carbide clamp shows better wear resistance compared to existing cast iron machining applications
- Stability: Due to the gap adjusting structure in the insert's contact area, it proves much stronger with a stable joint force
- Efficient inventory control: Less inventory required



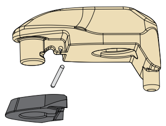
- Existing T-Holder is available only if changing each clamp type
- 3 types of Insert can be mounted in the same tool holder

New clamp for multifunction DCL type

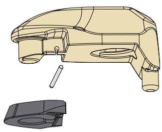
- The existing T-holder is only available if changing each type of clamp

Insert & clamp combination		
		
DCL S-4H	DCL S-4D	DCL S-4F
		
CN...A 1204 Insert with hole type	CN...X 1207 Insert with TaeguTec dimple type	CN...N 1204 Insert with flat type

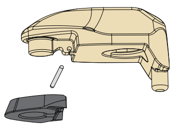
- New clamp for multifunction



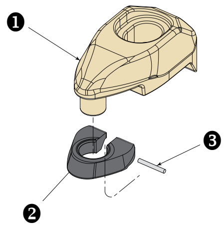
DCL S-4H

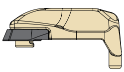
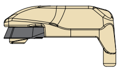
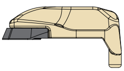


DCL S-4D

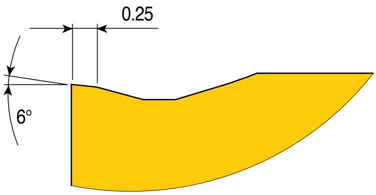


DCL S-4F



Clamp	Designation	Components			Insert	Shim
		❶ Clamp	❷ CTC plate	❸ PIN		
	DCL S-4H	DCL 4H	DCL 4-PL	PIN 0683	CN...A 1204	TSC 44
					DN...A 1504	TSD 44
					DN...A 1506	TSD 43
					SN...A 1204	TSS 44
	DCL S-4D	DCL 4D	DCL 4-PL	PIN 0683	CN...X 1207 CH	TSC 42
					DN...X 1507 CH	TSD 42
					SN...X 1207 CHX	TSS 42
	DCL S-4F	DCL 4F	DCL 4-PL	PIN 0683	CN...N 1204	TSC 44
					CN...N 1207	TSC 42
					DN...N 1504	TSD 44
					DN...N 1507	TSD 42
					SN...N 1204	TSS 44
					SN...N 1207	TSS 42

GU - General machining

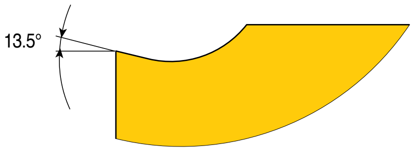


Cutting edge geometry

Main grades:
TT1300, TT3500

GU is designed for general machining in various materials such as steel, alloy steel and cast iron. Its 6 degrees top rake angle is very secure and shows good performance in medium to roughing application.

SU - Exotic materials



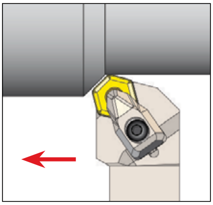
Cutting edge geometry

Main grades:
TT5100, TT5080

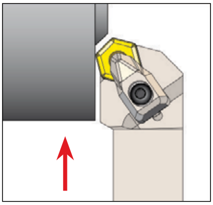
SU is designed for exotic materials machining such as Inconel. Its very sharp geometry reduces built-up-edges created while machining. The very smooth chipbreaker shape delivers chip control in sticky material and reduces crater wear.
When combined with the T-holder, the 45 degree entering angle helps reduce notch wear which is one of the worst effects in difficult-to-cut material machining.

User guide

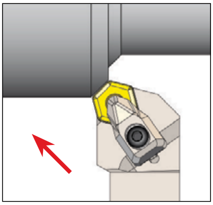
- HEX-TURN Insert with 12 cutting edges is an economical solution that cover facing, external turning, chamfering operations
- HEX-TURN Insert with 120 degree include angle has better corner strength than 90 degree SNMG type insert and can perform all operations possible with PSBNR/L, PSDNN & PSKNR holders of SNMG type insert for facing and external turning



External turning

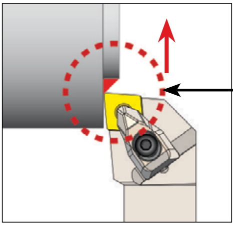


Facing



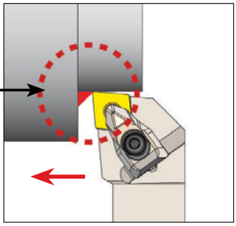
Chamfering

- When turning to a shoulder with HEX-TURN insert, the remaining stock(45 degree chamfer) can be easily removed using CNMG or WNMG ISO turning insert in a short time as shown below



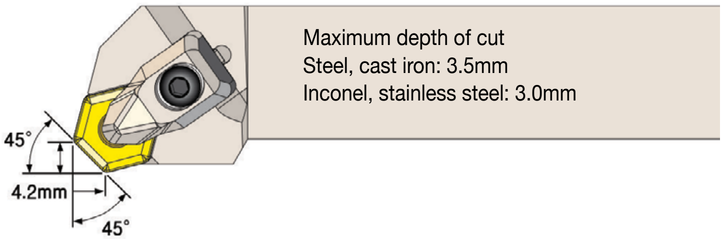
TCLNR

45 degree of chamfer
remaining area after
machining with HEX-TURN



TCLNR

- Length of cutting edge & maximum depth of cut



Machining of Cast Iron Turning Application

Machining of cast iron turning application

■ Grade selection by workpiece material ● Gray cast iron (HB180 - 220) ● Ductile cast iron (HB200 - 240)

Workpiece condition	Grades											
	TB670	KB90A	TB730	AW120	AB30	AS500	SC10	AS10	PV3010	CT3000	TT7005	TT7015
Scale and severe interruption	●	●	●			●		● ●			●	● ●
Scale and light interruption	●	●	●		● ●	● ●	● ●	● ●			● ●	● ●
No scale, continuous cut	●	●	●	●	● ●	● ●	●	●	● ●	● ●	● ●	●

■ Recommended cutting parameters

Materials	Grades											
	TB670	KB90A	TB730	AW120	AB30	AS500	SC10	AS10	PV3010	CT3000	TT7005	TT7015
	Cutting speed (m/min), Feed rate (mm/rev)											
Gray cast iron (HB180 - 220)		800-1200 0.1-0.5	800-200 0.1-0.3	400-1000 0.07-0.2	300-800 0.1-0.25	400-1000 0.2-0.6	300-1000 0.2-0.6	300-800 0.2-0.6	100-350 0.1-0.25	100-300 0.1-0.25	150-450 0.1-0.7	100-300 0.1-0.7
Ductile cast iron (HB200 - 240)	200-500 0.05-0.2				250-500 0.05-0.2	200-600 0.1-0.5	250-600 0.2-0.6	250-500 0.2-0.6	100-300 0.1-0.25	100-250 0.1-0.25	120-350 0.1-0.5	100-250 0.1-0.5

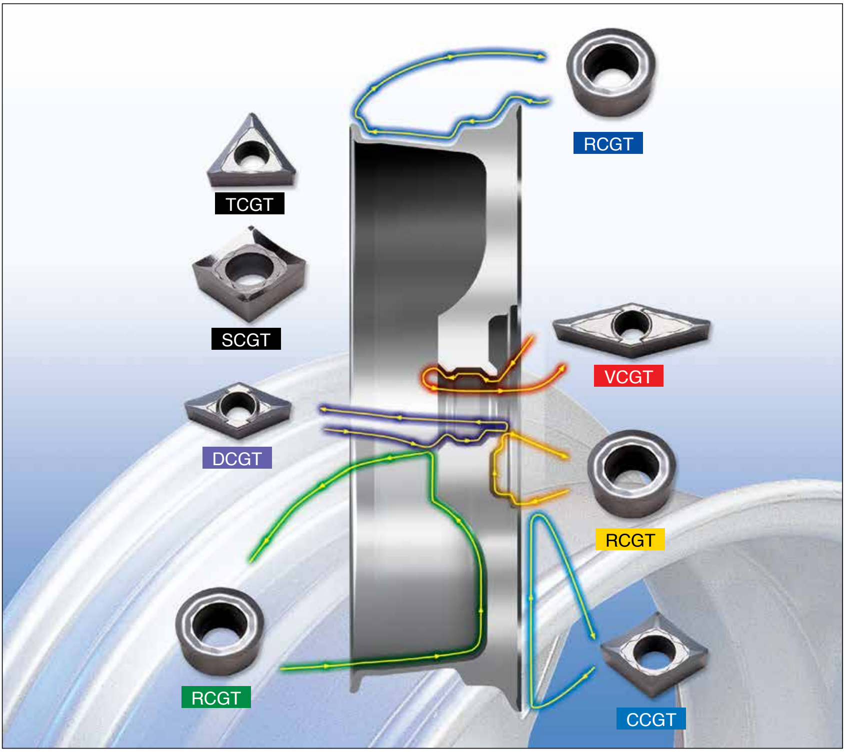
■ Chip breaker and grade selection by workpiece material (Gray cast iron)

Workpiece condition	Depth of cut	Chip breaker/Grade Recommended cutting conditions (V,f)				
Roughing (Scale & severe interruption)	4.0-6.0	KT/TT7005 300, 0.4	KT/TT7015 240, 0.4			
	6.0-	KT/TT7005 270, 0.4	KT/TT7015 220, 0.4			
Medium (Scale & light interruption)	1.0-2.5	- NMN/KB90A 760, 0.3	- NMN/KB90A 760, 0.3	- NGA/AS500 540, 0.35	MT/TT7005 360, 0.35	RT/TT7005 320, 0.4
	2.5-4.0	- NMN/KB90A 720, 0.35	- NGA/AS10 540, 0.35	RT/TT7005 300, 0.4		
Finishing (No scale & continuous cutting)	-1.0	- NMN/KB90A 800, 0.2	- NGA/AW120 800, 0.2	NGA/AB30 700, 0.2	NGA/AS500 600, 0.25	MT/TT7005 400, 0.25

■ Chip breaker and grade selection by workpiece material (Ductile cast iron)

Workpiece condition	Depth of cut	Chip breaker/Grade Recommended cutting conditions (V,f)				
Roughing (Scale & severe interruption)	4.0-6.0	KT/TT7015 225, 0.4				
	6.0-	KT/TT7015 210, 0.4				
Medium (Scale & light interruption)	1.0-2.5	- NMA/TB670 500, 0.2	- NGA/AB30 470, 0.2	MT/TT7005 305, 0.3	RT/TT7005 270, 0.35	
	2.5-4.0	- NGA/AS10 440, 0.3	MT/TT7015 260, 0.35	RT/TT7015 235, 0.35		
Finishing (No scale & continuous cutting)	-1.0	- NMA/TB670 550, 0.2	- NGA/AB30 520, 0.2	MT/TT7005 320, 0.2	MT/PV3010 320, 0.2	MT/CT3000 290, 0.2

Insert selection for aluminum alloy machining



FL chip breaker

- Wide range of applications for aluminum and other non-ferrous materials
- Very high positive rake geometry to minimize cutting forces and built-up edges

Machining conditions with K10 grade

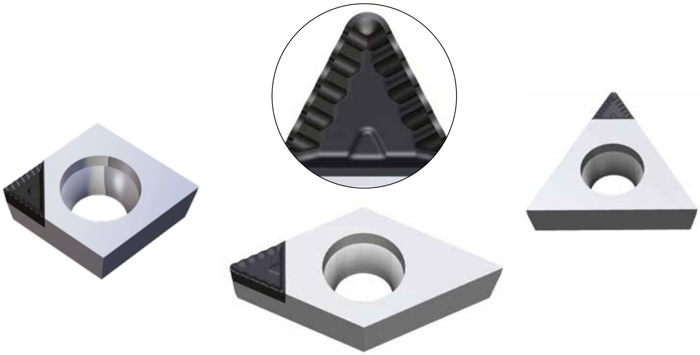
Materials		Hardness brinell (HB)	Kc (N/mm2)	Vc (m/min)	f (mm/rev)
Aluminum alloys (Forged)	Unhardened	50-70	500-600	2500-1000	0.1-0.6
	Hardened	90-110	700-900	1000-300	0.1-0.5
Aluminum alloys (Cast)	Unhardened	70-80	700-800	1000-300	0.1-0.5
	Hardened	80-100	800-950	600-200	0.1-0.4
Copper alloys		90-110	700	600-250	0.1-0.5
Bronze		100	1700	300-150	0.1-0.6

ML chip breaker

- Double sided negative ground insert
- Sharp positive cutting edge provides low cutting forces
- Improved surface quality and extended tool life in aluminum machining applications
- Sharp cutting edge minimizes built-up-edge

CB PCD chip breaker insert

- Serrated cutting edge ensures maximum chip control and low cutting resistance that performs remarkably well even in low depth of cut and low feed
- Unique cutting edge geometry guarantees excellent chipping resistance



Insert geometry by workpiece shape

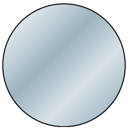
Workpiece shapes

Cutting edge strength

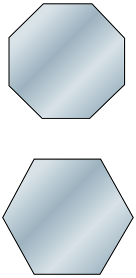
Chip breaker recommendation in medium to rough machining

Sharp ← → Strong

ML·MP·PC·MT·MC·MG-·RT

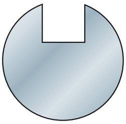


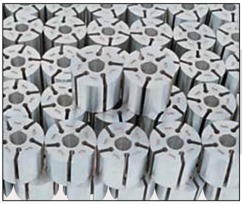
ML MP PC MT



MT PC MP MC

MC MT PC MG-





RT MC MG- MT

Severe interrupted cutting

Strong geometry required

Insert selection by workpiece materials

- Recommended cutting conditions

Insert style N : Negative inserts P : Positive inserts

Application F : Finishing M : Medium R : Roughing

Depth of cut (mm)

Workpiece, stability and machine condition

- Best: no scale, no interruption, good rigidity
- Normal: a little scale, a little interruption, good rigidity
- Poor: heavy scale, severe interruptions, poor rigidity

First and second choice grade, chip breaker, cutting speed & feed rate in mm/rev

					Workpiece material											
					0.15% Carbon steel (HB ≒ 150)				0.45% Carbon steel (HB180 - 200)				0.55% Carbon steel (HB200 - 220)			
N	F	- 1.0	Best	1	PV3010	FC	475	0.12	PV3010	FG	355	0.15	PV3010	FG	330	0.15
				2	CT3000	FC	430	0.12	TT8115	FG	340	0.15	TT8115	FG	315	0.15
	M	1.0 - 2.5	Best	1	TT5100	ML	330	0.20	TT8115	MP	330	0.30	TT8115	MP	305	0.30
				2	TT8125	ML	420	0.20	TT8125	MP	300	0.30	TT8125	MP	280	0.30
			Normal	1	TT5100	MP	315	0.24	TT8115	PC	310	0.30	TT8115	PC	290	0.30
				2	TT8125	MP	400	0.24	TT8125	PC	280	0.30	TT8125	PC	260	0.30
			Poor	1	TT8020	MT	235	0.24	TT8135	RT	190	0.32	TT8135	RT	180	0.32
				2												
		2.5 - 4.0	Best	1	TT5100	PC	300	0.28	TT8115	PC	310	0.35	TT8115	MP	290	0.35
				2	TT8125	PC	385	0.28	TT8125	PC	280	0.35	TT8125	PC	260	0.35
			Normal	1	TT5100	MT	285	0.28	TT8125	PC	280	0.35	TT8125	MT	260	0.35
				2	TT8125	MT	370	0.28	TT8125	MT	265	0.40	TT8125	MG-	245	0.40
			Poor	1	TT8020	MT	215	0.24	TT8135	RT	180	0.36	TT8135	RT	180	0.36
				2												
	R	4.0 - 7.0	Normal	1	TT5100	RT	230	0.45	TT8125	RT	260	0.56	TT8125	RT	240	0.56
				2	TT8125	RT	320	0.45	TT8115	RT	290	0.56	TT8135	RT	270	0.56
			Poor	1	TT8020	RT	180	0.36	TT8135	RT	180	0.45	TT8135	RT	160	0.45
				2												
		7.0 -	Normal	1	TT5100	RH	210	0.57	TT8125	RH	245	0.71	TT8125	RH	225	0.71
				2												
			Poor	1	TT8020	RH	165	0.46	TT8135	RH	165	0.57	TT8135	RH	150	0.57
				2												
P	F	- 1.0	Best	1	PV3010	FG	475	0.12	PV3010	FG	355	0.15	PV3010	FG	330	0.15
				2	CT3000	FG	420	0.12	CT3000	FG	315	0.15	CT3000	FG	295	0.15
	M	1.0 - 3.5	Best	1	TT5100	MT	285	0.17	TT8115	MT	310	0.20	TT8115	MT	285	0.20
				2	TT8125	MT	370	0.17	TT8125	MT	280	0.20	TT8125	MT	255	0.20
			Normal	1	TT5100	MT	275	0.17	TT8125	MT	280	0.20	TT8125	MT	255	0.20
				2	TT8125	MT	350	0.17	TT5100	MT	215	0.20	TT5100	MT	195	0.20
			Poor	1	TT8020	MT	220	0.17	TT8135	MT	190	0.20	TT8135	MT	180	0.20
				2												

▶ Insert selection by workpiece materials

■ Recommended cutting conditions

Insert style N: Negative inserts P: Positive inserts

Application F : Finishing M : Medium R : Roughing

Depth of cut (mm)

Workpiece, stability and machine condition

- Best: no scale, no interruption, good rigidity
- Normal: a little scale, a little interruption, good rigidity
- Poor: heavy scale, severe interruptions, poor rigidity

First and second choice grade, chip breaker, cutting speed & feed rate in mm/rev

					Workpiece material											
					Low carbon (0.13 - 0.18%) Alloy steel (HB150 - 180)				Cr-Mo alloy steel (HB200 - 220)				Ni-Cr-Mo alloy steel (HB200 - 220)			
N	F	- 1.0	Best	1	PV3010	FC	420	0.12	PV3010	FG	330	0.15	PV3010	FG	320	0.15
				2	CT3000	FC	380	0.12	TT8115	FG	315	0.15	TT8115	FG	305	0.15
	M	1.0 - 2.5	Best	1	TT5100	ML	295	0.20	TT8115	MP	305	0.30	TT8115	MP	295	0.30
				2	TT8125	ML	375	0.20	TT8125	MP	280	0.30	TT8125	MP	270	0.30
			Normal	1	TT5100	PC	285	0.24	TT8115	PC	290	0.30	TT8115	PC	280	0.30
				2	TT8125	PC	365	0.24	TT8125	MC	260	0.30	TT8125	PC	250	0.30
			Poor	1	TT8020	MT	205	0.24	TT8135	RT	180	0.32	TT8135	RT	170	0.32
				2												
		2.5 - 4.0	Best	1	TT5100	PC	265	0.28	TT8115	PC	290	0.35	TT8115	PC	280	0.35
				2	TT8125	PC	340	0.28	TT8125	PC	260	0.35	TT8125	PC	250	0.35
			Normal	1	TT5100	MT	255	0.28	TT8125	MT	260	0.35	TT8125	MT	250	0.35
				2	TT8125	MT	315	0.28	TT8125	MG-	245	0.40	TT8125	MG-	240	0.40
			Poor	1	TT8020	MT	190	0.24	TT8135	RT	180	0.36	TT8135	RT	170	0.36
				2												
	R	4.0 - 7.0	Normal	1	TT5100	RT	205	0.45	TT8125	RT	240	0.56	TT8125	RT	235	0.56
				2	TT8125	RT	250	0.45	TT8115	RT	270	0.56	TT8115	RT	260	0.56
			Poor	1	TT8020	RT	160	0.36	TT8135	RT	160	0.45	TT8135	RT	160	0.45
				2												
		7.0 -	Normal	1	TT5100	RH	185	0.57	TT8125	RH	225	0.71	TT8125	RH	220	0.71
				2						RT	225	0.64	TT8125	RT	220	0.64
			Poor	1	TT8020	RH	150	0.46	TT7100	RH	140	0.57	TT8135	RH	150	0.57
				2												
P	F	- 1.0	Best	1	PV3010	FG	420	0.12	PV3010	FG	330	0.15	PV3010	FG	320	0.15
				2	CT3000	FG	380	0.12	CT3000	FG	295	0.15	CT3000	FG	285	0.15
	M	1.0 - 3.5	Best	1	TT5100	MT	265	0.17	TT8115	MT	285	0.20	TT8115	MT	275	0.20
				2	TT8125	MT	345	0.17	TT8125	MT	255	0.20	TT8125	MT	250	0.20
			Normal	1	TT5100	MT	255	0.17	TT8125	MT	255	0.20	TT8125	MT	250	0.20
				2	TT8125	MT	330	0.17	TT5100	MT	195	0.20	TT5100	MT	190	0.20
			Poor	1	TT8020	MT	205	0.17	TT8135	MT	180	0.20	TT8135	MT	170	0.20
				2												

Insert selection by workpiece materials

■ Recommended cutting conditions

Insert style N : Negative inserts P : Positive inserts

Application F : Finishing M : Medium R : Roughing

Depth of cut (mm)

Workpiece, stability and machine condition

- Best: no scale, no interruption, good rigidity
- Normal: a little scale, a little interruption, good rigidity
- Poor: heavy scale, severe interruptions, poor rigidity

First and second choice grade, chip breaker, cutting speed & feed rate in mm/rev

					Workpiece material											
					Bearing steel (HB200 - 220)				Carbon tool steel (HB200 - 220)				Alloy tool steel (HB200 - 220)			
N	F	- 1.0	Best	1	PV3010	FG	330	0.15	PV3010	FG	330	0.15	PV3010	FG	320	0.15
				2	TT8115	FG	315	0.15	TT8115	FG	315	0.15	TT8115	FG	305	0.15
	M	1.0 - 2.5	Best	1	TT8115	MP	305	0.30	TT8115	MP	305	0.30	TT8115	MP	295	0.30
				2	TT8125	MP	280	0.30	TT8125	MP	280	0.30	TT8125	MP	250	0.30
			Normal	1	TT8115	PC	290	0.30	TT8115	PC	290	0.30	TT8115	PC	280	0.30
				2	TT8125	PC	260	0.30	TT8125	PC	260	0.30	TT8125	PC	250	0.30
			Poor	1	TT8135	RT	180	0.32	TT8135	RT	180	0.32	TT8135	RT	170	0.32
				2												
		2.5 - 4.0	Best	1	TT8115	PC	290	0.35	TT8115	MT	290	0.35	TT8115	PC	280	0.35
				2	TT8125	PC	260	0.35	TT8125	MT	260	0.35	TT8125	PC	250	0.35
			Normal	1	TT8125	MT	260	0.35	TT8125	MT	260	0.35	TT8125	MT	250	0.35
				2	TT8125	MG-	245	0.40	TT8125	MG-	245	0.40	TT8125	MG-	240	0.40
			Poor	1	TT8135	RT	180	0.36	TT8135	RT	180	0.36	TT8135	RT	170	0.36
				2												
	R	4.0 - 7.0	Normal	1	TT8125	RT	240	0.56	TT8125	RT	240	0.56	TT8125	RT	235	0.56
				2	TT8115	RT	270	0.56	TT8115	RT	270	0.56	TT8115	RT	260	0.56
			Poor	1	TT8135	RT	160	0.45	TT8135	RT	160	0.45	TT8135	RT	140	0.45
				2												
		7.0 -	Normal	1	TT8125	RH	225	0.71	TT8125	RH	225	0.71	TT8115	RH	220	0.71
				2												
			Poor	1	TT8135	RH	150	0.57	TT8135	RH	150	0.57	TT8135	RH	140	0.57
				2												
P	F	- 1.0	Best	1	PV3010	FG	330	0.15	PV3010	FG	330	0.15	PV3010	FG	320	0.15
				2	CT3000	FG	295	0.15	CT3000	FG	295	0.15	CT3000	FG	285	0.15
	M	1.0 - 3.5	Best	1	TT8115	MT	285	0.20	TT8115	MT	285	0.20	TT8115	MT	275	0.20
				2	TT8125	MT	255	0.20	TT8125	MT	255	0.20	TT8125	MT	250	0.20
			Normal	1	TT8125	MT	255	0.20	TT8125	MT	255	0.20	TT8125	MT	250	0.20
				2	TT5100	MT	195	0.20	TT5100	MT	195	0.20	TT5100	MT	190	0.20
			Poor	1	TT8135	MT	180	0.20	TT8135	MT	180	0.20	TT8135	MT	170	0.20
				2												

Insert selection by workpiece materials

■ Recommended cutting conditions

Insert style N : Negative inserts P : Positive inserts

Application F : Finishing M : Medium R : Roughing

Depth of cut (mm)

Workpiece, stability and machine condition

- Best: no scale, no interruption, good rigidity
- Normal: a little scale, a little interruption, good rigidity
- Poor: heavy scale, severe interruptions, poor rigidity

First and second choice grade, chip breaker, cutting speed & feed rate in mm/rev

Insert style	Application	Depth of cut	Condition	Choice	Workpiece material											
					High speed steel (HB220 - 260)				Cold working die steel (HB220 - 260)				Hard material (40≦HRC)			
N	F	- 1.0	Best	1	PV3010	FG	230	0.10	TT8115	FG	240	0.14	AB2010		120	0.10
				2	CT3000	FG	210	0.10	TT8125	FG	210	0.14	TB610		120	0.10
	M	1.0 - 2.5	Best	1	TT5080	ML	180	0.15	TT8115	MP	230	0.28	AB2010		120	0.15
				2	TT5100	ML	160	0.15	TT8125	MP	210	0.28	TB670		120	0.15
			Normal	1	TT5080	MP	170	0.20	TT8115	PC	215	0.28	AB20		100	0.15
				2	TT5100	MP	150	0.20	TT8125	PC	195	0.28	TB730		100	0.15
			Poor	1	TT5100	MT	135	0.25	TT8135	RT	130	0.29	AB30		80	0.10
				2									KB90A		80	0.10
		2.5 - 4.0	Best	1	TT5080	MP	170	0.20	TT8115	PC	215	0.32	AB20		100	0.15
				2	TT5100	MP	145	0.20	TT8125	PC	195	0.32	KB90A		100	0.15
			Normal	1	TT5080	MT	160	0.25	TT8125	MT	175	0.32	AB20		100	0.15
				2	TT5100	MT	135	0.25	TT8125	MG-	185	0.37	KB90A		100	0.15
			Poor	1	TT8135	RT	140	0.25	TT8135	RT	130	0.33	AB30		80	0.10
				2									KB90A		80	0.10
	R	4.0 - 7.0	Normal	1					TT8125	RT	180	0.52				
				2					TT8115	RT	205	0.52				
			Poor	1					TT8135	RT	125	0.41				
				2												
		7.0 -	Normal	1					TT8125	RH	170	0.65				
				2												
			Poor	1					TT8135	RH	115	0.52				
				2												
P	F	- 1.0	Best	1	PV3010	FG	230	0.10	PV3010	FG	250	0.14	TB670		150	0.10
				2	CT3000	FG	210	0.10	CT3000	FG	225	0.14	AB20		120	0.10
	M	1.0 - 3.5	Best	1	TT5080	MT	165	0.15	TT8115	MT	215	0.18	TB670		150	0.12
				2	TT5100	MT	145	0.15	TT8125	MT	195	0.18	AB20		120	0.12
			Normal	1	TT5080	MT	160	0.15	TT8125	MT	215	0.18	AB20		100	0.12
				2	TT5100	MT	140	0.15	TT5100	MT	195	0.18	TB670		100	0.12
			Poor	1	TT8135	MT	135	0.15	TT8135	MT	160	0.18	AB30		80	0.08
				2									KB90A		80	0.08

Insert selection by workpiece materials

■ Recommended cutting conditions

Insert style N : Negative inserts P : Positive inserts

Application F : Finishing M : Medium R : Roughing

Depth of cut (mm)

Workpiece, stability and machine condition

- Best: no scale, no interruption, good rigidity
- Normal: a little scale, a little interruption, good rigidity
- Poor: heavy scale, severe interruptions, poor rigidity

First and second choice grade, chip breaker, cutting speed & feed rate in mm/rev

					Workpiece material							
					Martensitic/Ferritic Stainless steel (HB180 - 200)				Austenitic stainless steel (HB180 - 200)			
N	F	- 1.0	Best	1	PV3010	SF	330	0.12	PV3010	SF	265	0.12
				2	TT9215	EA	260	0.12	TT9215	EA	210	0.12
	M	1.0 - 2.5	Best	1	TT9215	EM	230	0.20	TT9215	EM	200	0.20
				2								
			Normal	1	TT9225	EM	210	0.24	TT9225	EM	185	0.24
				2	TT9235	MP	180	0.24	TT9235	MP	145	0.24
			Poor	1	TT9235	MT	170	0.24	TT9235	MT	135	0.24
				2								
		2.5 - 4.0	Best	1	TT9225	EM	200	0.24	TT9225	EM	160	0.24
				2								
			Normal	1	TT9225	MP	190	0.28	TT9225	MP	150	0.28
				2	TT9235	MT	165	0.28	TT9235	MT	135	0.28
			Poor	1	TT9235	MT	165	0.24	TT9235	MT	125	0.24
				2								
	R	4.0 - 7.0	Normal	1	TT9225	ET	170	0.45	TT9225	ET	130	0.45
				2								
			Poor	1	TT9235	ET	150	0.36	TT9235	ET	110	0.36
				2								
		7.0 -	Normal	1	TT9225	RX	160	0.64	TT9225	RX	120	0.64
				2								
			Poor	1	TT9235	RX	135	0.55	TT9235	RX	100	0.55
				2								
P	F	- 1.0	Best	1	PV3010	FG	330	0.12	PV3010	FG	265	0.12
				2	TT9215	FG	270	0.12	TT9215	FG	220	0.12
	M	1.0 - 3.5	Best	1	TT9225	PC	195	0.17	TT9225	PC	160	0.17
				2								
			Normal	1	TT9225	PC	185	0.17	TT9225	PC	150	0.17
				2	TT9235	MT	160	0.17	TT9235	MT	130	0.17
			Poor	1	TT9235	MT	150	0.17	TT9235	MT	120	0.17
				2								

Insert selection by workpiece materials

■ Recommended cutting conditions

Insert style **N** : Negative inserts **P** : Positive inserts
Application F : Finishing M : Medium R : Roughing
Depth of cut (mm)
Workpiece, stability and machine condition
- Best: no scale, no interruption, good rigidity
- Normal: a little scale, a little interruption, good rigidity
- Poor: heavy scale, severe interruptions, poor rigidity

First and second choice grade, chip breaker, cutting speed & feed rate in mm/rev

					Workpiece material							
					Ni based super alloy				Titanium alloy Ti-6Al-4V			
N	F	- 1.0	Best	1	TC430		250	0.15	TT5080	EA	100	0.15
				2	TT5080	EA	60	0.15				
	M	1.0 - 2.5	Best	1	TC430		250	0.15	TT5080	EM	90	0.20
				2	TT5080	EM	60	0.20				
			Normal	1	TT5080	MP	50	0.20	TT5080	MP	80	0.20
				2								
			Poor	1	TT8020	MT	35	0.20	TT8020	MT	50	0.20
				2								
		2.5 - 4.0	Best	1	TT5080	EM	50	0.20	TT5080	EM	80	0.20
				2								
			Normal	1	TT5080	MP	45	0.20	TT5080	MP	70	0.20
				2								
			Poor	1	TT8020	MT	30	0.20	TT8020	MT	45	0.20
				2								
	R	4.0 - 7.0	Normal	1	TT5080	ET	40	0.20	TT5080	ET	60	0.20
				2								
			Poor	1	TT8020	ET	25	0.20	TT8020	ET	40	0.20
				2								
		7.0 -	Normal	1								
				2								
			Poor	1								
				2								
P	F	- 1.0	Best	1	TT5080	FG	60	0.10	TT5080	FG	100	0.10
				2								
	M	1.0 - 3.5	Best	1	TT5080	PC	50	0.15	TT5080	PC	80	0.15
				2								
			Normal	1	TT5080	PC	45	0.15	TT5080	PC	75	0.15
				2								
			Poor	1	TT8020	MT	30	0.15	TT8020	MT	50	0.15
				2								

Insert selection by workpiece materials

■ Recommended cutting conditions

Insert style N : Negative inserts P : Positive inserts

Application F : Finishing M : Medium R : Roughing

Depth of cut (mm)

Workpiece, stability and machine condition

- Best: no scale, no interruption, good rigidity
- Normal: a little scale, a little interruption, good rigidity
- Poor: heavy scale, severe interruptions, poor rigidity

First and second choice grade, chip breaker, cutting speed & feed rate in mm/rev

					Workpiece material							
					Gray cast iron (HB180 - 220)				Ductile cast iron (HB200 - 240)			
N	F	- 1.0	Best	1	AS500		600	0.25	AS500		440	0.20
				2	TT7005	MT	400	0.25	TT7005	MT	320	0.20
	M	1.0 - 2.5	Best	1	AS500		570	0.35	AS500		420	0.30
				2	TT7005	MT	380	0.35	TT7005	MT	305	0.30
			Normal	1	AS10		540	0.35	AS10		400	0.30
				2	TT7005	MT	360	0.35	TT7005	MT	290	0.30
			Poor	1	TT7005	RT	320	0.40	TT7015	RT	250	0.35
				2	TT7015	RT	270	0.40				
		2.5 - 4.0	Best	1	AS10		540	0.35	AS10		400	0.30
				2	TT7005	MT	360	0.35	TT7005	MT	275	0.30
			Normal	1	AS10		510	0.35	AS10		380	0.30
				2	TT7005	RT	320	0.40	TT7015	MT	260	0.35
			Poor	1	TT7005	RT	300	0.40	TT7015	RT	235	0.35
				2	TT7015	RT	255	0.40				
	R	4.0 - 7.0	Normal	1	TT7005	KT	300	0.60	TT7015	KT	240	0.52
				2								
			Poor	1	TT7015	KT	240	0.60	TT7015	KT	225	0.52
				2								
		7.0 -	Normal	1	TT7005	KT	270	0.80	TT7015	KT	210	0.70
				2								
			Poor	1	TT7015	KT	220	0.80	TT7015	KT	200	0.70
				2								
P	F	- 1.0	Best	1	TT7005	MT	400	0.18	TT7005	MT	320	0.15
				2	TB730		700	0.15				
	M	1.0 - 3.5	Best	1	TT7005	MT	380	0.25	TT7005	MT	305	0.20
				2								
			Normal	1	TT7005	MT	360	0.25	TT7005	MT	290	0.20
				2	TT7015	MT	305	0.25	TT7015	MT	250	0.20
			Poor	1	TT7015	MT	290	0.25	TT7015	MT	235	0.20
				2								

Insert selection by workpiece materials

▪ Recommended cutting conditions

Insert style **N** : Negative inserts **P** : Positive inserts

Application F : Finishing M : Medium R : Roughing

Depth of cut (mm)

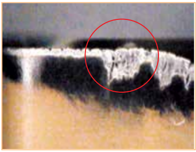
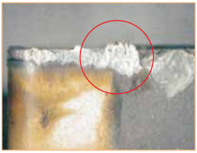
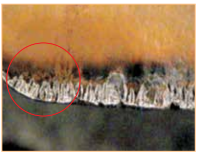
Workpiece, stability and machine condition

- Best: no scale, no interruption, good rigidity
- Normal: a little scale, a little interruption, good rigidity
- Poor: heavy scale, severe interruptions, poor rigidity

First and second choice grade, chip breaker, cutting speed & feed rate in mm/rev

					Workpiece material											
					Low Si aluminum alloy (12.2%<Si)				High Si aluminum alloy (12.2%≧Si)				Copper alloy			
N	F	- 1.0	Best	1	KP300	-	1300	0.10	KP500	-	600	0.10	KP300	-	1100	0.10
				2	K10	ML	500	0.15	K10	ML	150	0.15	TT5100	ML	500	0.15
	M	1.0 - 2.5	Best	1	KP300	-	1300	0.15	KP500	-	600	0.15	KP300	-	1100	0.15
				2	K10	ML	500	0.35	K10	ML	150	0.30	TT5100	ML	400	0.25
			Normal	1	KP300	-	1300	0.15	KP500	-	600	0.15	KP300	-	1100	0.15
				2	K10	ML	500	0.35	K10	ML	150	0.30	TT5100	ML	400	0.25
			Poor	1	KP300	-	1000	0.15	KP500	-	600	0.15	KP300	-	900	0.15
				2	K10	ML	400	0.35	K10	ML	120	0.30	TT5100	MP	320	0.25
		2.5 - 4.0	Best	1	KP300	-	1300	0.15	KP500	-	600	0.15	KP300	-	1100	0.15
				2	K10	ML	500	0.35	K10	ML	150	0.30	TT5100	MP	400	0.30
			Normal	1	KP300	-	1300	0.15	KP500	-	600	0.15	KP300	-	1100	0.15
				2	K10	ML	500	0.35	K10	ML	150	0.30	TT5100	MP	400	0.30
			Poor	1	KP300	-	1000	0.15	KP500	-	600	0.15	KP300	-	900	0.15
				2	K10	ML	400	0.35	K10	ML	120	0.30	TT5100	MT	320	0.30
P	F	- 1.0	Best	1	KP300	-	1300	0.10	KP500	-	600	0.10	KP300	-	1100	0.10
				2	K10	FL	500	0.15	K10	FL	150	0.13	TT5100	FG	400	0.15
	M	1.0 - 3.5	Best	1	KP300	-	1300	0.15	KP500	-	600	0.15	KP300	-	1100	0.15
				2	K10	FL	500	0.25	K10	FL	150	0.22	TT5100	FG	400	0.20
			Normal	1	KP300	-	1300	0.15	KP500	-	600	0.15	KP300	-	1100	0.15
				2	K10	FL	500	0.25	K10	FL	150	0.22	TT5100	FG	400	0.20
			Poor	1	KP300	-	1000	0.15	KP500	-	500	0.15	KP300	-	900	0.15
				2	K10	FL	400	0.25	K10	FL	120	0.25	TT5100	MT	320	0.20

Trouble Shooting

Problem		Cause
Crater wear		- Excessive cutting speed or feed rate (alloy steel and over 0.3% carbon steel) - Workpiece material contains high hardness chemical elements (tool steel, die steel)
Flank wear		- Excessive cutting speed (alloy steel and over 0.3% carbon steel) - Workpiece material contains high hardness chemical elements (tool steel, die steel) - Increase cutting speed if abnormal flank wear is caused by a very slow cutting speed
Deformation		- Excessive cutting speed or feed rate
Chipping		- Excessive feed rate - Interrupted cutting
Notching		- Machining scaled part - From machining work hardened materials
Built-up-edge		- Slow cutting speed - Sticky materials
Mechanical fracture		- Excessive feed rates when interrupted cutting
Thermal cracking		- Repeated thermal shock (interrupted cutting)

Solution
- Reduce cutting speed or feed rate or use more wear resistant grade - Use coolant - Use more positive rake geometry
- Reduce cutting speed or feed rate or use more wear resistant grade - Use coolant
- Reduce cutting speed or feed rate or use more wear resistant grade - Use coolant - Use more positive rake geometry
- Reduce cutting speed or feed rate or use more wear resistant grade - Use coolant
- Reduce cutting speed or feed rate or use more wear resistant grade - Use coolant - Use stronger insert geometry
- Reduce feed rate - Use tougher grade - Use stronger insert geometry - Remove coolant completely or apply coolant correctly
- Use tougher grade - Use stronger insert geometry - Increase lead angle
- Use tougher grade - Use more positive rake geometry - Increase lead angle
- Increase cutting speed - Use more positive rake geometry
- Use more positive rake geometry - Use tougher grade
- Use tougher grade - Use stronger insert geometry - Reduce feed rate - Remove coolant completely or apply coolant correctly - Increase cutting speed
- Use tougher grade - Use stronger insert geometry - Reduce feed rate - Remove coolant completely or apply coolant correctly

Change grade

← Harder

PV3010 > CT3000

TT7005 > TT7015 > TT7310 > TT8115 > TT9215 > TT5080 > TT8125 > TT5100 > TT9225 > TT9080 > TT9020 > TT8135 > TT7100 > TT9235 > TT8020

Change chip breaker

← Less B.U.E*
Less heat

FA	SF FX FG FC FM FT WS EA	ML VF	EM	MP MM	ET	PC	MT	WT	MC	MG-	RT HB	RH RX	HD HT HY HZ

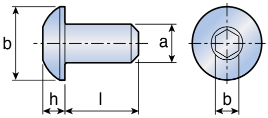
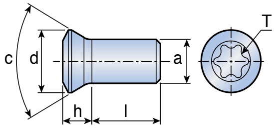
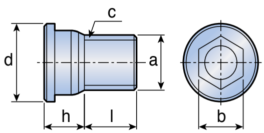
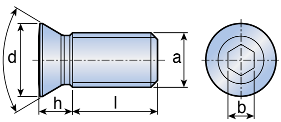
Chip control

Tight ↔ Open

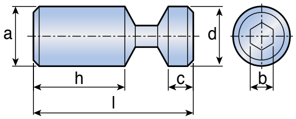
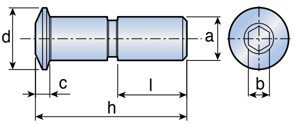
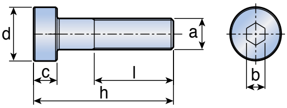
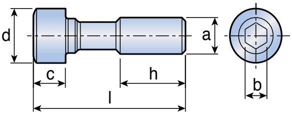
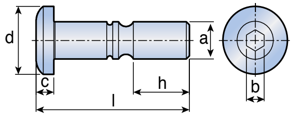
FA	FC FM FT SF FX FG WS EA	MC	PC	VF	ML	MP MM	MT WT	MG-	ET	RT KT HB	RH RX	HD HT HY HZ

*B.U.E: Built-Up-Edge

Screw

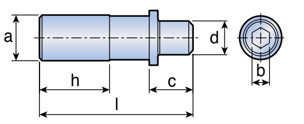
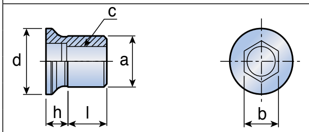
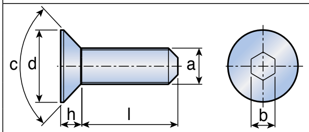
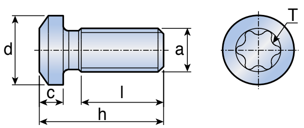
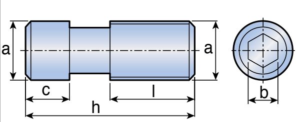
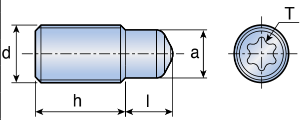
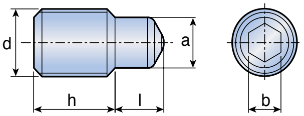
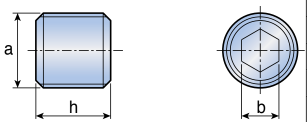
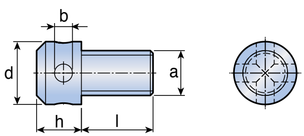
Shape	Description	Dimensions (mm)							Torque (N·m)
		a	d	h	l	b	c	T	
	BH M2.5X0.45X10	M2.5x0.45	4.75	1.5	10	1.5	-	-	0.8
	BH M4X0.7X8	M4x0.7	7.5	2.75	8	2.5	-	-	2.8
	BH M5X0.8X8	M5x0.8	9.5	3.55	8	3.0	-	-	5.5
	BH M5X0.8X10	M5x0.8	9.5	3.55	10	3.0	-	-	5.5
	BH M6X1X20	M6x1.0	10.5	4.2	20	4.0	-	-	9.5
	BH M6X1X25	M6x1.0	10.5	4.2	25	4.0	-	-	9.5
	BH M8X1.25X30	M8x1.25	14	5.2	30	5.0	-	-	-
	SO 22050I	M2.2x0.45	3.1	2.6	3.4	-	60°	T 7	0.9
	SO 25050I	M2.5x0.45	3.45	2.2	3	-	60°	T 7	0.9
	SO 25061I	M2.5x0.45	3.7	2	4	-	90°	T 8	0.9
	SO 25065I	M2.5x0.45	3.45	2.9	3.6	-	60°	T 7	0.9
	SO 30040I	M3x0.5	4.3	2.86	5.44	-	60°	T 9	2.0
	SO 30055I	M3x0.5	4.3	2.1	3.4	-	60°	T 9	2.0
	SO 30100I	M3x0.5	4.3	2.1	4.9	-	60°	T 9	2.0
	SO 35080I	M3.5x0.6	5.3	3.2	5.3	-	60°	T 15	3.0
	SO 35120I	M3.5x0.6	4.7	6.5	5.5	-	60°	T 10	2.0
	SO 35124I	M3.5x0.6	5.3	5	6.7	-	60°	T 15	3.0
	SO 40050I	M4x0.7	5.8	3	8.3	-	60°	T 15	3.5
	SO 40073I	M4x0.7	5.45	3	4.3	-	60°	T 15	3.5
	SO 40085I	M4x0.7	5.45	3.5	5	-	60°	T 15	3.5
	SO 45100I	M4.5x0.75	7	3.7	6.3	-	60°	T 20	5.0
	SO 45130I	M4.5x0.75	7	3.7	10.6	-	60°	T 20	5.0
	SO 50090I	M5x0.8	7	4.5	7.6	-	60°	T 20	5.5
	TS 35110I	M3.5x0.6	5.7	4.2	6.8	-	60°	T 15	3.0
	TS 40097I	M4x0.7	5.2	2.6	7.1	-	43°	T 15	3.5
	TS 50A105I	M5x0.8	7	4.7	5.8	-	60°	T 20	5.5
	SO 50090S	M5x0.5	6.3	3.1	5.4	3.5	M3.5X0.6	-	-
	SO 60105S	M6x0.5	8.5	4.7	5.8	5	M4.5X0.75	-	-
	SO 80180I	M8x1.25	10.7	4.7	13.3	4	60°	-	-

Screw

Shape	Description	Dimensions (mm)							Torque (N·m)
		a	d	h	l	b	c	T	
	**LCS 2**	M5x0.8	M5x0.8	8	14	2	2.2	-	2.5
	LCS 2B	M5x0.8	M5x0.8	4.5	10	2	1.5	-	2.5
	LCS 3	M6x1.0	6	9.7	16.5	2.5	3.5	-	3.0
	LCS 3B	M5x0.8	M5x0.8	8	12	2	2.5	-	2.5
	LCS 3-NX	M6x1.0	5.95	8.7	15.5	2.5	3.5	-	3.0
	LCS 4	M8x1.0	8	10	21	3	6	-	4.0
	LCS 4B	M6x1.0	6	8.5	13.5	2.5	1	-	3.0
	LCS 4S	M8x1.0	8	9.2	18	3	3	-	4.0
	LCS 5	M8x1.0	8	12	23	3	5.5	-	4.0
	LCS 5-L25.5	M8x1.0	7.95	14.5	25.5	3	5.4	-	4.0
	LCS 6	M10x1.0	10	15	27	4	6	-	6.0
	LCS 8	M12x1.0	12	18	36	5	10	-	10.0
	LCS 8-L39	M12x1.0	11.95	21	39	5	10	-	10.0
	LCS 8-L43	M12x1.0	10.85	25	43	5	10	-	10.0
	LCS 16C	M6x1.0	6	14	21	2.5	4	-	3.0
	LCS 25C	M10x1.0	10	18	30	4	6	-	6.0
	**CLS 1.25**	M3x0.5	4.5	9	4.7	1.5	1.3	-	2.0
	CLS 2	M5x0.8	6.5	15	6.3	2.5	1.2	-	3.0
	CLS 2C	M4x0.7	6.5	14.4	7.6	2.5	1.9	-	2.5
	CLS 3	M6x1.0	8.5	21.5	9.8	3	2.2	-	4.0
	CLS 3C	M5x0.8	8	19	9.5	3	2.5	-	3.5
	CLS 3S	M6x1.0	8.5	16.2	4.5	3	2.2	-	4.0
	CLS 16K	1/4-20 UNC	10	25	12	4	4	-	6.0
	**CSC 4**	1/4-20 UNC	11	30	17	4	5	-	6.0
	**DLS 3**	M4x0.7	6	8	16.8	2.5	3	-	2.0
	DLS 4	M5x0.8	8	8.5	21	3	3.5	-	4.2
	DLS 5	M6x1.0	10	12	26.5	4	4.5	-	6.0
	**WCS 2.5**	M5x0.8	9	8.5	20	2.5	2.8	-	3.0
	WCS 4	M6x1.0	11	12	26	3	3	-	4.0
	WCS 4B	M6x1.0	11	8	22.5	3	3	-	4.0

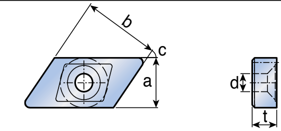
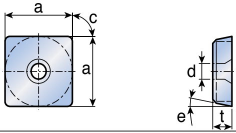
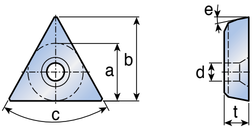
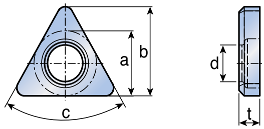
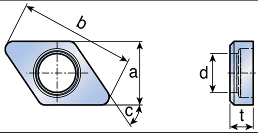
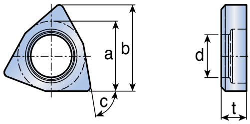
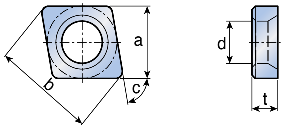
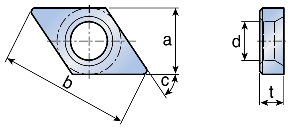
Components

Screw

Shape	Description	Dimensions (mm)						
		a	d	h	l	b	c	T
	WSS 2.52	M4.5x0.75	3.4	7	15	2.5	5	-
	WSS 2.52-1	M4.5x0.75	3.4	4.5	11	2.5	5	-
	WSS 33	M5x0.8	3.7	8	16.5	2.5	5	-
	WSS 43	M6x1.0	5	8	18	3	5	-
	TS 5035062S	M5x0.5	6.44	2.24	3.96	3.5	M3.5x0.6	-
	FH M3X0.5X10	M3x0.5	6	2	8	2	90°	-
	SC 4	M4x0.7	6.35	11	7.3	-	2.7	T 15
	SC 4-SH	M4x0.7	6.35	11	7.3	-	2.1	T 15
	XNSM 0520	M5x0.8	-	20	7	2.5	6.0	-
	XNSM 0620	M6x1.0	-	20	7	3	7.0	-
	XNSM 0825	M8x1.0	-	25	12.5	4	6.5	-
	BLCS 2	2.5	M3x0.35	3.5	1	-	-	T 6
	BLCS 3	3	M4x0.5	4.5	1.2	2	-	-
	RSS M4	M4x0.5	-	5	-	2	-	-
	RSS M5	M5x0.5	-	5	-	2.5	-	-
	SS M4X0.7X4-NL	M4x0.7	-	4	-	2	-	-
	AJM 5F	M5x0.5	7	5	8	2	-	-
	ASM 6	M6x0.75	10	6	12	2.5	-	-

Components

Shim

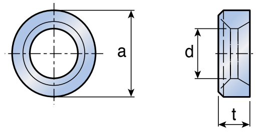
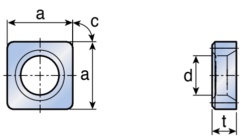
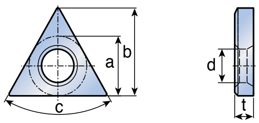
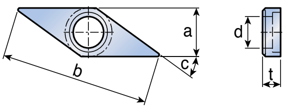
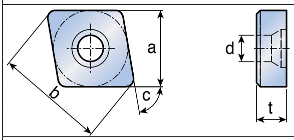
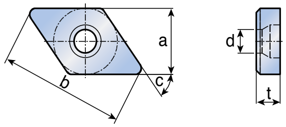
Shape	Description	Dimensions (mm) a	b	c	d	e	t
	**CSK 1604R/L**	9.3	14.7	55°	3.4	-	4.76
	**CSS 32**	8.15	-	90°	2.5	11°	3.18
	CSS 42	11.2	-	90°	2.5	11°	3.18
	**CST 32**	8.15	11.8	60°	2.5	11°	3.18
	CST 42	10.7	15.6	60°	3.4	11°	3.18
	CST 43	10.7	15.6	60°	3.4	11°	4.76
	**S 3**	9.525	13.08	60°	5.4	-	4.76
	S 31	9.525	13.08	60°	5.4	-	3.18
	WST 2.52	7.94	10.71	60°	4.8	-	3.18
	WST 33	8.63	11.95	60°	5.2	-	4.76
	WST 43	11.8	16.7	60°	6.2	-	4.76
	**S 45**	12.7	23.5	55°	7.7	-	4.76
	**MSW 32**	8.7	10.7	80°	5.4	-	3.18
	MSW 43	12.7	15.5	80°	7.7	-	4.76
	**LSC 32**	8.5	12.33	80°	5	-	3.18
	LSC 32A	9.525	13.148	80°	5	-	3.18
	LSC 42	11.6	16.93	80°	6.6	-	3.18
	LSC 53	14.8	21.91	80°	8.2	-	4.76
	LSC 63	17.9	25.85	80°	9.75	-	4.76
	LSC 83	24.4	36.63	80°	12.75	-	4.76
	LSC 84	24.4	36.63	80°	12.75	-	6.35
	LSC 85	24.4	36.63	80°	12.75	-	7.94
	LSC 64D	19.05	26.85	80°	9.75	-	6.35
	LSC 84D	25.4	36.73	80°	12.75	-	6.35
	LSC 85D	25.4	36.73	80°	12.75	-	7.94
	**LSD 3.52**	11.113	21.27	55°	6.65	-	3.18
	LSD 3.52B	10.4	19.73	55°	6.65	-	3.18
	LSD 32	8.4	17	55°	4.9	-	3.18
	LSD 42	11.59	28.06	55°	6.6	-	3.18
	LSD 43	11.59	28.06	55°	6.6	-	4.76
	SSD 32	8.4	17	55°	5.4	-	3.18

Technical Guide

Components

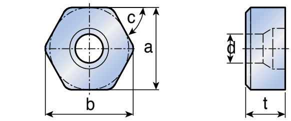
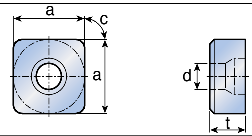
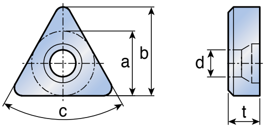
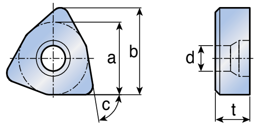
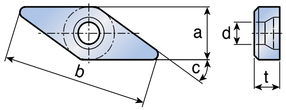
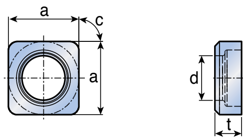
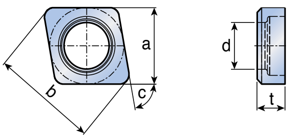
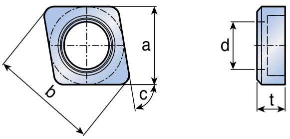
T-TURN

Shim

Shape	Description	Dimensions (mm)						
		a	b	c	d	e	t	
	LSR 1203	9.8	-	-	4.9	-	3.18	
	LSR 1604	13.5	-	-	6.6	-	4.76	
	LSR 2004	17.2	-	-	8.2	-	4.76	
	LSR 2506	22	-	-	9.7	-	6.35	
	LSR 3206	28	-	-	12.7	-	6.35	
	LSR 32	8.5	-	-	4.9	-	3.18	
	LSR 42	11.6	-	-	6.6	-	3.18	
	LSR 53	14.6	-	-	8.2	-	4.76	
	SSR 32	10.5	-	-	5.4	-	3.18	
	LSS 32	8.5	-	90°	5	-	3.18	
	LSS 32A	9.525	-	90°	5	-	3.18	
	LSS 42	11.75	-	90°	6.6	-	3.18	
	LSS 53	14.8	-	90°	8.2	-	4.76	
	LSS 63	17.9	-	90°	9.75	-	4.76	
	LSS 84	24.4	-	90°	12.75	-	6.35	
	LSS 85	24.4	-	90°	12.75	-	7.94	
	LSS 64D	19.05	-	90°	9.75	-	6.35	
	LSS 84D	25.4	-	90°	12.75	-	6.35	
	LSS 85D	25.4	-	90°	12.75	-	7.94	
	LSS 104	31.75	-	90°	12.75	-	6.35	
	SSS 32	8.4	-	90°	5.4	-	3.18	
	SSS 43N	11.2	-	90°	7.5	-	4.76	
				90°				
	LST 2.51.8	7.94	10.71	60°	5	-	2.7	
	LST 2.51.8B	7.4	9.9	60°	5	-	2.7	
	LST 2.52	7.94	10.71	60°	5	-	3.18	
	LST 2.52B	7.4	9.9	60°	5	-	3.18	
	LST 31.8	8.49	11.94	60°	5	-	2.7	
	LST 32	8.63	11.95	60°	4.9	-	3.18	
	LST 42	11.7	16.75	60°	6.6	-	3.18	
	LST 53	14.58	21.47	60°	8.2	-	4.76	
	LST 63	17.85	26.18	60°	9.7	-		
	SST 32	8.4	11.8	60°	5.4	-	3.18	
	SSV 32	8.3	26.2	35°	5.4	-	3.18	
	IVSN 324	9.2	27.8	35°	5.4	-	3.18	
	MSV 2.522	7.9	22.45	35°	5.4	-	3.18	
	SSVN 2.522	7.9	22.45	35°	5.4	-	3.18	
	TSC 42	12.7	17.99	80°	4.5	-	3.18	
	TSC 43	12.7	17.99	80°	4.5	-	4.76	
	TSC 44	12.7	17.99	80°	4.5	-	6.35	
	TSC 54	15.78	22.76	80°	5.5	-	6.35	
	TSD 42	12.7	24.71	55°	4.5	-	3.18	
	TSD 43	12.7	24.71	55°	4.5	-	4.76	
	TSD 44	12.7	24.71	55°	4.5	-	6.35	

Components

Shim

Shape	Description	Dimensions (mm)						
		a	b	c	d	e	t	
	**TSH 42**	12.7	14.05	60°	4.5	-	3.18	
	TSH 43	12.7	14.05	60°	4.5	-	4.76	
	TSH 44	12.7	14.17	60°	4.5	-	6.35	
	TSH 64	19.05	21.25	60°	5.5	-	6.35	
	**TSS 42**	12.7	-	90°	4.5	-	3.18	
	TSS 43	12.7	-	90°	4.5	-	4.76	
	TSS 44	12.7	-	90°	4.5	-	6.35	
	TSS 54	15.78	-	90°	5.5	-	6.35	
	**TST 33**	9.525	13.09	60°	4	-	4.76	
	TST 43	12.7	17.45	60°	4.5	-	4.76	
	**TSW 44**	12.7	15.23	80°	4.5	-	6.35	
	**TSV 33**	9.525	27	35°	4	-	4.76	
	**S 40**	12.7	-	90°	7.7	-	4.76	
	S 50	15.875	-	90°	7.7	-	4.76	
	**S 48**	12.7	17.82	80°	7.7	-	4.76	
	**E 43**	12.7	19.33	75°	7.7	-	4.76	

Components

Shim

Shape	Description	Dimensions (mm)						
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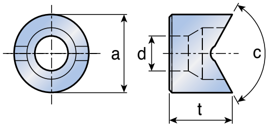
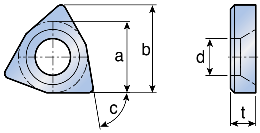
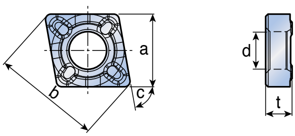
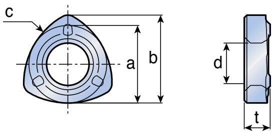
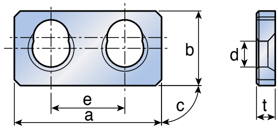
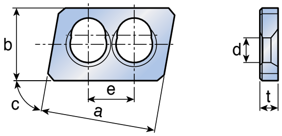
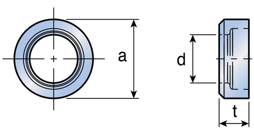
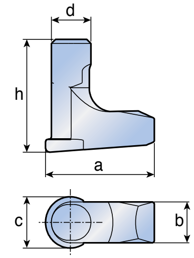
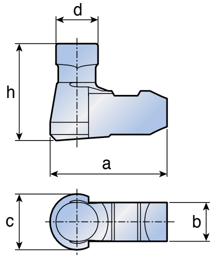
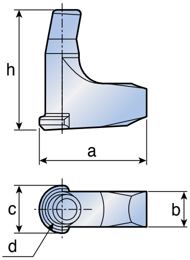
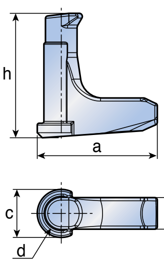
	**CBRS 06**	5.6	-	140°	2.5	-	4.5	
	CBRS 09	8.8	-	140°	3	-	6	
	CBRS 12	11	-	140°	3	-	6.5	
	CERS 06	5.6	-	120°	2.5	-	4.7	
	CERS 09	8	-	120°	3	-	6	
	CERS 12	11	-	120°	3	-	7	
	**LSW 32**	8.5	10.336	80°	5	-	3.18	
	LSW 32A	9.525	11.421	80°	5	-	3.18	
	PSW 32	8.7	10.7	80°	4.5	-	3.18	
	PSW 42	11.7	14.4	80°	5.5	-	3.18	
	TWN 432(T)	11.7	14.281	80°	6.4	-	3.18	
	**LSC 42-NXS**	11.7	16.424	80°	6.65	-	3.18	
	LSC 43-NX	12.7	17.979	80°	6.65	-	4.76	
	LSC 54-NX	15.875	23.25	80°	8.2	-	5.78	
	LSC 53-NX	15.875	23.25	80°	8.2	-	4.19	
	LSC 53-NXS	14.55	21.30	80°	8.2	-	4.19	
	LSS 54-NX	15.875	21.02	90°	8.1	-	5.78	
	LSS 53-NX	15.875	21.02	90°	8.1	-	4.19	
	LSS 53-NXS	14.55	19.58	90°	8.2	-	4.19	
	**LSB 53R/L**	14.9	17	R15	8.15	-	5	
	**LN 5025-T6.35**	49.9	25.3	90°	12.7	25	6.35	
	**LN 4025-T6.35-R/L**	40	25.4	80°	12.7	16	6.35	
	**S 43**	12.6	-	-	7.7	-	4.76	
	S 43-T8	12.6	-	-	7.7	-	7.94	

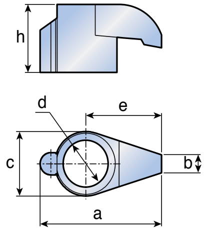
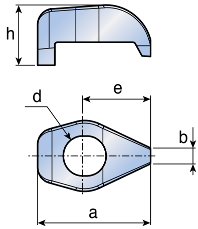
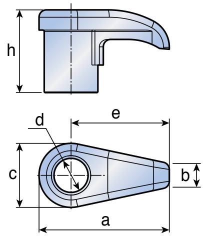
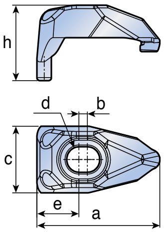
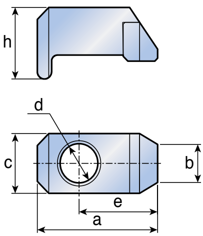
Components

Lever

Shape	Description	Dimensions (mm)						
		a	b	c	d	h		
	**LCL 3**	10.2	3.7	4.4	3.6	12.2		
	LCL 4	13.2	4.8	6	4.8	13.2		
	LCL 4A	16	4.8	6	4.8	14.6		
	LCL 5	19	6	7.6	6	17.5		
	LCL 6D	20.5	7.4	9.2	7.5	22.2		
	LCL 8	25.4	8.6	12.2	8.7	25.4		
	BLCL 2	7.5	2.2	3	2.6	7.8		
	BLCL 3	9.9	3	3.8	3.7	11		
	**LCL 2B**	7.7	2.7	3.6	2.1	6.5		
	LCL 2B	7.7	2.7	3.6	2.1	6.5		
	LCL 3B	10	3.2	4.6	3.6	8		
	LCL 3BH	10	3.2	4.6	3.6	9.6		
	LCL 4B	13.6	4.8	6	4.8	10.4		
	**LCL 10C**	10.8	3.4	4.6	3	11.6		
	LCL 12C	13	3.8	4.6	3.5	13.2		
	LCL 16C	18.3	4.7	6.2	4.5	18		
	LCL 20C	20.4	6	7.6	5.6	18.8		
	LCL 25C	24.2	7.5	9.4	7.5	24		
	LCL 32C	30	8.6	12.5	8	27		
	LCL 25CH	24.2	7.5	9.4	7.5	24		
	LCL 32CH	30	8.6	12.5	8	27		
	**LCL 08-NX**	9.5	3.6	4.4	1.3	12.1		
	LCL 08B-NX	10	3.2	4.59	1.3	9.9		
	LCL 09-NX	10.2	3.3	4.4	1.65	12.7		
	LCL 09B-NX	10	3.2	4.59	1.65	9.9		
	LCL 11-NX	16	4	6	2	15.2		
	LCL 12-NX	13.2	4.2	6	2.1	15.9		
	LCL 16-NX	19	5	7.6	5	19.7		
	LCL 25-NX	25.4	7.5	12.2	7.5	26.5		
	LCL 32-NX	30	8.6	12.5	8	28.2		

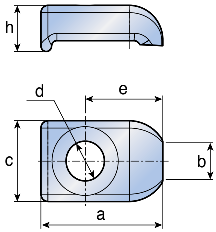
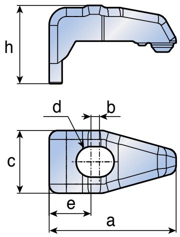
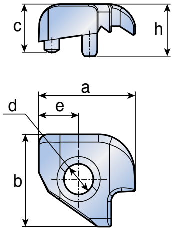
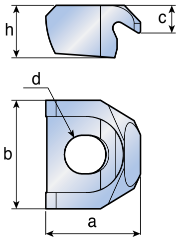
Components

Clamp

Shape	Description	Dimensions (mm)						
		a	b	c	d	e	h	
	**CL 1.25**	9.5	2	5.4	3.4	5.2	4.5	
	CL 2	14	2	7.8	5.2	8.7	7	
	CL 3	16.5	2	9	6.2	10	9	
	CL 4	21.5	3.08	11	8	13.4	11.6	
	**CL 2C**	13.2	1.8	-	4.5	7.7	6.8	
	CL 3C	17	2.2	-	5.5	9.3	9.3	
	**CLM 12**	22.35	6.3	10.9	M8x1.0	16.9	16.8	
	CLM 20	18.5	3.87	9.5	M6X1.0	13.75	9.65	
	CLM 30	25.4	4.81	13	M8x1.0	19.95	16.8	
	**DLM 2.5-NX**	19.62	1.5	10	4.2	6.31	11.75	
	DLM 3	21.2	1.5	11	4.2	7.24	12.5	
	DLM 3-NX	21.56	1.5	11	4.2	7.23	12.5	
	DLM 3V	33.4	2	14	6.2	11.66	16.1	
	DLM 3.5-LX	23.5	2	12.75	5.4	6.59	13.25	
	DLM 4	25.8	2	14.5	5.4	7.4	13.5	
	DLM 5	30	1.9	17	6.2	8.1	17	
	DLM 6	33	2	18	6.2	8.5	19	
	**BCL 6**	21	6.36	10	6.6	13.7	12	
	BCL 6-20A	21	5	10	6.6	13.7	12	

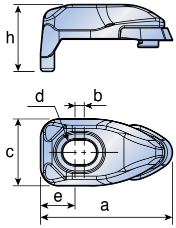
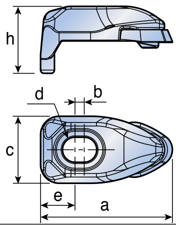
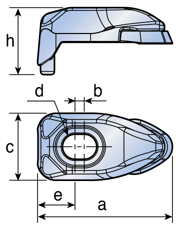
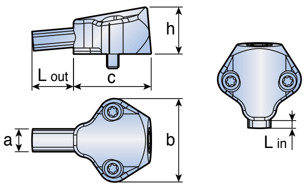
Components

Clamp

Shape	Description	Dimensions (mm)					
		a	b	c	d	e	h
	**3127 C**	17.45	5.6	11.1	5.5	11.1	6.35
	**CCL 4**	29.5	2	14	6.8	9.7	18.5
	**CL 16KR**	25.6	23.4	12.2	7.8	10.6	13.2
	CL 16KL	25.6	23.4	12.2	7.8	10.6	13.2
	**WC 2.53**	14.3	15	3.8	5.2	-	7.5
	WC 33	16.4	18	4.6	6.4	-	8.7
	WC 43	16.4	24	4.6	6.4	-	8.7

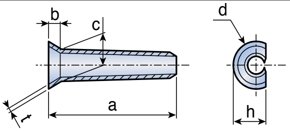
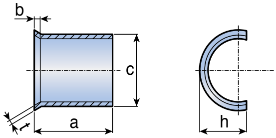
Components

Clamp

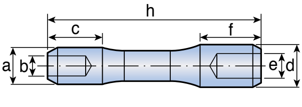
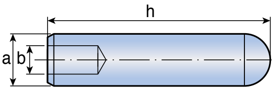
Shape	Description	Dimensions (mm)							
		a	b	c	d	e	h	L in	L out
	**DCL S-4H**	28.5	2	14.5	5.4	7.45	14.5	-	-
	**DCL S-4D**	28.5	2	14.5	5.4	7.45	14.5	-	-
	**DCL S-3F**	23.2	1.5	11	4.2	7.2	13	-	-
	DCL S-4F	29.1	2	14.5	5.4	8.1	14.5	-	-
	**CU-CW-TB**	5.7	20.8	19.4	-	-	11.7	2.1	10.3
	CU-D-TB	5.7	20.8	19.4	-	-	11.7	2	10.2
	CU-R-TB	5.7	20.8	19.4	-	-	11.7	2	10.3
	CU-V-TB	5.7	20.8	19.4	-	-	11.7	2.3	10.6

Components

Shim pin

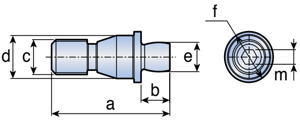
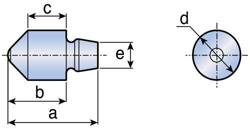
Shape	Description	Dimensions (mm)						
		a	b	c	d	h	t	
	**CSP 3**	9.8	0.9	2.4	3.5	2.5	0.3	
	CSP 16K	11.5	1	3.6	5.6	4	0.5	
	**LSP 3**	6.9	0.9	4.9	-	3.2	0.3	
	LSP 3A	5.3	0.9	4.9	-	3.2	0.3	
	LSP 3B	4	0.9	4.9	-	2.45	0.3	
	LSP 4	5.8	0.9	6.6	-	4.3	0.4	
	LSP 5	8.8	1	8.2	-	5.4	0.5	
	LSP 6	11	1	9.7	-	6	0.6	
	LSP 8	12	2	13	-	9	0.7	
	LSP 16C	7.7	0.7	6.6	-	4.3	0.4	

Shim pin punch

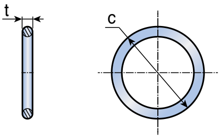
Shape	Description	Dimensions (mm)						
		a	b	c	d	e	f	h
	**SPP 3-4**	9	4	15	10	5.2	15	64
	SPP 5-6	12.1	6.6	18	14	8.1	20	70
	**SPP 8**	17	9.3	-	-	-	-	73

Components

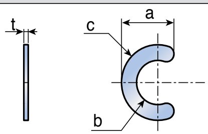
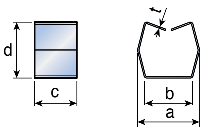
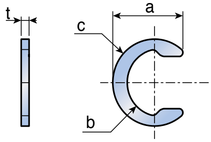
Lock pin

Shape	Description	Dimensions (mm)						
		a	b	c	d	e	f	m
	**MLP 3**	14.5	4.7	M4x0.7	4.8	3.7	6.3	2
	MLP 4	21.21	5.16	M6x1.0	7.37	5.03	8.71	2.5
	MLP 4S	13.7	5	M6x1.0	0	5.03	7	2.5
	MLP 4-06	18.5	6.7	M6x1.0	7.4	5	8.7	2.5
	**KP 48S**	9.5	6.2	4	5	2.6	-	-

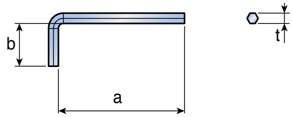
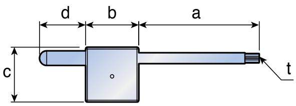
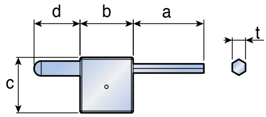
O-ring

Shape	Description	Dimensions (mm)	
		c	t
	**ID 6.4X0.9**	8.2	0.9

Snap ring

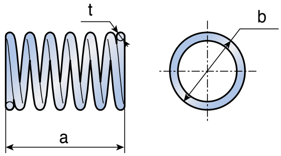
Shape	Description	Dimensions (mm)				
		a	b	c	d	t
	**CSR 1.25**	3	2.78	4	-	0.3
	CSR 2	4.7	7	6.5	-	0.4
	CSR 2C	4.3	3	5.6	-	0.3
	**LSR 2B**	3.8	3.3	2	3	0.1
	LSR 3B	4.3	3.4	3	3.8	0.1
	LSR 4B	5.9	4.9	4.3	4.8	0.1
	BLSR 2	3	2.5	1.5	2	0.1
	BLSR 3	3.9	3.3	1.8	2.2	0.1
	**CSR 4**	8.4	8	10	-	0.8
	WSR 4	7.5	5.8	6.3	-	0.7

Wrench

Shape	Description	Dimensions (mm)						
		a	b	c	d	t		
	**L-W 1.5**	45	14	-	-	1.5		
	L-W 2	50	16	-	-	2		
	L-W 2.5	56	18	-	-	2.5		
	L-W 3	63	20	-	-	3		
	L-W 3.5	65	21	-	-	3.5		
	L-W 4	70	25	-	-	4		
	L-W 5	80	28	-	-	5		
	L-W 6	90	32	-	-	6		
	L-W 8	100	36	-	-	8		
	L-W 10	112	40	-	-	10		
	L-W 12	125	45	-	-	12		
	L-W 14	140	56	-	-	14		
	L-W 17	160	63	-	-	17		
	L-W 19	180	70	-	-	19		
	**T 5**	34	15	15	13	T 5		
	T 6	34	15	15	13	T 6		
	T 7	34	15	15	13	T 7		
	T 8	39	19	19	13	T 8		
	T 9	42	19	19	13	T 9		
	T 10	42	22	22	14	T 10		
	T 15	45	22	27	15	T 15		
	T 20	49	22	30	15	T 20		
	T 25	53	22	35	18	T 25		
	**L-W 1.5F**	35	15	15	13	1.5		
	L-W 2F	38	15	15	13	2		

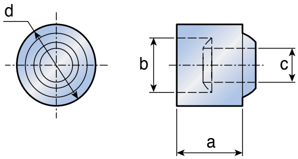
Components

Spring



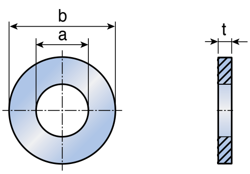
Description	Dimensions (mm) a	b	t				
DSP 3	8	5.6	0.6				
DSP 4	13	7	0.65				
DSP 5	13	9	0.75				
KSP 40	7.5	4	0.45				
KSP 48	13.5	4	0.45				
KSP 90	12.7	9	0.9				

Coolant nozzle



Description	Dimensions (mm) a	b	c	d			
NZ 62	4.5	4	2.5	6			
NZ 83	6	5.5	3.5	8			
NZ 104	7	5.5	4	10			
NZ 125	8	7.5	5	12			
NZ 146	10	9	6	14			

Washer



Description	Dimensions (mm) a	b	t				
MW 8.4x18	8.6	17	1.6				
MW 6.4x12	6.2	12.6	1.6				

Hose

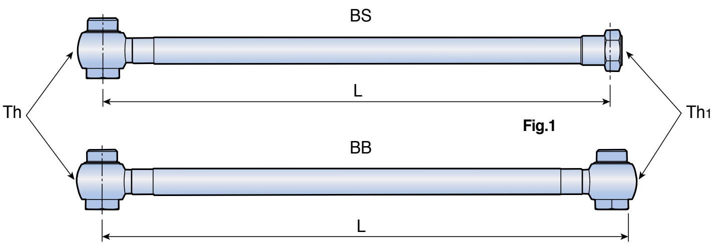
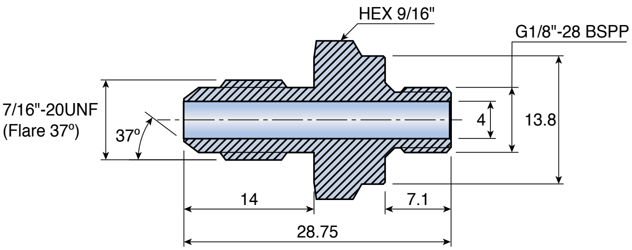


Fig.1

Fig.2

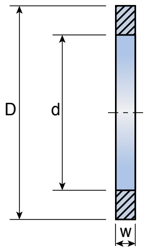
Designation		Dimension (mm)				Fig.
		L(mm)	Th	Th1	Max.pressure(Bar)	
TB HOSE	**G1/8-7-16-200BS**	200	G1/8"-28 BSPP	7/16"-20 UNF (Flare 37°)	260	1
	G1/8-7/16-250BS	250	G1/8"-28 BSPP	7/16"-20 UNF (Flare 37°)	260	1
	G1/8-G1/8-200BB	200	G1/8"-28 BSPP	G1/8"-28 BSPP	260	2
	G1/8-G1/8-250BB	250	G1/8"-28 BSPP	G1/8"-28 BSPP	260	2
	5/16-7/16-200BS	200	5/16"-24 UNF	7/16"-20 UNF (Flare 37°)	200	1
	5/16-G1/8-200BS	200	5/16"-24 UNF	G1/8"-28 BSPP	200	1

Adapter



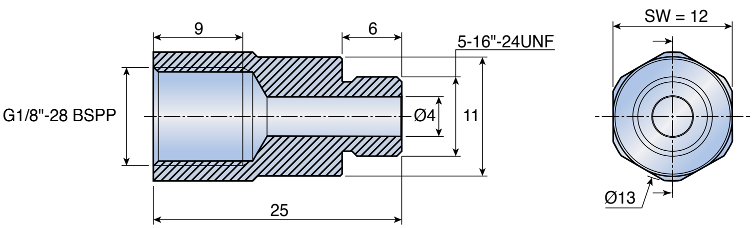
Designation
TB NIPPLE G1/8-7/16 UNF

Seal washer

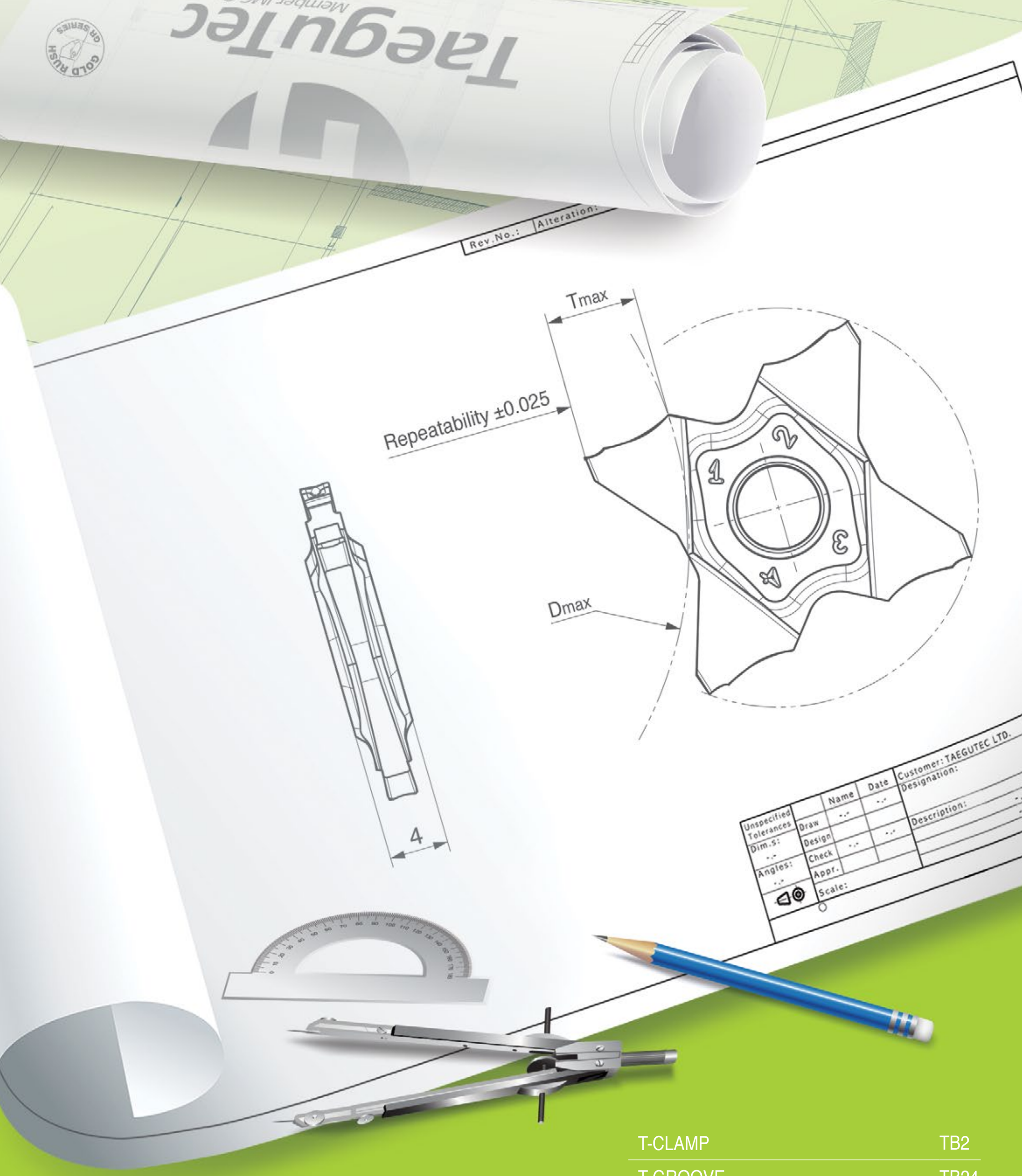


Designation		Dimension (mm)		
		D	d	w
TB COPPER	**SEAL 1/8"**	15	10	1
	SEAL 5/16"	12	8	1

Connector



Designation
TB CONECTOR 5/16"-G1/8"



TECHNICAL GUIDE

-Parting & Grooving

Contents

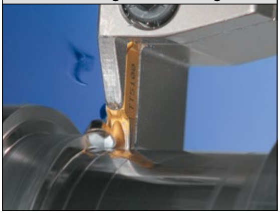
T-CLAMP ULTRA PLUS

- T-CLAMP ULTRA PLUS enables multi-functional operations in one system
- Deep grooving
- Parting and grooving
- Shallow grooving
- Turning and grooving
- Precision grooving and recessing
- Face grooving and face turning
- Undercutting and recessing

Parting

- Inserts
- Accuracy with good repeatability
- Molded chip breaker
- Top and bottom prism hold the insert firmly and accurately in the correct position
- TDJ/C is a unique double-ended insert for grooving and parting
- TSJ/C is a unique single-ended insert for deep grooving and parting
- TDT double-ended insert for side turning and grooving
- TDA double-ended insert for aluminum wheel machining

Turning & Grooving



- Blades
- Simple, accurate and rapid indexing
- Top and bottom seated insert alignment
- No additional spare parts
- Uses standard tool blocks

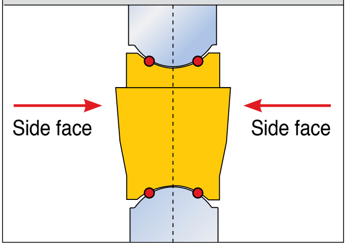
Face grooving & Turning

- Integral tool shanks
- Simple, accurate and rapid indexing
- Top and bottom seated insert alignment
- Stable support against side forces
- No additional spare parts
- Standard shank dimensions

Clamping stability of T-Clamp

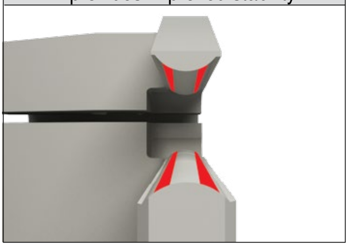
- Good side force resistance

Stable & Safe contact points



- Rigid long support

Longer T-Clamp seat provides improved stability



- Rigid concept provides improved straightness & surface finish

Advantages of T-CLAMP ULTRA PLUS system

- T-CLAMP ULTRA PLUS is available as either double-ended or single ended insert for maximum economy

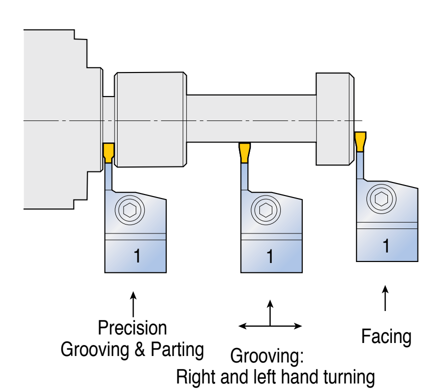
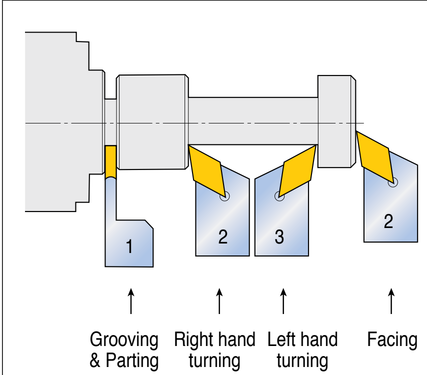
- Multifunction use
  - Right-hand and left-hand turning, grooving and parting with a single tool

- T-CLAMP ULTRA PLUS replaces a multitude of ISO tools
  - Reduces number of tools per operation
  - Reduces inventory

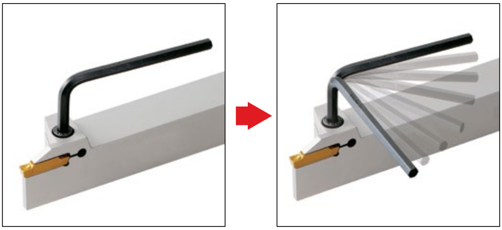
- Short cycle time
  - Short setup with less downtime
  - Reduces need for turret indexing

- Improved cycle time
  - The excellent surface finish obtained from rough turning may eliminate finish turning

T-CLAMP ULTRA PLUS system vs standard ISO system

T-CLAMP ULTRA PLUS system	Standard ISO system
	

Toolholder screw clamping force



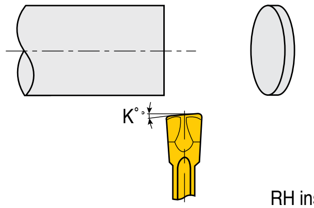
Screw	Recommended torque (N·m)
SH M5X0.8	5.5
SH M6X1	8.0
SH M8X1.25	12.0

Selecting inserts

- To match the correct insert to the cutting condition, the following variables must be considered
- Width of cut (width of insert)
- Chip breaker style
- Lead angle
- Corner radii
- Carbide grade

- Width of cut (WOC) and depth of cut (DOC)
- To select the proper width and depth of cut, the application must be considered
  The ratio DOC = 8 x WOC can be used when cutting steel
  For example, the maximum DOC for a 3mm wide insert is 24mm for parting a 48mm diameter bar
- Neutral inserts with a 0 lead angle provide the maximum DOC

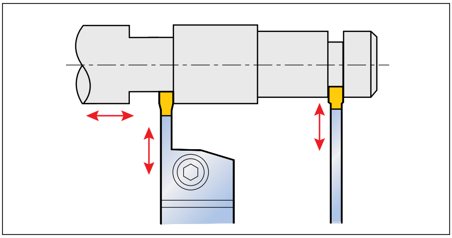
- Lead angle
- Use inserts with a lead angle to minimize pips or burrs
- Inserts are available with either R or L hand, with the point of angle toward the finished surface
- Increasing the lead angle reduces the pips or burrs, but will also produce a poor surface finish and short tool life
- Neutral inserts are recommended when a pip/burr is acceptable



RH insert shown

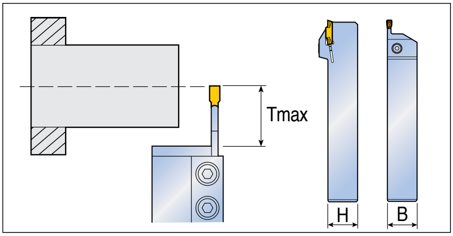
Insert support

- Integral shank toolholders offer the best rigidity
- A self clamp holder is only recommended for radial machining
- A screw clamp holder is recommended for axial and radial machining

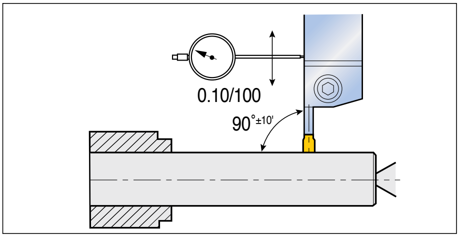


Blade or holder size

- To minimize vibration and deflection choose:
- Blade or toolholder with the smallest possible overhang (Tmax)
- Toolholder with the maximum shank size (H)
- Blade height that is larger than Tmax
- Blade or toolholder with the maximum blade width (largest possible insert seat size)

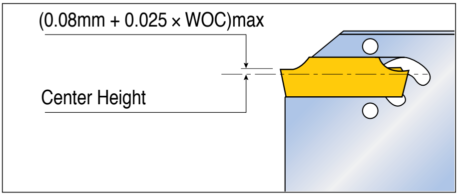


90° mounting



- The insert must be mounted 90° to the workpiece to obtain perpendicular surfaces and minimize vibration.

Setup



- The center height of the insert should be maintained within ±0.1mm
- The parting operation should be as close to the chuck as possible

Selecting preference priority

- Use insert with 0° lead angle
- Use the largest blade size possible
- The smallest appropriate width of cut

Machining

- Consistency of speed and feed improve performance
- Apply coolant abundantly (excluding ceramic AB30)
- Secure insert into clean pockets
- Cutting forces on soft workpiece materials may be insufficient to push insert well into pocket.
  Tap insert into place using a plastic hammer.
- On a conventional lathe, lock the carriage to prevent axial motion during parting-off

Usage

- Replace worn inserts immediately
  The price of a new insert is much less than the risk of damage from continuing with a worn edge
- Replace blade or damaged pockets
- Never try to repair damaged pockets

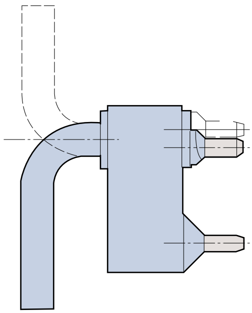
Chip breaker

▪ The chip breaker's function is to narrow the chip it occurs near the cutting edge at high temperature.
▪ Producing chips that are narrower than the groove gives the following advantages:
- Eliminates friction with groove walls
- Prevents chip overload
- Permits higher feeds
- Produces unscratched surfaces, eliminating additional facing

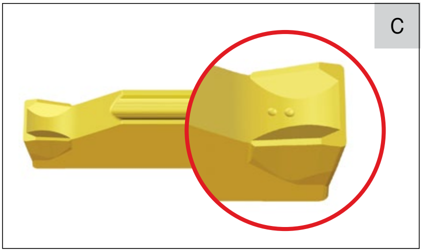
▪ Curling chips into compact spirals or breaking chips simplifies disposal
▪ Curling is affected by the chip breaker type and the machining conditions
▪ Select an appropriate chip breaker for the specific application

Extraction of insert

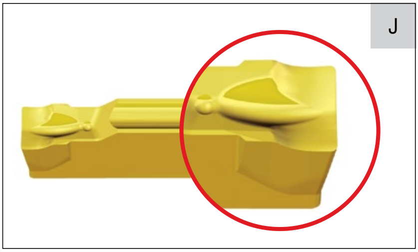
Insert clamping
Extractor (EDG-23B, EDG-33B) for blades



Selection of chip breakers



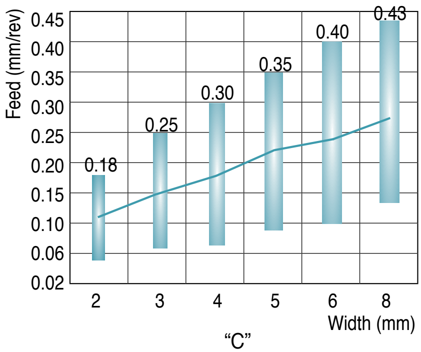
- For hard materials and tough applications
- For general applications on steel, alloy steel and stainless steel
- Medium-to-high feeds

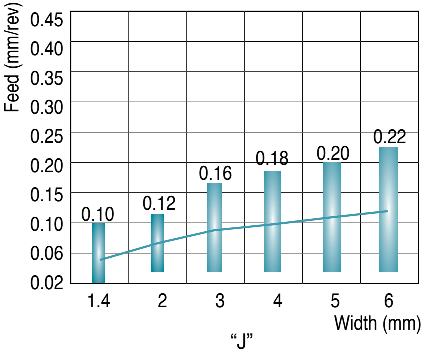


- For hard materials and tough applications
- For general applications on steel, alloy steel and stainless steel
- Medium-to-high feeds

■ Recommended feed range as a function of insert width

Material; SAE4140 (HB240)
Recommendations are for neutral inserts - for R/L inserts reduce feeds by 20 - 40%





	Workpiece materials				
	Alloy steel	Austenitic stainless	High - Temp alloys	Nonferrous materials	Cast iron
High	C	C	C	C Brass	C
Feed					
Low	J	J	J Titanium	J Aluminum	

Practical trouble shooting

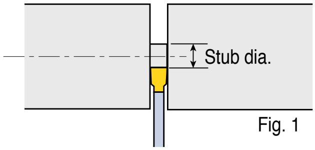


Fig. 1

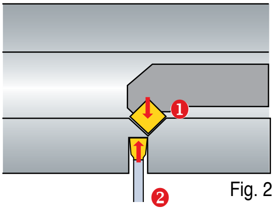
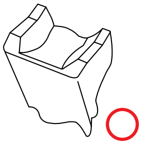


Fig. 2

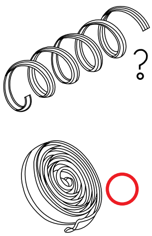
■ To reduce burr
- On a CNC machine, reduce feed by 50% when approaching center stub diameters ≅ WOC
- Check center height of cutting edge
- Use insert with lead angle
- If 0° lead angle must be used for whatever reason, apply narrow WOC
- Apply a supporting part-catcher (or adjust concentricity)
- For hollow bars, it is better to machine chamfers using ID boring tool prior to parting operation. (See picture)

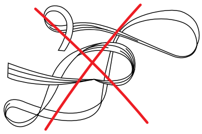
■ To improve surface finish
- Increase cutting speed
- Use neutral inserts
- Select chip breaker that provides optimum chip control
- Use coated carbide
- Improve coolant application
- Eliminate chatter

■ To improve flatness
- Check inserts and replace any that show wear
- Use neutral inserts
- Use largest blade possible, i.e., TGB 32- instead of TGB 26-
- Increase blade thickness and insert width
- Minimize blade overhang
- Check alignment and perpendicularity of tool to machine axis
- Optimize workpiece chucking
- Lock the carriage on manually operated lathes
- Apply coolant abundantly (excluding Ceramic AB30)
- Reduce feed

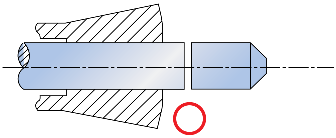


■ To improve chip control
- Replace worn inserts
- Choose a more appropriate chip breaker
- Use a neutral insert
- Check alignment and perpendicularity of tool to machine axis
- Apply coolant abundantly
- Increase feed
- At initial groove depth, interrupt feed momentarily to let the chip enter slot

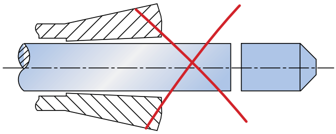




■ To improve chip control
- Part-off as close to chuck as possible
- Minimize blade overhang
- Improve chucking and monitor tool setup
- Change the RPM
- Increase the feed
- Lock the carriage on manually operated lathes

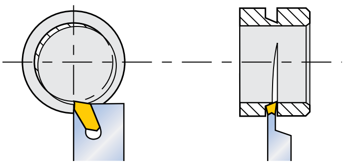


■ To prevent chipping of cutting edge
- Use appropriate carbide grade and geometry
- Use insert with larger corner radii
- Reduce feed at end of cut
- Eliminate chatter
- Increase speed
- Use strong grade
- Increase tool and setup rigidity
- Eliminate built-up edges



■ To prevent or reduce built-up edge
- Use appropriate carbide grade and geometry
- Increase speed
- Reduce feed
- Increase coolant flow/concentration

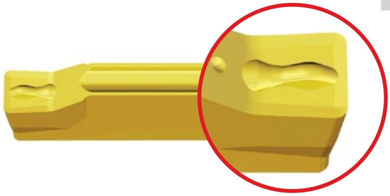
■ Parting on eccentric tubes
- Inserts with 4 degree lead angle are usually recommended for tubes; however, the combination of an eccentric bore and a robust machine may increase feed-snap on breakthrough and damage the cutting edge. Changing to an 8 degree lead angle insert will regulate the breakthrough.



Chip breaker style: "T" chip breaker

- The "T" chip breaker is available for turning and grooving of steel, alloy steel and stainless steel
- Inserts with "T" style chip breaker contain a central chipbreaking island for multi-direction chip control
- TDXT insert has the same chip breaker as "T" insert but it has more front & side clearance angle to use in nternal and face application. This insert will cover existing grounded TDIT/TDFT insert.

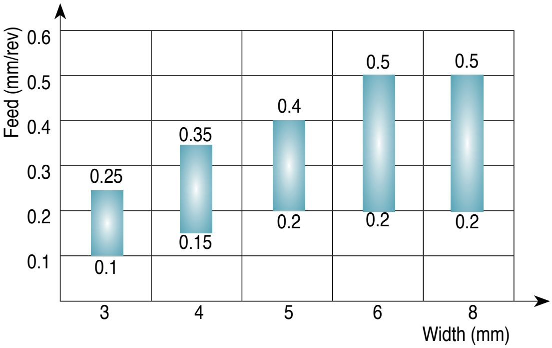
TDT-E T



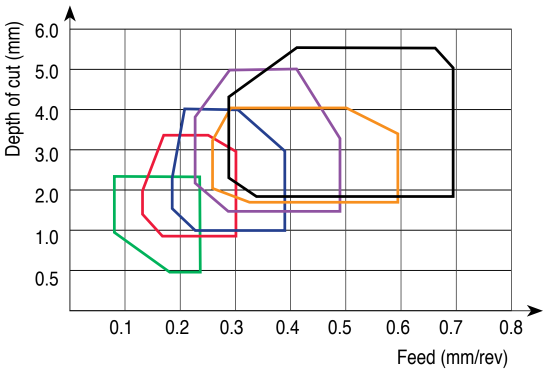
TDXT

TDT/TDXT cutting condition table

■ Grooving



■ Turning

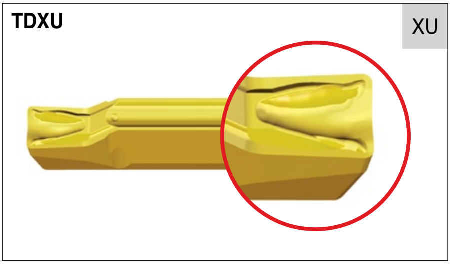


- Workpiece: SAE 1045 (C45)
- Cutting speed: Vc=100 - 180 m/min

TDT 10.00E-0.80
TDT 5.00E-0.80
TDT 8.00E-0.80
TDT 4.00E-0.80
TDT 6.00E-0.80
TDT 3.00E-0.40

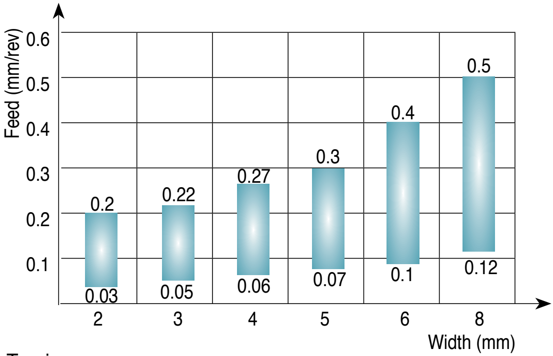
Chip breaker style: "XU" chip breaker

- First choice on general use in grooving & turning application
- Excellent chip-control ability
- Low to medium feeds in grooving & turning
- Multipurpose for external , internal & face grooving and turning machining is possible

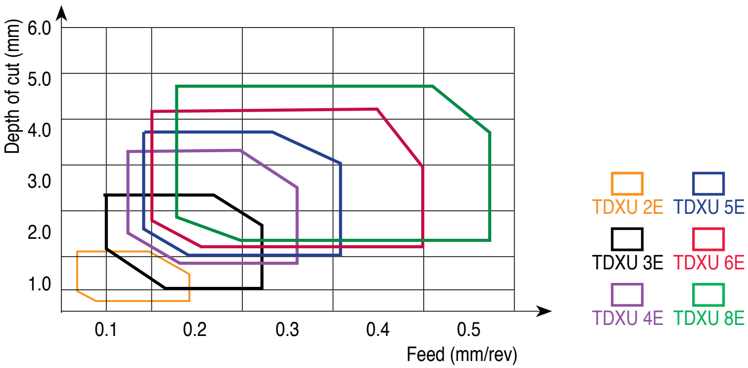


TDXU cutting condition table

■ Grooving



■ Turning



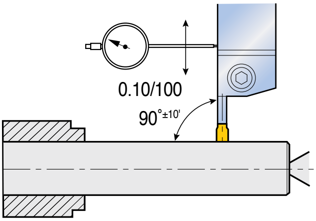
Contents

Toolholder or blade size

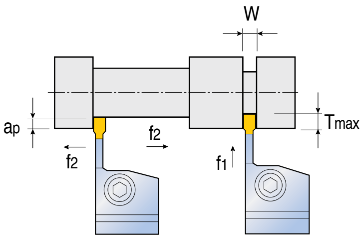
- To minimize risk of vibration and deflection always choose
- Toolholder or blade with the smallest possible overhang
- Toolholder with maximum shank dimension

90° mounting

- To minimize risk of vibration and deflection
  It is very important that the insert is mounted at 90° to the center line of the workpiece in order to obtain a perpendicular surface and reduce the risk of vibration



Machining definitions



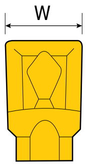
- Grooving
- Vc : Cutting speed (m/min)
- T : Maximum depth (mm)
- f1 : Feed in radial direction (mm/rev)

- Turning
- Vc : Cutting speed (m/min)
- apmax : Maximum depth of cut (mm)
- f2 : Feed in lateral direction (mm/rev)

Selecting inserts

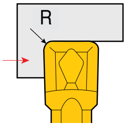
■ Insert width

- Insert width strongly affects strength
- For most efficient machining select the widest possible insert
- Chipbreaking range depends on insert width
- A narrow width improves chipbreaking at lower feed rates
- Wide inserts and strong blades require high forces and feed rates to achieve a frontal clearance angle



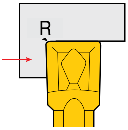
■ Corner radii - Lateral turning

- Choose large corner radii for long tool life



Large radii - Small side forces

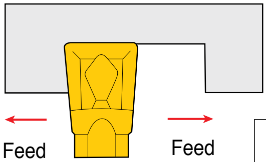
- Choose small corner radii to reduce cutting load and lower feed with narrow inserts



Small radii - Strong side forces

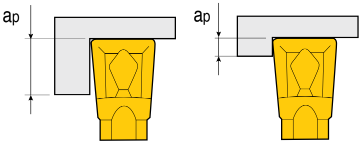
■ Turning feed

- Feed depends on chipbreaking range of the insert
- Maximum feed depends on insert width and is relative to the maximum load
- High feed with small corner radii may reduce tool life
- Maximum feed should not exceed the corner radii
- For better chip formation when grooving, feed can be interrupted at small intervals



Maximum feed:
f_{max}= Wx0.075

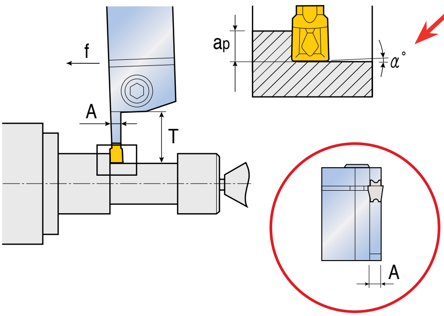
▪ Depth of cut
- Minimum depth of cut equals the corner radii
- Maximum depth of cut depends on maximum possible load
- Depth of cut depends on chipbreaking range
- Large depth of cut causes large deflection and large frontal clearance
- With a small depth of cut the deflection and frontal clearance may be too small



Maximum depth of cut: a_{pmax}= W x 0.8

▶ Principle of turning with T-CLAMP ULTRA PLUS tools

The clearance angle □° is a function of the side cutting forces and is not constant as is the case with ISO inserts.



Clearance angle between the insert and workpiece

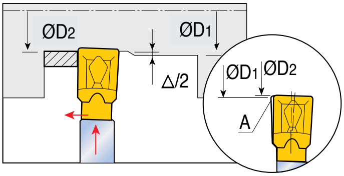
▪ The deflection is influenced by
- Feed: f
- Depth of cut: ap
- Overhang: T
- Cutting speed: Vc
- Workpiece material

✻ When these factors are properly applied, the insert (□°) creates a “Wiper” action providing excellent surface quality and tolerance

Finishing operation: Diameter compensation

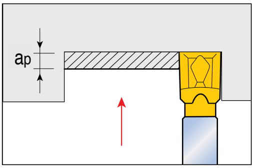
- A compensation factor for the finish diameter must be used in the final machining operation.
After grooving to the desired diameter, the machining direction changes to longitudinal turning.
At this point deflection occurs.
If machining continues without tool compensation, corner A will penetrate the workpiecs as a result of the deflection phenomenon (See picture). This will result in two different diameters $ØD_1$ from the grooving operation and $ØD_2$ from the turning operation. The difference between $ØD_1$ and $ØD_2$ is the change in diameter, designated at Delta △.
Tool compensation factor is calculated as shown:

$$\frac{\triangle}{2} = \frac{ØD_1 - ØD_2}{2}$$

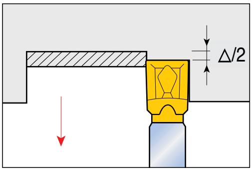


Bad

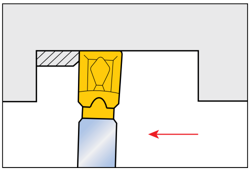
- Using the compensation factor will eliminate the difference in part diameter.
Follow this simple procedure during machining



❶ Groove to the final diameter



❷ Pull the tool back, a distance equal to the value of △/2



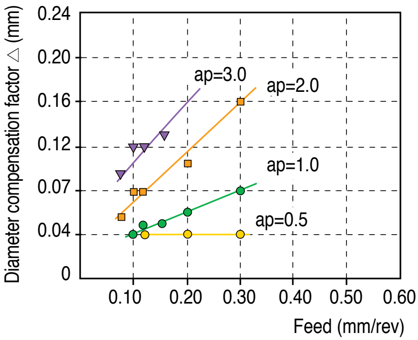
❸ Continue the finish turning operation

- The diagrams show experimental results for specific machining conditions. These are sample values that will vary with different workpiece materials and different holder types

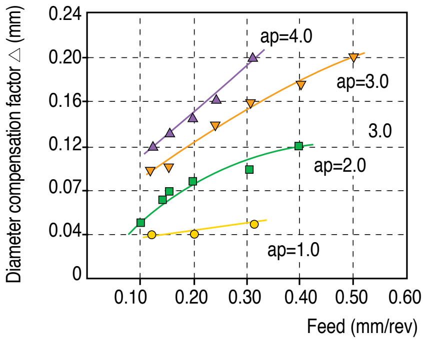
- Recommendation:

Measure the △value for your finishing operation in a short test using your selected finishing conditions.
Do not run your test using the final diameter

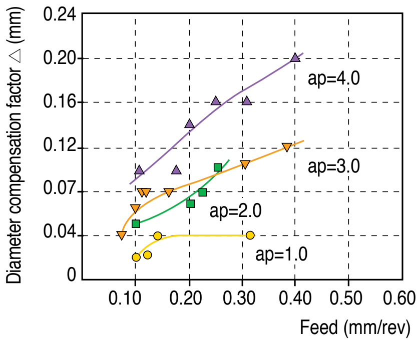
Insert: TDT 3.00E-0.40
Toolholder: TTER 2525-3



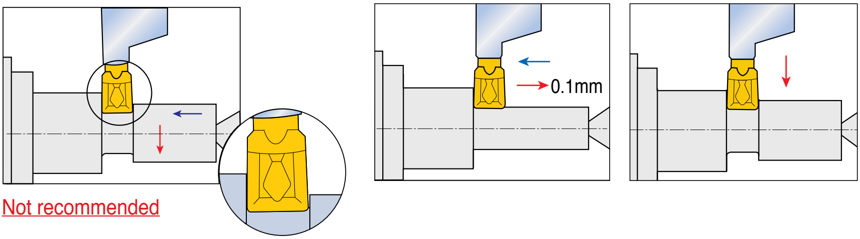
Insert: TDT 4.00E-0.40
Toolholder: TTER 2525-4



Insert: TDT 6.00E-0.80
Toolholder: TTER 2525-6



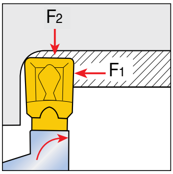
Multifunction operations



Not recommended

The multifunctional tools can operate in a sequence of grooving and turning modes. Moving from turning to grooving requires consideration of each basic principle. This will eliminate the possibility of insert breakage. In this situation, customers must release the side deflection necessary in turning but not recommended in grooving.

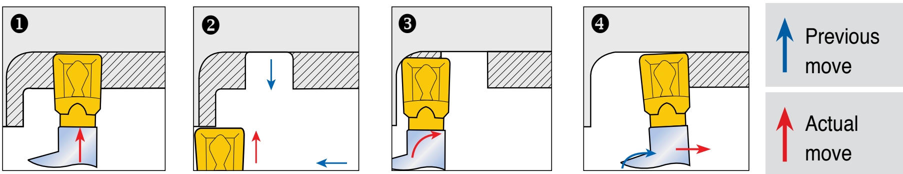
Machining a radius or chamfer



Not recommended

The machining of a corner with a radius or a chamfer larger than the radius of the insert always requires the combination of movement in two directions. Problems such as insert breakage result when this combined operation is used while the insert is plunged into the workpiece with material on all sides.
Insert breakage is caused by forces acting simultaneously in two different directions as shown in F_1 and F_2.

- Recommended procedure to optimize machining and eliminate insert breakage

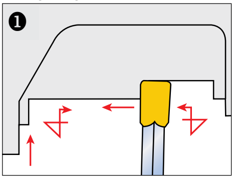


Machining between walls

One of the most important advantages of the T-CLAMP ULTRA PLUS system is the ability to machine between walls.
To achieve the best result - follow the recommended sequence

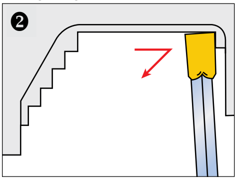
Leave steps near the wall. Do not arrive at the same Z value!!!

Roughing

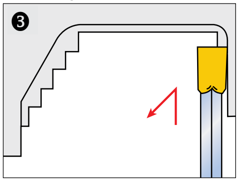


Z value=0.2 - 0.3mm

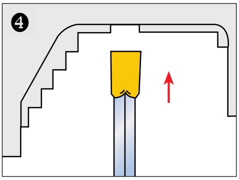
Roughing



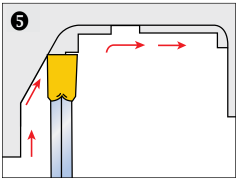
Finishing



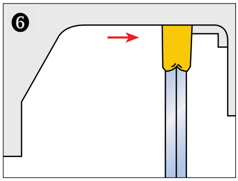
Finishing



Finishing



Finishing

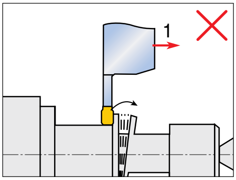


Eliminating a ‘Hanging ring’

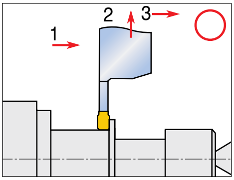
When turning at the end of a bar or toward a recess between two walls, a 'Hanging Ring' may be formed.

To eliminate the ‘Hanging ring’

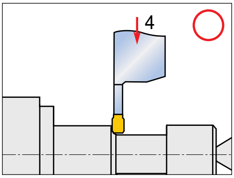
Roughing



Roughing

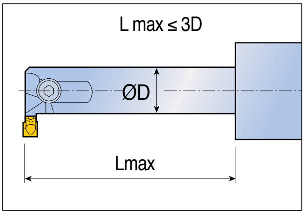


Finishing

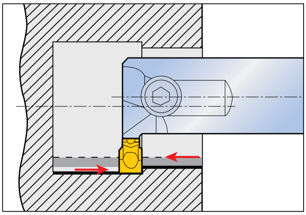


Optimizing internal machining

- The first pass uses one corner for roughing
- The other corner is used on the return path for semi-finishing or finishing
- Tool position looks out of sequence with the amount of material that is removed
- Rapid position back to initial groove and then continue with face turning toward the center



Toolholder Overhang

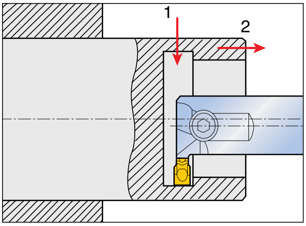


Efficient use of Insert corners

Improving internal turning in a blind hole

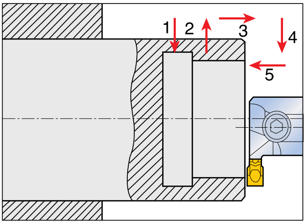
Internal turning in a blind hole brings about the problem of chip evacuation.
When the tool reaches the rear side wall, chips may be caught between the wall and the insert, causing breakage.

Two solutions that can eliminate this problem:



First solution

❶ Start by grooving at the rear wall
❷ Continue by turning from the inside toward the outside



Second solution

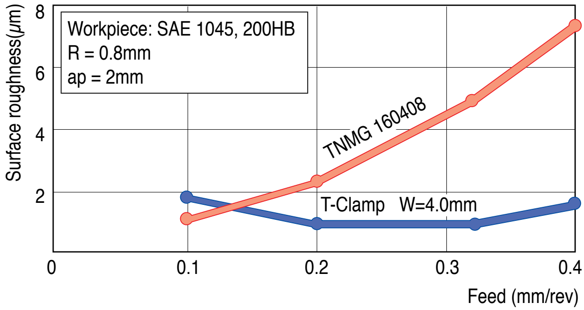
❶ Start by grooving at the rear wall
❷ Pull the tool back to the outside. Turn the final diameter from outside toward the groove

Surface quality

- Eliminating grinding operations

  Turning with T-CLAMP ULTRA PLUS Tools gives a surface quality superior to anything possible when using standard ISO tools. In fact, turning with T-CLAMP ULTRA PLUS Tools can produce a surface quality comparable to grinding.

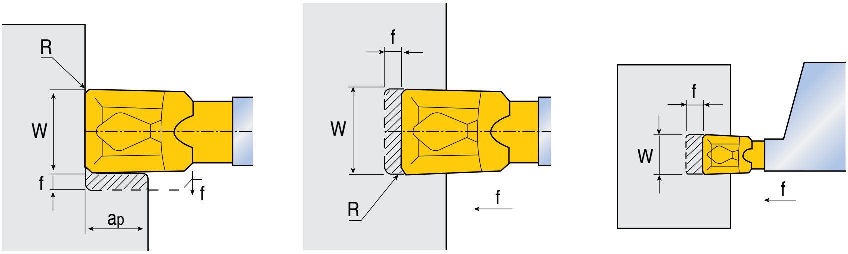
T-CLAMP ULTRA PLUS vs ISO turning inserts



Calculation of required machine power

Turning	Grooving / Parting	Face grooving
$P = \dfrac{Kc \cdot ap \cdot f \cdot Vc}{\square \cdot 45 \cdot 10^3}$ [HP]	$P = \dfrac{Kc \cdot W \cdot f \cdot Vc}{\square \cdot 45 \cdot 10^3}$ [HP]	$P = \dfrac{Kc \cdot W \cdot f \cdot Vc}{\square \cdot 45 \cdot 10^3}$ [HP]

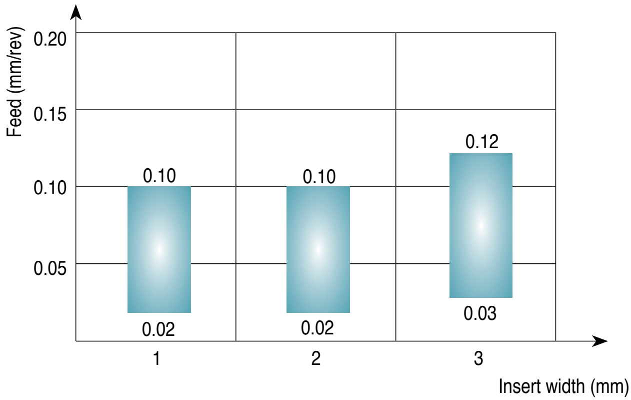
Turning	Grooving / Parting	Face grooving
$P = \dfrac{Kc \cdot ap \cdot f \cdot Vc}{\square \cdot 61 \cdot 10^3}$ [kw]	$P = \dfrac{Kc \cdot W \cdot f \cdot Vc}{\square \cdot 61 \cdot 10^3}$ [kw]	$P = \dfrac{Kc \cdot W \cdot f \cdot Vc}{\square \cdot 61 \cdot 10^3}$ [kw]



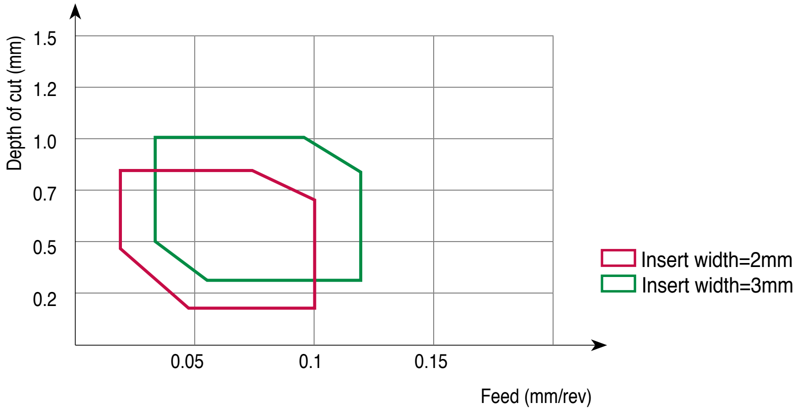
Where Kc appears : Specific cutting forces (N/mm^2) could be used.
$\square$: Efficiency ($\square \approx 0.8$)

TDIM,TDIP cutting conditions

▪ Grooving

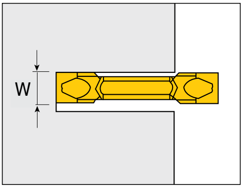


▪ Turning

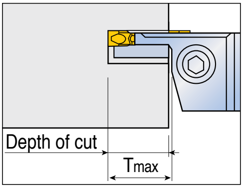


Tool selection for face turning & face grooving

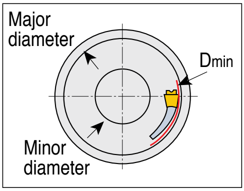
- Follow these three recommendations for selecting the correct cutting too



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



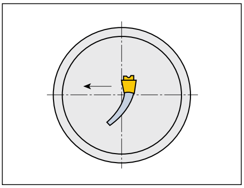
Choose the shortest toolholder overhang, according to the maximum depth required



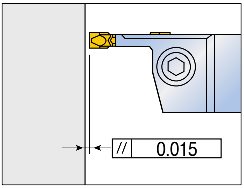
Choose the tool range with the largest diameter depending on the initial grooving diameter required in the application

Tool adjustment

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



Check the cutting-edge height at center line, take a light cut toward the center, and check for a burr

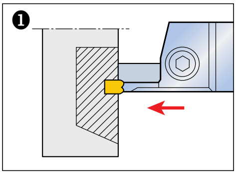


Check parallelism of cutting edge and the machined surface. Correct position can guarantee good surface quality when face turning in both directions

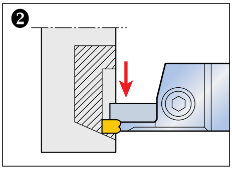
Optimizing the machining procedure

▪ For roughing

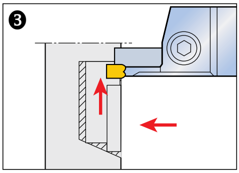
Basic steps for roughing operations when face turning with T-CLAMP ULTRA PLUS tools



Grooving into initial diameter range



Turning away from center

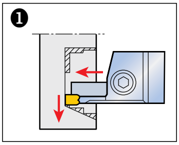


Rapid position back to initial groove and continue with face turning toward center

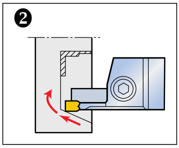
- When face grooving, reduce the speed by 40% in relation to that used in face turning

▪ For finishing

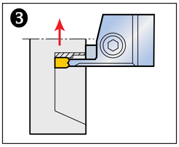
Basic steps for finishing operations when face turning with T-CLAMP ULTRA PLUS tools



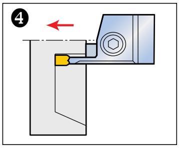
After initial groove move away from center



Finish major diameter and radius



Rapid position back to initial groove and continue with face turning toward center

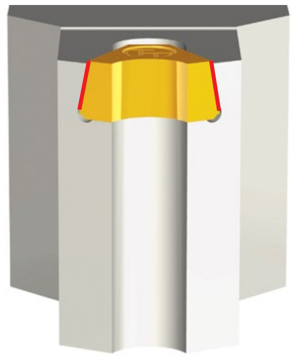


Finish minor diameter

- When face grooving, reduce the speed by 40% in relation to that used in face turning

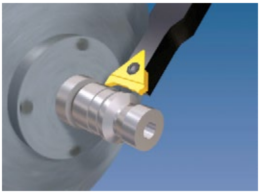
T-GROOVE clamping system

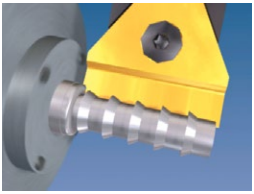
- Angled screw & wedge clamping provide rigidity and security of insert clamping
- One tool and one shot operation provide highly accurate machining
- One tool and one shot operation provide high productivity
- Replacing HSS profiled tools and brazed carbide profile tools
- Several profile inserts can be mounted on one holder
- One insert for external & internal machining

Dovetail clamping	Angled screw clamping
	

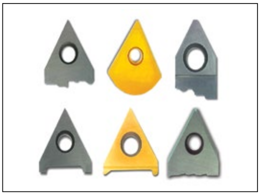
- Angle screw & dovetail clamping provide rigidity and security of insert clamping

■ External profiling insert
- Blank size: 10, 15, 20, 25mm



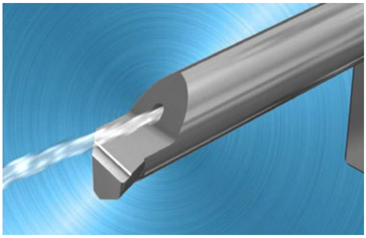


■ Special insert



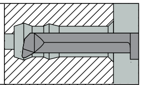
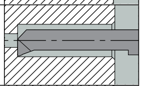
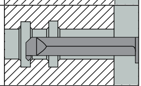
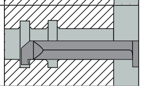
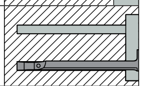
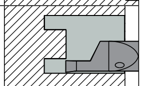
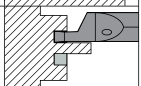
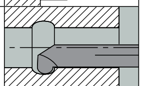
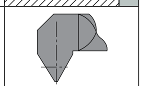
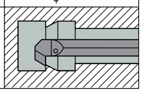
TOPMICRO

- Internal machining from Ømin 0.6mm
- Best solution for internal turning, profiling, grooving and face machining especially on small diameters
- TiAlN coating for extended tool life
- Shank diameters - Ø4mm & Ø7mm
- Internal coolant through the body directly to the cutting edge
- Promotes better chip evacuation and longer tool life



Machining program

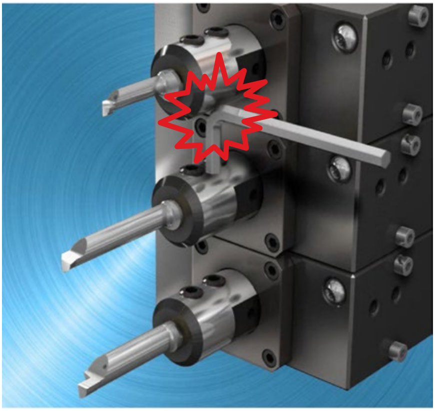
Includes a large variety of tools for various applications

Turning & Chamfering	MINT... Type Min. Bore Dia.: Ø0.6-7.0mm	
Turning & Profiling	MINP... Type Min. Bore Dia.: Ø2.8-5.0mm	
Turning & 45° Chamfering	MINC... Type Min. Bore Dia.: Ø5.0-6.8mm	
Grooving	MING... Type Min. Bore Dia.: Ø2.0-6.8mm	
Deep face grooving	MINF... Type Min. Bore Dia.: Ø15mm	
Face grooving	MINF... Type Min. Bore Dia.: Ø6.0-8.0mm	
Face grooving	MINA... Type Min. Bore Dia.: Ø6.0mm	
Profiling	MINR... Type Min. Bore Dia.: Ø5.0-6.8mm	
Threading	MINN... Type Min. Bore Dia.: Ø4.0-7.0mm	
Back turning	MINB... Type Min. Bore Dia.: Ø3.0-7.0mm	

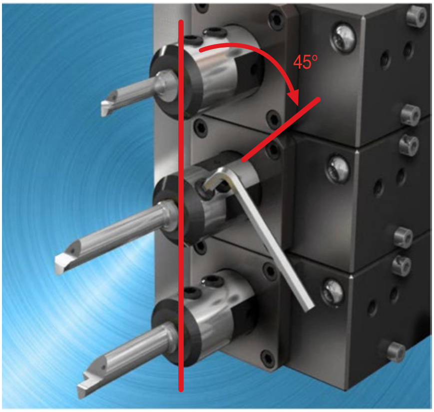
Sleeves

- Angular clamping design avoids interference with the other sleeves at the tool post during tool change
- The unique design facilitates simplified tool change on swiss type and other multi-spindle lathes
- Reduced machine downtime, tool inventory and overall costs

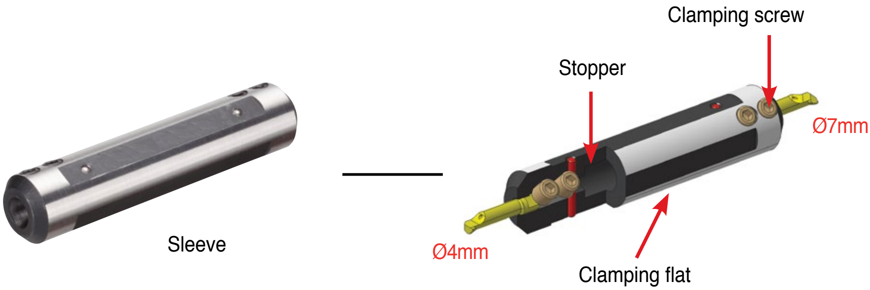
Conventional



TOPMICRO



▪ TOPMICRO sleeves have a stopper inside the hole:
- Prevents any tool movement during machining
- Enables tool change without resetting tool offsets



for TOPMICRO (Ø4mm or Ø7mm)

Insert features

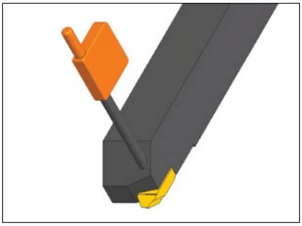
- Excellent surface finish and repeatability credit to high precision ground inserts
- Ultra fine, ground cutting edge prevents micro-chipping and promotes longer tool life
- Chip breaker designed for low cutting force and smooth chip evacuation

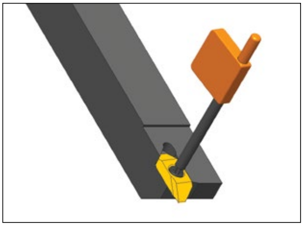
Main grade: TT9010 features

- For roughing to finishing applications in small parts machining
- High mechanical shock resistance
- Ultra fine grain size substrate with TiN PVD coating

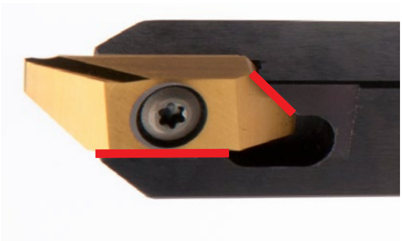
Toolholder features

- Designed for setting on small automatic lathe machines
- Precision ground toolholders ensure accurate mounting to the lathe promoting stable machining
- Insert indexing from both sides of holder

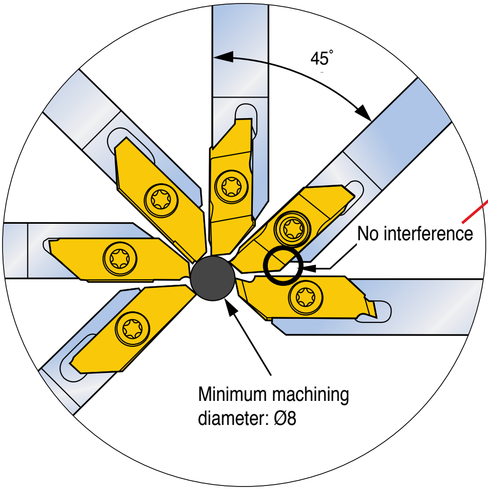


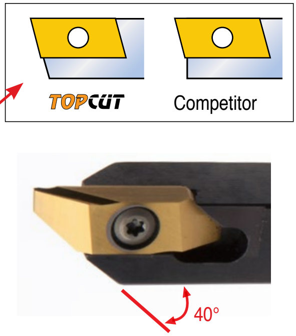


- Dovetail shape of insert & pocket means a stable clamping system

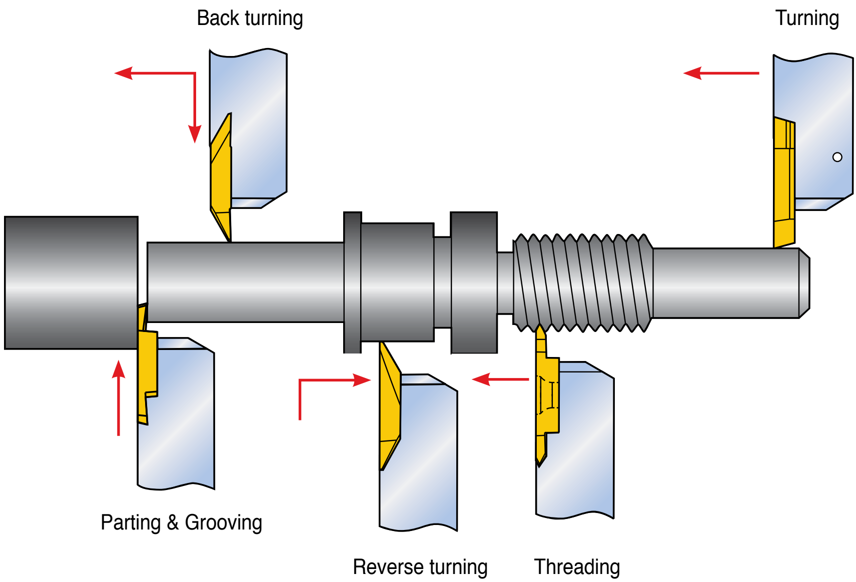


- High clearance angle on both insert and holder ensures no interference with other holders when mounted on radial tool post

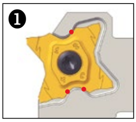


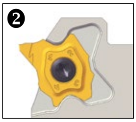


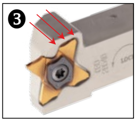
Applications



QUADRUSH







- 4 cutting edges for better economy

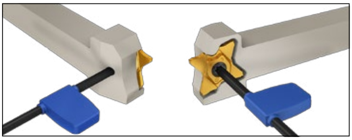
- 3 contact points away from the cutting edges (Fig.1)
  - Accurate positioning of insert when indexing
  - Even if edges are broken any remaining edge can be used (Fig.2)

- Pocket protects unused edges from chips during the machining process (Fig.3)

- TQC
  - Grooving and parting of hard materials
  - medium and high feed rate

- TQJ
  - Positive rake angle for soft materials, parting of tubes, small diameters and thin-walled parts
  - Low to medium feed rate

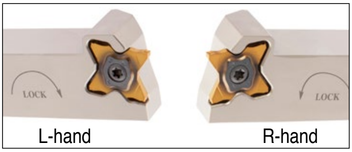
- TQS
  - Straight cutting edges with high positive rake angle
  - Insert width from 0.5 to 8.2mm as standard and special item
  - CT3000 (cermet) grade is available for Improved surface quality, tool life and higher cutting speeds



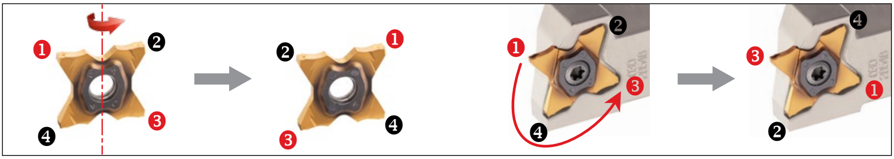
- Unique torx key & screw for insert clamping
  - Insert indexing from both sides of the holder
  - A major advantage over swiss type lathes

- Side lock torx screws
  - Ensures rigid clamping in holder

- 2 different setting screws are applied
  - L-hand holder: R-hand screw
  - R-hand holder: L-hand screw



Guideline for insert positioning

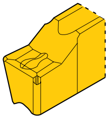
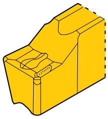
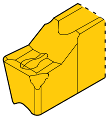
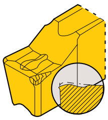


Correct

Wrong

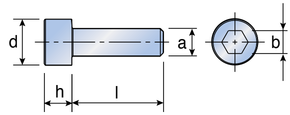
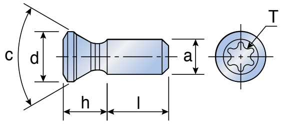
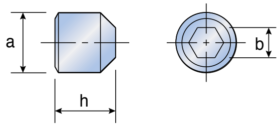
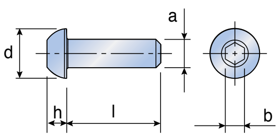
Contents

Trouble Shooting

Problem	Cause	Solution
 Rapid flank wear short tool life	- Excessively high cutting speed - Carbide with too low wear resistance	- Decrease cutting speed - Use a carbide with higher hardness or a coated carbide
 Cratering short tool life	- High cutting temperature on insert rake face at high feed and speed	- Decrease feed and speed - Use coated grade
 Cutting edge/ Insert fracture	- High load on insert - Insert width too narrow - Grade too brittle	- Use wider insert for maximum support - Decrease feed and speed - Choose a tougher grade
 Plastic deformation	- High heat pressure decreasing carbide hardness	- Use a bigger corner radius and decrease feed and speed - Choose carbide with higher hardness
Chip control spaghetti-like chips coil under holder and interfere with operation	- Small depth of cut - Feed too slow - Insert width too large - Insert radius too large	- Check chipbreaking range - Increase depth of cut - Increase feed rate - Use narrower insert with a smaller radius
Poor surface finish	- Small depth of cut, i.e. less than corner radius	- Increase depth of cut to minimum radius size
Vibration and poor surface quality	- Small front clearance angle between insert and workpiece leads to rubbing action	- Increase feed to get suitable clearance - Before starting, check that the front cutting edge is parallel to workpiece

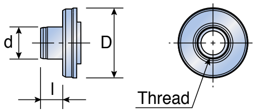
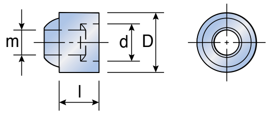
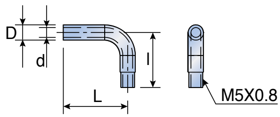
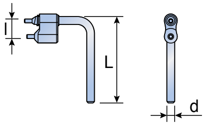
Components

Screw

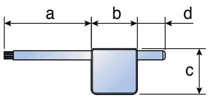
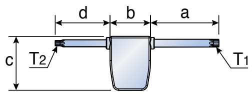
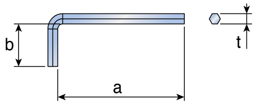
Shape	Description	Dimensions (mm)							Torque (N.m)
		a	d	h	l	b	c	T	
	**SH M4x0.7x20-MO**	M4x0.7	6.0	3.9	20.0	3	-	-	3.5
	SH M5x0.8x10	M5x0.8	8.5	5.0	10.0	4	-	-	5.5
	SH M5x0.8x12	M5x0.8	8.5	5.0	12.0	4	-	-	5.5
	SH M5x0.8x16	M5x0.8	8.5	5.0	16.0	4	-	-	5.5
	SH M5x0.8x20	M5x0.8	8.5	5.0	20.0	4	-	-	5.5
	SH M5x0.8x25	M5x0.8	8.5	5.0	25.0	4	-	-	5.5
	SH M6x1.0x16	M6x1.0	10.0	6.0	16.0	5	-	-	8.0
	SH M6x1.0x20	M6x1.0	10.0	6.0	20.0	5	-	-	8.0
	SH M6x1.0x25	M6x1.0	10.0	6.0	25.0	5	-	-	8.0
	SH M6x1.0x40	M6x1.0	10.0	6.0	40.0	5	-	-	8.0
	SH M8x1.25x20	M8x1.25	13.0	8.0	20.0	6	-	-	12.0
	SH M8x1.25x25	M8x1.25	13.0	8.0	25.0	6	-	-	12.0
	SR M6x30	M6x1.0	10.0	6.0	30.0	5	-	-	8.0
	**TS 40093I**	M4x0.7	5.7	5.0	4.0	-	60°	T15	3.5
	TS 40097I	M4x0.7	5.2	3.4	6.3	-	60°	T15	3.5
	TS 40A115I	M4x0.7	5.5	5.4	6.1	-	60°	T15	3.5
	TS 40B100I	M4x0.7	6.0	4.0	6.0	-	-	T15	3.5
	TS 45120I	M4.5x0.75	6.9	4.5	7.5	-	-	T20	5.0
	TS 50125I	M5x0.8	6.4	5.3	7.2	-	43°	T10/20	5.5
	TS 50125IL	M5x0.8	6.4	5.3	7.2	-	43°	T10/20	5.5
	TS 60190I	M6x1.0	8.5	7.0	12.0	-	60°	4(Hexa)	6.0
	CSTB-4SD	M4x0.7	5.5	3.5	4.5	-	60°	T8	3.5
	**SS M5x0.8x4-MG**	M5x0.8	-	4	-	2.5	-	-	2.5
	SS M5x0.8x6-MG	M5x0.8	-	6	-	2.5	-	-	2.5
	**BH M6x1x20**	M6x1.0	10.5	4.2	20.0	4	-	-	5.5

Components

Spare part

Shape	Description	Dimensions (mm)						
		D	d	L	l	m	Thread	
Seal 	**PL 16**	16	8.0	-	7.0	-	M6x1.0	
	PL 20	20	8.5	-	7.0	-	M6x1.0	
	PL 25	25	11.5	-	8.5	-	R 1/8	
	PL 32	32	11.5	-	8.5	-	R 1/8	
	PL 40	40	11.5	-	8.5	-	R 1/8	
Nozzle 	**NZ-125**	12	7.5	-	8.0	5.0	-	
Nozzle Pipe 	**NZP-5**	5	3.2	21	18.0	-	-	
Extractor 	**EDG-23B**	-	6.0	78	14.5	-	-	
	EDG-33B	-	6.0	78	15.0	-	-	

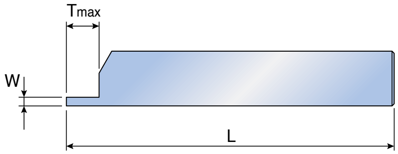
Wrench

Shape	Description	Dimensions (mm)						
		a	b	c	d	t	T1	T2
	**T 8**	39.0	19	19	13.0	-	-	-
	T 15	45.0	22	27	15.0	-	-	-
	T 20	49.0	22	30	15.0	-	-	-
	**T10/20**	33.5	25	28	26.5	-	T20	T10
	**L-W 2.5**	56.0	18	-	-	2.5	-	-
	L-W 3	63.0	20	-	-	3.0	-	-
	L-W 4	70.0	25	-	-	4.0	-	-
	L-W 5	80.0	28	-	-	5.0	-	-
	L-W6	90.0	32	-	-	6.0	-	-

Tailor-made Order Form

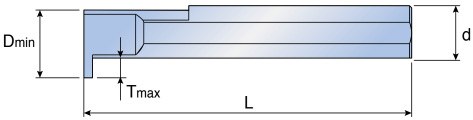
Specific dimensions

External holder



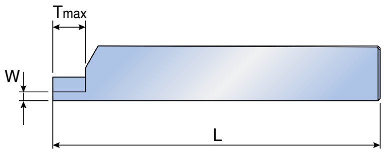
Right handed shown

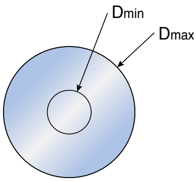
Internal holder



Right handed shown

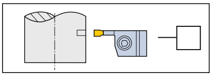
Facing holder



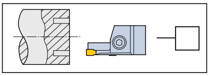


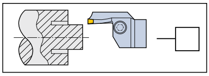
Right handed shown

External holder



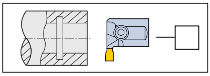
Facing holder





RN type

Internal holder



Holder handed

- Right handed ☐
- Light handed ☐

Insert

- Grade: ____________
- Chip breaker type: ____________

Quantity

- ____________ pcs

Workpieces

- Part: ____________
- Material: ____________
- Hardness: ____________

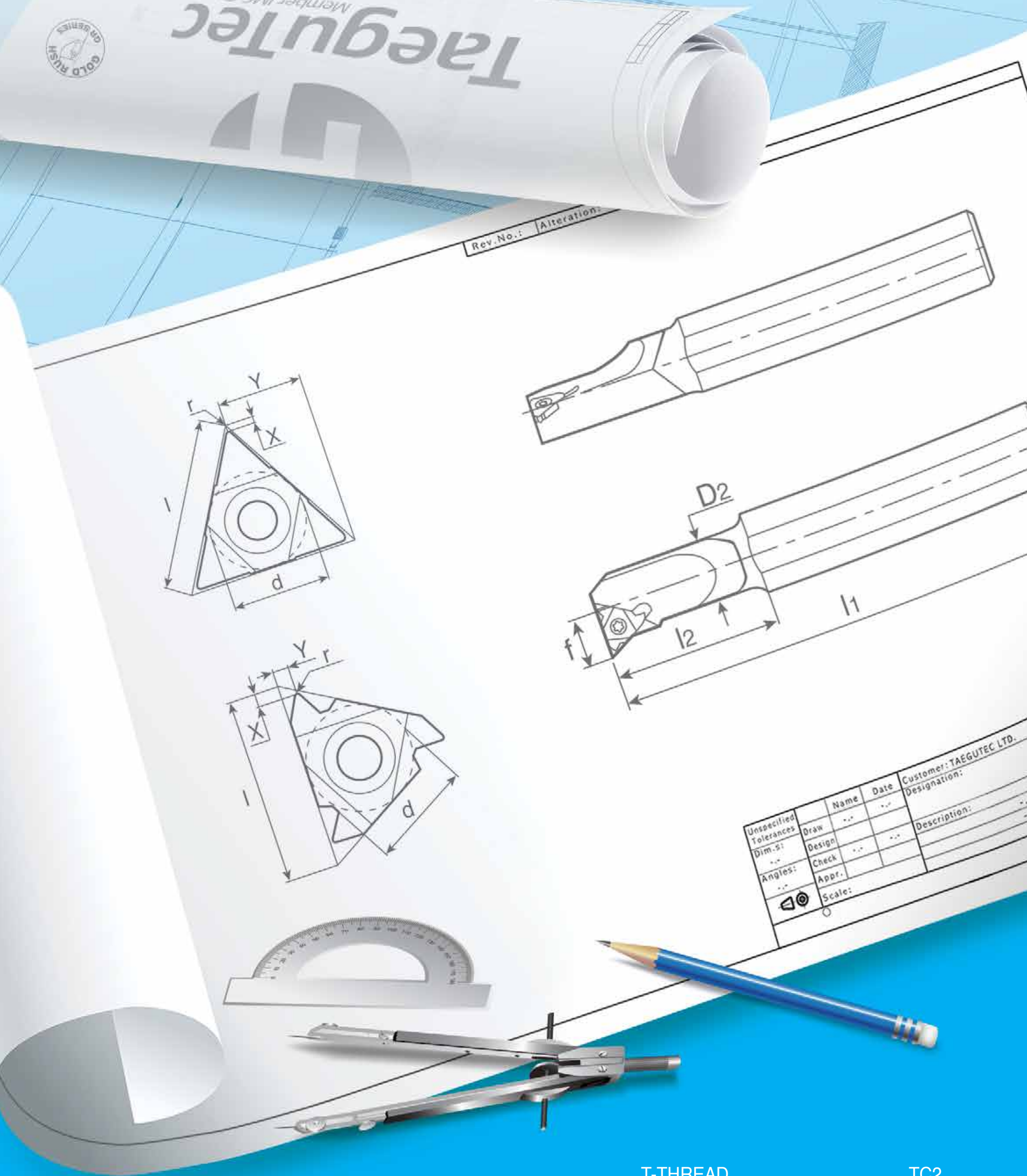
Comment

■ Customer: ____________ ■ Contact: ____________

■ Address : ____________

■ Telephone : ____________ ■ Fax : ____________

■ E-mail : ____________

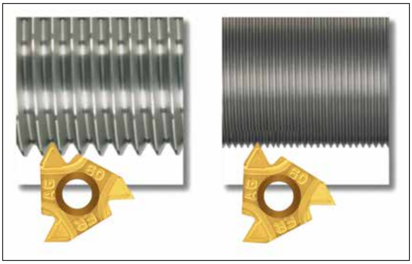


TECHNICAL GUIDE

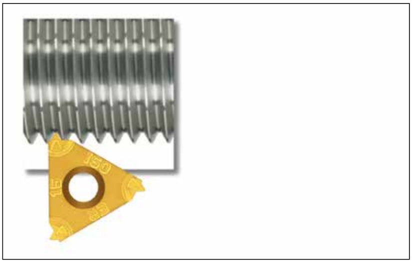
-Thread Making

Contents

Threading inserts - Types and profiles



■ Partial profile
- Suitable for a wide range of pitches with a common angle (60° or 55°)
- Inserts with small root-corner radius suitable for the smallest pitch range
- Additional operations to complete the outer / internal diameter is necessary
- Not recommended for mass production
- Eliminates the need for different inserts



■ Full profile
- Performs complete thread profile
- Root corner radius is suitable only for the relevant pitch
- Recommended for mass production
- Suitable for one profile only

Insert geometries

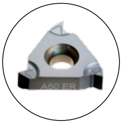
■ Geometry M
- First choice for most operations and materials
- Sintered chip breaker for excellent chip control with short broken chips

■ Geometry B
- Molded chip breaker with sharp cutting edges lower cutting force
- Solution for stainless steels, high temperature alloys, mild steel
- Improved chip breaking and better chip evacuation
- Better surface quality

■ Regular type (No suffix)
- Sharp cutting edge for machining of ductile materials
- Low cutting forces and reduced built-up edge
- wide range of profiles and size

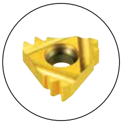
■ Multi-tooth
- Full profile but 2 or 3 cutting teeth on each corner
- Higher productivity due to fewer passes
- Recommended for mass production and larger batches
- Optimal distribution of cutting load

Geometry M
(eg. 16ERM)



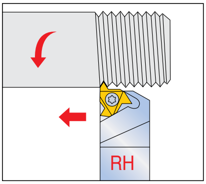
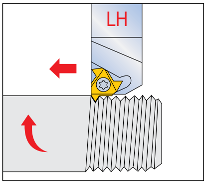
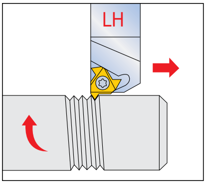
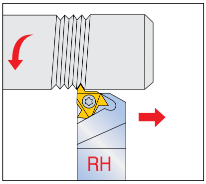
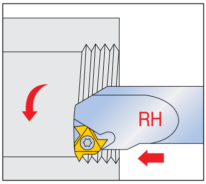
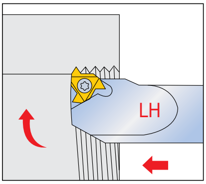
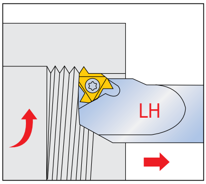
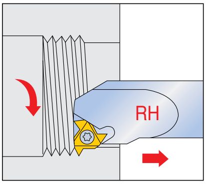
Geometry B
(eg. 16ERB)

Regular type
(eg. 16ER)



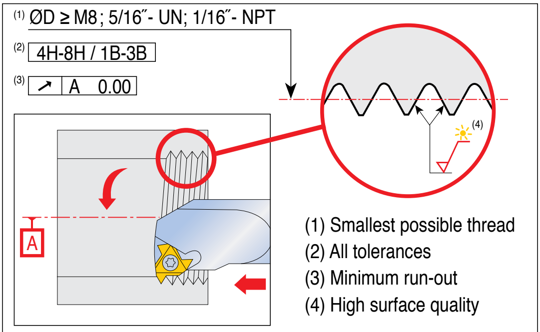
Multi-tooth
(eg. 16ER...-2M/3M)

Thread turning methods

	Right-hand thread	Left-hand thread
External thread		
	 Change anvil to negative[1]	 Change anvil to negative[1]
Internal thread		
	 Change anvil to negative[1]	 Change anvil to negative[1]

- [1] See page TC4

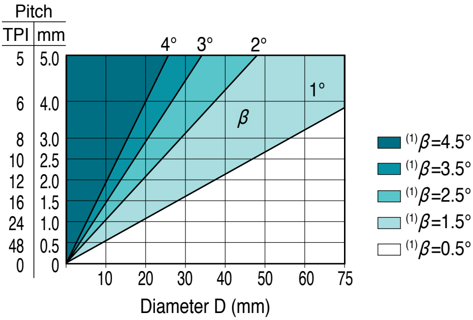
Mini - tool features



(1) Smallest possible thread
(2) All tolerances
(3) Minimum run-out
(4) High surface quality

Thread helix angle and anvil selection

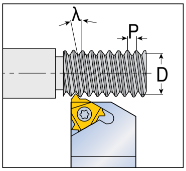
■ Helix angle λ evaluation



(1)β -Effective inclination angle

$$tg\ \lambda = \frac{1 \times P}{3.14 \cdot D}$$

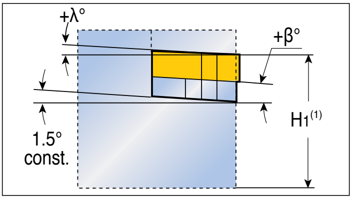
$$\lambda^\circ = \frac{20 \times P}{D}$$



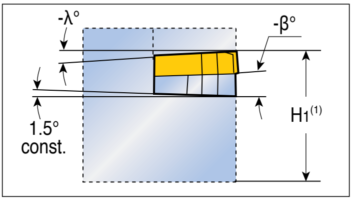
P - Pitch (mm)
D - Effective diameter of thread (mm)
λ - Angle of inclination

Anvil selection according to thread helix angle λ

		Standard						
Thread helix angle λ		> 4°	3°- 4°	2°- 3°	1°- 2°	0°- 1°	Negative anvils	
	Inclination angle β	4.5°	3.5°	2.5°	1.5°	0.5°	-0.5°	-1.5°
I(d)	Toolholder	Anvil designation						
16	EX RH OR IN LH	AE 16 +4.5	AE 16 +3.5	AE 16 +2.5	AE 16	AE 16 +0.5	AE 16 -0.5	AE 16 -1.5
(3/8)	EX LH OR IN RH	AI 16 +4.5	AI 16 +3.5	AI 16 +2.5	AI 16	AI 16 +0.5	AI 16 -0.5	AI 16 -1.5
22	EX RH OR IN LH	AE 22 +4.5	AE 22 +3.5	AE 22 +2.5	AE 22	AE 22 +0.5	AE 22 -0.5	AE 22 -1.5
(1/2)	EX LH OR IN RH	AI 22 +4.5	AI 22 +3.5	AI 22 +2.5	AI 22	AI 22 +0.5	AI 22 -0.5	AI 22 -1.5
27	EX RH OR IN LH	AE 27 +4.5	AE 27 +3.5	AE 27 +2.5	AE 27	AI 27 +0.5	AE 27 -0.5	AE 27 -1.5
(5/8)	EX LH OR IN RH	AI 27 +4.5	AI 27 +3.5	AI 27 +2.5	AI 27	AI 27 +0.5	AI 27 -0.5	AI 27 -1.5
22U	EX RH OR IN LH	AE 22U +4.5	AE 22U +3.5	AE 22U +2.5	AE 22U	AE 22U +0.5	AE 22U -0.5	AE 22U -1.5
(1/2U)	EX LH OR IN RH	AI 22U +4.5	AI 22U +3.5	AI 22U +2.5	AI 22U	AI 22U +0.5	AI 22U -0.5	AI 22U -1.5
27U	EX RH OR IN LH	AE 27U +4.5	AE 27U +3.5	AE 27U +2.5	AE 27U	AE 27U +0.5	AE 27U -0.5	AE 27U -1.5
(5/8U)	EX LH OR IN RH	AI 27U +4.5	AI 27U +3.5	AI 27U +2.5	AI 27U	AI 27U +0.5	AI 27U -0.5	AI 27U -1.5



■ Anvils for positive inclination angle β applicable when turning
- RH thread with RH holder or LH thread with LH holder

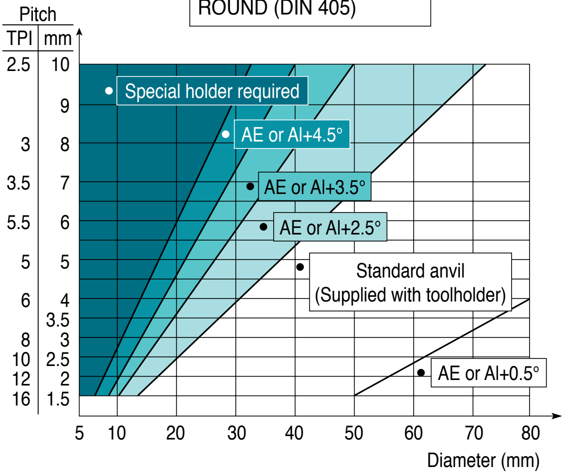


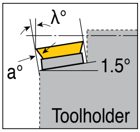
■ Anvils for negative inclination β used when turning
- RH thread with LH holder or LH thread with RH holder

• (1) H_1 remains constant for every anvil combination.

▶ Anvil selection according to thread helix angle λ

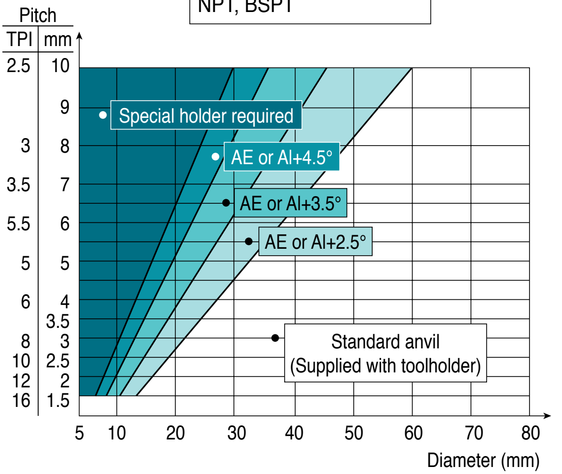
ACME
STUB ACME
TRAPEZE (DIN 103)
ROUND (DIN 405)





AE anvils : EX-RH and IN-LH toolholders
AI anvils : IN-RH and EX-LH toolholders

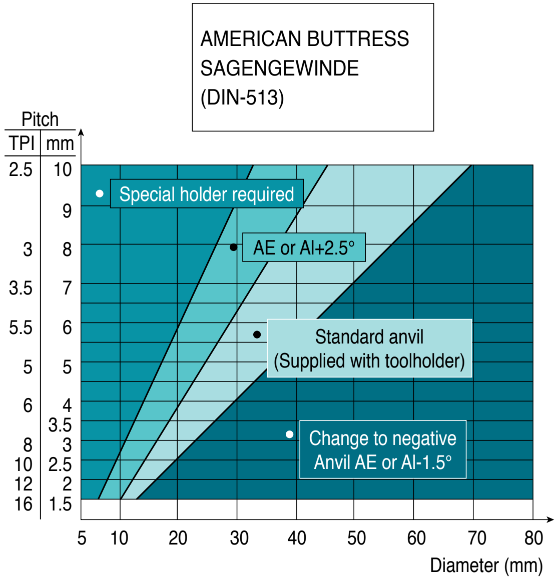
PARTIAL PROFILES 60°
PARTIAL PROFILES 55°
ISO, UN,WHITWORTH,
NPT, BSPT

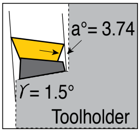


AE anvils : EX-RH and IN-LH toolholders
AI anvils : IN-RH and EX-LH toolholders

Contents

Anvil selection according to thread helix angle λ





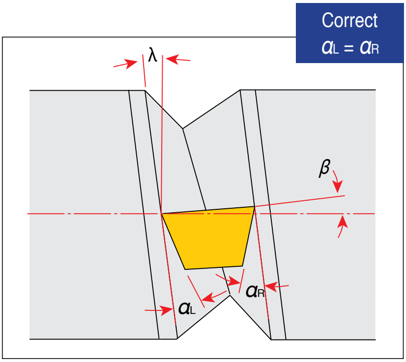
Replacing the standard anvil with a negative angle anvil will eliminate side rubbing.

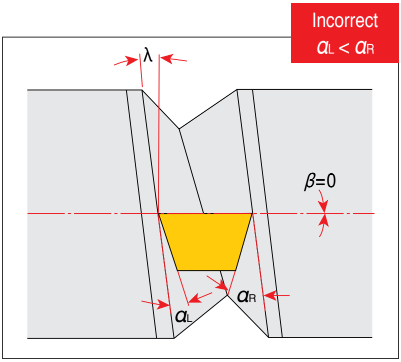
AE anvils : EX-RH and IN-LH toolholders

AI anvils : IN-RH and EX-LH toolholders

Flank clearance and effective inclination angle

Inclination angle β of the cutting edges correspond to a specific thread helix angle λ and insures equal clearance angle on both sides of insert.

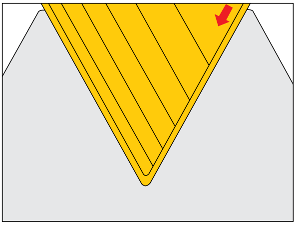




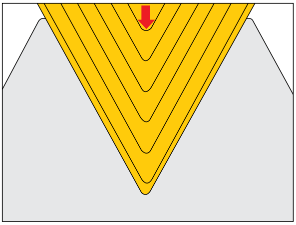
α - Flank clearance angle
λ - Helix angle
β - Effective inclination angle is achieved by selecting the suitable anvil

Infeed methods for threading operations

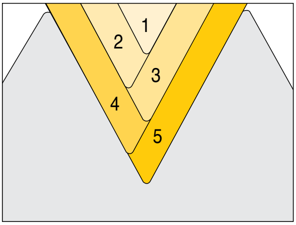
Flank infeed



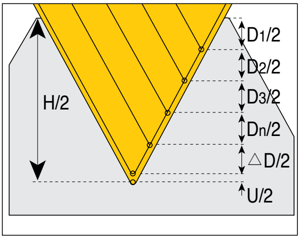
Radial infeed



Alternating flank infeed

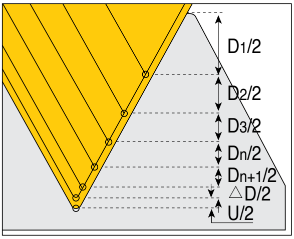


Flank equal
Equal depth of cut for each pass



$$\frac{D_1}{2} = \frac{D_2}{2} = \frac{D_3}{2} = \frac{D_n}{2}$$

Flank diminishing
Diminished depth of cut for each pass



$$\frac{D_1}{2} > \frac{D_2}{2} > \frac{D_3}{2} > \frac{D_n}{2} > \frac{D_{n+1}}{2}$$

TS-THREAD solid carbide tool

▪ Features
- More flutes in relation to cutting diameter, spiral flutes reduce cutting forces
- Sharp ground helical cutting edges
- Low cutting forces
- Short machining time
- Thread diameter accuracy adjustment
- Thread milling next to bottom of blind hole
- Bottom thread relief not required
- Excellent and controlled thread surface finish
- No problem with broken taps
- One tool is suitable for various thread milling profile
- Easy and efficient machining for thread milling on CNC milling centers
- Threading of asymmetric parts
- Large variety of tool diameters

▪ Diameter range
- Metric: 0.72-25mm

TS-THREAD TMTSR tool with indexable inserts

▪ Features
- Dovetail pocket design absorbs and carries high cutting forces and high rigidity
- Large variety of thread forms and standards
- Most inserts are double-sided with two cutting edges
- Enables production of precision threads on CNC milling machines and machining centers, using helical interpolation programs
- For internal or external threads that are not located on the rotation axis of the part
- For precision threading
- Prevents chip jamming, which commonly occurs when tapping
- Cost advantage over tapping for large diameters
- Eliminates regrinding
- A single insert can be used for many diameters with the same pitch, for right or left thread
- Tapered threads do not require taper reaming
- Eliminates the removal of broken taps in holes

▪ Diameter range
- End mills
  Metric: 9.5-50mm
- Shell mills
  Metric: 63-100mm

▪ Insert sizes
- 12, 14, 21, 30, 40mm

TS-THREAD TMTSRH tool with long helical indexable inserts is the ultimate solution for very fast and efficient thread milling.

■ Features
- The helical inserts engage with the workpiece smoothly and exert lower cutting forces and reduce vibration, when compared with straight, negative axial tools
- Enables machining at very high feeds and produces a high quality surface finish
- Simple and very convenient screw clamping mechanism makes insert indexing accurate and user-friendly
- By using these tools, thread production time can be very short

■ Diameter range
- Metric: 23-63mm

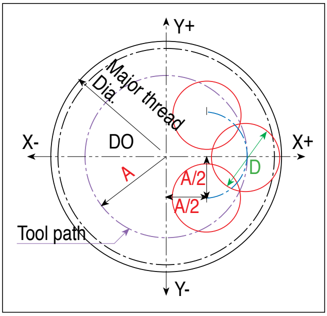
■ Insert sizes
- 27mm for tool diameter 23mm
- 32mm for tool diameter 32mm
- 37mm for tool diameter 45mm
- 38mm for tool diameter 63mm

- Thread milling CNC program for internal thread

Right-hand thread (climb milling) from bottom up.
Program is based on tool center.
This method of programming needs no tool radius compensation value, other than an offset for wear.

$A = \frac{Do-D}{2}$

A = Radius of tool path
Do = Major thread diameter
D = Cutting diameter



- General program

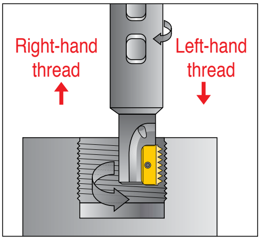
```
G90   G00 G54 G43 H1X0 Y0 Z10 S...
G00   Z-(to thread depth)
G01   G91 G41 D1 X(A/2) Y-(A/2) Z0 F...
G03   X(A/2) Y(A/2) R(A/2) Z(1/8 pitch)
G03   X0 Y0 I-(A) J0 Z(pitch)
G03   X-(A/2) Y(A/2) R(A/2) Z(1/8 pitch)
G01   G40 X-(A/2) Y-(A/2) Z0
G90   X0 Y0 Z0
```

- Internal thread

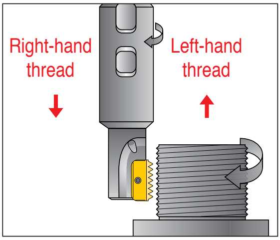
Example: M 48x2.0 IN-RH (Thread depth 25mm)
Toolholder: TMTSR0029 J30 (Cutting dia. 29mm)
Insert: TMT30 I2.0 ISO
A=(Do-D)/2=(48-29)/2=9.5
A/2=4.75
(Tool compensation of radius=0)

```
G90   G0 G54 G43 G17 H1X0 Y0 Z10 S1320
G0    Z-25
G01   G91 G41 D1X 4.75 Y-4.75 Z0 F41
G03   X4.75 Y4.75 R4.75 Z0.25
G03   X0 Y0 I-9.5 J0 Z2.0
G03   X-4.75 Y4.75 R4.75 Z0.25
G01   G40 X-4.75 Y-4.75 Z0
G90   G0 X0 Y0 Z0
M30
%
```

Internal thread



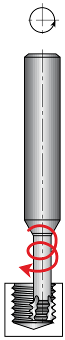
External thread



Thread milling operation is applicable for thread cutting in non-symmetrical parts utilizing the advantage of helical interpolation programs on modern machining centers.

TMTECS small diameter, short solid carbide thread mills

- The TMTECS solid carbide thread mills are used for the production of small internal threads. These thread mills feature a short 3-tooth cutting zone with 3 flutes and a released neck between the cutting zone and the shank.
- This unique tool design offers very precise profiles and a high performance TT9030 submicron carbide grade with PVD titanium aluminum nitride coating. The very short profile exerts a low force which minimizes tool bending. This facilitates parallel and high thread precision for the entire length.



- Compared to taps, the TS-THREAD is more accurate, thread machining is substantially faster and there is no danger of a broken tap being stuck in the hole.

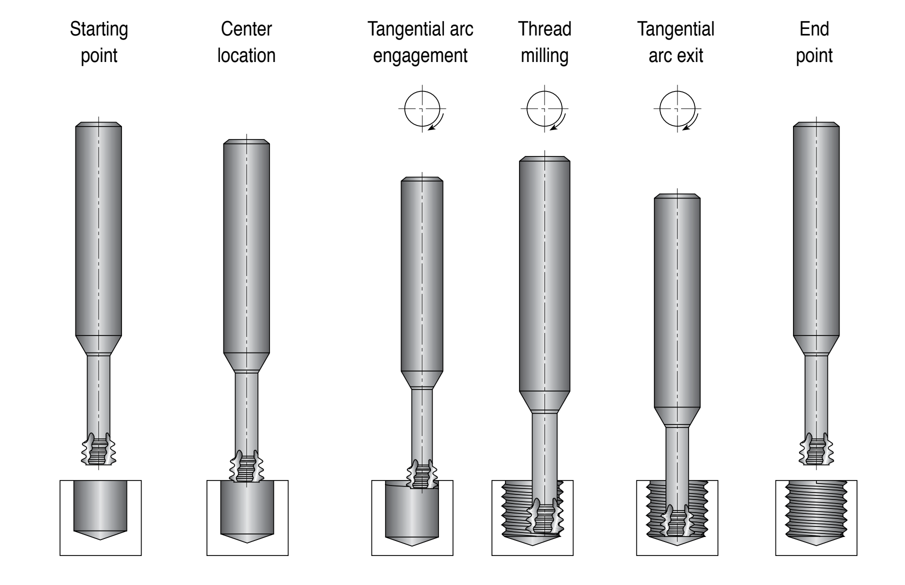
■ Thread mill vs. Tap

Features	Solid carbide thread mills	Taps
Thread surface quality	High	Medium
Thread geometry	Very accurate	Medium
Thread tolerance	4H, 5H, 6H with std. cutter	6H with standard tap, 4H with special tap
Machining time	Shorter or same as tap	Short
Machining load	Very low	High
Range of thread diameters	Wide range of diameters	Specific tap for each thread size
Right/left-hands threading	Same cutter	Specific tap for right and left-hands
Geometric shape	Full profile	Partial profile

■ Features
- Minimum thread size: M1.4x0.3 (1.1mm bore diameter) up to M20x2.50
- 2xD and 3xD threading lengths
- High cutting speeds
- Short cycle time
- Low cutting forces due to the short contact profile resulting in accurate and parallel thread
- Prevents oval threads near thin walls
- No more dealing with broken taps
- Reliable threading in blind holes
- Excellent performance on hardened steel, high temperature alloys and titanium

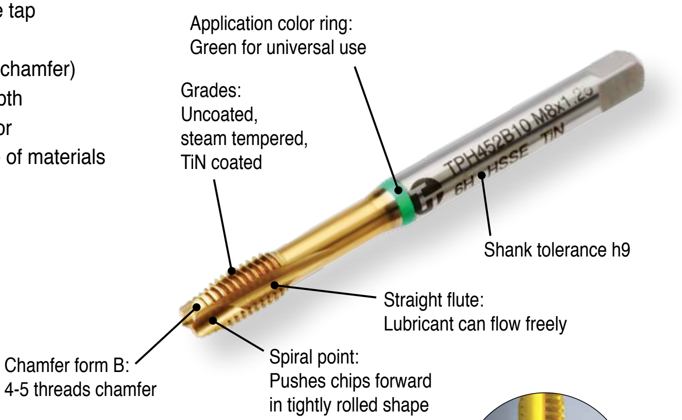
Thread milling - Recommended procedure

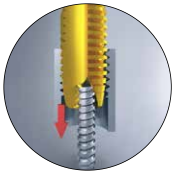
- TMTECS small diameter, short solid carbide thread mills



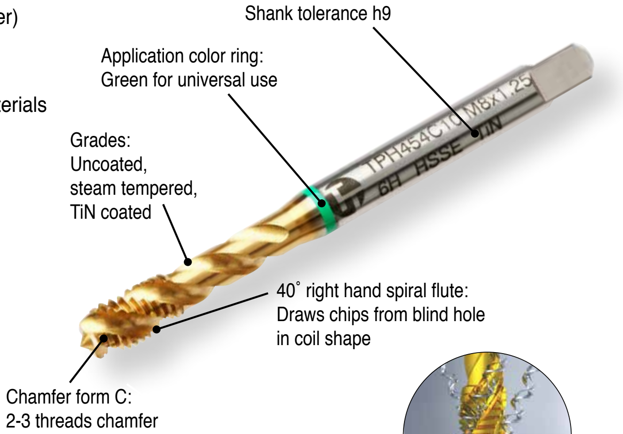
Features

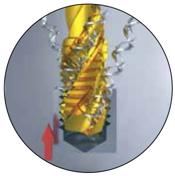
■ Straight flute with spiral point
- Premium HSS-E through hole tap
- Straight flute with spiral point
- Chamfer form B (4-5 threads chamfer)
- Capable up to 3xD thread depth
- Optimized cutting geometry for universal use in a wide range of materials
- ISO 2-6H tolerance
- Industrial standard
  M2-M10: DIN371
  M12-M20: DIN376
  MF8-MF16: DIN374





■ Right hand spiral flute, 40˚
- Premium HSS-E blind hole tap
- Right hand 40˚ spiral flute
- Chamfer form C (2-3 threads chamfer)
- Capable up to 3xD thread depth
- Optimized cutting geometry for universal use in a wide range of materials
- ISO 2-6H tolerance
- Industrial standard
  M2-M10: DIN371
  M12-M20: DIN376
  MF8-MF16: DIN374





T-TAP grades

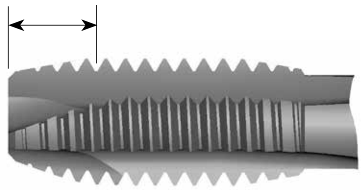
Grades	Code	Color	Characteristics & applications
Uncoated	No	Bright metal 	• Economical choice • Recommended for steel up to max. 800N/mm² and non ferrous materials
Steam tempered	05	Dark black 	• Ferric oxide layer at the cutting edges protect the surface and prevent built-up edge • Recommended for mild steels, low carbon steels and stainless steels
TiN coated	10	Gold yellow 	• PVD titanium nitride layer • High hardness, chemical stability and heat resistance • Longer tool life credit to balanced characteristics • Universal application on a wide range of materials

Application (ISO)	P	M	K	N	S
Uncoated	○		○	●	
Steam tempered	●	●	○	○	
TiN coated	●	●	○	○	○

● : Recommended
○ : Suitable

Chamfer

The tap chamfer is the tapering of the threads to distribute cutting action over several teeth. It generally reduces cutting forces, increases tool life and allows higher cutting speed. When the tap enters the hole and begins to cut, each tooth in the chamfer gradually enlarges the thread in the part. Only the “first full thread” behind the chamfer produces the finished size of the thread. The teeth beyond the first full thread serve to guide and support the tap as it creates the desired complete threaded depth of the tapped hole. Chamfer lengths are selected based upon the type of hole to be tapped.



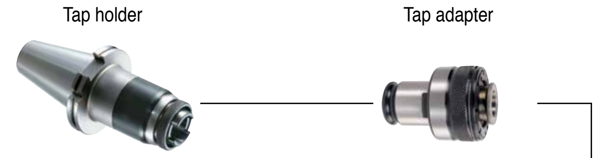
■ Long thread chamfer:
- Through hole
- Blind hole with sufficient room at the bottom

■ Short thread chamfer:
- Thread to the bottom of blind hole

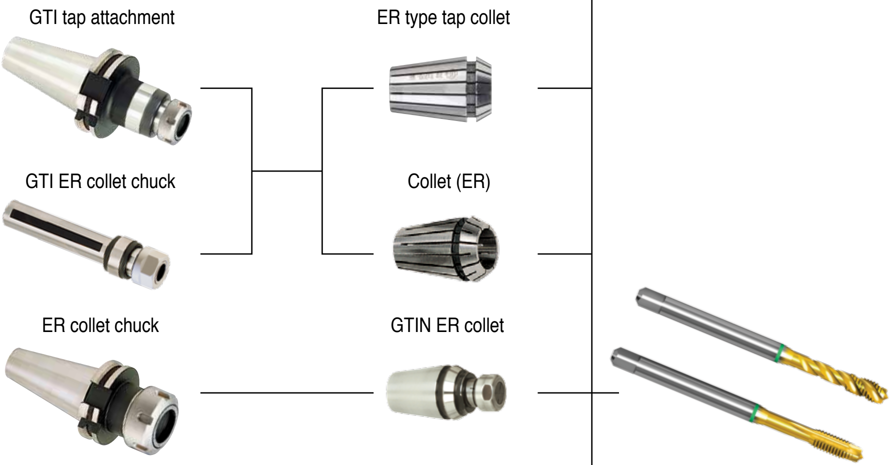
Form A	Form B	Form C	Form D	Form E	Form F
5-6 threads	4-5 threads	2-3 threads	3.5-5 threads	1.5-2 threads	1-1.5 threads

TaeguTec standard tap chucking system

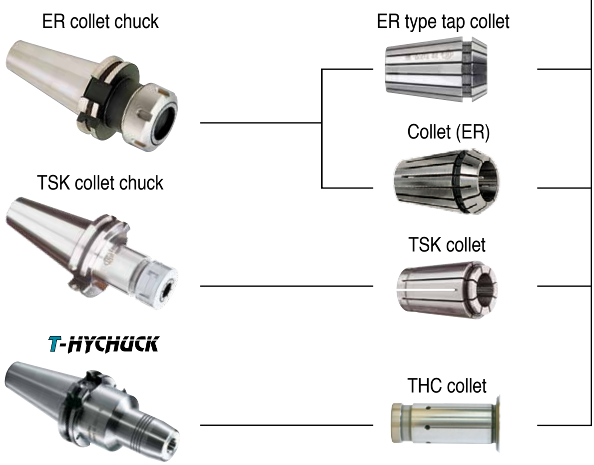
■ Quick change & torque safety type provided with tension and compression



■ Tension & compression with radial floating function

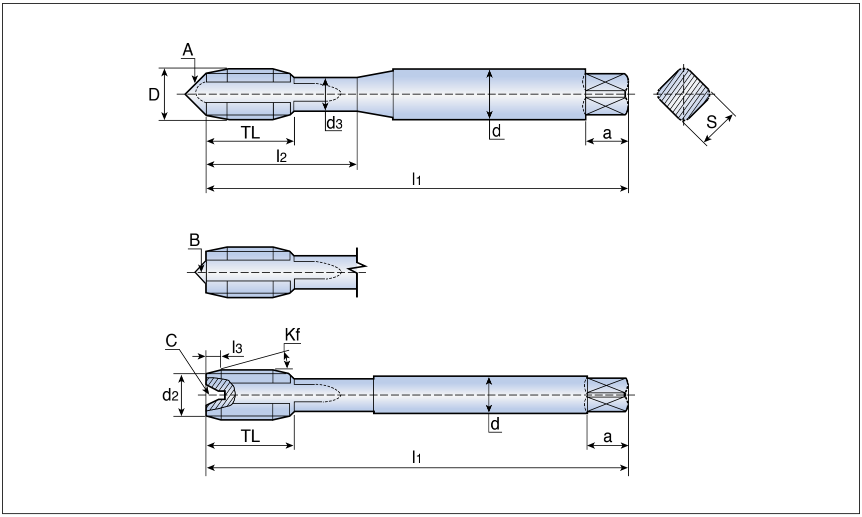


■ Rigid tap holders



Taps - Technical vocabulary

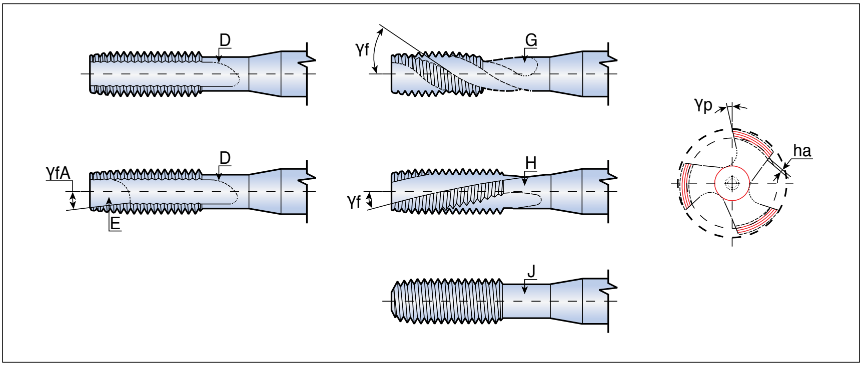
- Letters of dimensions



A = External center
B = Reduced external center
C = Internal center
D = Major diameter of tap
d = Shank diameter of tap

d_2 = Chamfer diameter
d_3 = Neck diameter
l_1 = Total length
TL = Thread length
l_2 = Effective length

l_3 = Chamfer length
S = Square size
a = Square length
Kf = Chamfer angle



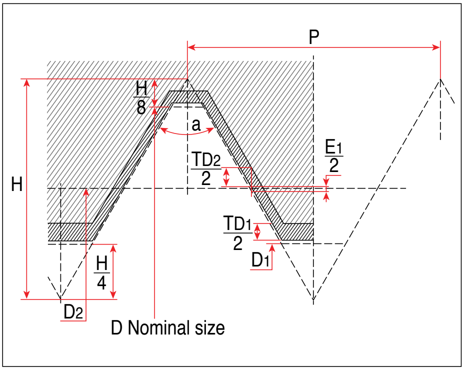
D = Straight flutes
E = Spiral point
G = Right hand spiral
H = Left hand spiral
J = Roll tap

γf = Flute angle
γfA = Angle of spiral point
γp = Chip angle
ha = Chamfer relief

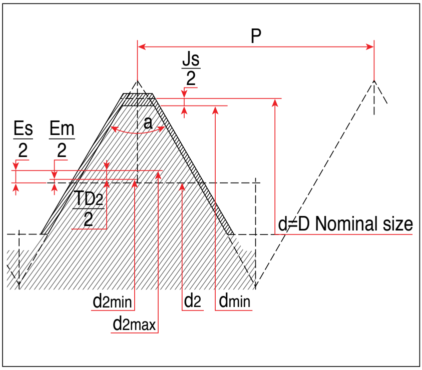
Tap tolerances (Thread portion of taps)

Extracted from DIN EN 22 857

▪ Female thread profile

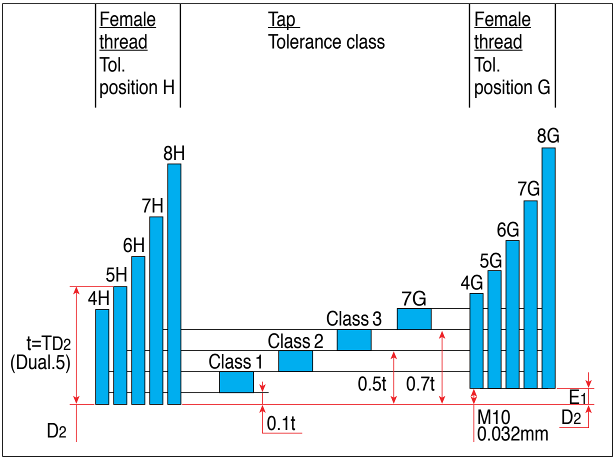


▪ Profile of tap



E_1 = Theoretical size
D = Nominal diameter
D_1 = Nominal core diameter
D_2 = Flank diameter
H = Triangular height
P = Pitch
TD_1 = Tolerance of core hole diameter
TD_2 = Tolerance of flank diameter
a = Thread angle

d = D = Nominal diameter
d_{min} = Minimum outside diameter
d_2 = D_2 = Minimum outside diameter
d_{2max} = Maximum flank diameter
d_{2min} = Minimum flank diameter
Em = Minimum flank diameter
Es = Maximum flank diameter
Js = Minimum clearance in diameter
P = Pitch
TD_2 = Tolerance of the flank diameter



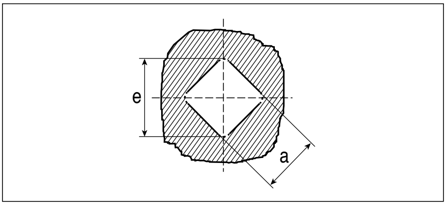
Tolerance class of tap		Area of tolerance of thread to be cut				
According						
DIN	ISO					
4H	ISO1	4H	5H	-	-	-
6H	ISO2	4G	5G	6H	-	-
6G	ISO3	-	-	6G	7H	8H
7G	-	-	-	-	7G	8G

Contents

Squares

DIN 10 - 6.97 Tab. 1

- Inner squares



- Outer squares

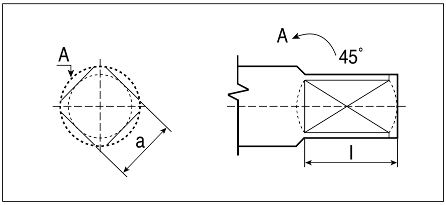
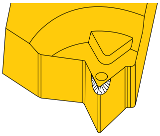
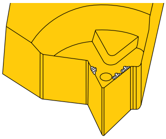
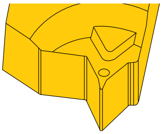
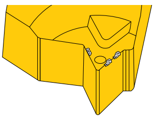


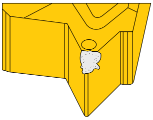
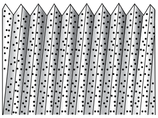
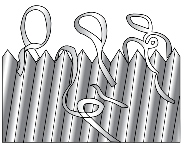
Chart 1	Nom. Dim.	Square						Cylindrical shaft		
		Inner square			Outer square			Diameters		Preferred diameter
	a	a		e	a		l	d		d
		max.	min.	min.	max.	min.	js 16[1]	from	to	
Description of a square with nom	2.1	2.260	2.120	2.89	2.100	2.010	5	2.47	2.83	2.5; 2.8
	2.4	2.560	2.420	3.27	2.400	2.310	5	2.83	3.20	-
Dimension a = 10mm	2.7	2.860	2.720	3.67	2.700	2.610	6	3.20	3.60	3.5
Square DIN 10-10	3.0	3.160	3.020	4.08	3.000	2.910	6	3.60	4.01	4
	3.4	3.610	3.430	4.60	3.400	3.280	6	4.01	4.53	4.5
Dimensions in millimeters	3.8	4.010	3.830	5.15	3.800	3.680	7	4.53	5.08	5
	4.3	4.510	4.330	5.86	4.300	4.180	7	5.08	5.79	5.5
	4.9	5.110	4.930	6.61	4.900	4.780	8	5.79	6.53	6
	5.5	5.710	5.530	7.41	5.500	5.380	8	6.53	7.33	7
	6.2	6.460	6.240	8.35	6.200	6.050	9	7.33	8.27	8
	7	7.260	7.040	9.54	7.000	6.850	10	8.27	9.46	9
	8	8.260	8.040	10.77	8.000	7.850	11	9.46	10.67	10
	9	9.260	9.040	12.10	9.000	8.850	12	10.67	12.00	11; 12
	10	10.260	10.040	13.43	10.000	9.850	13	12.00	13.33	-
	11	11.320	11.050	14.77	11.000	10.820	14	13.33	14.67	14
	12	12.320	12.050	16.10	12.000	11.820	15	14.67	16.00	16
	13	13.320	13.050	17.43	13.000	12.820	16	16.00	17.33	-
	14.5	14.820	14.550	19.44	14.500	14.320	17	17.33	19.33	18
	16	16.320	16.050	21.44	16.000	15.820	19	19.33	21.33	20
	18	18.320	18.050	24.11	18.000	17.820	21	21.33	24.00	22
	20	20.395	20.065	26.78	20.000	19.790	23	24.00	26.67	25
	22	22.395	22.065	29.44	22.000	21.790	25	26.67	29.33	28
	24	24.395	24.065	32.12	24.000	23.790	27	29.33	32.00	32
	26	26.395	26.065	34.79	26.000	25.790	29	32.00	34.67	-
	29	29.395	29.065	38.79	29.000	28.790	32	34.67	38.67	36
	32	32.470	32.080	42.80	32.000	31.750	35	38.67	42.67	40
	35	35.470	35.080	46.80	35.000	34.750	38	42.67	46.67	45
	39	39.470	39.080	52.20	39.000	38.750	42	46.67	52.06	50
	44	44.470	44.080	58.81	44.000	43.750	47	52.06	58.67	56
	49	49.470	49.080	65.48	49.000	48.750	52	58.67	65.33	63
	55	55.560	55.100	73.48	55.000	54.700	58	65.33	73.33	70
	61	61.560	61.100	81.50	61.000	60.700	64	73.33	81.33	80
[1] Does not apply to tools	68	68.560	68.100	90.83	68.000	67.700	71	81.33	90.66	90
activated by hand	76	76.560	76.100	101.51	76.000	75.700	79	90.66	101.33	100

Trouble Shooting

Problem	Cause	Solution
 Premature wear	- Cutting speed too high	- Reduce RPM
	- Infeed depth too small	- Increase depth of cut - Modify flank infeed
	- Highly abrasive material	- Use coated grade
	- Inadequate coolant supply	- Apply coolant
	- Wrong inclination anvil	- Reselect anvil
	- Wrong turned dia. prior to threading	- Check turned dia.
	- Insert is above center line	- Check center height
 Chipped edge	- Cutting speed too high	- Reduce RPM
	- Depth of cut too large	- Reduce depth of cut
	- Wrong grade	- Use coated grade - Use tougher grade
	- Poor chip control	- Modify flank infeed
	- Inadequate coolant supply	- Apply coolant
	- Center height incorrect	- Adjust center height
 Plastic deformation	- Excessive heat in cutting zone	- Reduce RPM - Reduce depth of cut - Check turned dia.
	- Wrong grade	- Use coated grade - Use harder grade
	- Inadequate coolant supply	- Apply more coolant
 Built-up edge	- Cutting edge too cold	- Increase RPM - Increase depth of cut
	- Wrong grade	- Use coated grade
	- Inadequate coolant supply	- Apply coolant

Contents

Trouble Shooting

Problem	Cause	Solution
 Broken nose during 1st pass	- Cutting edge too cold	- Increase RPM
	- Depth of cut too large	- Reduce depth of cut - Increase number of infeed passes
	- Wrong grade	- Use tougher grade
	- Wrong turned dia. prior to threading	- Check turned dia.
	- Corner height incorrect	- Adjust center height
	- Infeed depth too shallow	- Modify flank infeed
	- Wrong inclination anvil	- Reselect anvil
	- Tool overhang too long	- Reduce tool overhang
 Poor surface finish	- Wrong cutting speed	- Increase RPM - Reduce RPM
	- Excessive heat in cutting zone	- Reduce depth of cut
	- Poor chip control	- Modify flank infeed
	- Inadequate coolant supply	- Apply coolant
	- Wrong inclination anvil	- Reselect anvil
	- Tool overhang too long	- Reduce tool overhang
	- Center height incorrect	- Check center height
 Poor chip control	- Excessive heat in cutting zone	- Reduce RPM - Change depth of cut - Check turned dia.
	- Wrong grade	- Use coated grade - Check turned dia. - Use M-type insert
	- Inadequate coolant supply	- Apply coolant
	- Wrong turned dia. prior to threading	- Check turned dia.

Trouble Shooting

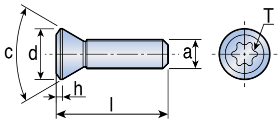
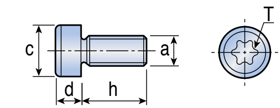
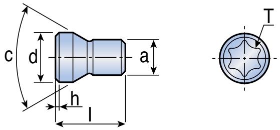
Problem	Cause	Solution
Thread too big	- Wrong tool type - Cutting edge not suited for the material	- Select the correct tool for both hole and material types for the hole type and material
	- Galling on tap flanks	- Optimize lubrication - Work with coated tool
	- Diameter of core hole too small, tool cuts with the core	- Select correct core hole diameter as per the TaeguTec chart
	- Accumulated chipping	- Blind hole: Select correct tap (Spiral tap) - Through hole: Select correct tap (Spiral point)
	- Wrong angle or false positioning of the core hole	- Change tool chucking, use chuck with centerline pendulum
	- Tolerance tap to gauge not correctly matched	- Select tool with correct tool tolerance
Thread too narrow	- Tolerance tap to gauge not correctly matched	- Select tool with correct tool tolerance
	- Incorrect tool type	- Select the correct tool for both hole and material types
Thread is cut axially	- Pressure of chuck too high or too low	- Select correct pressure
	- Incorrect pressure	- Use chucking with length compensation - Work with routing cartridge - Select correct tool type
Distortion of pitch (Go-side of gauge cannot be inserted all the way)	- Tap does not cut with correct pitch	- Select correct tool - Select correct chuck pressure
Thread with preamplitude	- Incorrect pressure	- Chucking with length compensation - Work with routing cartridge - Select correct tool type
Rough tool surface	- Wrong tool type	- Choose correct tool

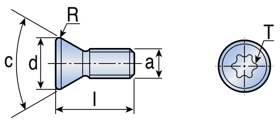
Trouble Shooting

Problem	Cause	Solution
Rough tool surface	- Chip congestion	- See "problems of thread too big"
	- Core hole diameter too small	- Select correct core hole diameter as per the TaeguTec chart
	- Galling on tap flanks	- Use coated taps - Optimize lubrication
	- Cutting speed is too low	- Change to higher cutting speed
Tool life not as expected	- Cutting speed too high or too low	- Select cutting speed from TaeguTec chart
	- Lubrication insufficient, wrong consistency	- Provide correct lubrication
	- High abrasion due to a lack of coating or incorrect coating	- Pay attention to TaeguTec recommendations

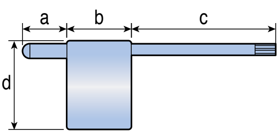
Components

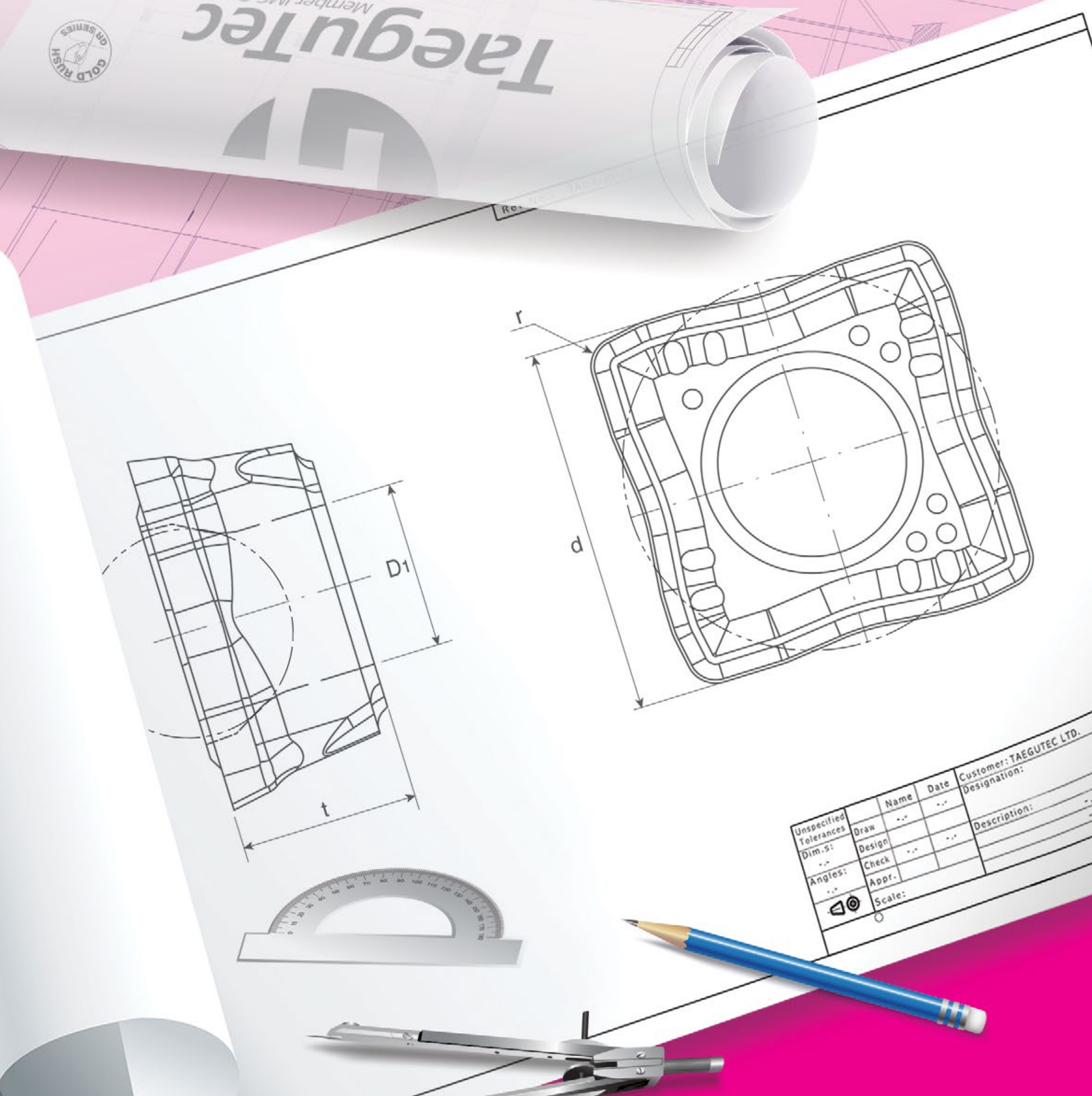
Screw

Shape	Description	Dimension (mm)						Torque (N.m)
		a	c	d	h	l	T	
	**S11**	M2.6x0.45	60°	4.5	0.35	6.5	T8	1.6
	S16	5-40 UNC	60°	5.5	0.70	12.2	T10	2.0
	S16S	5-40 UNC	60°	5.5	0.80	9.7	T10	2.0
	S22	8-32 UNC	60°	7.5	0.65	14.8	T20	2.5
	S22S	8-32UNC	60°	7.5	0.65	11.8	T20	2.5
	TS40	M5.0x0.8	60°	8.4	1.60	22	T25	5.0
	**A16**	5-40 UNC	5.4	2.7	6.8	-	T10	2.0
	A22	8-32UNC	6.8	3.8	6.2	-	T20	2.5
	A27	M5.0x0.8	8.5	3.5	6.0	-	T25	5.0
	**TS 20038I**	M2.0x0.4	60°	2.7	0.15	3.8	T6	0.6

Shape	Description	Dimension (mm)						Torque (N.m)
		a	c	d	l	R	T	
	**TS 20054I**	M2.0x0.4	60°	3.5	5.4	0.4	T6	0.6

Wrench

Shape	Description	Dimension (mm)						
		a	b	c	d			
	**T-6/5**	13	15	34.5	15			
	T-8/5	13	19	39.0	19			
	T-10/5	14	22	42.0	22			
	T-20/5	15	22	49.0	30			
	T-25	18	22	53.0	35			



TECHNICAL GUIDE

-Holemaking

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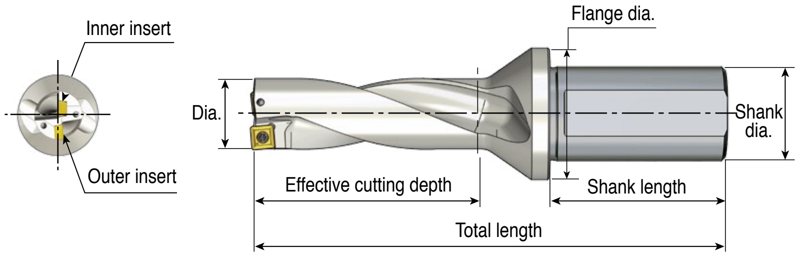
Indexable drill nomenclature



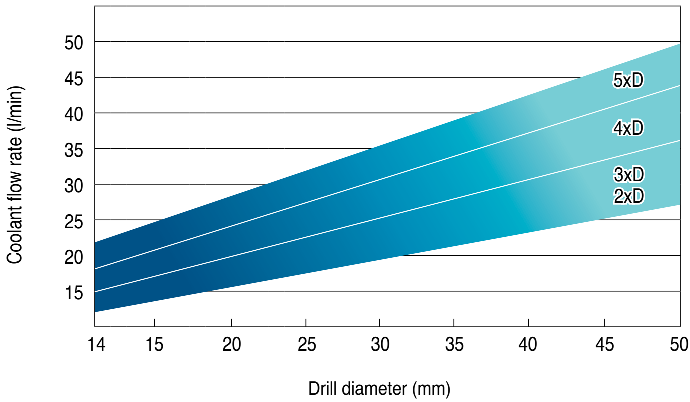
Optimal chip shape

Optimal chips from outer insert	Optimal chips from inner insert
	
Too loose	Too short
	

Features of TOPDRILL

- 4 cornered economical insert design
- The same insert is applicable for both internal and external pocket
- Improved machinability due to ideally configured cutting edge
- Applicable to most materials including low carbon and mild steel
- Helix flute geometry by twisted coolant channels enabling excellent chip evacuation and high precision hole operation
- Enhanced insert's durability with new grade (TT9080)

Coolant volume



Maximum radial adjustment (Stationary drilling)

Drill diameter	Insert	Radial shift	Max' hole (Ø)
14	SOMT 050204 DP	0.5	15.0
15		0.4	15.8
16		0.3	16.6
17	SOMT 060204 DP	0.5	18.0
18		0.4	18.8
19		0.3	19.6
20	SOMT 070306 DP	0.5	21.0
21		0.4	21.8
22		0.3	22.6
23	SOMT 08T306 DP	0.5	24.0
24		0.5	25.0
25		0.4	25.8
26		0.3	26.6
27	SOMT 09T308 DP	0.5	28.0
28		0.5	29.0
29		0.5	30.0
30		0.5	31.0
31		0.3	31.6
32	SOMT 11T308 DP	0.5	33.0
33		0.5	34.0
34		0.5	35.0
35		0.5	36.0
36		0.4	36.8
37	SOMT 130408 DP	0.5	38.0
38		0.5	39.0
39		0.5	40.0
40		0.5	41.0
41		0.5	42.0
42		0.5	43.0
43		0.5	44.0
44	SOMT 150510 DP	0.5	45.0
45		0.5	46.0
46		0.5	47.0
47		0.5	48.0
48		0.5	49.0
49		0.5	50.0
50		0.5	51.0

Hole tolerance (Based on stable conditions)

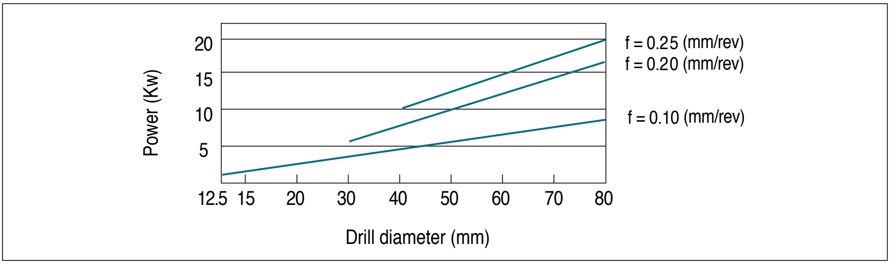
Depth of drilling	Hole tolerance(mm)	Depth of drilling	Hole tolerance(mm)
2xD	0/+0.15	4xD	0/+0.25
3xD	0/+0.20	5xD	0/+0.30

Coalant supply for T-DRILL

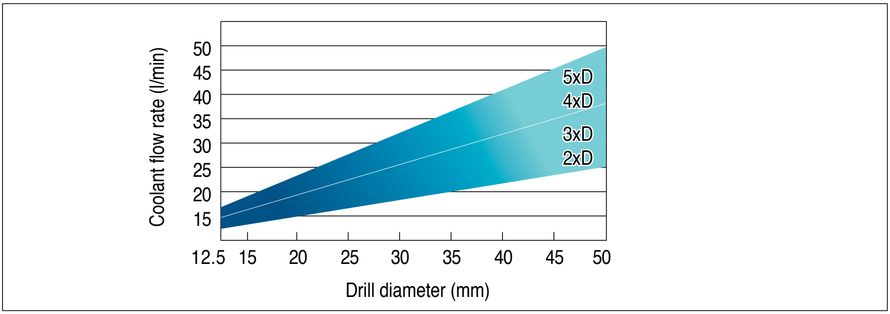
- It is important to ensure that the recommended coolant pressure is applied
- Low pressure can cause vibration and reduced tool life
- The recommended minimum pressure is 4kg/cm^2 for 2xD and 3xD T-DRILL and for the 4xD T-DRILL the minimum recommended pressure is 5kg/cm^2

Net power consumption & coolant

- Net power consumption



- Coolant volume



Trouble shooting

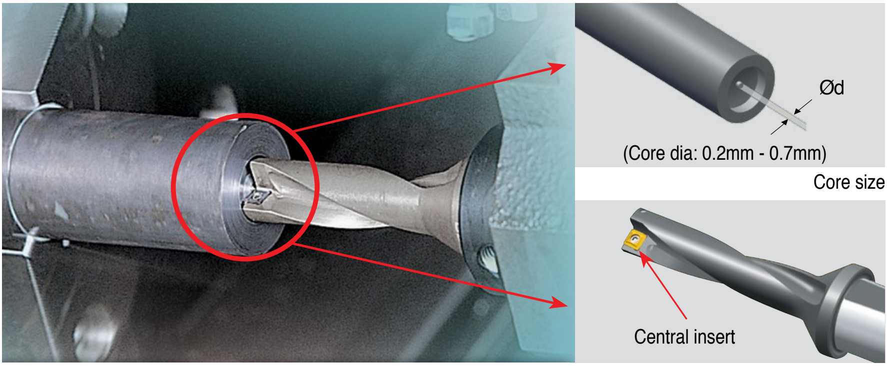
Problems with chip evacuation	Solution	
Long chip	Soft materials Low carbon steel, Mild steel, Stainless steel speed: ↑ feed: ↓	Alloy steel, Carbon steel speed: ↑ feed: ↓
Short or tight chip	Increase coolant pressure speed: ↓ feed: ↓	

Set-up

On first hole – please retract the drill after drilling to a depth of 3mm - 6mm
and check it has produced a small core within 0.2mm - 0.7mm

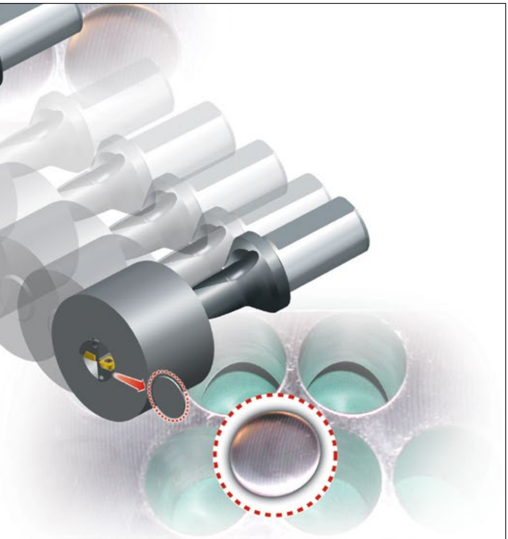
If a core is not created:
- It can cause insert breakage and vibration when drilling
- Please reverse the drill body 180 degrees in tool post and try again

If core size is a higher than recommended values:
- Please adjust offsets to bring core to correct size
- Failure to do so can cause overload and vibration during drilling



Initial set up of T-DRILL

Safety precaution



Precaution:
On a stationary drilling application,
there is a risk of accidents caused by
the disc being thrown from the part.

Hole tolerance and maximum hole size with radial adjustment

Drill diameter	Insert	Radial shift	Max' hole (Ø)
13	SPMG 050204	+0.5	14.0
14		+0.5	15.0
15		+0.5	16.0
16	SPMG 060204	+0.5	17.0
17		+0.5	18.0
18		+0.5	19.0
19		+0.5	20.0
20		+0.5	21.0
21		+0.25	21.5
22	SPMG 07T308	+0.5	23.0
23		+0.5	24.0
24		+0.5	25.0
25		+0.5	26.0
26		+0.25	26.5
27		+0.25	27.5
28	SPMG 090408	+0.5	29.0
29		+0.5	30.0
30		+0.5	31.0
31		+0.25	31.5
32		+0.25	32.5
33		+0.25	33.5
34	SPMG 110408	+0.5	35.0
35		+0.5	36.0
36		+0.5	37.0
37		+0.5	38.0
38		+0.5	39.0
39		+0.5	40.0
40		+0.25	40.5
41		+0.25	41.5
42	SPMG 140512	+0.5	43.0
43		+0.5	44.0
44		+0.5	45.0
45		+0.5	46.0
46		+0.5	47.0
47		+0.5	48.0
48		+0.25	48.5
49		+0.25	49.5
50		+0.25	50.5

• Choose the shortest possible drill for best performance and productivity results

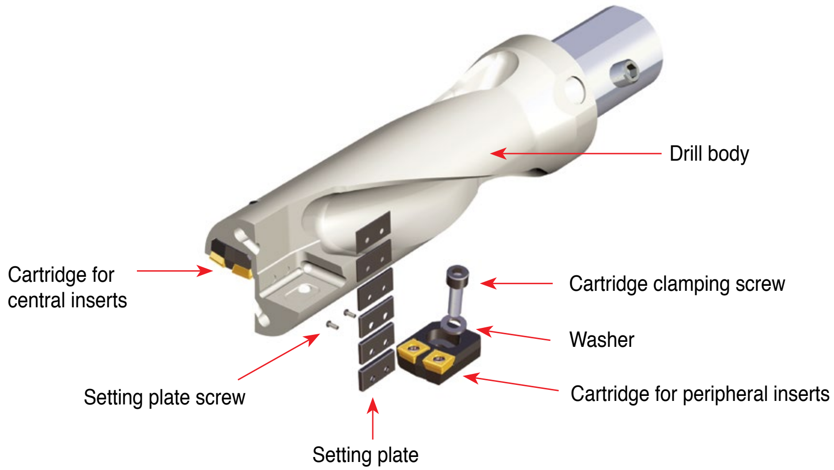
Hole tolerance (Based on stable conditions)

Depth of drilling	Hole tolerance(mm)	Depth of drilling	Hole tolerance(mm)
2xD	0/+0.20	4xD	0/+0.30
3xD	0/+0.25	5xD	0/+0.35

Information for setting plates

Thickness (mm)	Diameter adjustment	Setting plate			
		For TDR 07CA	For TDR 09CA	For TDR 11CA	For TDR 12CA
0.5	1.0	TDP-0701	TDP-0901	TDP-1101	TDP-1101
1.0	2.0	TDP-0702	TDP-0902	TDP-1102	TDP-1102
1.5	3.0	-	TDP-0903	TDP-1103	TDP-1103
2.0	4.0	-	TDP-0904	TDP-1104	TDP-1104
2.5	5.0	-	TDP-0905	TDP-1105	TDP-1105
3.0	6.0	-	-	TDP-1106	TDP-1106

- For stable drilling, TaeguTec can supply fixed sized peripheral cartridges without a setting plate or alternately a solid drill body without the cartridge is also available on request.

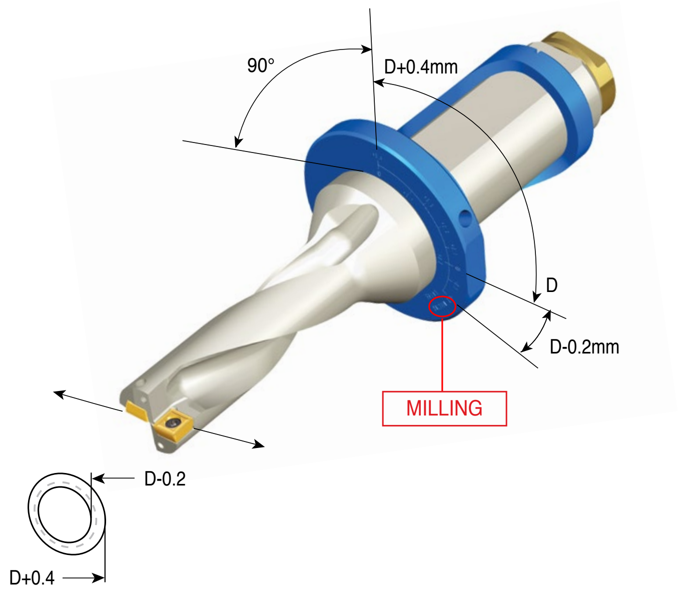


- Under the unstable condition, TaeguTec recommend to use the specificperipheral cartridge for max' diameter drilling

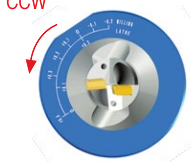
Description	Insert		Diameter range
	Inner	Outer	
TDR 09CA-P1-T62	SPMG 09	SPMG 11	57 - 62
TDR 09CA-P2-T66	SPMG 09	SPMG 11	63 - 66
TDR 11CA-P1-T73	SPMG 11	SPMG 12	67 - 73
TDR 12CA-P2-T80	SPMG 12	SPMG 14	74 - 80

Milling application

- On a milling machine the sleeve can change the drill's nominal diameter by shifting the drill's axis out of the tool spindle.

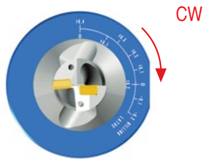


- Drill diameter: 30mm



Hole dia. 29.8mm


Hole dia. 30mm

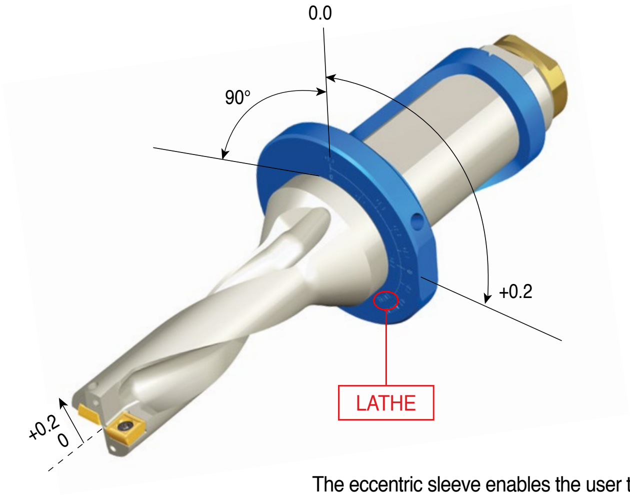


Hole dia. 30.4mm

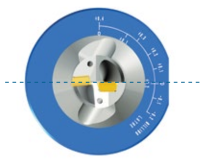
- To enlarge the diameter, turn the sleeve clockwise & to reduce the diameter, turn sleeve counterclockwise as shown.

▶ Lathe application

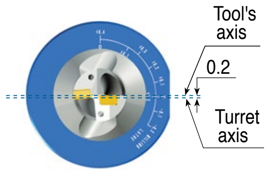
- On a lathe, the eccentric sleeve can shift the drill's axis to coincide with the spindle axis.



The eccentric sleeve enables the user to align the drill's axis with the spindle axis to within 0.2mm range (turn the sleeve counter clock wise to raise it).

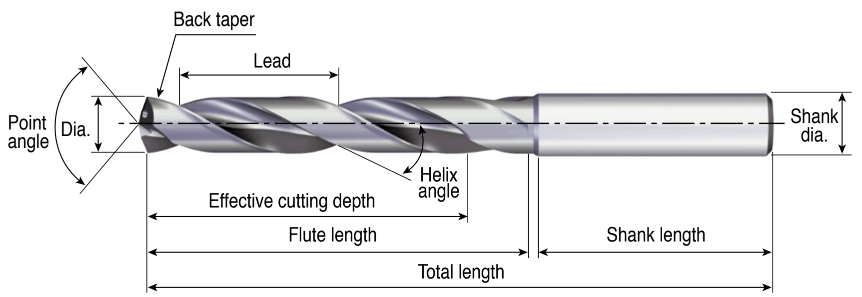


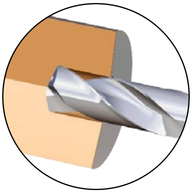
Nominal D
Tool and turret axis coincide

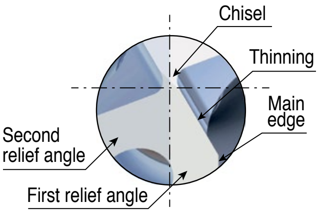


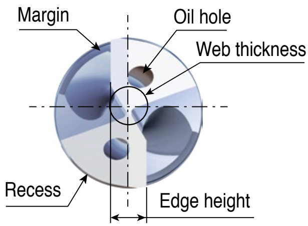
Nominal D+0.2

Drill nomenclature







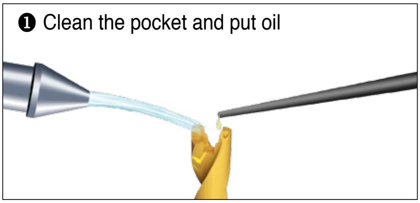


Cutting features according to drill geometry conditions

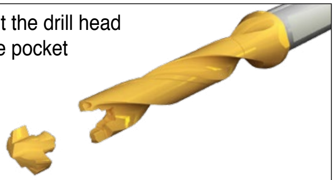
Helix angle	Hardened materials (Inconel, Titanium, etc.)	Small ← Helix angle → Large	Soft materials (Al, Copper, etc.)
Flute length	Determined by the cutting depth, however, the length must be as short as possible due to tool life issues		
Point angle	In general 140°		
	For soft and easier cutting materials	Small ← Point angle → Large	Hardened and high efficiency cutting materials
Margin	The role of the drill guide will cause friction during drilling operation		
	Bad guide	Small ← Margin width → Large	Good guide Load ↑ ➡ Jiggle ↑

Set-up for DRILLRUSH

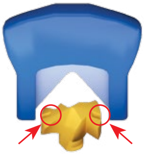
❶ Clean the pocket and put oil



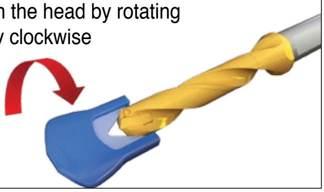
❷ Mount the drill head on the pocket



❸ Insert key into the slot head

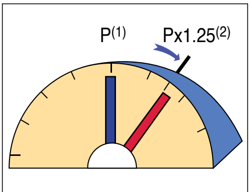


❹ Tighten the head by rotating the key clockwise



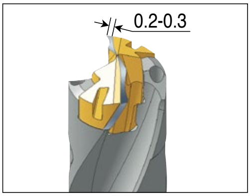
Indication of head wear

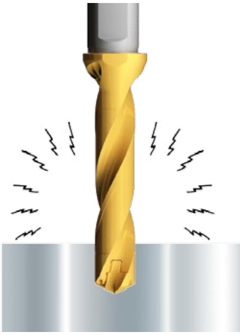
- Power restriction



(1) New drilling head
(2) Worn-out drilling head

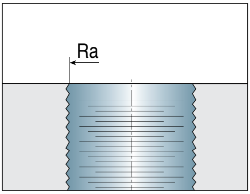
- Wear limit



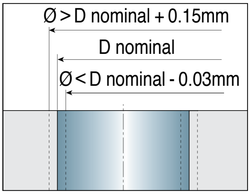


Vibration noise drastically increases

- Surface finish declines

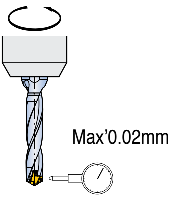


- Diameter change

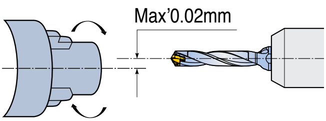


Maximum runout

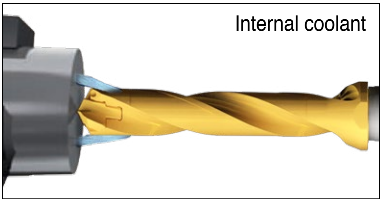
- Rotational runout

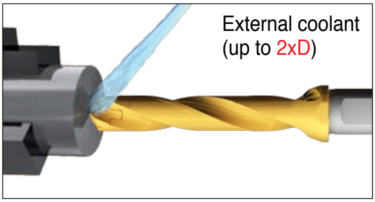


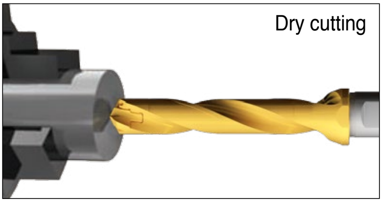
- Stationary runout



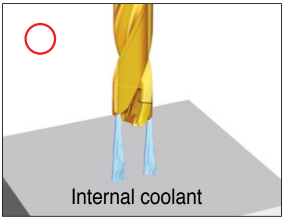
▶ Coolant recommendations (Lathe)

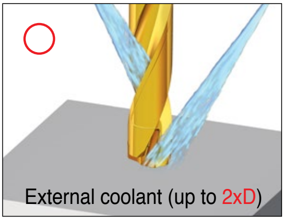


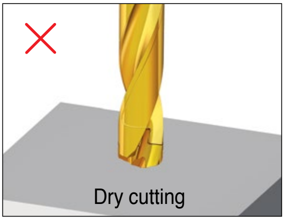




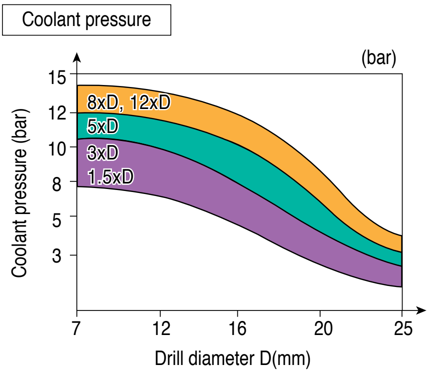
▶ Coolant recommendations (Machining center)

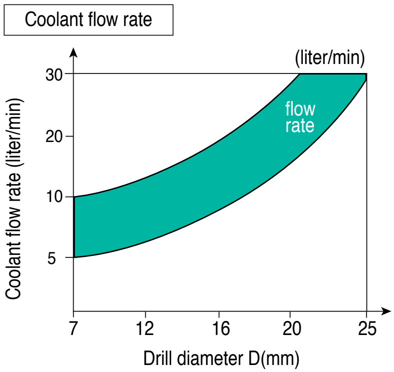




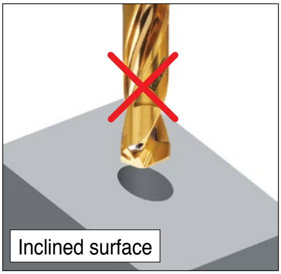


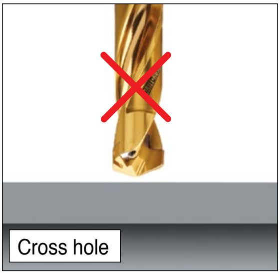
▶ Recommended coolant pressure and flow rate

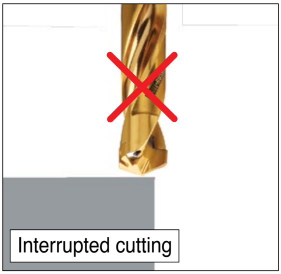




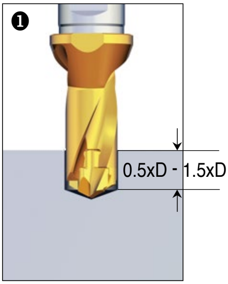
Drilling limitation

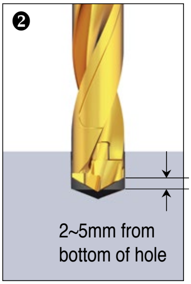


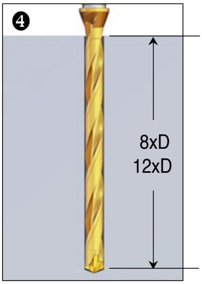




Recommended procedure for long drills like 8xD, 12xD







- Pre-hole drilling with 0.5xD - 1.5xD deep for centering
- Slow rotation and feed during entrance to the pre-hole
- Activate the cooling system for 2 - 3 seconds
- Continue drilling at recommended cutting conditions
- After drilling, exit from hole at reduced speed and feed

Plug for stationary machines

TaeguTec supplies special plugs with an internal thread for coolant connections used on lathes that can be pressed into the cavity on the back end of the shank.

Item no.	Description	Shank diameter	Internal thread
6102019	PL-TCD-12	12	G 1/16
6102020	PL-TCD-16	16	G 1/16
6102021	PL-TCD-20	20	G 1/8
6102022	PL-TCD-25	25	G 1/8
6102023	PL-TCD-32	32	G 1/8

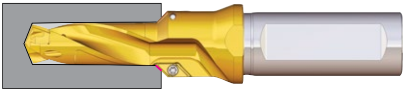
DRILLRUSH for pre-thread hole

■ Drill body
- Cost effective solution that replaces the high cost of special solid carbide step drills
- A twisted through coolant channel for smooth chip evacuation & high penetration rates
- Two symmetrically designed standard chamfering inserts firmly seated for optimal performance via balanced cutting
- Eliminates the need for solid carbide drill regrinding

■ Insert
- Widely capable AOMT insert is designed for both chamfering and counter boring
- Indexable inserts include two cutting edges for optimum chip control
- Capable of machining a wide range of workpiece materials
- Inserts specifically designed for both blind and through-hole applications
- Indexable inserts mean economy and flexibility over a wide range of applications

Drilling with chamfer (45°)

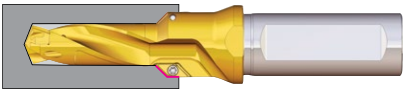
Blind hole



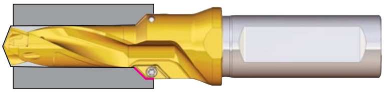
Through hole

Drilling with counter boring

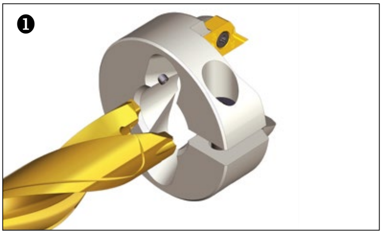
Blind hole



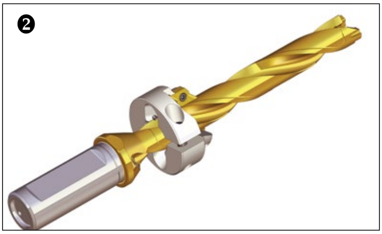
Through hole



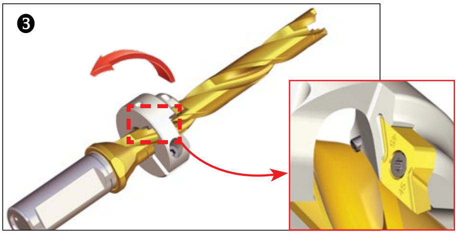
Chamfering ring



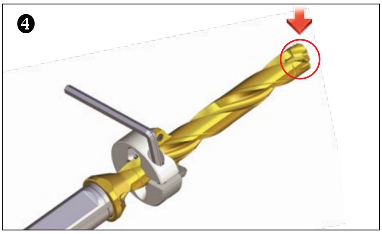
❶ Insert the chamfering ring on to the drill body.
The stopper must be inside the flute.



❷ Slide the chamfering ring to
the desired position.

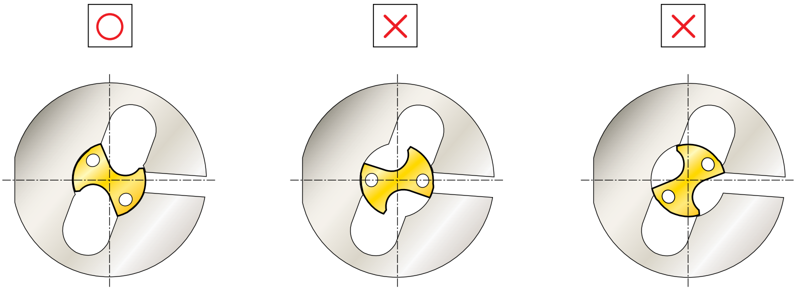


❸ Rotate the chamfering ring counterclockwise
until stopper engages the flute edge.

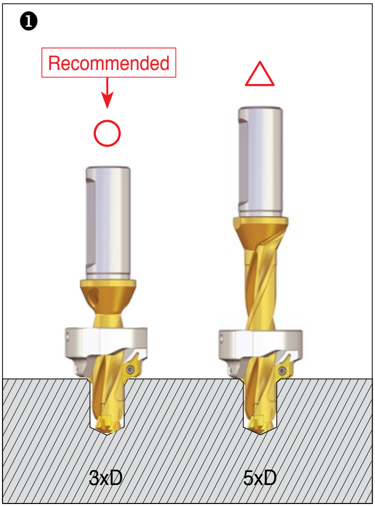


❹ Tighten the chamfering ring and clamp
the drill head.

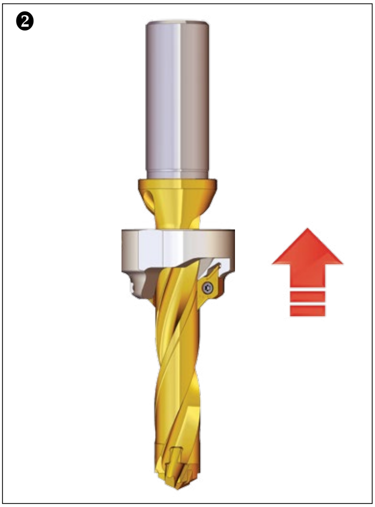
- When the chamfering ring is clamped correctly, the drill flute will be aligned
with the chamfering ring flute.



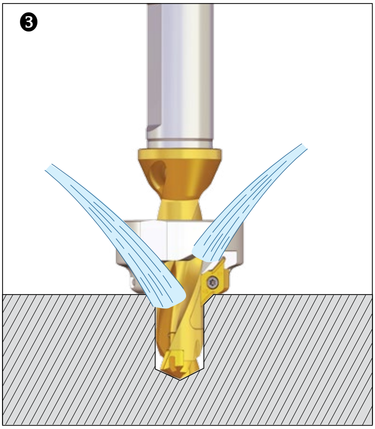
▶ Stable machining



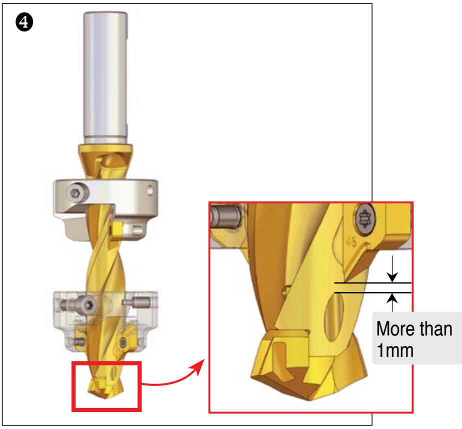
If possible, always use a short holder.
If not, reduce the cutting speed to minimize vibration.



Mount the chamfering ring as close as possible to the drill shank when drilling a through hole.

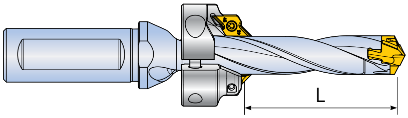


For better insert life, apply external and internal coolant to the insert.

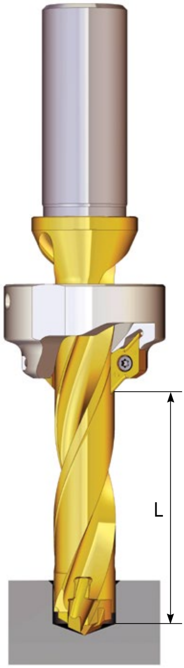


When mounting the chamfering ring, please ensure that it does not block the coolant.

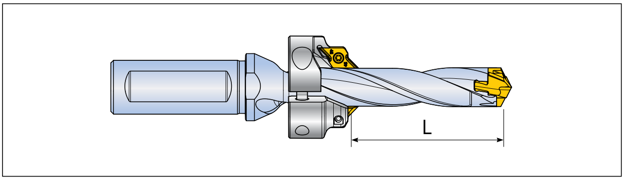
▶ Chamfering ring designation - DRILLRUSH



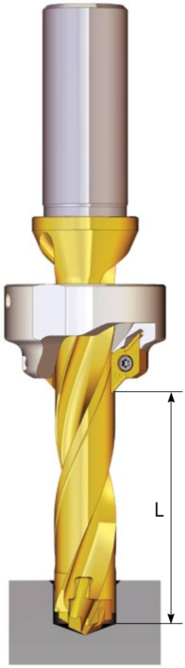
	Designation	CFR designation	L	
			min	max
3D	TCD 130-134-16T3/S0-3D	CFR D130-A45	19	19
	135-139-16T3/S0-3D	CFR D135-A45	19	20
	140-144-16T3/S0-3D	CFR D140-A45	21	22
	145-149-16T3/S0-3D	CFR D145-A45	22	23
	150-159-20T3/S0-3D	CFR D150-A45	23	23
	160-169-20T3/S0-3D	CFR D160-A45	24	25
	170-179-20T3/S0-3D	CFR D170-A45	26	28
	180-189-25T2/S0-3D	CFR D180-A45	27	30
	190-199-25T2/S0-3D	CFR D190-A45	29	33
	200-209-25T2/S0-3D	CFR D200-A45	30	36
	210-219-25T2/S0-3D	CFR D210-A45	32	39
	220-229-25T2/S0-3D	CFR D220-A45	33	42
	230-239-32T2/S0-3D	CFR D230-A45	35	45
	240-249-32T2/S0-3D	CFR D240-A45	36	48
	250-259-32T2/S0-3D	CFR D250-A45	38	51
5D	TCD 100-104-16T3/S0-5D	CFR D100-A45	28	28
	105-109-16T3/S0-5D	CFR D105-A45	29	30
	110-114-16T3/S0-5D	CFR D110-A45	31	33
	115-119-16T3/S0-5D	CFR D115-A45	32	35
	120-124-16T3/S0-5D	CFR D120-A45	33	45
	125-129-16T3/S0-5D	CFR D125-A45	34	40
	130-134-16T3/S0-5D	CFR D130-A45	36	43
	135-139-16T3/S0-5D	CFR D135-A45	37	43
	140-144-16T3/S0-5D	CFR D140-A45	38	48
	145-149-16T3/S0-5D	CFR D145-A45	39	48
	150-159-20T3/S0-5D	CFR D150-A45	41	53
	160-169-20T3/S0-5D	CFR D160-A45	43	58
	170-179-20T3/S0-5D	CFR D170-A45	46	63
	180-189-25T2/S0-5D	CFR D180-A45	48	68
	190-199-25T2/S0-5D	CFR D190-A45	51	73
	200-209-25T2/S0-5D	CFR D200-A45	53	78
	210-219-25T2/S0-5D	CFR D210-A45	56	79
	220-229-25T2/S0-5D	CFR D220-A45	58	84
	230-239-32T2/S0-5D	CFR D230-A45	61	89
	240-249-32T2/S0-5D	CFR D240-A45	63	94
	250-259-32T2/S0-5D	CFR D250-A45	66	99



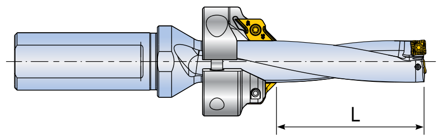
▶ Chamfering ring designation - DRILLRUSH



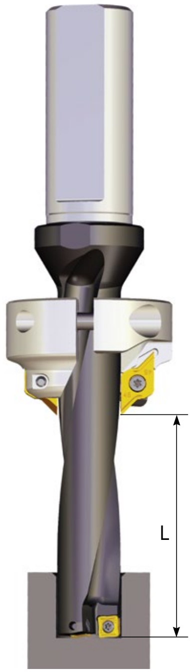
	Designation	CFR designation	L min	L max
8D	TCD 100-104-16T3/S0-8D	CFR D100-A45	45	58
	105-109-16T3/S0-8D	CFR D105-A45	49	62
	110-114-16T3/S0-8D	CFR D110-A45	49	66
	115-119-16T3/S0-8D	CFR D115-A45	53	70
	120-124-16T3/S0-8D	CFR D120-A45	53	74
	125-129-16T3/S0-8D	CFR D125-A45	57	78
	130-134-16T3/S0-8D	CFR D130-A45	57	82
	135-139-16T3/S0-8D	CFR D135-A45	61	84
	140-144-16T3/S0-8D	CFR D140-A45	61	88
	145-149-16T3/S0-8D	CFR D145-A45	65	92
	150-159-20T3/S0-8D	CFR D150-A45	65	96
	160-169-20T3/S0-8D	CFR D160-A45	69	103
	170-179-20T3/S0-8D	CFR D170-A45	73	111
	180-189-25T2/S0-8D	CFR D180-A45	77	118
	190-199-25T2/S0-8D	CFR D190-A45	81	126
	200-209-25T2/S0-8D	CFR D200-A45	85	134
	210-219-25T2/S0-8D	CFR D210-A45	89	142
	220-229-25T2/S0-8D	CFR D220-A45	93	150
	230-239-32T2/S0-8D	CFR D230-A45	97	158
	240-249-32T2/S0-8D	CFR D240-A45	101	166
	250-259-32T2/S0-8D	CFR D250-A45	105	174
12D	TCD 120-124-16S0-12D	CFR D120-A45	87	121
	125-129-16S0-12D	CFR D125-A45	90	127
	130-134-16S0-12D	CFR D130-A45	93	133
	135-139-16S0-12D	CFR D135-A45	96	137
	140-144-16S0-12D	CFR D140-A45	99	143
	145-149-16S0-12D	CFR D145-A45	102	149
	150-159-20S0-12D	CFR D150-A45	105	155
	160-169-20S0-12D	CFR D160-A45	111	166
	170-179-20S0-12D	CFR D170-A45	117	178
	180-189-25S0-12D	CFR D180-A45	123	189
	190-199-25S0-12D	CFR D190-A45	129	201
	200-209-25S0-12D	CFR D200-A45	135	213
	210-219-25S0-12D	CFR D210-A45	141	225
	220-229-25S0-12D	CFR D220-A45	147	237



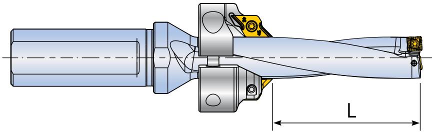
▶ Chamfering ring designation - TOPDRILL and T-DRILL



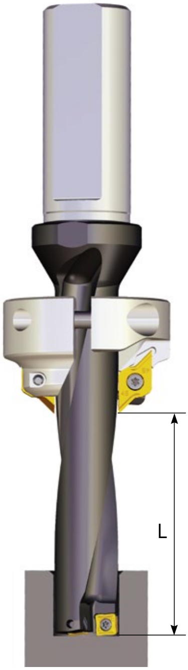
	TOPDRILL	T-DRILL	CFR designation	L	
				min	max
3D	TOP -	TDR 3125-20T2-05	CFR D125-A45	16	16
	-	3130-20T2-05	CFR D130-A45	16	16
	-	3135-20T2-05	CFR D135-A45	17	18
	3140-20T2-05	3140-20T2-05	CFR D140-A45	17	18
	3145-20T2-05	3145-20T2-05	CFR D145-A45	18	19
	3150-20T2-05	3150-20T2-05	CFR D150-A45	18	19
	3155-20T2-05	3155-25T2-06	CFR D160-A45	19	21
	3160-20T2-05	3160-25T2-06	CFR D160-A45	19	21
	3165-25T2-06	3165-25T2-06	CFR D170-A45	21	24
	3170-25T2-06	3170-25T2-06	CFR D170-A45	22	24
	3175-25T2-06	3175-25T2-06	CFR D180-A45	23	27
	3180-25T2-06	3180-25T2-06	CFR D180-A45	23	26
	3185-25T2-06	3185-25T2-06	CFR D180-A45	24	29
	3190-25T2-06	3190-25T2-06	CFR D190-A45	25	29
	3195-25T2-07	3195-25T2-06	CFR D190-A45	25	32
	3200-25T2-07	3200-25T2-06	CFR D200-A45	26	32
	3205-25T2-07	3205-25T2-06	CFR D200-A45	27	35
	3210-25T2-07	3210-25T2-06	CFR D210-A45	27	35
	3215-25T2-07	3215-25T2-07	CFR D210-A45	28	38
	3220-25T2-07	3220-25T2-07	CFR D220-A45	29	38
	3225-25T2-08	3225-25T2-07	CFR D220-A45	29	41
	3230-25T2-08	3230-25T2-07	CFR D230-A45	30	41
	3235-25T2-08	3235-25T2-07	CFR D230-A45	31	44
	3240-25T2-08	3240-25T2-07	CFR D240-A45	31	44
	3245-25T2-08	3245-25T2-07	CFR D240-A45	32	47
	3250-25T2-08	3250-25T2-07	CFR D250-A45	33	47
4D	TOP -	TDR 4125-20T2-05	CFR D125-A45	25	26
	-	4130-20T2-05	CFR D130-A45	25	26
	-	4135-20T2-05	CFR D135-A45	27	30
	4140-20T2-05	4140-20T2-05	CFR D140-A45	28	30
	4145-20T2-05	4145-20T2-05	CFR D145-A45	29	34
	4150-20T2-05	4150-20T2-05	CFR D150-A45	30	34
	4155-20T2-05	4155-25T2-06	CFR D160-A45	31	37
	4160-20T2-05	4160-25T2-06	CFR D160-A45	32	37
	4165-25T2-06	4165-25T2-06	CFR D170-A45	33	41
	4170-25T2-06	4170-25T2-06	CFR D170-A45	34	41
	4175-25T2-06	4175-25T2-06	CFR D180-A45	35	45
	4180-25T2-06	4180-25T2-06	CFR D180-A45	36	44
	4185-25T2-06	4185-25T2-06	CFR D180-A45	37	48



Chamfering ring designation - TOPDRILL and T-DRILL

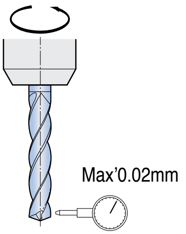


	TOPDRILL		T-DRILL		CFR designation	L	
						min	max
4D	TOP	4190-25T2-06	TDR	4190-25T2-06	CFR D190-A45	38	48
		4195-25T2-07		4195-25T2-06	CFR D190-A45	39	52
		4200-25T2-07		4200-25T2-06	CFR D200-A45	40	52
		4205-25T2-07		4205-25T2-06	CFR D200-A45	41	56
		4210-25T2-07		4210-25T2-06	CFR D210-A45	42	56
		4215-25T2-07		4215-25T2-07	CFR D210-A45	43	60
		4220-25T2-07		4220-25T2-07	CFR D220-A45	44	60
		4225-25T2-08		4225-25T2-07	CFR D220-A45	45	64
		4230-25T2-08		4230-25T2-07	CFR D230-A45	46	64
		4235-25T2-08		4235-25T2-07	CFR D230-A45	47	68
		4240-25T2-08		4240-25T2-07	CFR D240-A45	48	68
		4245-25T2-08		4245-25T2-07	CFR D240-A45	49	72
		4250-25T2-08		4250-25T2-07	CFR D250-A45	50	72
5D	TOP	-	TDR	5125-20T2-05	CFR D125-A45	31	39
		-		5130-20T2-05	CFR D130-A45	33	39
		-		5135-20T2-05	CFR D135-A45	34	44
		5140-20T2-05		5140-20T2-05	CFR D140-A45	35	44
		5145-20T2-05		5145-20T2-05	CFR D145-A45	36	49
		5150-20T2-05		5150-20T2-05	CFR D150-A45	38	49
		5155-20T2-05		5155-25T2-06	CFR D160-A45	39	53
		5160-20T2-05		5160-25T2-06	CFR D160-A45	40	53
		5165-25T2-06		5165-25T2-06	CFR D170-A45	41	58
		5170-25T2-06		5170-25T2-06	CFR D170-A45	43	58
		5175-25T2-06		5175-25T2-06	CFR D180-A45	44	63
		5180-25T2-06		5180-25T2-06	CFR D180-A45	45	62
		5185-25T2-06		5185-25T2-06	CFR D180-A45	46	67
		5190-25T2-06		5190-25T2-06	CFR D190-A45	48	67
		5195-25T2-07		5195-25T2-06	CFR D190-A45	49	72
		5200-25T2-07		5200-25T2-06	CFR D200-A45	50	72
		5205-25T2-07		5205-25T2-06	CFR D200-A45	51	77
		5210-25T2-07		5210-25T2-06	CFR D210-A45	53	77
		5215-25T2-07		5215-25T2-07	CFR D210-A45	54	82
		5220-25T2-07		5220-25T2-07	CFR D220-A45	55	82
		5225-25T2-08		5225-25T2-07	CFR D220-A45	56	87
		5230-25T2-08		5230-25T2-07	CFR D230-A45	58	87
		5235-25T2-08		5235-25T2-07	CFR D230-A45	59	92
		5240-25T2-08		5240-25T2-07	CFR D240-A45	60	92
		5245-25T2-08		5245-25T2-07	CFR D240-A45	61	97
		5250-25T2-08		5250-25T2-07	CFR D250-A45	63	97

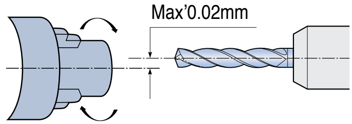


Maximum runout for H-DRILL

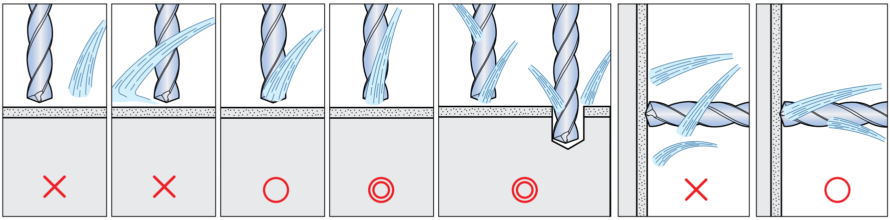
■ Rotational runout



■ Stationary runout



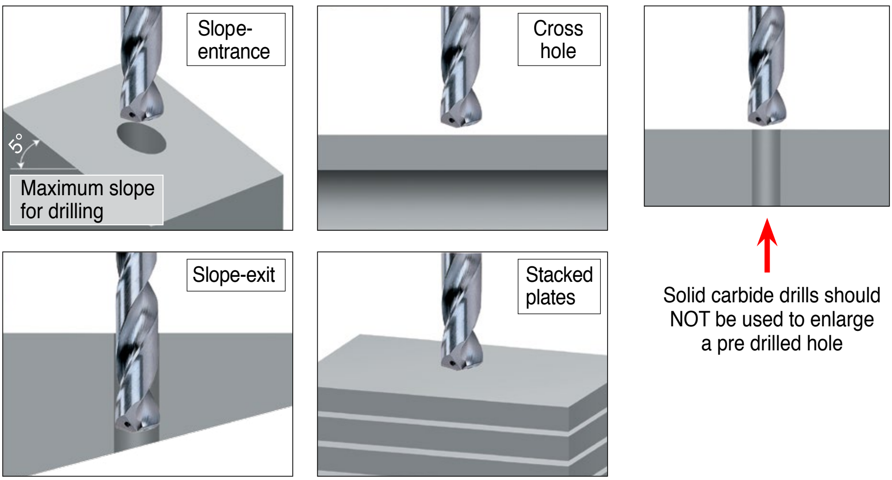
■ Recommended external coolant supply



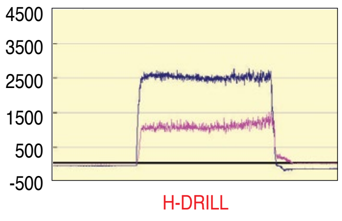
× : Bad ○ : Good ◎ : Excellent

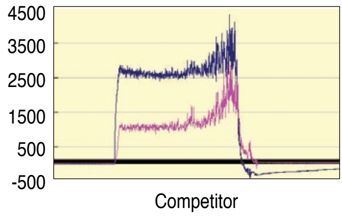
Unstable drilling conditions

■ TaeguTec recommends 30 - 40% reduction of feed when drilling on:



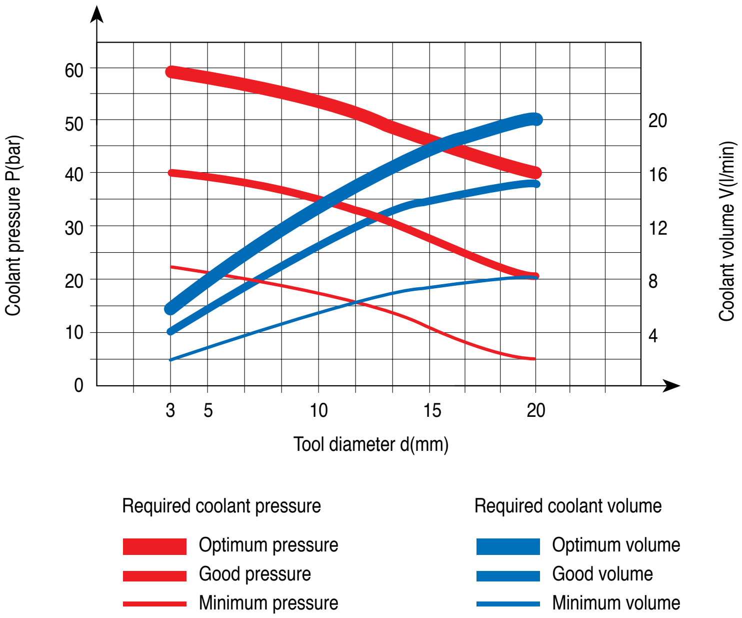
Stable drilling with low cutting force



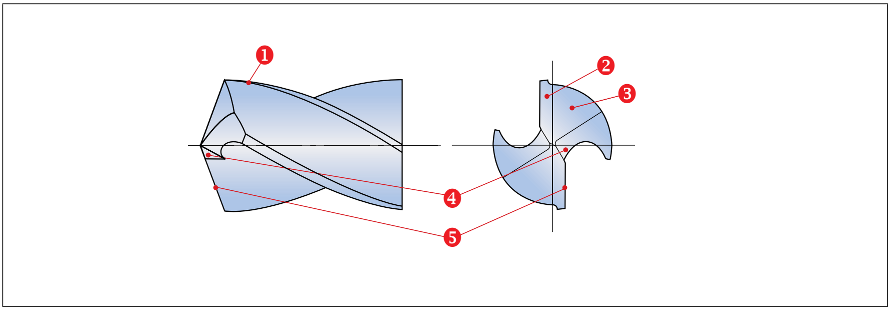


- Drill size : Ø12.0mm
- Material : SAE 4140
- Speed : 100(m/min)
- feed : 0.25(mm/rev)
- Depth : 60(mm)
- Internal coolant supply, through hole

Recommended coolant pressure and volume

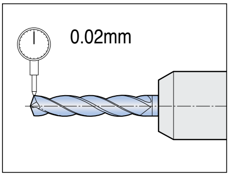


Regrinding instructions



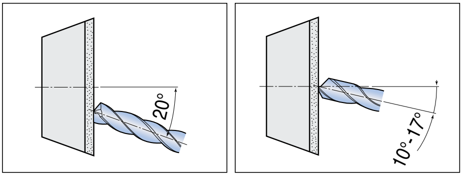
1 Clamping

- Set up the drill in a collet chuck - the total run out must not exceed 0.02mm



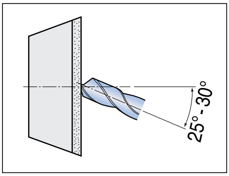
2 Grinding for 1st clearance angle

- Set the drill for point angle (140°) and 1st clearance angle (10°-17°)
- Keep the cutting edge in the horizontal plane
- Grind the 1st clearance angle to a depth of 0.02 - 0.03mm, try spark-out 2 - 3 times to keep the lip height within 0.02mm when finishing

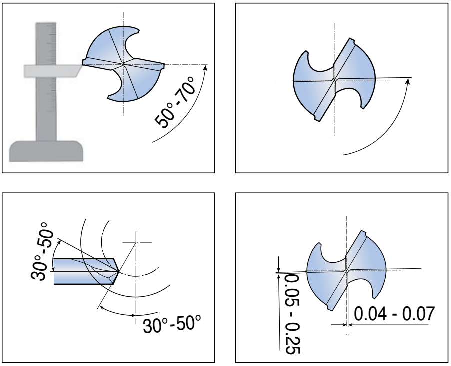


3 Grinding for 2nd clearance angle

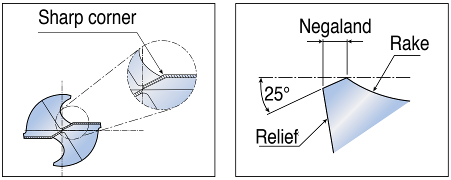
- Set the drill for 2nd clearance angle (25° - 30°)
- Grind the 2nd clearance faces of both cutting edges one by one in order to make the intersection between the 1st and 2nd clearance parallel with cutting edge



❹ Thinning
- Keep workhead horizontal
- Using height gauge, keep two corners of cutting edge horizontal
- Rotate the drill to 50°- 70° to keep the chisel edge vertical
- Set wheel location for thinning to 30°- 50° with reference to drill axis
- Edge part of thinning must be away from drill center by 0.04 - 0.07mm



❺ Honing
- After making negaland as shown, finish with diamond hand lapper



■ Negaland width
- SHO, SHD : 0.03 - 0.08mm
- BHD : 0.06 - 0.08mm

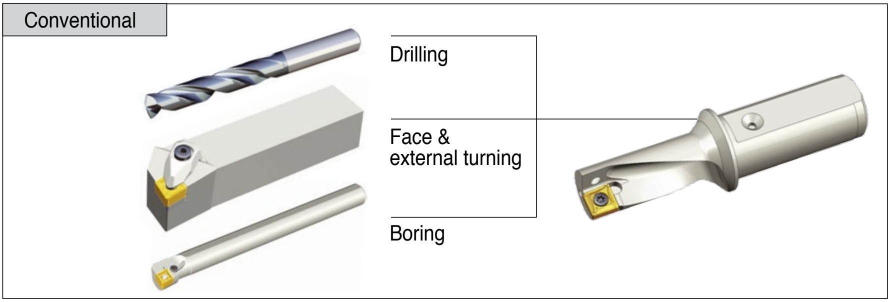
■ Tool life can be affected by the surface roughness of negaland
- Use very fine hand stone (#1500)
- Make uniform width of negaland

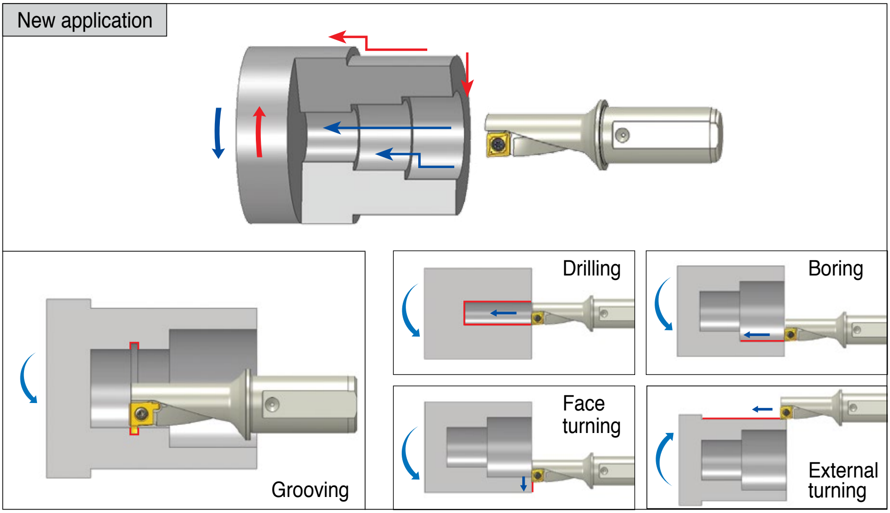
Check point	Recommendation
- Is the lip height within 0.02mm? - Is there any defect in cutting edge? - Is the negaland fine and uniform?	- Recommend wet grinding - Diamond wheel: 250 - 400mesh - Diamond file: 140mesh - Diamond hand lapper: 800 - 1500mesh

Multi-function system

- Drilling, boring and turning with one tool
- Short set-up and cycle time
- Minimized tool positions and reduced tooling cost

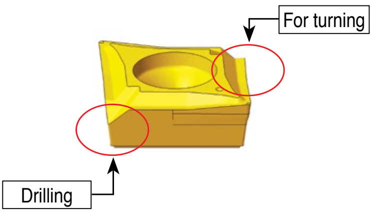
Application





Features

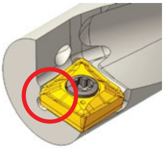
- Internal coolant supply
- Helical flute for smooth chip flow
- Large chip gullet for good chip evacuation
- Two different unique geometries for drilling and turning
- High helix cutting edge to minimize cutting forces
- Excellent chip control at low feed and small d.o.c.



Technical information

■ Insert positioning

- Cutting edge for drilling should be positioned in the center of tool body.

Cutting edge for drilling  ○	 ○	 ✕
Correct	Correct	Wrong

■ Coolant pressure

- Pressure must be above 2 bar in 3xD drills, regardless of drilling diameter.
  (Optimal pressure is above 5 bar)

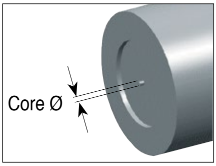
■ Optimization of chip shape

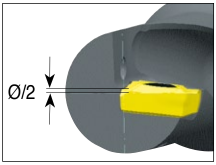
- Material with low carbon content (low carbon steel / low carbon alloy steel)
  High speed machining is recommended to make the chips thinner as many problems are caused by thick chips
- Material with medium to high carbon content (carbon steel / alloy steel)
  If too tight? ➡ Increase speed if the speed is slow or reduce feed
  If too loose? ➡ Reduce speed if the speed is high or increase feed

■ Set-up

- Please check formation of core and its size after drilling
  3mm to 6mm depth and diameter. Core should be within 0.15 - 0.45mm.

  Please adjust Y-axis of tool body by using clamping unit if it is available or reverse the tool body 180° and fix it into a turret to check the core again if clamping unit is not available.
- If a core does not appear,
  It can cause breakage of insert and vibration when drilling or turning
- If the size of core is over the recommended limit.
  It will cause overload and vibration

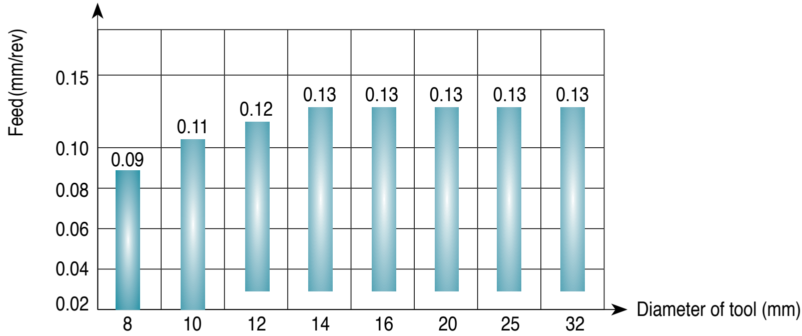




Chip control range

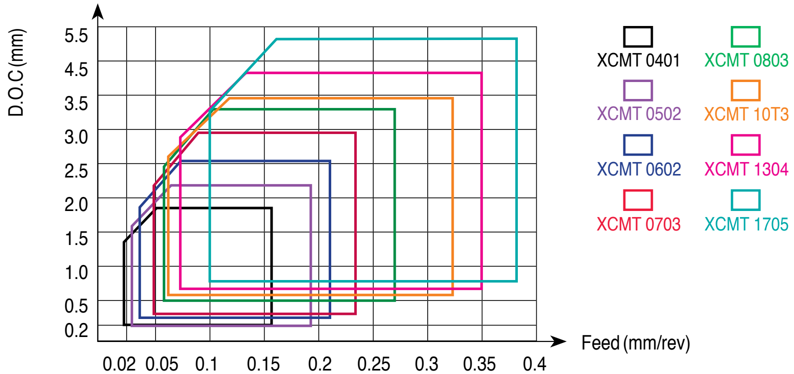
■ Drilling

Alloy steel (AISI: 4140, 220BHN), Vc=120m/min



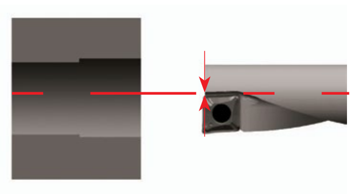
■ Turning

Carbon steel (220BHN), Vc=150m/min



Radial adjustment (Off-center drilling)

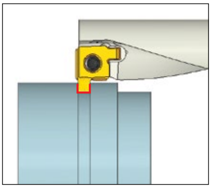
Radial adjustment is dependent on drill diameter



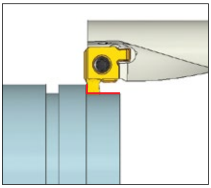
Holder	Drill dia.	Dmin	Dmax
TCAP 08 -	8	7.86	8.35
TCAP 10 -	10	9.82	10.60
TCAP 12 -	12	11.82	12.60
TCAP 14 -	14	13.80	14.60
TCAP 16 -	16	15.76	16.50
TCAP 20 -	20	19.80	20.60
TCAP 25 -	25	24.80	25.80
TCAP 32 -	32	31.80	33.00

Application

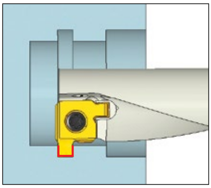
Substitute the existing solid drill, boring bar and lathe turning holder, the TOPCAP has been purposely designed to fulfill multi-function machining from drilling to lathe operations.
It is capable of handling various grooving operations by adding a set of uniquely designed inserts and holders.



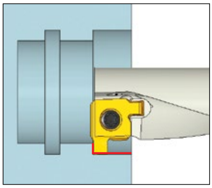
External grooving



External turning



Internal grooving



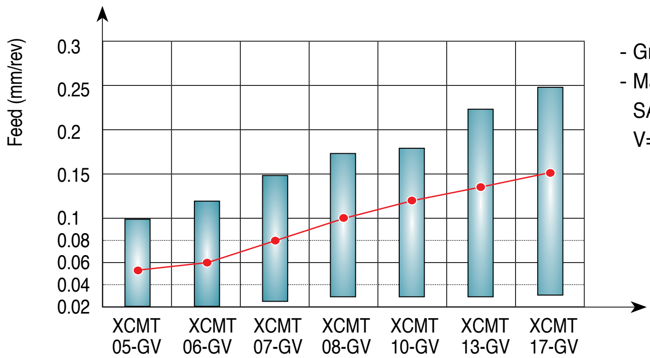
Internal turning

Features

- Can use both new and existing inserts
- Cutter protects alternate cutting edge
- Smooth chip evacuation with internal coolant system
- Cost saving – holder indexes 2 different insert types

Recommended cutting conditions

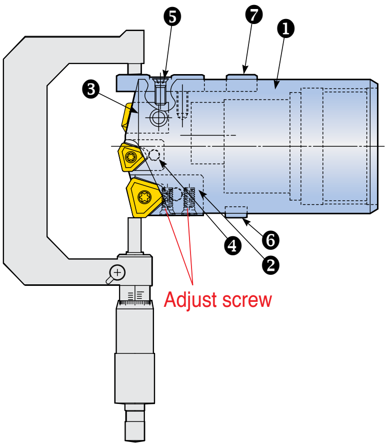
Chip control range for XCMT-GV



- Grooving
- Material :
  SAE4140 (220BHN),
  V=120m/min)

▶ Setting instructions for TBTA 3.../ 5.../ 7... / 9...series

Setting the diameter when indexing and replacing inserts



❶ Head shank
❷ Outer cartridge & lock screw
❸ Inner cartridge & lock screw
❹ Center cartridge & lock screw
❺ Guide pad & lock screw
❻ Sub guide pad & lockscrew
❼ Guide pad protector & lock screw

STEP 1: Slide the Guide Pad ❺ forward as shown in the diagram
- locate the lock screw ❺ as shown and tighten

STEP 2: Loosen the adjust screws and the lock screw of the outer cartridge ❷
STEP 3: Firmly push the outer cartridge toward the center of the head
STEP 4: Slightly tighten the lock screw ❷ and adjust the diameter with the two adjust screws
STEP 5: When adjustment is completed, firmly tighten the lock screw ❷

■ Replacing inserts:
- Clean insert pockets carefully and remove even the smallest foreign particles from insert pocket. Fasten insert securely in the cartridge and ensure it is completely seated.

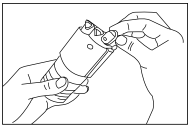
■ Replacing guide pad:
- Guide pad pockets are precisely produced and are back tapered, therefore the guide pads may be reversed and used again when excessive wear occurs on the corner.

Guide pads are ground to size for immediate use.

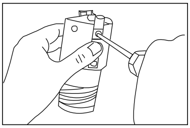
■ Note:
- Although lock screws have been treated with an anti-friction lubricant, please re-apply a suitable anti-friction lubricant regularly to avoid "lock-up".

▶ Cartridge style drill head diameter setting instruction

In the final inspection, the drill head diameter is set and inspected with a master insert. However, the inserts in the market have a tolerance fluctuation so each time you change or index the insert, the diameter must be adjusted as per the following method.



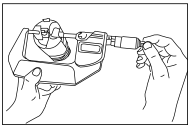
a) Remove the inner cartridge to avoid interference with the guide screw.



b) The dimensional guide pad must be slid forward to measure the diameter.

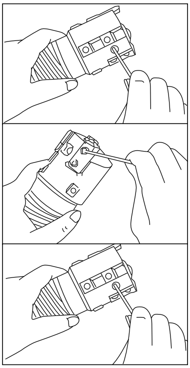
❶ Loosen the lock screw and slide the guide pad forward

❷ Retighten the lock screw at the measuring position



c) Measure the diameter with a micrometer.
We recommend setting the tool diameter at h8 tolerance to the cutting diameter.

If the diameter is incorrect, go to step 4 below.
If it's correct, go to step 5 below.



d) Adjust the outer cartridge

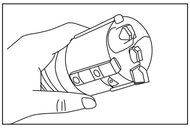
❶ First loosen the lock screw of the outer cartridge and then tighten it slightly

❷ Proceed to adjust the diameter, using the 2 adjust screws and measure with a micrometer

❸ When set to the size, retighten the lock screw.

❹ Recheck the diameter with a micrometer. If it is still out of tolerance, repeat the procedure from the step

Note : When a corner change is made on the insert, it must be adjusted to correct size or damage can be caused to the head or workpiece material.



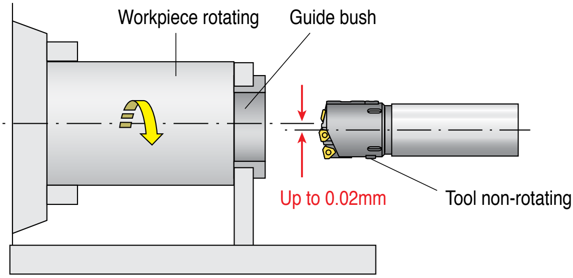
e) Slide the dimensional guide pad back to the original position and tighten the lock screw.

f) Replace the inner cartridge and tighten the lock screw.

Note : Please check all the lock screws are firmly tightened as they may come loose if vibration occurs during drilling. material.

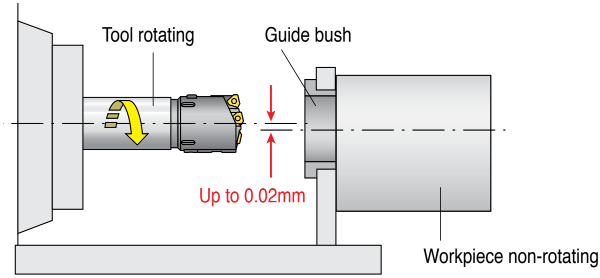
Workpiece rotating system

- Should be applied only when the workpiece and the tool axis are in line.
- Better result is expected for hole straightness and wear-resistance of the guide bush compared to tool rotating system.
- Keep the alignment between guide bush and spindle within 0.02 mm.



Tool rotating system

- Can be applied when the workpiece and the tool axis are not in line.
- Keep the alignment between guide bush and spindle within 0.02 mm.



Coolant management

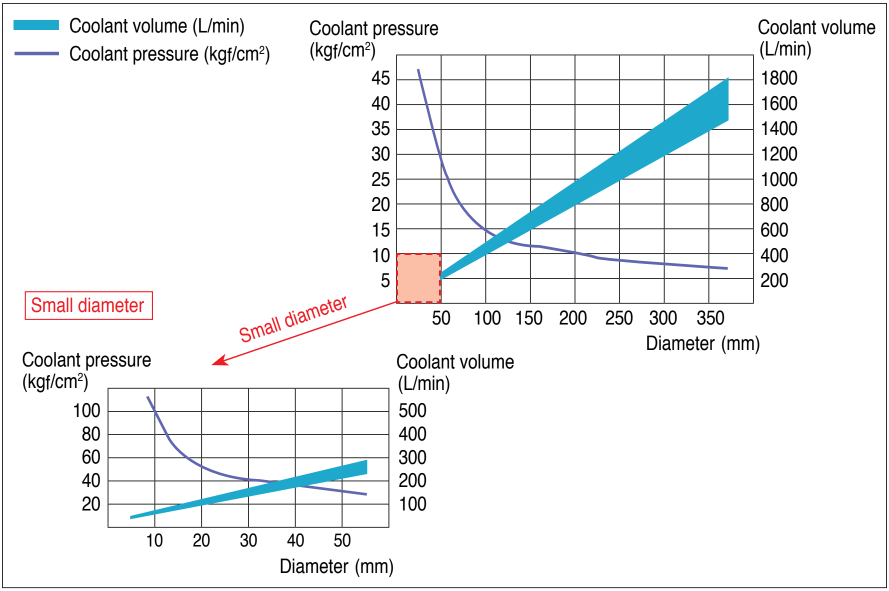
▪ Coolant temperature
- The suitable coolant temperature is 30 to 40°C (90 - 100°F).
- If it exceeds this temperature, the coolant will deteriorate which will cause short tool life and poor surface finish.

▪ Coolant filtration
- The coolant must be filtered in order to protect the guide pads and the surface finish.

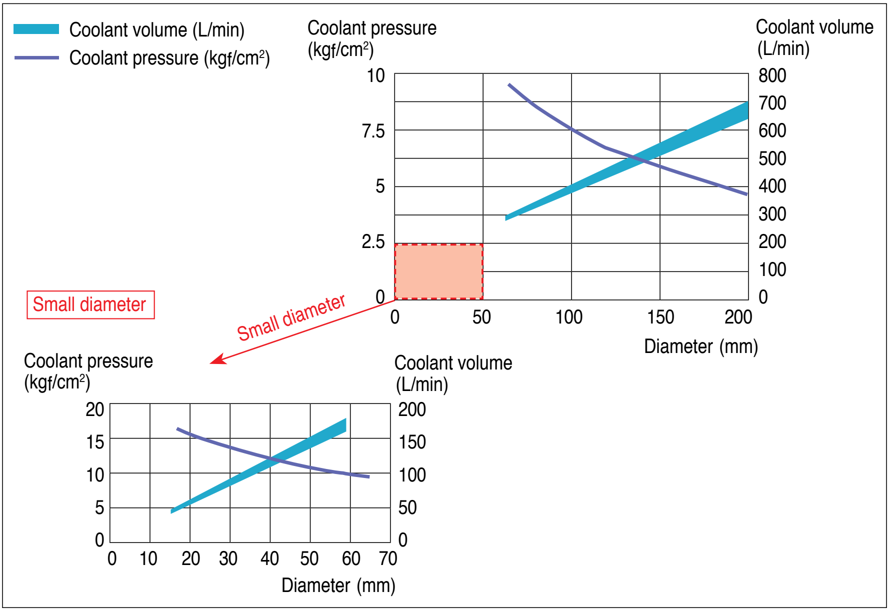
▪ Using water-soluble coolant
- The concentration of water-soluble coolant is recommended to be around 10% (dilution rate 1/10) in order to protect the guide pads.

Recommended coolant volume & pressure

▪ Single tube system

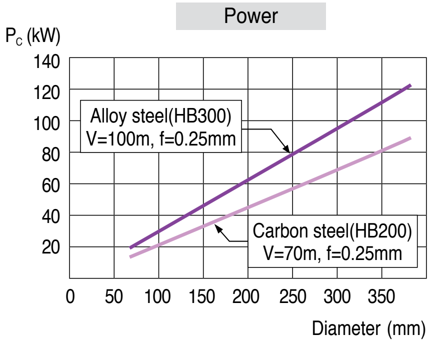


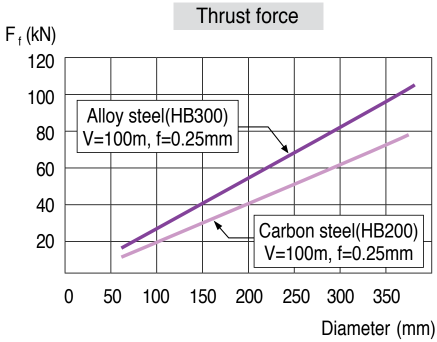
▪ Double tube system



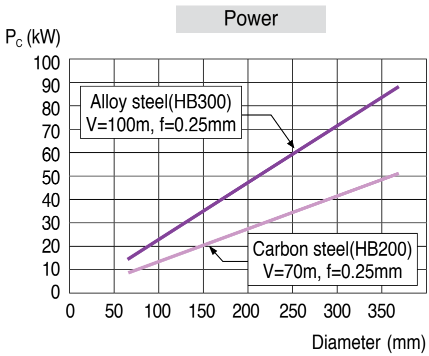
Recommended power(kw) & thrust force

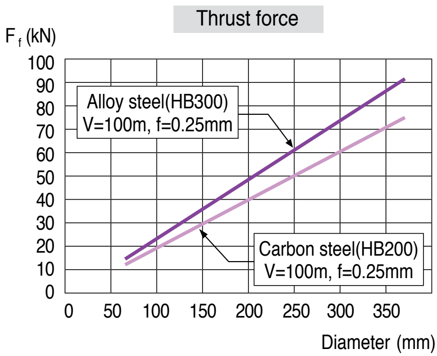
▪ Single tube system



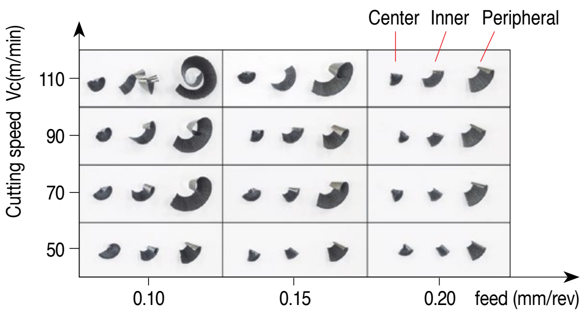


▪ Double tube system

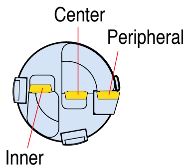




Cutting condition and chip form



- Diameter: ∅30.00
- Material :
  Low alloy steel,
  AISI4340



• From left to right in each box the order is center, inner and peripheral chip.

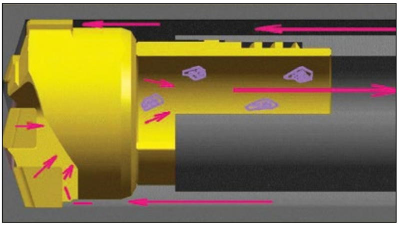
Grades combination for ISO applications

	Grades	ISO range						
		10	15	20	25	30	35	40
P	TB20X							
	TB25X							
M	TB25X							
	TB33X							
K	TB27X							
N	TB27X							
S	TB27X							

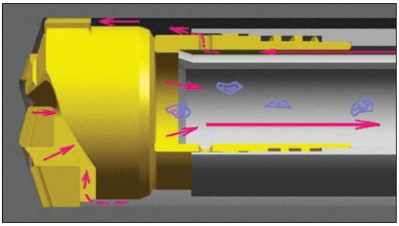
- Put a request coating no. at the end of grade
  TB__3 : TiAIN coated
  TB__4 : TiCrAIN coated

Deep hole drilling systems

▪ Single tube system

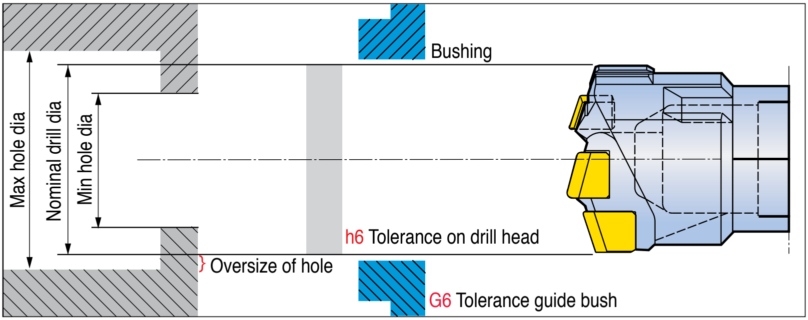


▪ Double tube system



Calculation guidelines

Application: BTA & BTS type
Drill dia: 12.6 - 65.0mm
Hole tolerance: IT9
Surface finish: Ra 2μm
Coolant: Neat or soluble oil



Nominal drill dia = Min hole dia + 2/3 X (Max hole dia - Min hole dia)
Max hole dia - Tool dia>0.05mm
Finish ground to the desired diameter to tolerance ISO h6.

• Normally the drill diameter is set at the lower limit plus (+) two thirds (2/3) of the tolerance.

■ G6 tolerance (for guide bush)

Guide bush dia (ømm)	Tolerance (mm)
10.01-18.0	+0.006 - +0.017
18.01-30.0	+0.007 - +0.020
30.01-50.0	+0.009 - +0.025
50.01-65.0	+0.010 - +0.029

■ h6 tolerance (for drill dia)

Drill dia (ømm)	Tolerance (mm)
10.01-18.0	-0.006 - 0
18.01-30.0	-0.013 - 0
30.01-50.0	-0.016 - 0
50.01-65.0	-0.019 - 0

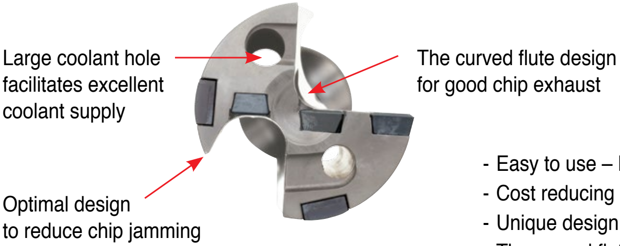
Hole tolerance

Diameter D(mm)		Tolerance class (μm)								
>D	≤D	B10	C9	C10	D8	D9	D10	E7	E8	E9
–	3	+180 +140	+85 +60	+100 +60	+34 +20	+45 +20	+60 +20	+24 +14	+28 +14	+39 +14
3	6	+180 +140	+100 +70	+118 +70	+48 +30	+60 +30	+78 +30	+32 +20	+38 +20	+50 +20
6	10	+208 +150	+116 +80	+138 +80	+62 +40	+76 +40	+98 +40	+40 +25	+47 +25	+61 +25
10	18	+220 +150	+138 +95	+165 +95	+77 +50	+93 +50	+120 +50	+50 +32	+59 +32	+75 +32
18	30	+244 +160	+162 +110	+194 +110	+98 +65	+117 +65	+149 +65	+61 +40	+73 +40	+92 +40
30	40	+270 +170	+182 +120	+220 +120	+119 +80	+142 +80	+180 +80	+75 +50	+89 +50	+112 +50
40	50	+280 +180	+192 +130	+230 +130						
50	65	+310 +190	+214 +140	+260 +140	+146 +100	+174 +100	+220 +100	+90 +60	+106 +60	+134 +60
65	80	+320 +200	+224 +150	+270 +150						
80	100	+360 +220	+257 +170	+310 +170	+174 +120	+207 +120	+260 +120	+107 +72	+126 +72	+159 +72
100	120	+380 +240	+267 +180	+320 +180						
120	140	+420 +260	+300 +200	+360 +200	+208 +145	+245 +145	+305 +145	+125 +85	+148 +85	+185 +85
140	160	+440 +280	+310 +210	+370 +210						
160	180	+470 +310	+330 +230	+390 +230						
180	200	+525 +340	+355 +240	+425 +240	+242 +170	+285 +170	+355 +170	+146 +100	+172 +100	+215 +100
200	225	+565 +380	+375 +260	+445 +260						
225	250	+605 +420	+395 +280	+465 +280						

Hole tolerance

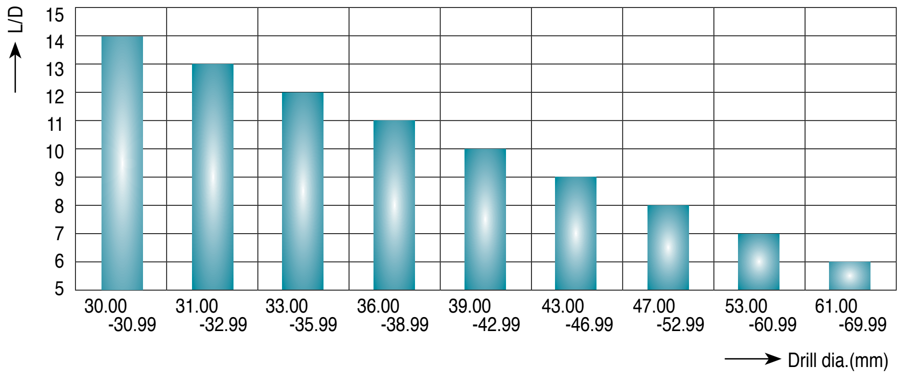
Diameter D(mm)		Tolerance class (μm)									
>D	≤D	F6	F7	F8	G6	G7	H6	H7	H8	H9	H10
–	3	+12 +6	+16 +6	+20 +6	+8 +2	+12 +2	+6 0	+10 0	+14 0	+25 0	+40 0
3	6	+18 +10	+22 +10	+28 +10	+12 +4	+16 +4	+8 0	+12 0	+18 0	+30 0	+48 0
6	10	+22 +13	+28 +13	+35 +13	+14 +5	+20 +5	+9 0	+15 0	+22 0	+36 0	+58 0
10	18	+27 +16	+34 +16	+43 +16	+17 +6	+24 +6	+11 0	+18 0	+27 0	+43 0	+70 0
18	30	+33 +20	+41 +20	+53 +20	+20 +7	+28 +7	+13 0	+21 0	+33 0	+52 0	+84 0
30	40	+41 +25	+50 +25	+64 +25	+25 +9	+34 +9	+16 0	+25 0	+39 0	+62 0	+100 0
40	50										
50	65	+49 +30	+60 +30	+76 +30	+29 +10	+40 +10	+19 0	+30 0	+46 0	+74 0	+120 0
65	80										
80	100	+58 +36	+71 +36	+90 +36	+34 +12	+47 +12	+22 0	+35 0	+54 0	+87 0	+140 0
100	120										
120	140	+68 +43	+83 +43	+106 +43	+39 +14	+54 +14	+25 0	+40 0	+63 0	+100 0	+160 0
140	160										
160	180										
180	200	+79 +50	+96 +50	+122 +50	+44 +15	+61 +15	+29 0	+46 0	+72 0	+115 0	+185 0
200	225										
225	250										

Features of HFD drill



- Easy to use – Direct mount
- Cost reducing inserts
- Unique design eliminates chip jamming
- The curved flute design acts as a chip exhaust
- New solution over 5xD

Drilling depth depends on diameter



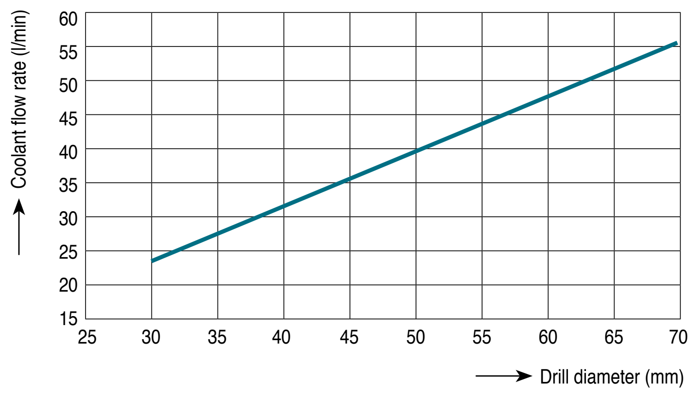
Insert & guide pad

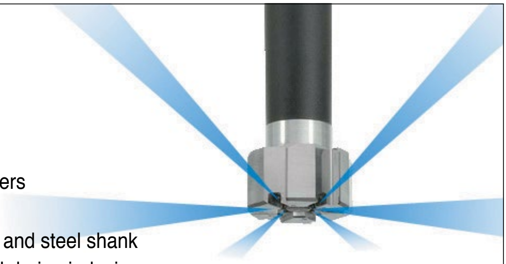
Tool dia. (mm)	Insert			Guide PAD
	Outer	Inner	Center	
30.00-33.00	NPMT 06504 RG	NPMT 06504 RG	NPMT 06504 LG	PAD-GO07CD
33.01-36.00	NPMT 06504 RG	NPMT 06504 RG	NPMT 0804 LG	PAD-GO07CD
36.01-39.00	NPMT 0804 RG	NPMT 06504 RG	NPMT 0804 LG	PAD-GO07CD
39.01-42.00	NPMT 0804 RG	NPMT 0804 RG	NPMT 0804 LG	PAD-GO08CD
42.01-45.00	NPMT 0804 RG	NPMT 0804 RG	NPMT 09504 LG	PAD-GO08CD
45.01-48.00	NPMT 09504 RG	NPMT 0804 RG	NPMT 09504 LG	PAD-GO10CD
48.01-51.00	NPMT 09504 RG	NPMT 09504 RG	NPMT 09504 LG	PAD-GO10CD
51.01-57.00	NPMT 09504 RG	NPMT 09504 RG	NPMT 12504 LG	PAD-GO10CD
57.01-63.00	NPMT 12504 RG	NPMT 09504 RG	NPMT 12504 LG	PAD-GO12CD
63.01-69.00	NPMT 12504 RG	NPMT 12504 RG	NPMT 12504 LG	PAD-GO12CD

Pilot hole size

Tool dia. (mm)	Pilot hole tolerance	Pilot hole depth (mm)
30.00-39.00	H8	Min. 10.0
39.01-45.00	H8	Min. 12.5
45.01-57.00	H8	Min. 15.0
57.01-69.00	H8	Min. 17.5

Coolant volume





▶ TM-REAM advantages

- High speed / high production
- No setup time
- Low runout (maximum 3㎛)
- One shank can be used for a range of hole diameters and various types of cutting edges
- Durable, due to the combination of a carbide head and steel shank
- No fear of losing any clamping parts which may fall during indexing
- Internal coolant directed optimally to the cutting edges (see illustration)
- Possibility of applying Minimal Quantity Lubrication (MQL) systems
- No need to remove the tool, due to frontal indexing

▶ Reamer flutes

■ Straight flutes

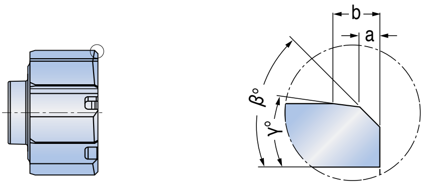
Used mainly for blind holes, usually have a positive rake on the leading chamfer. The chips can flow freely when flushed out.

■ Left-hand

Used only for through holes.
The left-hand flute pushes the chips forward.
They do not flow along the flutes and do not damage surface quality.
The helical flute operation is more stable than that of the straight flute.
Therefore, it has less tendency to vibrate.
Left-hand reamers should be used for interrupted and irregular holes.

Lead geometry parameters code key

When choosing a reamer, it is important to select a lead geometry which covers the reaming allowance.



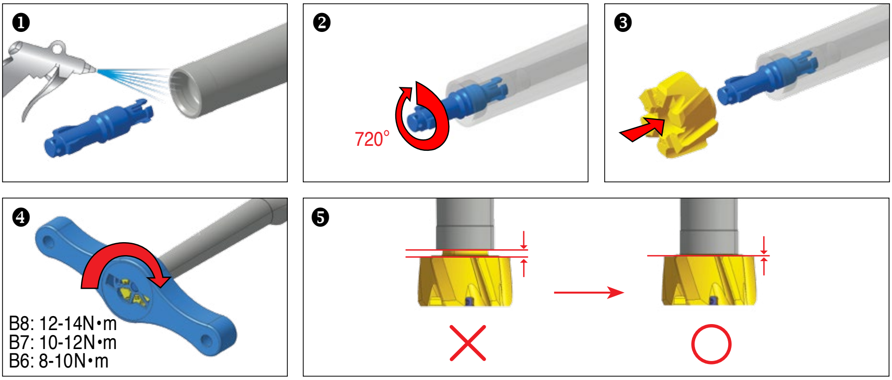
Lead code	β°	a(mm)	γ°	b(mm)
A	45°	0.5	-	-
B	25°	1.07	-	-
C	45°	0.5	8°	0.75
D	30°	0.5	4°	1.85
E	45°	0.2	-	-
F	90°	-	-	-
G	75°	0.15	-	-
X	Specially tailored (undesignated)			

Reaming allowance (Based on diameter)

Reaming allowance is the stock material which should be removed by reaming.
It is recommended to leave different reaming allowances depending on the workpiece material and the pre-hole quality. Pre-hole should be smooth and straight, without deep scratches on it.

Material \ Hole (Ømm)	<9.5	9.5-11.5	11.5-13.5	13.5-16	16-32	>32
Steel and cast iron	0.07-0.10	0.07-0.15	0.10-0.20	0.10-0.30	0.10-0.30	0.20-0.40
Aluminum and brass	0.07-0.10	0.10-0.15	0.15-0.25	0.20-0.30	0.20-0.40	0.20-0.50

Assembly



▪ First assembly

- Clean the toolholder pocket (Fig. ❶)
- Clean the reamer head clamping cone
- Insert the clamping screw into the holder and rotate it 2-3 turns in a clockwise direction (Fig. ❷)
- Clamp the reaming head on the screw. Please note that it can be assembled only in a specific position relative to the screw (rotate the head until locating the correct position) (Fig. ❸)
- Manually rotate the reaming head until it sits firmly in the pocket
  Tighten with the special key: 12-14 N·m (the toolholder should be clamped into an adapter) (Fig. ❹)
- Make sure there is no face gap between the toolholder and the reaming head (Fig. ❺)

▪ Indexing

- Release the reaming head with the key, turning in a counter-clockwise direction until it rotates freely
- Rotate by hand another one turn
- Remove the reamer head from the tool. The clamping screw should remain inside!!!
- Clean the pocket of the toolholder (Fig. ❶)
- Clean the cone on the reamer head
- Clamp the reaming head on the screw. Please note that it can be assembled only in one position relative to the screw (rotate the head until locating the correct position) (Fig. ❸)
- Manually rotate the reaming head. In the beginning it should rotate without the screw and then (after 1/6 of a turn) it should engage with the screw. Rotate until it sits firmly in the pocket
  If the screw is rotating together with the reaming head from the beginning,
  remove the reaming head and open the screw another one turn
- Tighten with the special key: 12-14 N·m (the toolholder should be clamped into an adapter) (Fig. ❹)
- Make sure that there is no face gap between the toolholder and the reaming head (Fig. ❺)

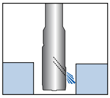
TB-REAM

TB-REAM is suitable for high precision applications and tight hole diameter tolerance (IT≥5).
The high surface quality and accurate bore geometry achieved with theTB-REAM very often saves necessity for additional machining operations such as honing or internal grinding that had been previously required.
The reamer body has carbide guiding pads brazed on it. The adjustment system guarantees a user-friendly and easy process for adjusting the required diameter and back taper control.
A strong and reliable insert clamping mechanism in the pocket, together with nickel plated body ensure long tool life.
The TB-REAM reamers were designed for high speed reaming. This feature is most advantageous in mass production applications. When large batches are involved, the indexable insert with the double cutting corner provides high productivity and an extremely economical solution.

Bore types

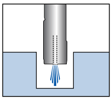
■ Through hole coolant

A reamer body for a through hole includes coolant hole outlets located behind the insert, which direct the chips forward to prevent scratching the hole surface.
Moreover, extra holes are located behind the pads in order to convey lubricant and reduce the friction between the pads and the hole's surface.



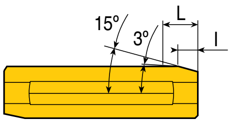
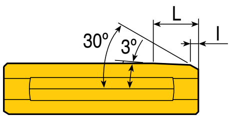
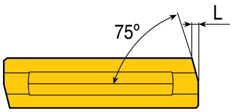
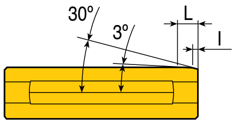
■ Blind hole coolant

For blind hole applications the coolant outlet is located at the front end of the tool. The blind hole causes the coolant with the chips to flow backwards.

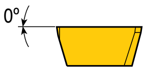
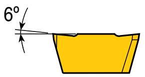
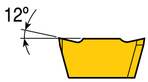


Front angles and cutting geometries

■ 4 standard lead angles are available:

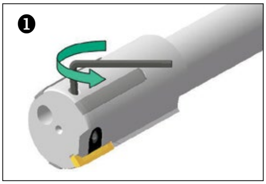
Lead	L (mm)	l (mm)		Use
A	3	1		High surface quality at lower cutting conditions
B	1.3	0.5		Universal use Ideal for high speed cutting conditions
C	0.55			Suitable for aluminum and brass
D	0.6	0.2		Geometry for blind hole and low feed rates

■ 3 standard cutting angles are available:

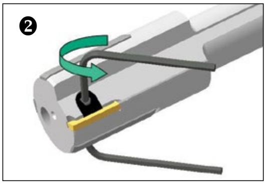
Lead	Angle (°)	Use
00		For cast iron applications
06		General use
12		For stainless steel and aluminum

Contents

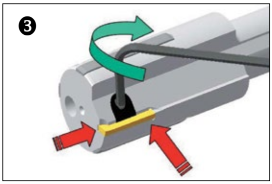
Insert indexing



- Rotate the adjustment screws 1 turn counter-clockwise (CCW).



- Rotate the clamping screw CCW from the top and or clockwise from the bottom,turning both sides simultaneously.



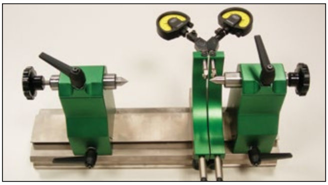
- Remove the insert. Clean the insert and the pocket. Place the sharp edge on the outer position.
- Press the insert against the back stopper and the two adjustment pins. Tighten the clamping wedge by rotating the clamping screw CW from the top or CCW from the bottom.

Setting process

There are two optional setting mechanisms: a comparison micrometer and a setting device.

■ Comparison micrometer with dial gauge
- Low cost solution and readily available for small workshops
- Prone to damage the cutting edge therefore not recommended

■ Setting device, located between centers
- Shorter setting time
- Modular system
- Higher accuracy
- No risk of damaging the cutting edge



■ TaeguTec designation: TB-SETTING L450

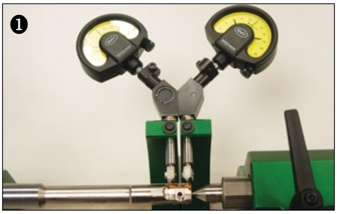
Using a comparison micrometer

- Set the micrometer to the correct diameter using the precision blocks.
- Adjust the frontal diameter and back taper by turning the adjustment screw C.W.
  The frontal diameter should be larger than the rear diameter by approximately 0.015 mm.

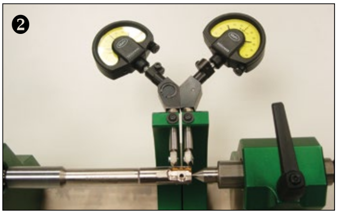
Using a setting device

- TaeguTec is offering a mechanical setting device. It enables an easy, quick and accurate adjustment.
- Due to its modular construction, it can be used for standard as well as for special and more complicated reamer adjustments.

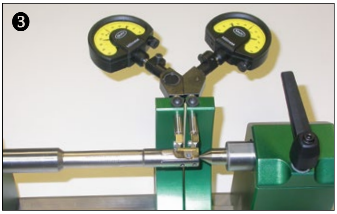
Using a setting device



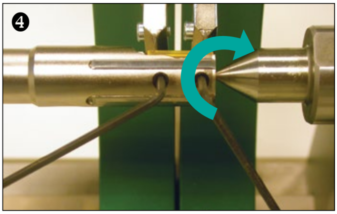
Place the reamer between fixture's centering pins



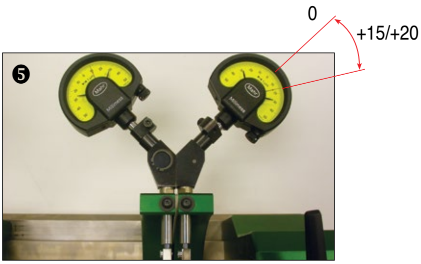
Use the pad as a zero reference to set the indicators to zero



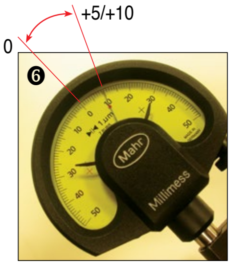
Rotate and position the insert against indicators



Tighten the adjustment screws in a clockwise direction



Adjust the frontal side of insert to +15/20 microns



Adjust the back side of insert to +5/10 microns

Hole tolerance

Diameter D(mm)		Tolerance (μm)															
>D	≤D	B10	C9	C10	D8	D9	D10	E7	E8	E9	F6	F7	F8	G6	G7	H6	H7
–	3	+180 +140	+85 +60	+100 +60	+34 +20	+45 +20	+60 +20	+24 +14	+28 +14	+39 +14	+12 +6	+16 +6	+20 +6	+8 +2	+12 +2	+6 0	+10 0
3	6	+180 +140	+100 +70	+118 +70	+48 +30	+60 +30	+78 +30	+32 +20	+38 +20	+50 +20	+18 +10	+22 +10	+28 +10	+12 +4	+16 +4	+8 0	+12 0
6	10	+208 +150	+116 +80	+138 +80	+62 +40	+76 +40	+98 +40	+40 +25	+47 +25	+61 +25	+22 +13	+28 +13	+35 +13	+14 +5	+20 +5	+9 0	+15 0
10	14	+220 +150	+138 +95	+165 +95	+77 +50	+93 +50	+120 +50	+50 +32	+59 +32	+75 +32	+27 +16	+34 +16	+43 +16	+17 +6	+24 +6	+11 0	+18 0
14	18																
18	24	+244 +160	+162 +110	+194 +110	+98 +65	+117 +65	+149 +65	+61 +40	+73 +40	+92 +40	+33 +20	+41 +20	+53 +20	+20 +7	+28 +7	+13 0	+21 0
24	30																
30	40	+270 +170	+182 +120	+220 +120	+119 +80	+142 +80	+180 +80	+75 +50	+89 +50	+112 +50	+41 +25	+50 +25	+64 +25	+25 +9	+34 +9	+16 0	+25 0
40	50	+280 +180	+192 +130	+230 +130													
50	65	+310 +190	+214 +140	+260 +140	+146 +100	+174 +100	+220 +146	+90 +60	+106 +60	+134 +60	+49 +30	+60 +30	+76 +30	+29 +10	+40 +10	+19 0	+30 0
65	80	+320 +200	+224 +150	+270 +150													

Hole tolerance

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<tr><th colspan="18">Tolerance (μm)</th></tr>
<tr><th>H8</th><th>H9</th><th>H10</th><th>JS6</th><th>JS7</th><th>K6</th><th>K7</th><th>M6</th><th>M7</th><th>N6</th><th>N7</th><th>P6</th><th>P7</th><th>R7</th><th>S7</th><th>T7</th><th>U7</th><th>X7</th></tr>
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-20</td><td>-14
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-30</td></tr>
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0</td><td>+48
0</td><td>±4</td><td>±6</td><td>+2
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-9</td><td>0
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-78</td><td>-64
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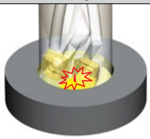
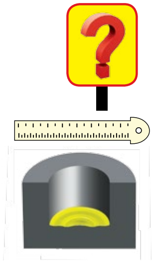
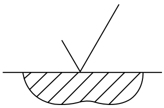
-121</td></tr>
</table>

Trouble Shooting

Problem	Image	Cause	Solution
Abnormal insert wear		- Incorrect cutting conditions	- Reset as per recommended cutting condition
		- Incorrect insert application	- Re-index by insert geometry & grade as per recommended insert tables
		- Lack of cutting fluid	- Check for sufficient cutting fluid supply - Check for sufficient density of cutting fluid supply - Change to internal coolant supply when external coolant supply is finished - Check direction of external coolant supply
Chipping		- Insufficient insert application	- Change inserts
		- Built-up-edge	- Increase cutting speed or change insert geometry
		- Irregular surface	- Decrease feed when drilling on the workpiece
Vibration		- Weak machine set-up	- Select a sufficient powered machine
		- Unstable fixture	- Change to a stronger clamping fixture
		- Lack of cutting fluid	- Check for sufficient cutting fluid supply - Check for sufficient density of cutting fluid supply - Change to internal coolant supply when external coolant supply is finished - Check direction of external coolant supply
		- Insufficient cutting condition	- Re-index to recommended cutting conditions
		- Chipping of insert	- Change inserts
		- Vibration during machining	- Check off-set - Use after rotating drill to 180°
		- Using insert with exceeded tool life	- Change insert before abrasion loss of insert is 0.3mm
		- Surface too rough	- Flatten entrance before drilling
		- Using long overhang drill	- Select a shorter overhang
		- Layered workpiece	- Strong fixture
		- Using damaged insert	- Change tool
		- Improper machine set -up	- Check machine and fixture

Trouble Shooting

Indexable Drill

Problem	Image	Cause	Solution
Core		- Core created during machining	- Re-index to recommended cutting conditions - Short overhang
		- Core created with workpiece clamped into the lathe	- Check lathe set-up - Short overhang
Incorrect hole diameter		- Tapered holes (expanding/decreased hole size)	- Reset speed and feed as per recommend cutting conditions - Increase cutting fluid - Check lathe set-up - Adjust off-set in the lathe
		- Tapered holes (Different entrance & exit hole size)	- Reset speed and feed as per recommended cutting conditions - Increase cutting fluid - Short overhang
		- Overlapped workpiece (layered plate)	- Strong clamping of workpiece - Decrease feed
Poor surface roughness		- Lack of cutting fluid	- Check for sufficient cutting fluid supply - Check for sufficient density of cutting fluid supply - Change external coolant supply for internal coolant supply
		- Incorrect insert geometry & grade	- Re-index by insert shape & grade as per recommended inserts table
		- Weak machine set-up	- Check machine set-up
		- Incorrect cutting conditions	- Reset by speed and feed as per recommended cutting conditions - Decrease feed
Machine stoppage		- Lack of machine torque	- Decrease the feed
		- Insert fused to the workpiece	- Check clamping of the insert screw - Check cutting fluid supply - Check cutting condition
Chip jamming		- Bad chip control	- Check cutting fluid supply - Change external coolant supply to internal coolant supply - Increase cutting fluid supply - Decrease feed - Increase cutting speed
		- Incorrect insert geometry	- Re-index by insert geometry & grade as per recommended inserts table
		- Use of damaged insert	- Change insert

Trouble Shooting

Problem	Part	Image	Cause	Solution
Chipping	Point		- Feed too high (hardened material)	- Decrease feed
			- Weak drill body	- Reduce overhang and use a center drill
			- Chisel too small	- Check chisel
			- Lack of honing on chisel part	- Check honing
			- Unstable fixture	- Check fixture
Chipping	Cutting edge		- Incorrect cutting conditions (chipping of built-up-edge)	- Increase cutting speed and decrease feed
			- Weak drill body	- Reduce overhang and decrease cutting speed
			- Lack of honing on edge part	- Check honing
			- Insufficient relief angle	- Check relief angle
			- Incorrect grade	- Change grade
			- Unstable tool holding	- Change tool holding
Chipping	Edge corner		- Improper grade	- Change grade
			- Unstable toolholder	- Change toolholder
			- Toolholder vibration	- Check clamping direction of the toolholder
			- Lack of cutting fluid	- Increase cutting fluid supply
			- Unstable fixture	- Check fixture
Chipping	Margin		- Interrupted cutting in the hole entrance	- Flatten entrance and reduce feed to 30~50%
			- Incorrect margin shape	- Large back taper and small margin width
			- Weak drill body	- Short overhang and use a center drill
			- Lack of cutting fluid	- Increase cutting fluid supply
			- Unstable fixture	- Check fixture
			- Wear too large	- Reduce regrinding time
Breakage	Body		- Cutting conditions too high	- Decrease cutting speed and feed
			- Weak drill body	- Correct tool geometry and use a center drill
			- Lack of cutting fluid	- Increase cutting fluid supply
			- Unstable fixture	- Check fixture
			- Wear too large & first chipping	- Reduce regrinding time
			- Bad chip evacuation	- Change tool shape

Trouble Shooting

Solid Type Drill

Problem	Part	Image	Cause	Solution
Wear too large	Cutting edge		- Incorrect speed and feed	- Reduce cutting speed and increase feed
			- Incorrect relief angle	- Increase relief angle
			- Incorrect grade	- Change grade
			- Lack of cutting fluid	- Increase cutting fluid supply and fill fluid tank
			- Wear too large	- Reduce regrinding time
Wear too large	Cutting corner		- High cutting speed and feed	- Reduce cutting speed and increase feed
			- Incorrect relief angle	- Increase relief angle
			- Incorrect grade	- Change grade
			- Toolholder vibration	- Check clamping direction of the toolholder
			- Lack of cutting fluid	- Increase cutting fluid supply and fill fluid tank
			- Wear too large	- Reduce regrinding time
Wear too large	Margin		- Cutting speed too high	- Decrease cutting speed
			- Interrupted cutting in entrance	- Flatten entrance and reduce feed to 30~50%
			- Toolholder vibration	- Check clamping direction of the toolholder
			- Lack of cutting fluid	- Increase cutting fluid supply and fill fluid tank
			- Wear too large	- Reduce regrinding time
Built-up-edge	Cutting edge		- Cutting speed too low	- Increase cutting speed
			- Negarland too large	- Change to a sharper edge drill bit
			- Lack of cutting fluid	- Increase cutting fluid supply and fill fluid tank (Internal coolant)
Pre check list		- Proper tool selection in the application? - Good machine spindle and chuck? - Good fixture? - Correct cutting conditions? - Toolholder rigidly clamped ? - Enough cutting fluid supply?		

Trouble Shooting

Division	Problem	Cause	Solution
Dimension	Expanding hole	- Incorrect speed & feed	- Increase speed and decrease feed
		- Chisel wear too large	- Reduce regrinding time
		- Improper point shape	- Select correct geometry & grind to proper dimensions
		- Chuck weakness	- Change tool holding
		- Toolholder vibration (including chisel jiggle)	- Check clamping direction of the toolholder
		- Cutting fluid pressure too high	- Decrease cutting fluid
		- Chip pecking	- Change cutting conditions
Dimension	Decreasing hole	- Incorrect cutting conditions	- Increase speed and increase the feed
Dimension	Jiggle	- Margin wear too large	- Reduce regrinding time
		- Toolholder vibration	- Check clamping direction of the toolholder
		- Lack of cutting fluid	- Increase cutting fluid supply
		- Unstable fixture	- Check fixture
Position		- Incorrect cutting conditions	- Decrease feed
		- Cutting rough and hard Inclined entrance	- Flatten entrance and reduce feed to 30~50%
		- Toolholder vibration	- Check clamping direction of the toolholder
		- Chuck weakness	- Change toolholder
		- No pre hole	- Pre hole (use drill with higher point angle 5~10°)
Shape	Straightness	- Wear too large	- Reduce regrinding time
		- Weak drill body	- Select proper tool geometry
		- Toolholder vibration (including chisel jiggle)	- Check clamping direction of the toolholder
		- Rough entrance surface	- Flatten entrance and make pre-hole
		- Unstable fixture	- Check fixture
		- Chip pecking	- Change cutting conditions

Trouble Shooting

Solid Type Drill

Division	Problem	Cause	Solution
Shape	Roundness	- Wear too large	- Reduce regrinding time
		- Insufficient relief angle	- Decrease relief angle
		- Weak drill body	- Select proper tool geometry
		- Toolholder vibration (including chisel jiggle)	- Check clamping direction of the toolholder
Shape	Cylindricity	- Incorrect cutting conditions	- Increase feed
		- Margin wear too large	- Reduce regrinding time
		- Toolholder vibration (including chisel jiggle)	- Check clamping direction of the toolholder
Surface roughness		- Incorrect cutting conditions	- Increase speed and decrease feed
		- Wear too large	- Reduce regrinding time
		- Toolholder vibration	- Check clamping direction of the toolholder
		- Chuck weakness	- Change tool holding
		- Lack of cutting fluid	- Increase cutting fluid supply and fill fluid tank
		- Chip pecking	- Change cutting conditions
Chip control		- Long chip	- Increase feed and select proper tool geometry
		- Stretched chip	- Check honing size and chipping and breakage
Jiggle		- Relief angle too large	- Decrease relief angle
		- Weak drill body	- Select proper tool geometry
		- Chip pecking	- Change cutting conditions

Trouble Shooting

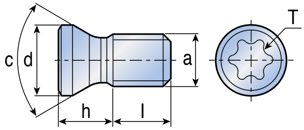
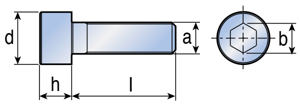
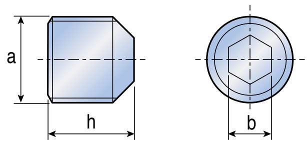
Problem	Cause	Solution
Chips too small	- Improper cutting conditions	- Adjust speed and feed
	- Chip breaker or chip breaker radius too small and deep	- Amend chip breaker
	- Faulty tool geometry	- Use correct geometry
	- Misalignment of shank and spindle	- Correct misalignment
	- Material variation	- Try to adjust by altering speeds and feeds
	- Loose or oversize guide bushes	- Change bushing
	- Poor starting conditions (workpiece not centered)	- Center workpiece
Chips too large	- Improper cutting conditions	- Adjust speed and feed
	- Chip breaker or chip breaker radius too large and shallow	- Amend chip breaker
	- Oversized guide bush or guide bush misalignment	- Correct misalignment or change bush
Erratic chip pattern	- Lack of uniformity in workpiece material	- Adjust speeds & feeds or amend chip breaker
	- Faulty feed mechanism (likely to occur with hydraulic feed system)	- Consult machine builder or sales engineer
	- Inncorrect carbide grade	- Check grade charts for guidelines
	- Chips jamming because of inadequate coolant supply	- Increase coolant supply
	- Pressure or incorrect tool geometry	- Correct tool geometry
	- Misalignment of shank and spindle	- Correct misalignment
	- Excessive vibration due to insufficient workpiece / tool rigidity	- Contact machine builder or tool manufacturer
	- Wrong choice of coolant	- Consult with tool manufacturer
	- Under or oversized guide bushing	- Change bushing
Stringy chips	- Incorrect tip geometry	- Amend chip breaker
	- Lack of uniformity in workpiece material	- Adjust with speed & feed or amend chip breaker
	- Faulty feed mechanism (likely to occur with hydraulic feed system)	- Consult with machine builder or sales engineer
	- Cooling contaminated with fines	- Clean coolant
	- Chemical affinity between workpiece and carbide	- Check possibility of changing grade
	- Chipped cutting edge	- Replace drill
	- Feedrate too low	- Increase feed

Trouble Shooting

Problem	Cause	Solution
Carbide tip breakage	- Dull tool	- Hone cutting edges if required
	- Inadequate coolant	- Check volume and pressure
	- Contaminated coolant	- Check coolant
	- Guide bush tolerance too tight	- Replace if necessary or undersize drill
	- Misalignment of shank and spindle	- Correct misalignment
	- Tool geometry error	- Correct geometry
	- Material variation	- Try to adjust by altering speeds and feeds
Short tool life	- Improper speed or feed	- Adjust accordingly
	- Incorrect carbide grade	- Choose proper grade for material
	- Worn guide bushes	- Replace guide bush
	- Excessively warm coolant	- Check coolant temperature & system
	- Incorrect cutting fluid	- Replace if possible
	- Misalignment of shank and spindle	- Correct misalignment
	- Tool geometry error	- Correct geometry
	- Material variation	- Try to adjust by altering speeds and feeds
Poor surface finish	- Misalignment	- Check and adjust
	- Inadequate dampening of shank causing vibration	- Provide vibration dampers
	- CB too far above or below center line	- Correct chip breaker
	- Faulty cutter or guide pad geometry	- Correct geometry
	- Misalignment between workpiece and drill	- Correct misalignment
	- Workpiece deflection	- Improve clamping and rigidity
	- Excessive vibration	- Contact tool or machine manufacturer
	- Tool geometry error	- Correct geometry
	- Cutting speed too low	- Increase cutting speed
	- Feed too light especially in hardened material	- Increase feed
	- Uneven feed	- Correct feed mechanism

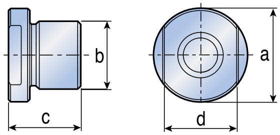
Components

Screw

Shape	Description	Dimensions (mm)							Torque (N.m)
		a	d	h	l	c	b	T	
	TS 18034I/HG-P	M1.8x0.35	2.75	1.9	1.5	55	-	T6-P	0.5
	TS 20038I/HG-P	M2x0.4	2.7	2	1.8	60	-	T6-P	0.6
	TS 20043I/HG-P	M2x0.4	2.7	2.1	2.2	60	-	T6-P	0.6
	TS 22052I/HG-P	M2.2x0.45	3.15	2.33	2.87	60	-	T7-P	0.9
	TS 25064I	M2.5x0.45	3.5	2.6	3.8	50	-	T8	1.2
	TS 25064I/HG-P	M2.5x0.45	3.5	2.73	3.67	50	-	T8-P	1.2
	TS 30100I/HG-P	M3x0.5	4.3	2.86	4.14	60	-	T9-P	2.0
	TS 35088I	M3.5x0.6	5.1	3.47	5.28	60	-	T10	3.0
	TS 35088I/HG-P	M3.5x0.6	5.1	3.67	5.08	60	-	T10	3.0
	TS 40093I	M4x0.7	5.7	5	4.3	60	-	T15	3.5
	TS 45A100I/HG	M4.5x0.75	7	4.2	5.8	60	-	T20	5.0
	TS 50115I	M5x0.8	7	4.96	6.54	60	-	T20	5.5
	SO 25065I	M2.5x0.45	3.45	2.9	3.6	60	-	T7	0.9
	SO 50090I	M5x0.8	7	4.5	7.6	60	-	T20	5.5
	SH M3x0.5x10	M3x0.5	6	3	10	-	2.5	-	3.0
	SH M4x0.7x12	M4x0.7	7	4	12	-	3	-	4.5
	SH M4x0.7x16	M4x0.7	7	5	16	-	3	-	4.5
	SH M5x0.8x16	M5x0.8	8.5	5	16	-	4	-	5.5
	SH M6x1.0x20	M6x1.0	10	6	20	-	5	-	8.0
	SS M4x0.7x4	M4x0.7		4			2		
	SS M6x1x6	M6x1.0		6			3		
	SS M8x1.25x8	M8x1.25		8			4		
	SS M10x1.5x10	M10x1.5		10			5		

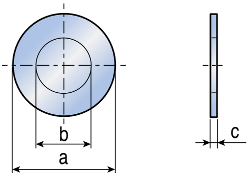
Components

Cooling hole plug



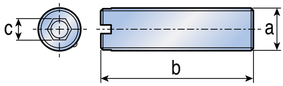
Shape	Description	Dimensions (mm)			
		a	b	c	d
	SL 20M	18	M13x1.0	13	14
	SL 25M	22	M16x1.5	17	17
	SL 32M	29	M22x2.0	21	22
	SL 40M	38	M30x2.0	21	22

Washer



Shape	Description	Dimensions (mm)		
		a	d	h
	MW 4.3x8	4.3	8	0.8
	MW 5.5x10	5.3	9.8	1.0
	MW 6.4x12	6.2	12.6	1.6

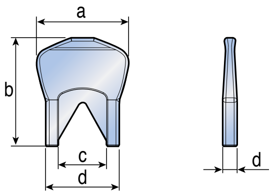
Back screw



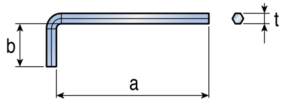
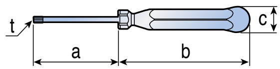
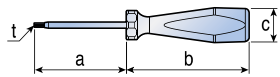
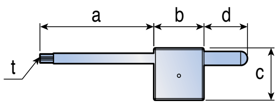
Shape	Description	Dimensions (mm)		
		a	d	h
	M6x1-SP	M6x1.0	28	3
	M10x1.5-SP	M10x1.5	36	5

Components

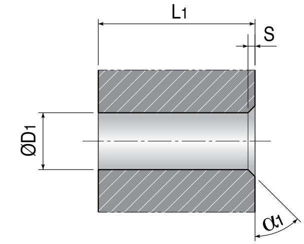
Key

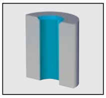
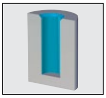
Shape	Description	Dimensions (mm)				
		a	b	c	d	e
	**K TCD D060-D099**	40	47	21	32	6.3
	K TCD D100-D199	40	47	21	32	6.3
	K TCD D200-D269	50	60	27.5	43	8

Wrench

Shape	Description	Dimensions (mm)				
		a	b	c	d	t
	**L-W3**	63	20	-	-	3
	L-W4	70	25	-	-	4
	**TD 6P**	45	70	17	-	T6-P
	TD 7	45	70	17	-	T7
	TD 7P	45	70	17	-	T7-P
	**TD 8**	55	70	24	-	T8
	TD 9	65	80	27	-	T9
	TD 9P	65	80	27	-	T9-P
	TD 10	70	90	29	-	T10
	TD 10P	70	90	29	-	T10-P
	TD 15	70	100	29	-	T15
	TD 20	90	100	33	-	T20
	**T 6P**	34	15	15	13	-
	T 7P	34	15	15	13	-
	T 8P	39	19	19	13	-

▶ Specific dimensions



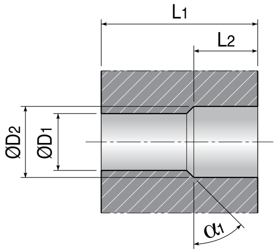



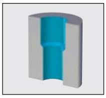
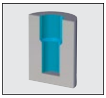
Through ☐ Blind ☐

ØD1 ________ L1 ________

α1 ________ S ________

•Holetolerance ________



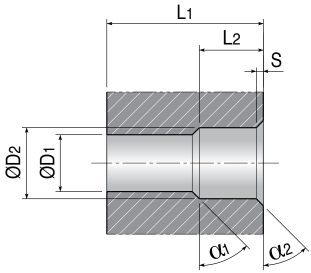
Through ☐ Blind ☐

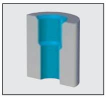
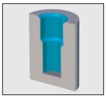
ØD1 ________ ØD2 ________

L1 ________ L2 ________

α1 ________ ________

•Holetolerance ________



Through ☐ Blind ☐

ØD1 ________ ØD2 ________

L1 ________ L2 ________

α1 ________ α2 ________

S ________ ________

•Holetolerance ________

Drill type

•TOPDRIL ________ ☐

•T-DRILL ________ ☐

Technical data

•Machine type

MCT ☐ Lathe ☐

Vertical ☐ Horizontal ☐

Machine name ________

Power ________ Kw

•Coolant supply

Internal ☐ External ☐

Coolant pressure ________ bar

Coolant type ________

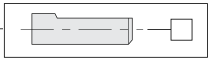
Workpiece

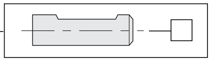
•Part ________

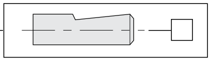
•Material ________

•Hardness ________

Shank type

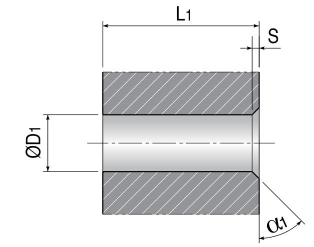

Cylindrical shank (ISO 9766)

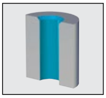
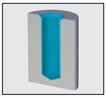

Weldon shank


Whistle notch shank

Comment

Specific dimensions



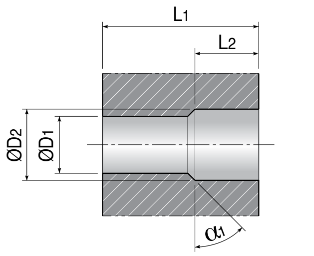



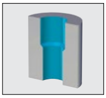
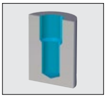
Through ☐ Blind ☐

ØD1 ______ L1 ______

α1 ______ S ______

•Holetolerance ______



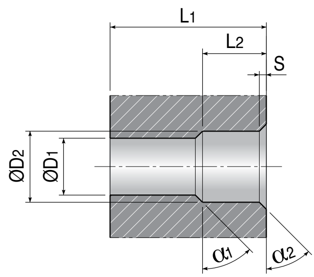
Through ☐ Blind ☐

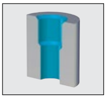
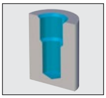
ØD1 ______ ØD2 ______

L1 ______ L2 ______

α1 ______ ______

•Holetolerance ______



Through ☐ Blind ☐

ØD1 ______ ØD2 ______

L1 ______ L2 ______

α1 ______ α2 ______

S ______ ______

•Holetolerance ______

Comment

Technical data

•Machine type

MCT ☐ Lathe ☐

Vertical ☐ Horizontal ☐

Machine name ______

Power ______ Kw

•Coolant supply

Internal ☐ External ☐

Coolant pressure ______ bar

Coolant type ______

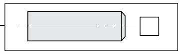
Workpiece

•Part ______

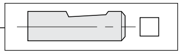
•Material ______

•Hardness ______

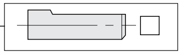
Shank type



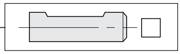
Cylindrical shank (ISO 9766) ☐



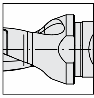
Whistle notch shank ☐

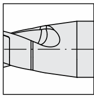


Cylindrical with flat type ☐



Weldon shank ☐

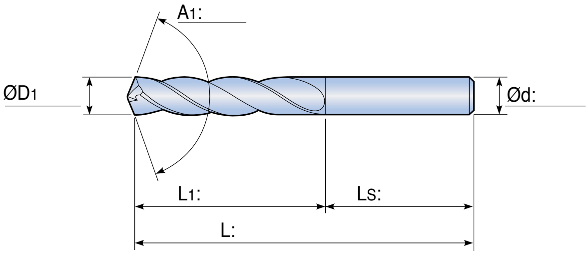
 ☐

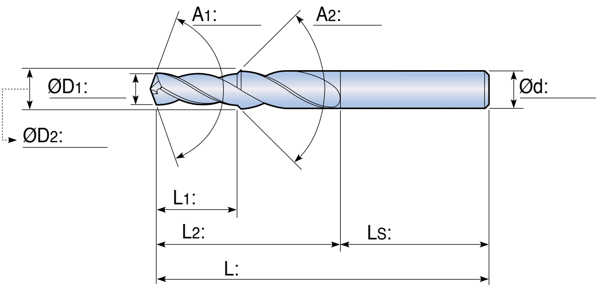
 ☐

•Shank dia: ______

•Shank length: ______

Specific dimensions





• $ØD_1$, $ØD_2$ would be hole dimensions and please note hole tolerance if possible

Technical data	

•Machine type

MCT ☐ Lathe ☐

Vertical ☐ Horizontal ☐

Machine name ______

Power ______ Kw

•Coolant supply

Internal ☐ External ☐

Coolant pressure ______ bar

Coolant type ______

Workpiece

•Part ______

•Material ______

•Hardness ______

Shank type

•Blind hole ______ ☐

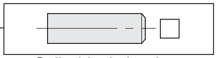
•Through hole ______ ☐

Coating

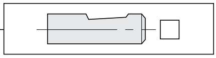
•TiAlN ______ ☐

•Non-coated ______ ☐

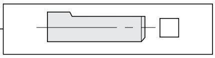
Shank type



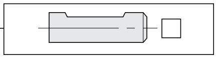
Cylindrical shank



Whistle notch shank



Cylindrical with flat type



Weldon shank

Comment

Tailor-made Order Form

▶ Deep hole drilling order form

★: Mandatory data field

Campany name :	Inquiry number :
Address :	Inquiry date :
Contact person :	Customer No :

Workpiece (If possible,please attach a drawing)				
Product name				
Hole diameter (ø)	(mm)			
Hole depth (drilling length)	(mm)			
No. of holes				
Tolerance (of hole)				
Surface finish (Rz,Ra...)				
Deviation (mm/100)				
Straightness (mm/100)				
Material				
Material (DIN,AISI,JIS...)				
Hardness (HB,HS,HRC...)				
Condition★	☐ Annealed	☐ Quenched	☐ Tempered	
	☐ Cast	☐		
	☐ Other	☐		

Machine			
Machine supplier name			
Machine type/model			
Rigidity	☐ Good	☐ Normal	☐ Bad
Date of manufacture			
Retrofitted	☐ NC lathe	☐ M/C	☐ Other
Double rotation (TR/WR)	☐ Tool and workpiece		
Rotating workpiece (WR)	☐		
Rotating tool (TR)	☐		
Safety devices			
Motor power	(kw)		

Type of coolant			
Coolant supplier name			
Water based	☐ Soluble	☐ Emulsion	%
Oil based	☐		
Coolant pressure	(bar)		
Coolant volume	(L/min)		

Tailor-made Order Form

▶ Deep hole drilling order form

★: Mandatory data field

Tool (Drill head)			
Drill diameter(ø)	(mm)		
Thread	☐ Inner	☐ Outer	
Brazed	☐		
Indexable	☐ Adjustable	☐ Direct mount	☐
Coating	☐ Coated	☐ Uncoated	
Coating type	☐ TiN	☐ TiAlN	☐ Other
• Solid drilling	☐		
• Counterboring	☐		
Cutting angle★ Brazed indexable	☐ 20°	☐ 45°	
	☐ Nomal angle	☐ Close angle	
Pre-bored size(per side)	(mm)		
Bottom finishing★	☐ Fullball R	☐ Flatbottom R	☐ Corner R
	☐ Compound R		
• Trepanning	☐		
Core size(ø)	(mm)		☐
Tube inner dia(ø)	(mm)		
Tube outer dia(ø)	(mm)		
Tube			
Outside dia(ø)	(mm)		
Total length(L)	(mm)		
Internal thread	☐		
External thread	☐ 4 Starts	☐ 2 Starts	☐ 1 Starts
Tube thread	☐ 1 end	☐ Both ends	
Inner tube length	(mm)		
Inner tube slit	☐ 1 end	☐ Both ends	

Drilling system		
Single tube system	☐	STS
Double tube system	☐	DTS

Boring conditions	
Through hole drilling	☐
Blind hole drilling	☐
Cross hole drilling★	☐

★ Please sketch your drilling application

General Information	Production			
Quantity per year:				
Present performance status:				
grade, tool life, etc:				
Cutting data:	Vc=	m/min,	N=	rpm
	f=	mm/rev,	F=	mm/min

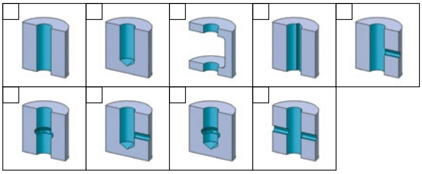
▶ T-REAM order form

★: Mandatory data field

Date :	Subsidiary:
Company★ :	Enquiry dead line:
Contact person:	
Address:	

Request reason	
New tool ☐	Problem ☐
Quality	
Cycle time	
Alternative supplier	
Other	

Workpiece	
Description★	
Hardness★	
Pre-hole size★	(Tolerance :)
Depth★	
Bore type	



Clamping information	

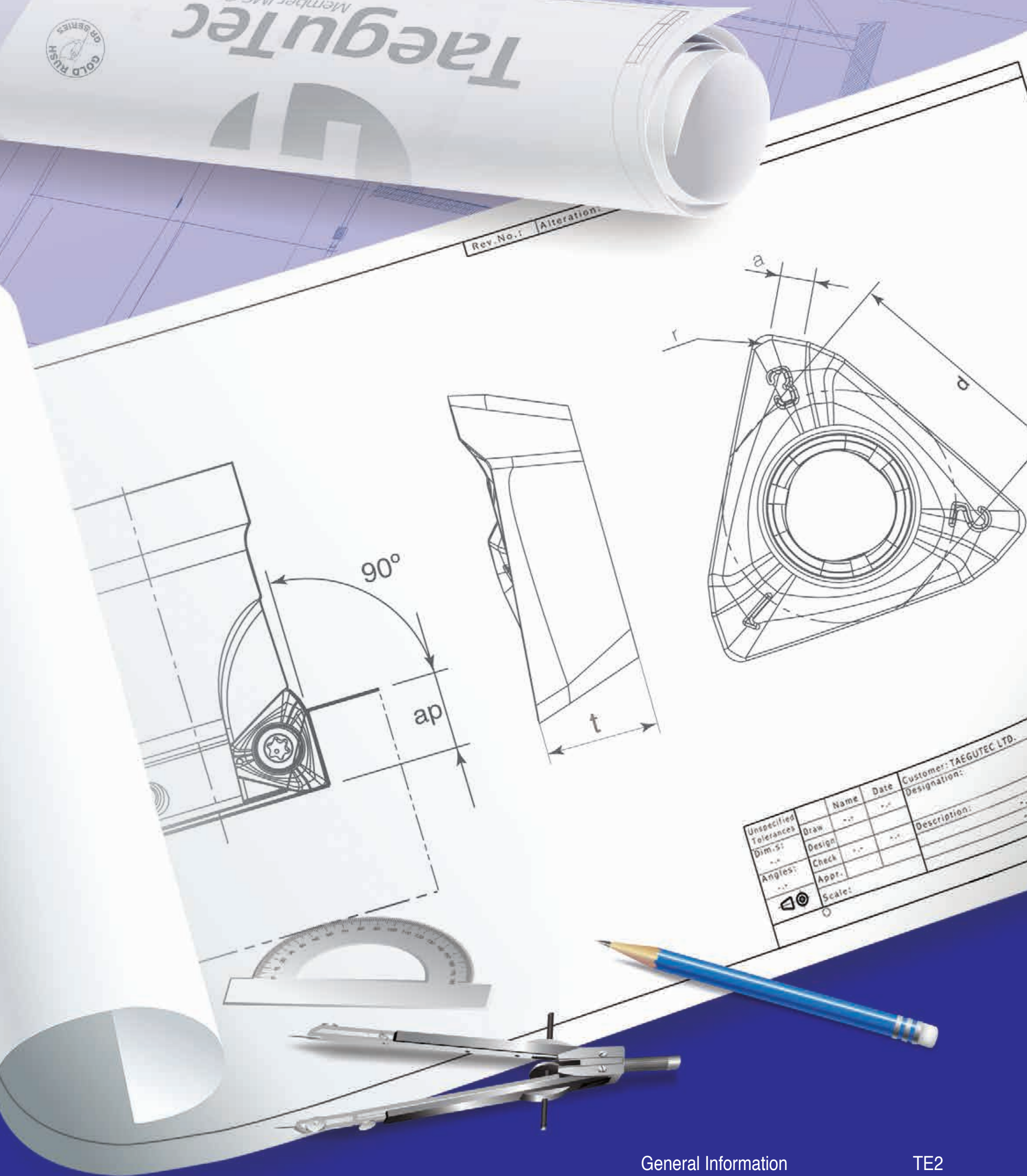
Existing tool	
Maker	
Tool type	
Speed & Feed	
Tool life	
No of teeth	
Coolant type	

Machine		
Model		
Type★	vertical	☐
	horizontal	☐
	multi-spindle	☐
Adaption★		
Max RPM		
Power		
Spindle accuracy		
Coolant		

Lubricant	
Oil	☐
MQL	☐
Emulsion	☐
Ratio of mixture	
Coolant pressure	

Quality requirement	
Tolerance★	
Surface finish(Ra)★	
Roundness	
Straightness	
Cylindricity	
Concentricity	

Tool	
Type★	TM(Index multi-edge) ☐ TB(Single blade) ☐ TS(Solid) ☐ Other ☐ ( )
Diameter★	
Depth of cut★	
Coolant★	Internal ☐ External ☐
Shank type★	
Holder type	Collet ☐ Hydraulic ☐ Other ☐
Adjustable adaptor	Yes ☐ No ☐



TECHNICAL GUIDE

-Milling

Contents

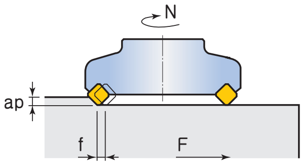
Power calculation

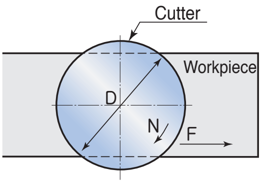
$$W = \frac{Q \times Ks}{60 \times 102 \times \eta}(kw)$$

$$Hp = \frac{W}{0.75}$$

$$Q = \frac{L \times F \times ap}{1000} = \frac{ap \times f \times V \times L \times Z}{\pi \times D}$$

W : Power(kw)
Hp : Horse power
Q : Chip removal (cm^3/min)
L : Width of cut (mm)
F : Table feed (mm/min)
ap : Axial depth of cut (mm)
Ks : Specific cutting force (kg/mm^2)
η : Machine efficiency (0.5 - 0.75)

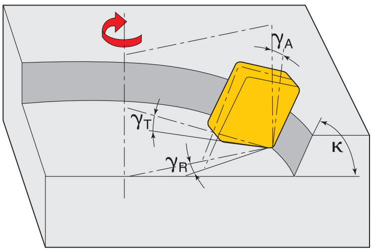




Specific cutting force(Ks)

Material		Hardness (HB)	Specific cutting force (Kg/mm^2)
Carbon steel		100 - 150	220
		120 - 180	230
		200 - 250	250
Alloy steel		120 - 200	230
		250 - 300	275
Stainless 300 series		-	325
Stainless 400 series		-	300
Steel casting	Carbon steel	< 225	210
	Alloy steel	150 - 250	220
	Stainless steel	150 - 300	250
Gray cast iron		150 - 300	120 - 140
Nodular cast iron		125 - 300	125 - 180
Aluminum		-	100 - 140
Copper		-	140 - 200

Angle nomenclature



κ : Entering angle
γA : Axial rake angle
γR : Radial rake angle
γT : True rake angle

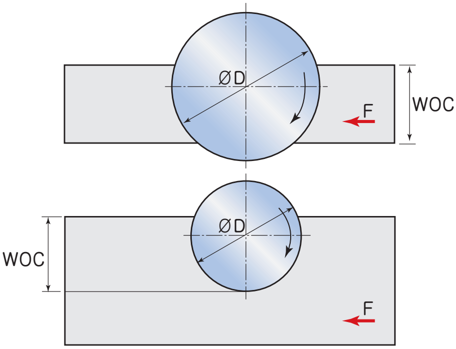
Choosing cutter diameter

The best cutter diameter (ØD) should be selected upon the workpiece dimensions (a).

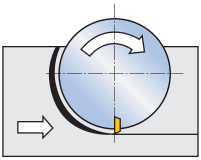
D $\cong$ 1.3 - 1.5 WOC

If the machine power is limited or the workpiece is too wide, select a cutter diameter that takes more than two passes or that matches the power of machine. When the appropriate cutter diameter is not available, proper cutter position will give good results.

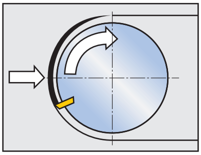
WOC = 3/4D



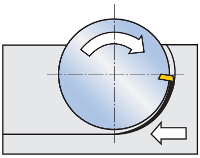
Cutter position



- Conventional milling (Up milling)
  The feed direction of the workpiece is opposite to that of cutter rotation. The chip thickness starts at zero and increases to the maximum at the end of cut. In Up milling, the insert wear is severe with excessive friction and high temperature caused by the rubbing or burnishing effect in the insert.

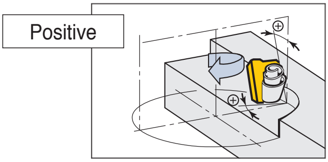


- Channel milling (Up and down milling)
  The cutter position is in the middle of the workpiece and the cutting force is alternately changed in the radial direction. It causes vibration when the spindle structure is weak. Channel milling is a combination of conventional and climb milling. When channel milling is necessary use positive geometry cutters at reduced speeds and feeds with coolant.

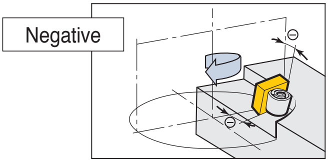


- Climb milling (Down milling)
  Climb milling is normally recommended.
  The feed direction of workpiece is the same as that of cutter rotation. So the chip thickness starts from the maximum and decreases to zero at the end of cut. The tool life is long with less heat and minimum work hardening of workpiece.

Rake angle



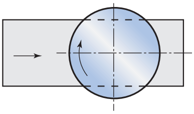
- Easy chip removal
- Apply to all materials under 300 brinell hardness
  Especially on light setups and low HP 40 Taper
  or smaller milling machines.



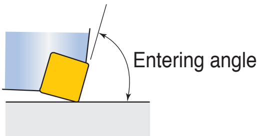
- Apply to cast iron which gives short chip.

- Positive rake angle type is popular and this increases machine efficiency and reduces heat generation. It is possible to reduce machine damage compared to machining with negative rake angle insert, which require high power consumption.
- For milling hard materials that require high edge strength, negative rake angle inserts are preferable.

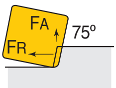
Selection of entering angle



Entering angle of face mill is usually less than 90° for easy chip flow and increased edge strength.

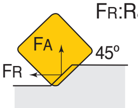


Generally, entering angle are 45° and 75° with the most popular entering angle being 45°. This is economical and enables increased efficiency of power consumption in milling from finishing to roughing.



45° entering angle is suitable for heavy cutting and provides excellent cutting edge strength. With 45° entering angle, axial cutting force is nearly equal to radial cutting force; this is very effective for long overhang milling.

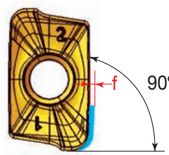
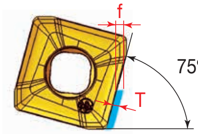
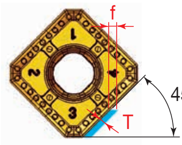
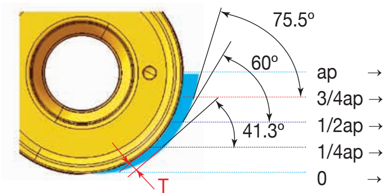
FA:Axial cutting force
FR:Radial cutting force



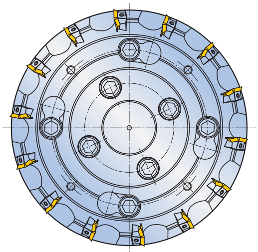
When corner damage is likely to occur in milling of cast iron, 45° entering angle is recommended.

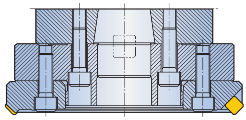
When it is difficult to position the cutter owing to workpiece shape, bigger entering angles are preferable.

▶ Entering angle & chip thickness

Shape	Chip thickness	Feed
	T = f	Low feed
	T = f x sin75º ≒ 0.965f	
	T = f x sin45º ≒ 0.707f	High feed
	T = f T ≒ f x sin75º = 0.968f T ≒ f x sin60.0º = 0.866f T ≒ f x sin41.3º = 0.660f T = 0	Low feed High feed

▶ Quick change cutter multi-bolt type





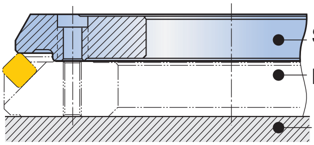
- Light weight cutter
  Quick change cutters are separated into two parts when the cutter diameter is over 200mm - the cutter and adapter. The adapter is mounted on the main spindle of the machine and the cutter is then mounted on the adapter.The weight of cutter is usually half of total cutter weight, this results in reduced weight load & improved safety.

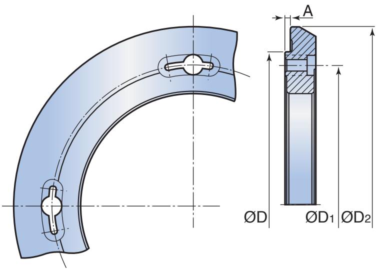
- Save changing time
  Change over times can be reduced by up to 20% compared to conventional cutters.

- Excellent surface finish
  The accurate insert and minimum cutter run-out guarantee excellent surface finish. Capable of very high feed rates.

- Simple & rigid design
  Simple design includes a wedge & wedge screw.

▶ Setting plate





Designation	Dimension (mm)			
	A	D	D_1	D_2
SP03 - I	5.0	47	-	85
SP04 - I	5.0	60	-	105
SP05 - I	5.0	82	-	130
SP06 - I	5.0	96	-	165
SP08 - I	5.0	160	137	203
SP10 - I	5.0	210	187	253
SP12 - I	5.0	274	250	318
SP14 - I	5.0	314	290	358
SP16 - I	5.0	354	332	403

▶ Quick change cutter adapter

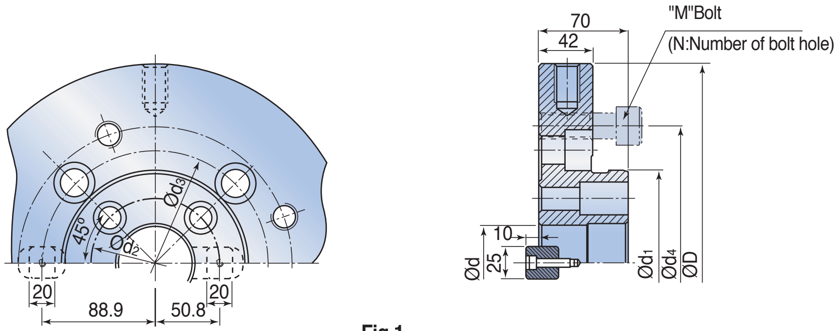


Fig.1

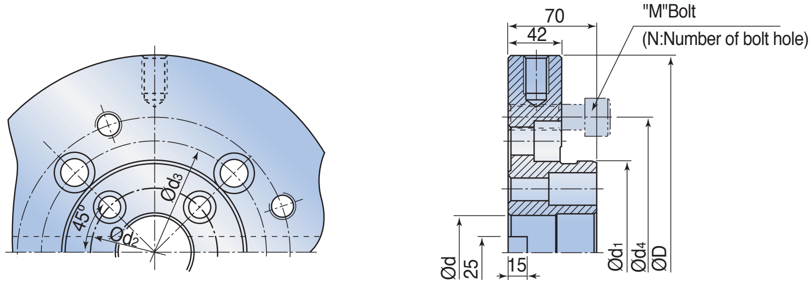
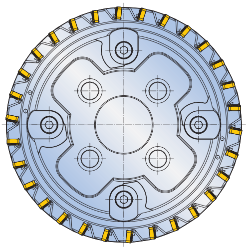


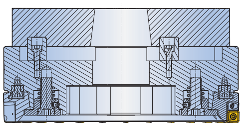
Fig.2

Designation	Dimension (mm)								Weight (Kg)
	D	d	d_1	d_2	d_3	d_4	M	N	
QA 08 K/M	198	47.625	63.5	101.6	-	114.3	M16x40	4	10
QA 10 K/M	248	60	133.35	101.6	-	177.8	M16x50	4	15
QA 12 K/M	313	60	146.05	101.6	177.8	215.9	M20x50	4	19.7
QA 14 K/M	353	60	215.9	101.6	177.8	260.4	M20x50	6	24
QA 16 K/M	398	60	254.0	101.6	177.8	304.8	M20x50	6	29

• K: Adapter with setting key (Fig.1)
M: Adapter without setting key (Fig.2)

New quick change cutter multi-bolt type

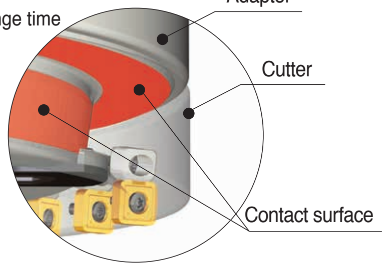




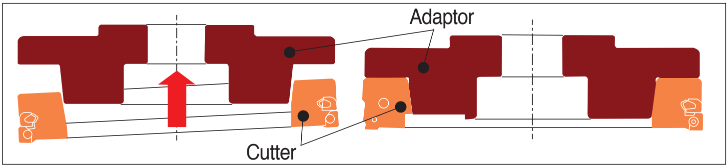
- Light weight cutter
  Reduced cutter weight almost half of conventional one achieves easy handling & improved safety

- Quick and easy system
  Quick and easy system with optimized design for reducing tool change time

- Double face contact
  Excellent repeatability and accuracy
  High stiffness

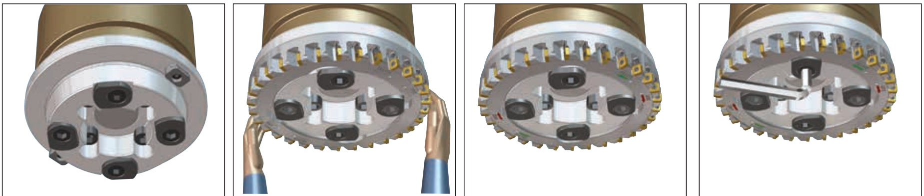


- Easy mounting by taper fitting



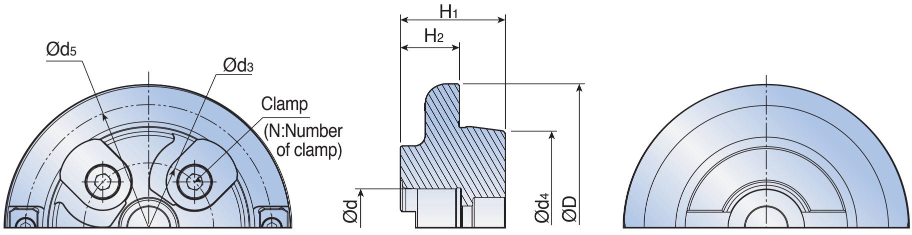
Setting procedure

- Easy mounting and self positioning by taper fitting



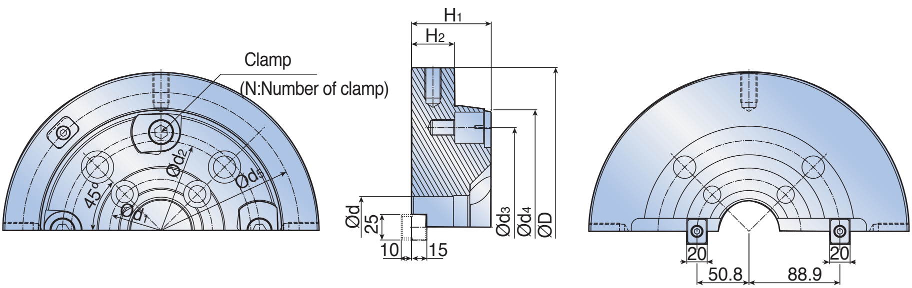
❶Combine the adapter and spindle using 4 screws → ❷Assemble the cutter and adapter chucking position of key and key way → ❸Rotate the cutter following "Lock" direction → ❹Lock the clamping screws as much as about 100º

▶ New quick change cutter-basic arbor type



Designation	Dimension (mm)										Weight (kg)
	D	d	d_1	d_2	d_3	d_4	d_5	N	H_1	H_2	
TQCA D160-FM40	150	40	-	-	68	100.37	129	4	31	55	4.17
TQCA D200-FM60	190	60	-	-	108	140.37	169	4	31	55	5.89
TQCA D250-FM60	240	60	-	-	158	190.37	219	4	31	55	10.4

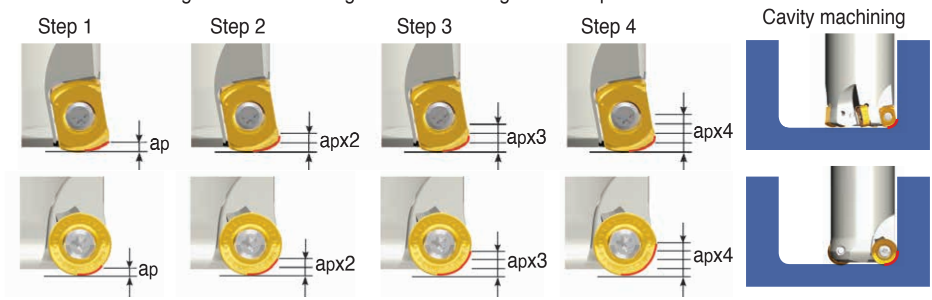
▶ New quick change cutter-spindle mounting type



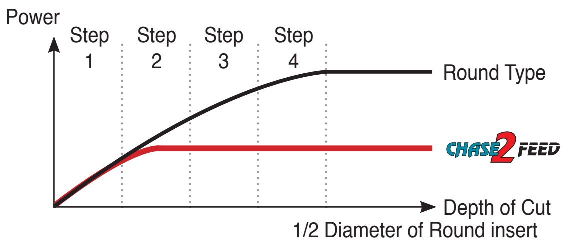
Designation	Dimension (mm)										Weight (kg)
	D	d	d_1	d_2	d_3	d_4	d_5	N	H_1	H_2	
TQCA D250	248	60	101.6	-	158	190.37	219	4	72	48	17.56
TQCA D315	313	60	101.6	177.8	195	230.33	273.5	4	77	42	39.05
TQCA D355	353	60	101.6	177.8	235	270.33	313.5	8	77	42	55.53
TQCA D400	398	60	101.6	177.8	280	315.33	358.5	8	77	42	68.47

Advantage of CHASE2FEED-against round insert

- Cavity machining with CHASE2FEED lower cutting force due to small contact area
  Possible more higher feed machining due to low cutting force compare to round insert



- However the round type has big contact area of about 2.5 times than CHASE2FEED at the step 4

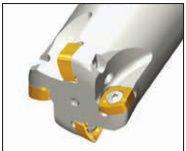


The graph show the mutual relation between machine power and depth of cut for round insert and CHASE2FEED

Ultra high feed rate due to high density

D32, BLMP 12-
2 teeth

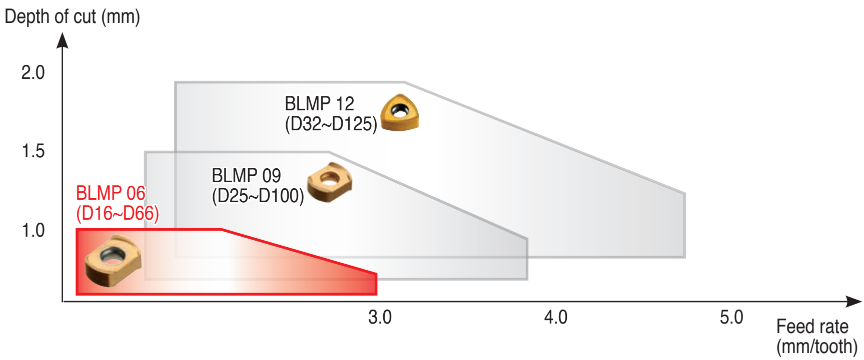
D32, XDMX 13-
2 teeth



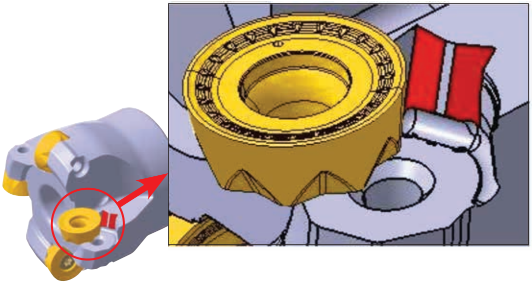
D32, XDMX 08-
4 teeth

D32, BLMP 06-
5 teeth

CHASE2FEED high feed application guide



Features of CHASEMOLD

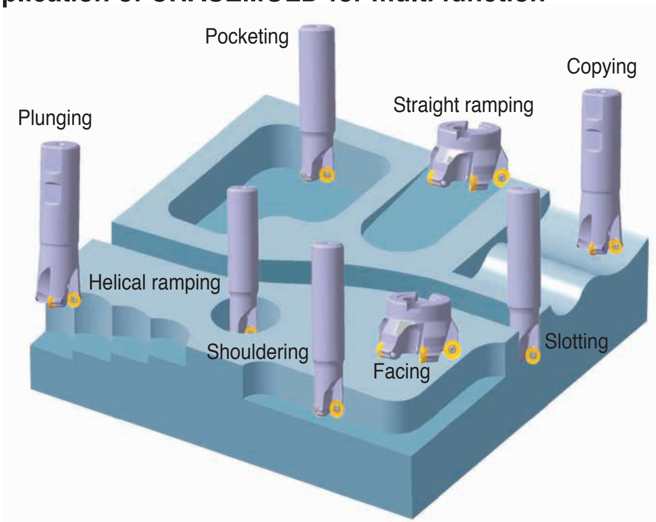


- Exceptional performance at very high feed rates
- Reliable machining even under difficult conditions
- Long tool life through optimum geometry of inserts
- Anti-rotating system (over R5 inserts)

Insert geometries

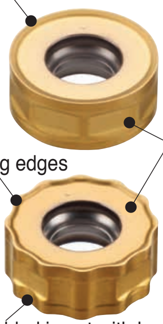
MR	M	MM	ML	MLL	L	AL
						
Hardened steel and interrupted cut	General opaeration	Light cutting, SUS400 series	Light cutting, SUS300 series	Difficult-to-cut material (HRSA) with high feedrate	Heat resistance super alloy	Aluminum & non-ferrous alloy

Application of CHASEMOLD-for multi function

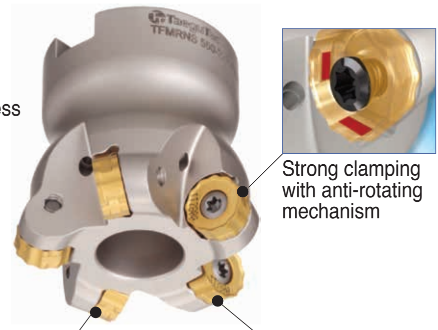


Features of CHASE2MOLD

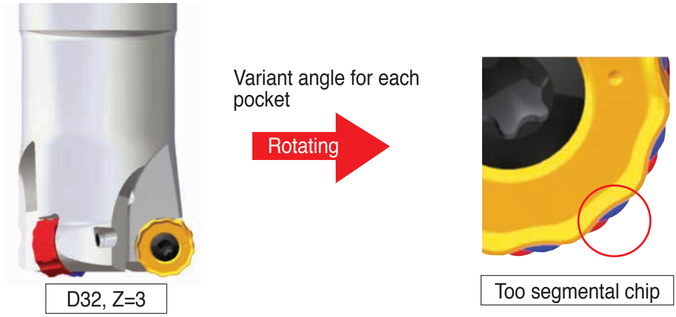
■ Insert



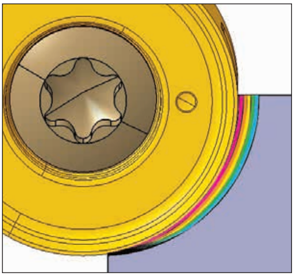
■ Cutter



Split type insert

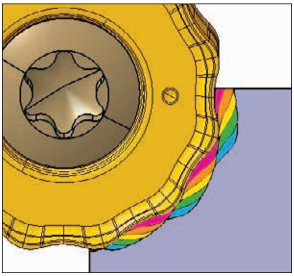


■ Shredded type insert for long overhang with less cutting force due to its differential pocket angle which will do fragmentation.



- First
- Second
- Third
- Fourth
- Fifth

TFMRNS 550-22R-12
(D50, z=5, DOC=6mm, fz=0.2)

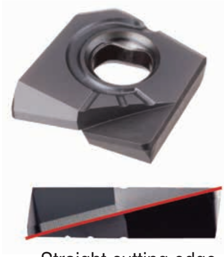


■ Every pocket in the cutter body is designed to enable unique insert orientation
- When using serrated inserts, this unique orientation means better chip splitting resulting in superior surface finish and lower power consumption

Insert geometries

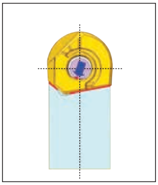
Helical cutting edge
NFB –SM
D8-D32 mm
For high speed of
hardened steel

Straight cutting edge
NFB –FM
D8-D32 mm
For general
applications

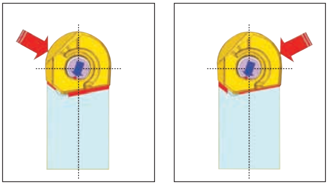


Straight cutting edge
NFR –R00
D8-D25 mm
Various Corner R
R0.3-R3.0 mm

Advantage of FINEBALL pocket

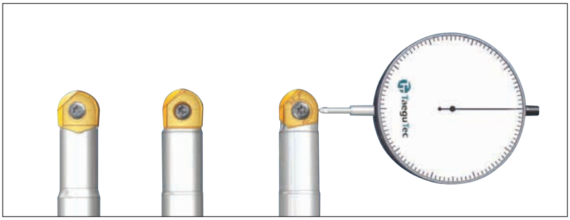


Clamping



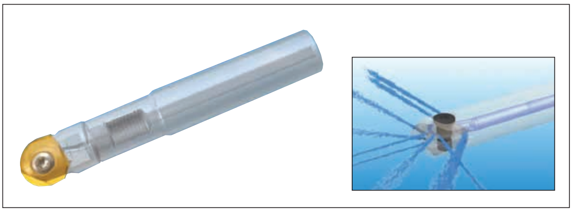
Machining

- Strong body & clamping
- Reliable mounting
- Accurate & stable
- Long durability



	Competitor "A"	Competitor "B"	TaeguTec
Axial force(F1)	○	◎	◎
Radial force(F2)	△	△	○
Repeatability	○	○	◎
Duration	△	△	○

◎ Very good
○ Good
△ Medium

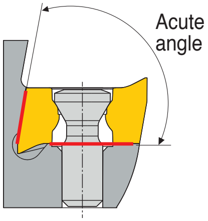


- Coolant through(Modular type)

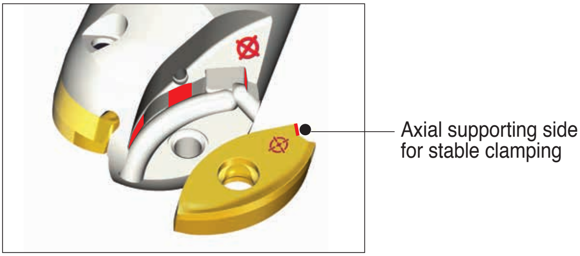
Contents

▶ Features of DUETBALL

- Dovetail mechanism clamping provides increased security and insert clamping
- High helix cutting edge for smooth milling
- Ground insert for excellent high precision
- Economical double sided insert
- Inserts are applicable for both internal and external pockets making it easier to control inventory
- The direct cooling system and good chip evacuation extends the tool’s life
- Standardization from minimum diameter 16mm, 20mm, 25mm, 30mm to 32mm in end mill and modular types



Dovetailed mechanism

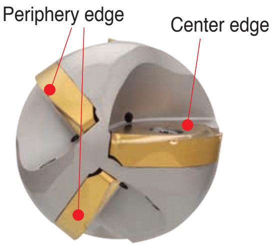


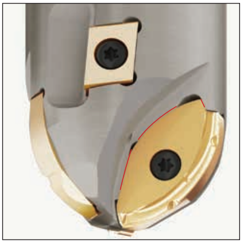
- Please check both insert and pocket for correct positioning.
  Insert marked ⊕ must be clamped in pocket marked ⊕ on the cutter.

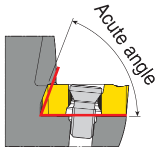
- One insert can be applied to both central and peripheral pockets

Features of TRIOBALL

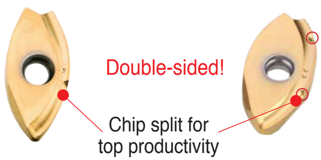
- Effective 3 flute design enables high feed machining to enhance productivity
- Unique double-sided insert with 2 cutting edges
- A highly stable cutting performance with thick cutting edges
- Excellent chip evacuation with a coolant hole
- Dovetail mechanism clamping provides increased security and insert clamping

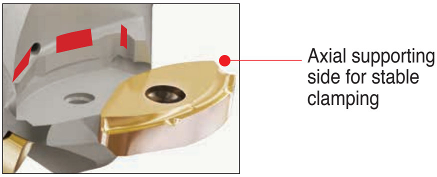






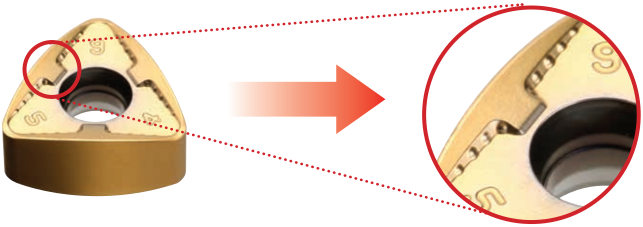
Dovetailed mechanism





Features of CHASE2BALL

- 6 cutting edges promote economy and productivity in cast iron and tool steel
- Low cutting resistance credit to half effective flute design
- Thick inserts (8mm) enable stable machining
- Insert design with high positive cutting edges
- Excellent performance in heat treated steel and welded components
- Enhanced protection of the holder pocket due to reinforced design



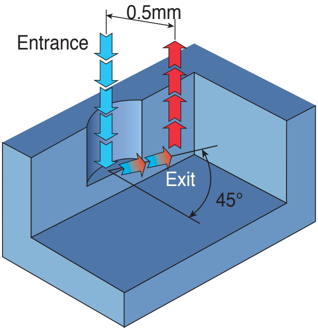
6RBE 50-M insert

- Thickness: 7.98 mm
- Negative insert
- Double sided insert for economic solution
- Half effective for low cutting force
- Unique designed to prevent insert breakage

Features of CHASE2PLUNGE

- Available in rough and semi-finishing plunge milling applications
- 4 corner, double sided helical cutting edge insert for economical machining
- Strong clamping force credit to wide contact surface and a high tensile screw (M3.0mm)
- Applied internal coolant system for longer tool life and excellent chip evacuation
- M type insert for general milling, ML type for difficult-to-cut materials
- Covers face milling, 90° milling and plunge milling operations

Programming tip

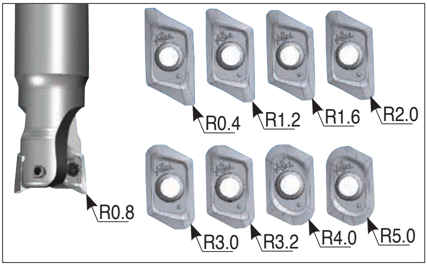


To avoid interference with material after plunge milling, please retract the spindle with a 45° and a distance of 0.5mm

Features of CHASEALU

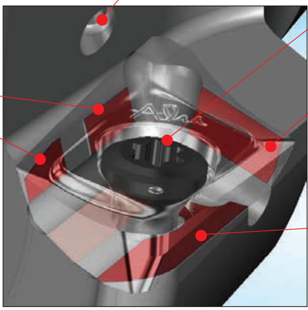
- Exceptional productivity for aluminum and non-ferrous material machining
- Can be applied to rough and finish machining
- Available in various corner radii (R0.4mm to R5.0mm)
- Secure, stable and unique “V” bottom insert design
- No movement during high ramp machining

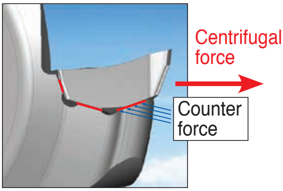
Insert



Various corner radii

Body





Features of CHASE2MILL for 90° face milling

- 90° cutter with 4 corner indexable inserts
- High density cutter maximises productivity
- High positive cutting edges - smooth cutting with low cutting force
- Thick insert design - stable and reliable performance
- Excellent surface finish achieved by wide wiper flat
- True 90° cutting edge guarantees squareness quality and wall accuracy
- Ramping capability

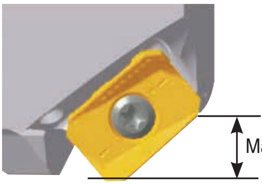
ANM(H)X 1607

ANM(H)X 1106

Features of CHASE2MILL for 45° face milling

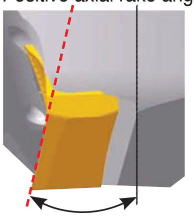
- Cutter's 45° entry angle + AN16 insert mean extremely smooth and silent cutting.
- High helix 4 corner inserts
- Excellent finish with wide wiper flats
- 8.4mm D.O.C
- Full ground periphery

Maximized depth of cut



Achieves smooth cutting in challenging depth of cuts situations

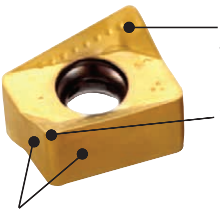
Positive axial rake angle



Generates less cutting forces and enables higher feed rates.

ANM(H)X 1607 ANR-M

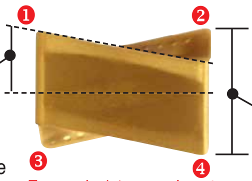
Insert features



Extra positive rake angle for low cutting force

Wide wiper flat for excellent surface finish

Ground all around for high precision machining(ANHX)



Positive axial rake angle reduces machine power enabling a higher feed rate

Economical 4 corner insert

Stronger & thicker insert for maximum durability

True 90° up to 11.0mm axial depth of cut

Insert geometries

ANMX 1607…M	ANHX 1607…M	ANHX 1607…ML	ANHX 1607…MR	ANHX 1607…AL
				
For general use eco type	For general use precision type	For light cut and sticky material	For roughing and interrupted cut	For aluminum and non-ferrous material

ANMX 110608R-M	ANHX 110608R-M	ANHX 1106..R-AL	ANHX 1607 ANR-M
			
Economical type general use	Precision type better surface finish	Ground and polished aluminum alloy	45˚ Cutter type insert

Compare the teeth of cutter

D63: AN11 – 7 teeth

D63: AN16 – 6 teeth

Diameter (mm)	No. of teeth	
	AN11	AN16
D25	2	-
D32	3	2
D40	4	3
D50	4, 6	3, 4
D63	5, 7	4, 6
D80	8, 10	5, 7
D100	9, 12	5, 8
D125	10, 14	7, 10

Features of splitter insert

- Chip splitter type insert reduces cutting load for heavy milling applications
- Reduces cutting load – High table feed can be achieved
- Reduces vibration (chatter free) and noise
- Insert's helical cutting edge geometry enables double feed rate
- Improves chip evacuation (chip split into small pieces)
- Reduces heat generation
- Suitable for long overhang machining (weak machining and fixture applications)
- High depth & width of cut
- Mountable on all standard cutter lines without any modification
- Protects the machine spindle credit to reduced vibration

CHASEMILL

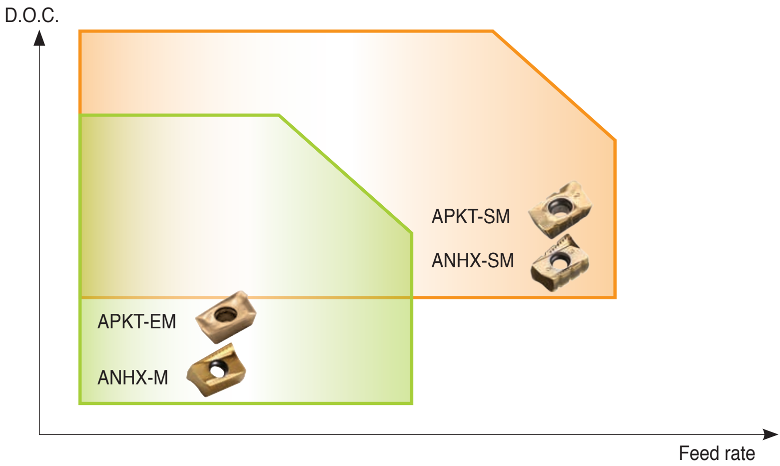
CHASE2MILL


APKT 1204 PER-SM


APKT 1705 PER-SM


ANHX 160708R-SM

Application guide in general use



▶ How to use spliter

- 3 splitting grooves on one cutting edge and 2 splitting grooves on the opposite side

APKT ANHX

- Full proof configuration-inserts have metal color appearance only on the 3 groove side for simplified mounting

APKT

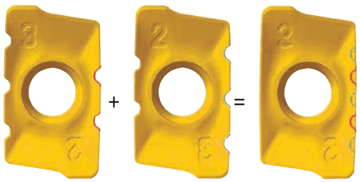
Side A Side B

ANHX

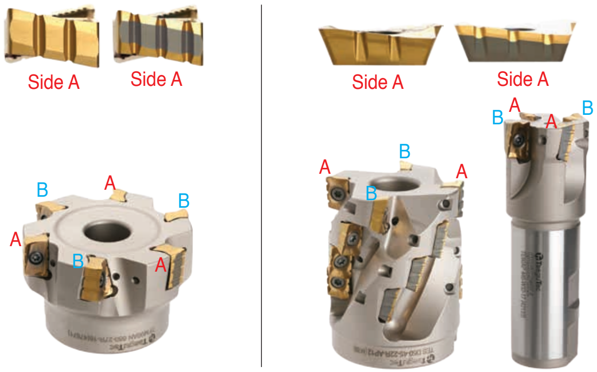
Side A Side B

Notice: When insert mounting, ensure they are mounted in a staggered formation
i.e. 1st tooth-2 groove side; 2nd tooth-3 groove side and repeat action for the remaining teeth

- Both cutting edges split chip to small pieces for cutting load reduction and create complete cutting edge when combined.

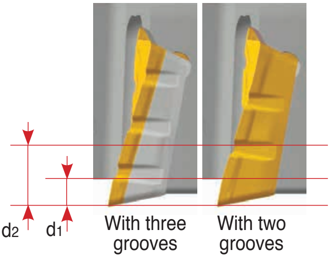


- For optimum machining efficiency, use even numbered flute type cutters

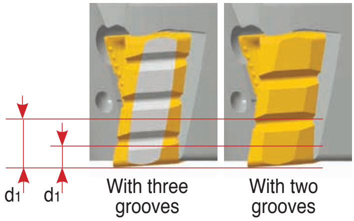


Also applicable to odd numbered flute type cutters

■ The splitter inserts effective in axial depth of cuts ≥ d1



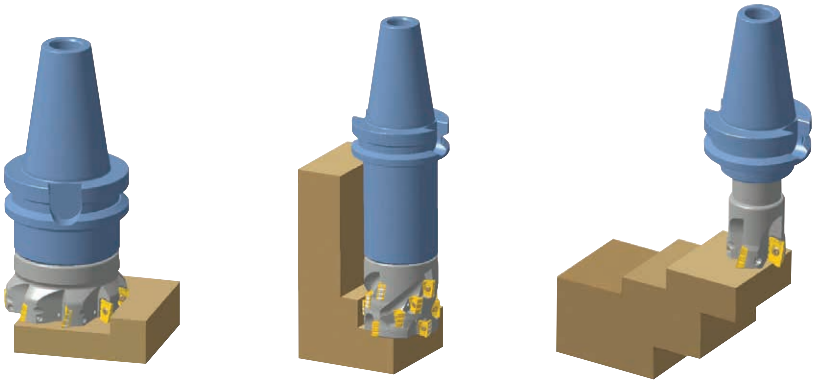
Depth of cut	APKT 17	APKT 12
d_1	3mm	2.4mm
d_2	6.5mm	5.2mm



Depth of cut	ANHX 16
d_1	2.5mm
d_2	6mm

Application guide in general use

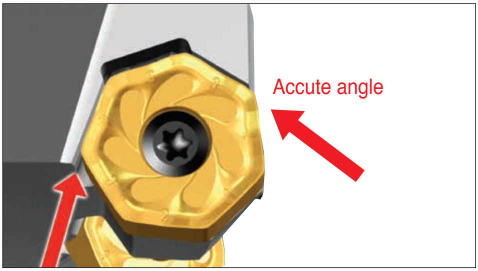
■ Splitter insert suitable for all 90° milling operations where improved productivity is required.



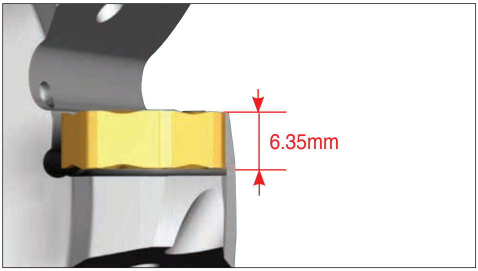
Deep and wide engagement   Long overhang machining   Unstable fixture

▶ Features of CHASE2HEPTA

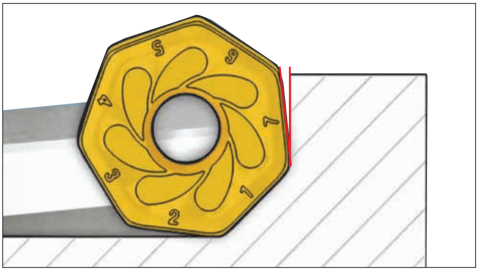
■ Accute clamping angle- strong clamping power
- self positioning



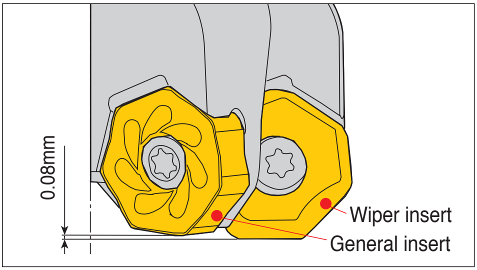
■ Thick insert thickness-excellent strength & toughness



■ No interferance with wall of work piece during sholdering positioning

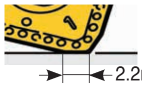


■ Wiper insert for good surface finish



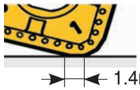
Features of each entering angle cutter and insert

Entering angle 75 º



2.2mm

ENTN-M

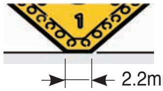


1.4mm

XTN

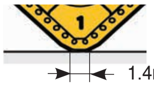
- Lower cutting load
- Small burr size

Entering angle 45 º



2.2mm

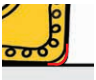
ANT(N)-M(ML,MP,AL)



1.4mm

XTN

Entering angle 88 º



ZN-M(ML)

- Smaller burr size by chamfer

C08-ZN-M

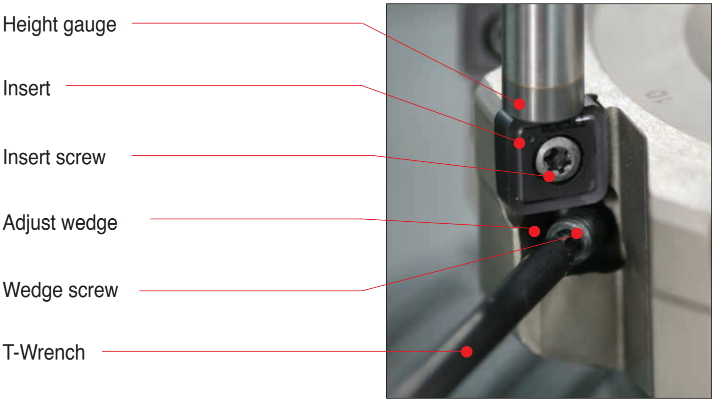
- Various corner R
- Precise 90º to avoid interruption

Entering angle 90 º

8/12/16/20-M(MM/ML/CE)

Contents

Setting instructions



❶ Move the adjust wedge to its bottom-most position by rotating the wedge screw clockwise.

※Please avoid using too much force.

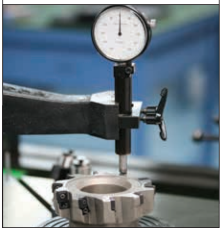
❷ Mount new cutting edge of insert. Make sure that the insert pocket is thoroughly cleaned before mounting insert.

※Please fix the insert screw completely as readjustment is not expected once it is done.

❸ Measure the Runout of the cutter when all inserts are mounted and select the highest insert as a reference.

※Please ensure that insert edge does not get damaged during setting.
Use optimum dial pressure only.

❹ Set the height of cutter, raising the reference insert by turning the wedge screw counter clockwise.

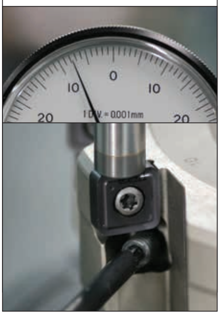


※Increase height by 0.01mm at least from the highest insert.

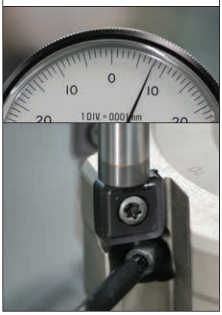
❺-1 Adjust axial Runout of the remaining inserts with the same process as used with the reference insert.

※Please note that max adjustment height should not exceed 0.1mm(.004")

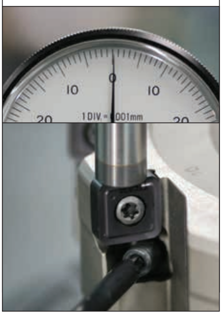
❺-2 Adjust Runout in the range of 0.005mm rotating the wrench gradually.



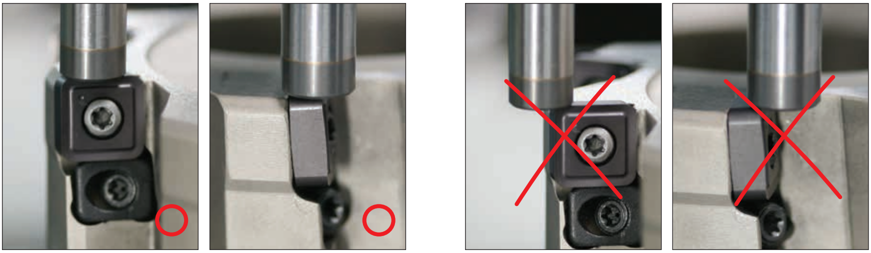
❺-3 If it is beyond the acceptable range, please reset it with the orderof ❶-❷-❺



❻ Runout adjustment is completed.(you don't have to clamp the insert screw anymore once it is fixed.)

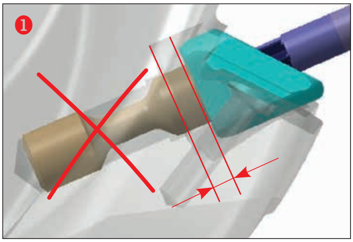


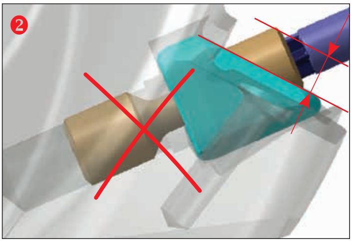
Gauge user guide

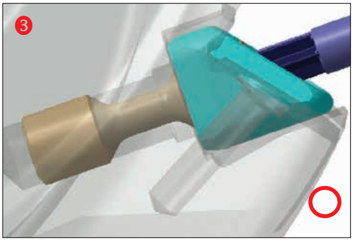


Special precautions

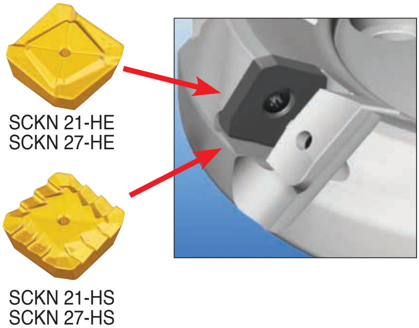
- While loading a new insert corner, ensure that the adjust wedge is in the bottom-most position
  Bottom out the adjust wedge completely before unclamping the insert from cutter
- Clean the insert and pocket thoroughly before mounting fresh insert /corner
- While assembling adjust wedge onto cutter body, please ensure that the adjust wedge is tightened
  until it reaches the bottom







▶ 60° entering angle

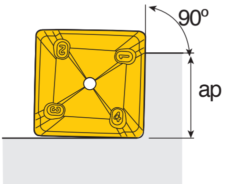


■ Large and thick insert design is suitable for heavy machining, that enableds depth of cut up to 18mm(SCKN27)

■ Reduced cutting load with helix cutting edge
■ Good for general heavy machining

■ Reduced machining noise and improved workpiece finishes credit to serrated geometry that forms fine chips
■ Can be machined at higher feed rate

▶ 90° entering angle



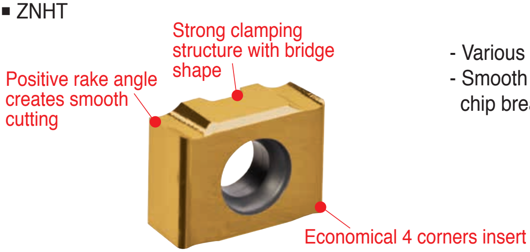
■ Thick insert design (7mm) suitable for heavy machining conditions
■ True 90º entering angle with 4 cutting corners means longer tool life and economy
■ High positive cutting edge inclination for smooth cutting in heavy machining conditions

▶ Features of TOPSLOT

■ SLOT

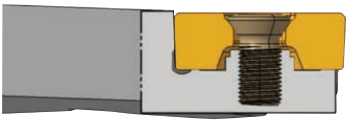
- Strong clamping credit to insert bottom face's unique concave shape
- Dovetail shape of insert's cutting edge designed for strong machining power
- Cutter's protrusion screw hole secures the maximum number of threads enabling stable clamping

■ ZNHT



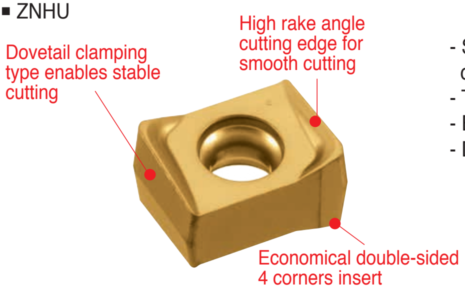
- Various corner preparation with coner and chamfer
- Smooth and light cutting due to insert's positive chip breaker

■ SLOT & ZNHT



- More threads make more clamping power

■ ZNHU

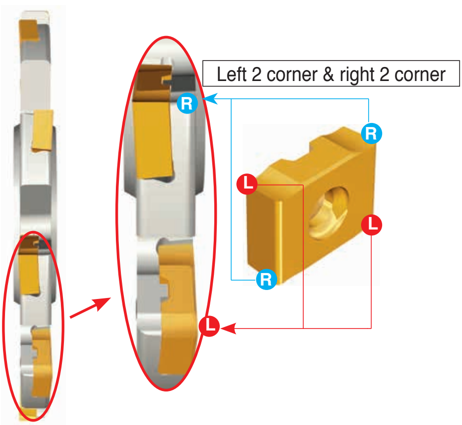


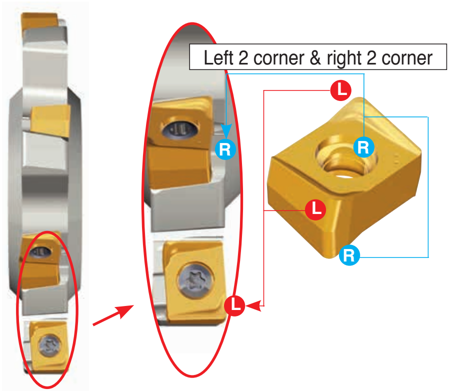
- Smooth & light cutting due to positive insert's chip breaker
- Thick double sided insert for powerful cutting action
- Economical true 4 corner cutting edges(2 Right+2 Left)
- Dovetail clamping type enables stable cutting

Range of SLOT & ZNHT & ZNHU

26mm							
10mm							
6mm							
3mm							
Thickness / Diameter	25mm	80mm	100mm	160mm	200mm	250mm	315mm

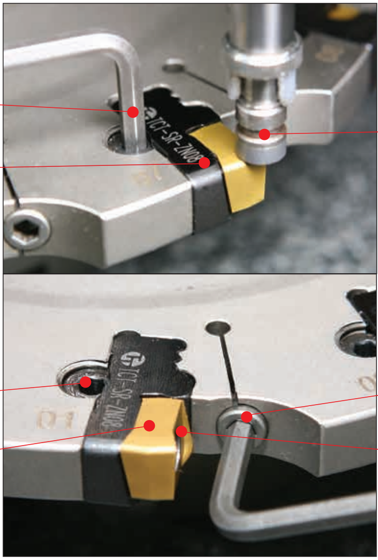
TOPSLOT Cutter with ZNHT & ZNHU





- Just with one insert, right & left can be covered.

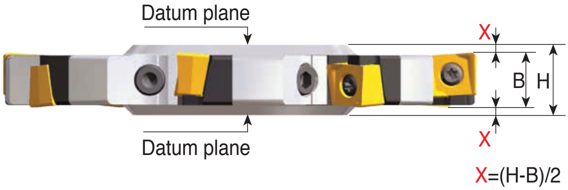
Part names



Setup instructions

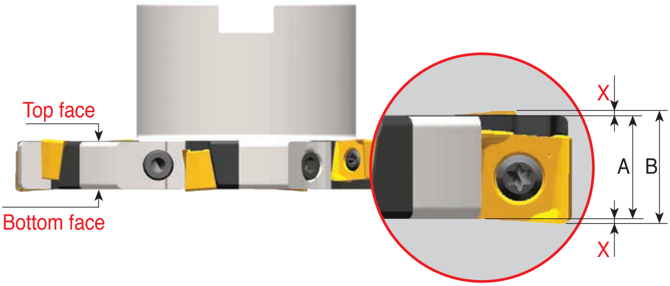
■ Disk type

B=Target width
H=Cutter height
X=Adjustment value



■ Flange type

B=Target width
H=Cutter height
X=Adjustment value



▶ Setting procedure

■ Disc type

❶ Index unused inserts firmly onto the cartridge

❷ Turn the clamping screw 60º-90º turn counter-clockwise

❸ a)Adjust the adjust screw to the desired 'X' value by measuring from the datum plane to the cutting edge of the inserts
b)Tighten the clamping screw

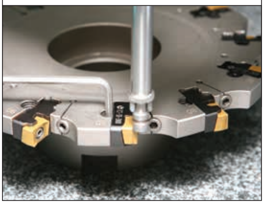
※ To eliminate backlash, adjust the cartridges upward above the designated 'X' value
* Turn the adjust screw clockwise to descend the cartridge
* Turn the adjust screw counter-clockwise to ascend the cartridge

❹ Inserts on same cutter face are must be adjusted to same desired value

❺ Repeat steps ❶- ❹ on the opposite side of the cutter face

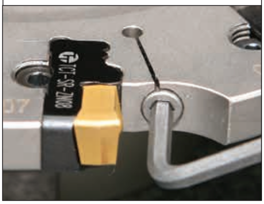
■ Flange type

❶ For bottom face inserts, repeat disc type steps ❶- ❹



❷ For top face set-up, the use of setting plate is mandatory and the height gauge must be reset to '0'

❸ Put the cutter bottom face on the setting plate and turn clamping screw 1/2~1 turns counter-clockwise



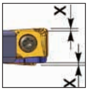
❹ Adjust the cartridge to the desired value (A+X) by turning the adjust screw then tighten the clamping screw

*Turn the adjust screw clockwise to descend the cartridges.
*Turn the adjust screw counter-clockwise to ascend the cartridges

❺ Inserts on the same face must be adjusted to the same desired value

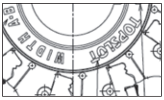
■ Important set-up points

- All adjustments must be done on a plain, flat surface
- For improved accuracy, remove any foreign substances from the insert and insert pocket surfaces before clamping
- 'X' value should be equal for both top and bottom faces when adjusting



- Width of cut must be adjusted within the range that is the laser-marked on the cutter

  Ex) WIDTH 10 – 12
  WIDTH 20 - 23



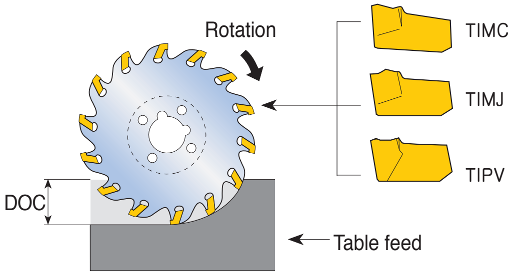
- To eliminate backlash, the cartridges must be set upward on both the bottom and top face to achieve desired width

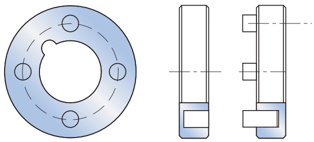
Narrow width slotting cutters

-Metric cutting diameters:
75mm, 100mm, 125mm, 160mm, 250mm
-Cutting width ranges: 1.6mm - 6.35mm
-Geometry: Positive Rake
-Applications: Slotting and sawing
-Materials: Carbon steels, alloy steels, stainless steels, cast iron, aluminum and exotics

■ Features / Benefits of slotting cutters
- Narrow width applications to 1.6mm
- Simple easy-to-mount inserts
- Secure insert retention self-positioning insert stopper for repeatability
- Drive flange mounting for extra stability
- Minimal radial runout
- Efficient chip evacuation
- Reduced cutting forces
- Improved tool life
- Economical

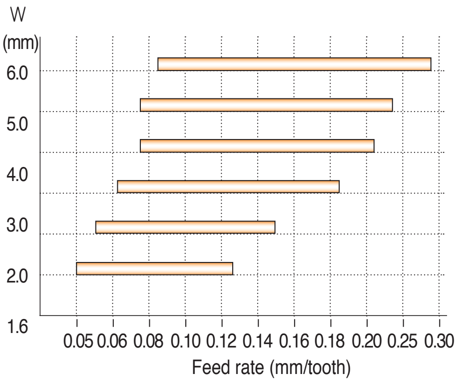
Recommended feed rates for - TSC slotting cutters

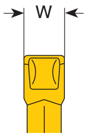




Drive flange set recommended for style 2 cutters

▶ Recommended feed rates (Based on insert width)





Feed rates are for radial D.O.C. =>1/4 the cutter diameter
For radial DOC <1/4 the cutter diameter increase feed rates by the following %

DOC/Cutter diameter	1/4	1/6	1/8	1/10	1/20
Increase feed rate by ->	0%	15%	30%	45%	45%

- Cutter entry

Climb milling enters the workpiece with a thick chip and exits with a thin chip. Honed inserts are recommended.
Conventional milling enters the workpiece with a thin chip and exits with a thick chip.
Sharp inserts are recommended. Climb milling should be used whenever possible, especially when replacing high speed steel slotting cutters. On machines with backlash eliminators, climb milling is preferred.

- Cutter mounting

The use of drive flange sets are recommended to prevent denting of arbor drive keys and to provide added stability during increased metal removal rates.

- Insert mounting

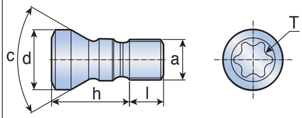
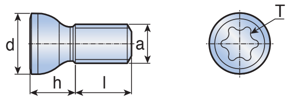
Manually place insert in pocket and seat in place by using a wooden or plastic hammer.
This will ensure self positioning for insert repeatability and minimal radial runout.
Pockets must be clean and free of debris prior to installation.

Trouble Shooting

Problem	Cause	Solution
 Normal flank wear	Most desirable wear - Excessive cutting speed - Insufficient wear resistance grade - Feed rate too low	- Reduce cutting speed - high resistance grade - Increase feed rate
 Chipping (Frittering)	Start from micro chipping - Grade too high wear resistannce - Week edge geometry - Strong entry shock - Long overhange - Caused by vibration or bending - Feed rate too high - Built-up edge	- Slect a tougher grade - Strong edge geometry - Reduce entry shock; speed up, feed low - Minimize defelction (short overhang) - Rigid clamping and improve stability - Reduce feed rate - Increase cutting speed
 Built-up edge	Friction, affinity, heating, pressure… - Too low cutting speed - Dry machining - Negaitve cutting edge	- Increase cutting speed - Use coolant - Positive(sharp) cutting edge
 Notching	Bad surface roughness - work hardening - Burr	- Reduce cuttiing speed - Use stronger insert geometry - Change lead angle - Reduce feed rate
 Thermal crack	Repeated thernal shock(Temperature difference) - Incorrect cooling supply - Cutting speed too high - Interrupt cutting	- Abundantly cooling or dry machining - Reduce cutting speed - Decrease feed rate - Select a tougher grade - high resistance grade to thermal shock

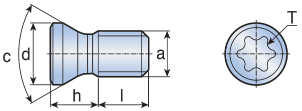
Components

Insert screw

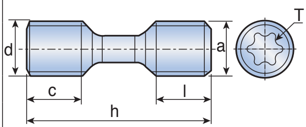
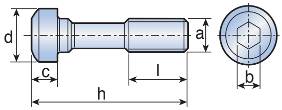
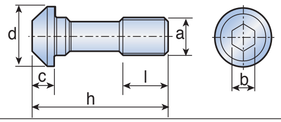
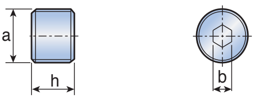
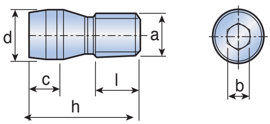
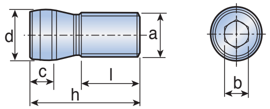
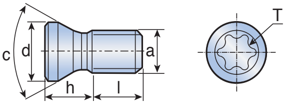
Shape	Description	Dimensions (mm)						Torque (Nm)
		a	d	h	l	c	T	
	**TS 18041I/HG**	M1.8x0.35	2.4	2	2.09	60	T6-P	0.5
	TS 20038I	M2x0.4	2.7	2.04	1.76	60	T6	0.6
	TS 20043I/HG-P	M2x0.4	2.7	2.1	2.2	60	T6-P	0.6
	TS 22046I	M2.2x0.45	3.15	1.93	2.67	60	T7	0.9
	TS 22052I/HG	M2.2x0.45	3.15	2.33	2.87	60	T7	0.9
	SO 25050I	M2.5x0.45	3.45	2.2	3	60	T7	0.9
	TS 25055I/HG	M2.5x0.45	3.75	2.92	2.58	50	T8	1.2
	TS 25064I	M2.5x0.45	3.5	2.6	3.8	50	T8	1.2
	TS 25064I/HG-P	M2.5x0.45	3.5	2.73	3.67	50	T8-P	1.2
	TS 25A075I/HG	M2.5x0.45	4.5	3.3	4.2	60	T8-P	1.2
	TS 25B024I/HG	M2.5x0.35	3.6	1.9	0.7	60	T7-P	0.9
	TS 25B031I/HG	M2.5x0.35	3.6	1.9	1.4	60	T7-P	0.9
	TS 25B042I/HG	M2.5x0.35	3.6	2.3	2.05	60	T7-P	0.9
	TS 25B053I/HG	M2.5x0.35	3.6	2.3	3.15	60	T7-P	0.9
	TS 30085I/HG	M3x0.5	4.3	2.86	5.64	60	T9	2.0
	TS 30A060I/HG	M3x0.5	4.4	3	3	60	T9	2.0
	TS 35070I/HG	M3.5x0.6	5.3	3.7	3.3	60	T15	3.0
	TS 35085I/HG	M3.5x0.6	5.3	4.15	4.6	60	T15	3.0
	TS 35088I	M3.5x0.6	5.1	3.47	5.28	60	T10	2.0
	TS 35A070I/HG	M3.5x0.6	4.8	3.6	3.4	60	T10-P	2.0
	TS 35A088I/HG	M3.5x0.6	4.8	4.4	4.35	60	T10-P	2.0
	TS 40085I/HG	M4x0.7	5.7	4	4.5	60	T15	3.5
	TS 40093I	M4x0.7	5.7	5	4.3	60	T15	3.5
	TS 40093I/HG	M4x0.7	5.7	5	4.3	60	T15	3.5
	TS 40097I	M4x0.7	5.2	3.4	6.3	43	T15	3.5
	TS 40097I-N3.5	M4x0.7	5.2	3.5	6.2	43	T15	3.5
	TS 40120I	M4x0.7	5.7	5	7	60	T15	3.5
	TS 40120I/HG	M4x0.7	5.7	5	7	60	T15	3.5
	TS 40A115I	M4x0.7	5.5	5.4	6.1	60	T15	3.5
	TS 40G110I	M4x0.7	5.7	4.5	6.5	60	T15	3.5
	TS 40K051I	M4x0.5	5.5	2.8	2.3	60	T15	3.5
	TS 40K061I	M4x0.5	5.5	3.3	2.8	60	T15	3.5
	TS 40K070I	M4x0.5	5.5	3.3	3.7	60	T15	3.5
	TS 40K080I	M4x0.5	5.5	3.3	4.7	60	T15	3.5
	TS 45A100I/HG	M4.5x0.75	7	4.2	5.8	60	T20	5.0
	TS 50115I	M5x0.8	7	4.96	6.54	60	T20	5.5
	TS 50A121I/HG	M5x0.8	7	4	8.1	60	T20	5.5
	TS 50B106I/HG	M5x0.8	6.25	4.2	6.4	40	T20	5.5
	TS 60170I	M6x1.0	8.5	6.5	10.5	60	T25	6.0
	**TS 25C065I/HG**	M2.5x0.45	3.9	2.9	3.6	-	T8	1.2
	TS 35C110I	M3.5x0.6	6	4.3	6.7	-	T15	3.0
	TS 40B100I	M4x0.7	6	4	6	-	T15	3.5
	TS 45120I	M4.5x0.75	6.9	4.5	7.5	-	T20	5.0
	TS 50C130I/HG	M5x0.8	7.1	5	8	-	T20	5.0
	TS 60A130I	M6x0.75	8.1	5.5	8	-	T25	6.0

Components

Insert screw

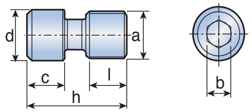
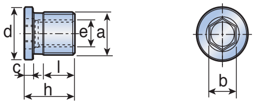
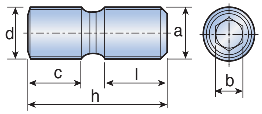
Shape	Description	Dimensions (mm)							Torque (Nm)
		a	d	h	l	c	e	T	
	**TS 25F080A**	M2.5x0.35	3.7	4.8	2.1	60	60	T8	1.1
	TS 30F100A	M3x0.35	4.6	6.1	2.2	60	60	T10	2.0
	TS 40F120A	M4x0.5	6	7.6	3	60	60	T15	4.0
	TS 50F160A	M5x0.5	7	10.4	3.5	60	60	T20	5.0
	TS 60F200A	M6x0.75	8.2	12.2	4.5	60	60	T25	6.0
	TS 70F250A	M7x0.75	10	15.4	5.6	60	60	T25	7.0
	TS 80F300A	M8x1.0	12	17.7	7.3	60	60	T30	8.0

Screw

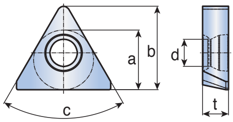
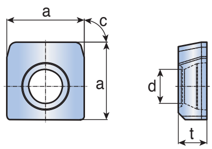
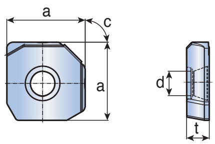
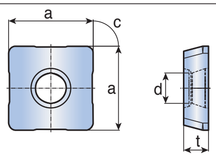
Shape	Description	Dimensions (mm)							Torque (Nm)
		a	d	h	l	b	c	T	
	**AWS 0620**	M6x1	M6x1	20	6	-	6	T 15	
	**DLS 4**	M5x0.8	8	21	8.5	3	3.5	-	
	**DLS 4-18L**	M5x0.8	8	18	6.5	3	3	-	
	**SA M8-6.0**	M8x1	-	6	-	3	-	-	
	SA M8-9.0	M8x1	-	9	-	3	-	-	
	**TS 50G120C**	M5x0.8	6	12.5	5	3	3.5	-	
	**TS 70B160C**	M7Xx1	8	16	8.5	4	3.5	-	
	**TS 60170I**	M6x1.0	8.5	6.5	10.5	-	60	T25	6.0

Components

Screw

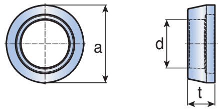
Shape	Description	Dimensions (mm)							
		a	d	h	l	b	c	e	
	**TS 80160W**	M8x1	8.5	16	6	4	6	-	
	TS 80200W	M8x1	8.5	20	9.5	4	6	-	
	**TS 8050088S**	M8x0.75	9.7	8.8	5.1	5	1.5	M5x0.8	
	TS 9060011S	M9x.075	10.7	11	7	6	1.5	M6x0.75	
	**WS 8**	M8x1(R.H)	M8x1(L.H)	21	9.5	4	8	-	
	WS 8M	M8x1(R.H)	M8x1(L.H)	17	7	4	7	-	
	WS 8S	M8x1(R.H)	M8x1(L.H)	15	6	4	5	-	
	WS 8	M8x1(R.H)	M8x1(L.H)	21	9.5	4	8	-	
	WS 8M	M8x1(R.H)	M8x1(L.H)	17	7	4	7	-	
	WS 8S	M8x1(R.H)	M8x1(L.H)	15	6	4	5	-	

Shim

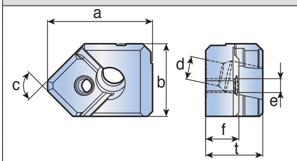
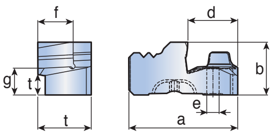
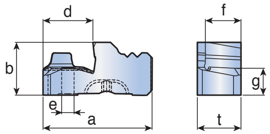
Shape	Description	Dimensions (mm)						
		a	b	c	d	e	t	
	**TSTP 22N**	11	15.4	60˚	4.95	-	4.76	
	**TSSP 12N**	11.4	-	90˚	5	-	4.2	
	TSSP 15N	14	-	90˚	5	-	4.76	
	TSSDSE 12N	10.5	-	90˚	5	-	4.1	
	TSSDSE 15N	12.9	-	90˚	5	-	4.76	
	**TSSC 21R-ST**	19.2	-	90˚	6	-	5.56	
	TSSC 27R-ST	24.7	-	90˚	7	-	6.35	
	**TSSE 21N-ST**	17.7	-	90˚	6.4	-	5.2	

Components

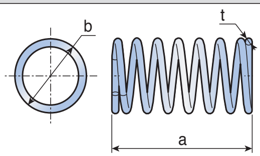
Shim

Shape	Description	Dimensions (mm)						
		a	b	c	d	e	t	
	TSRY 16NS	13.5	-	90 °	8.45	-	4.75	
	TSRY 20NS	17.3	-	90 °	9.4	-	4.75	

Cartridge

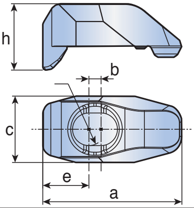
Shape	Description	Dimensions (mm)							
		a	b	c	d	e	f	g	t
	TCT23-SN16R	32	23	90 °	7	M4.5x0.75	10.1	-	17.3
	TCT-SR-ZN08	22	10.7	-	10.1	M3x0.5	7.1	5.5	8.8
	TCT-SR-ZN11	23.5	14	-	12.1	M4x0.7	10.2	7.2	12.8
	TCT-SR-ZN14	23.5	16	-	12	M4x0.7	13.5	8.2	18.8
	TCT-WR-ZN08	22	10.7	-	10.1	M3x0.5	7.1	5.5	10.8
	TCT-WR-ZN11	23.5	14	-	12.1	M4x0.7	10.2	7.2	15.8
	TCT-SL-ZN08	22	10.7	-	10.1	M3x0.5	7.1	5.5	8.8
	TCT-SL-ZN11	23.5	14	-	12.1	M4x0.7	10.2	7.2	12.8
	TCT-SL-ZN14	23.5	16	-	12	M4x0.7	13.5	8.2	18.8
	TCT-WL-ZN08	22	10.7	-	10.1	M3x0.5	7.1	5.5	10.8
	TCT-WL-ZN11	23.5	14	-	12.1	M4x0.7	10.2	7.2	15.8

Spring

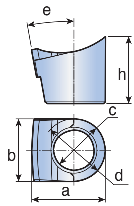
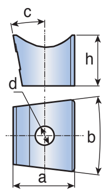
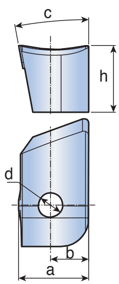
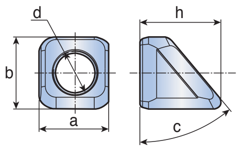
Shape	Description	Dimensions (mm)						
		a	b	c	d	h		
	DSP 4	-	-	-	7	13		

Components

Clamp

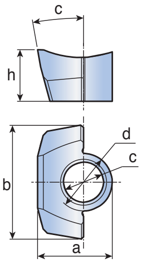
Shape	Description	Dimensions (mm)						
		a	b	c	d	e	h	
	**CCL 5M**	22.93	2	11	5.4	7.61	11	

Wedge

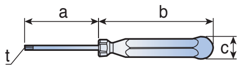
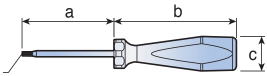
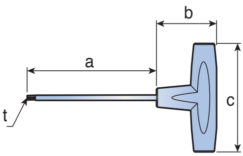
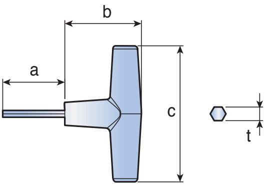
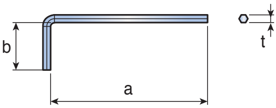
Shape	Description	Dimensions (mm)						
		a	b	c	d	e	h	
	**WFZ 8H**	12.8	10.9	M8X1.0(L.H)	10.9	10°	11.7	
	WFZ 8H-SN	12.8	10.9	M8X1.0(L.H)	10.9	10°	9.8	
	**WPA 8**	17.1	14°	10.5°	5.3	-	14.02	
	WPA 8-SE16	16.69	14°	10.5°	5.3	-	14.02	
	**WSC 8R**	15.24	8.3	10.5°	5.3	-	14.5	
	WSC 8R-21	15.24	8.3	10.5°	5.3	-	14.5	
	**AJS 1010R**	9.6	10	50°	M6X1.0(L.H)	-	11.25	

Components

Wedge

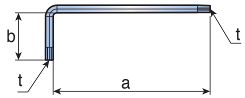
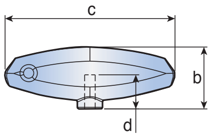
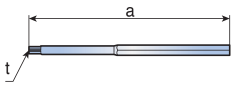
Shape	Description	Dimensions (mm)						
		a	b	c	d	e	h	
	**WFO-8Z**	13	20	M8X1.0(L.H)	10	10˚	9	

Wrench

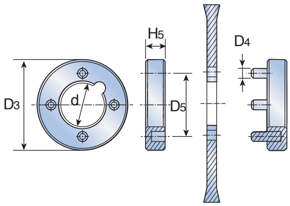
Shape	Description	Dimensions (mm)						
		a	b	c	d	t		
	**TD 6**	45	70	17	-	T6		
	TD 6P	45	70	17	-	T6-P		
	TD 7	45	70	17	-	T7		
	TD 7P	45	70	17	-	T7-P		
	**TD 8**	55	70	24	-	T8		
	TD 8P	55	70	24	-	T8-P		
	TD 9	65	80	27	-	T9		
	TD 10	70	90	29	-	T10		
	TD 10P	70	90	29	-	T10-P		
	TD 15	70	100	29	-	T15		
	TD 20	90	100	33	-	T20		
	**T-T15**	95	45	80	-	T15		
	T-T20	100	45	80	-	T20		
	T-T25	100	45	80	-	T25		
	T-T30	100	45	80	-	T30		
	**T-W 3**	29	45	80	-	3		
	T-W 4	36.5	45	80	-	4		
	**L-W 3**	63	20	-	-	3		
	L-W 4	70	25	-	-	4		

Components

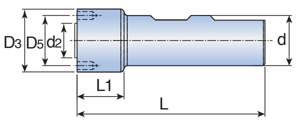
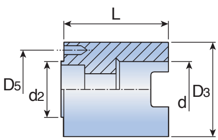
Wrench

Shape	Description	Dimensions (mm)						
		a	b	c	d	t		
	**L-T7P**	71	18	-	-	T7-P		
	L-T15	136	27	-	-	T15		
	**SW6-T**	-	37	100	20	-		
	**BLD T25/M7**	118	-	-	-	T25		

Flange set

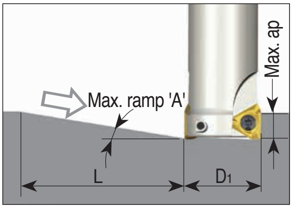
Shape	Description	Dimensions (mm)						
		d	D_3	D_5	D_4	H_5		
	**TR 22-46**	22	46	32	5	10		
	TR 32-55	32	55	45	6	10		
	TR 40-80	40	80	63	11	12		

Drive shank

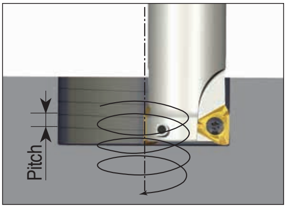
Shape	Description	Dimensions (mm)						
		d	D_3	d_2	D_5	L_1	L	Screw
	**TR 22-46**	32	40	22	32	30	120	SR76-963
	TR 32-55	32	55	32	45	-	60	SR76-943
	TR 40-80	40	80	40	63	-	60	SR76-944

Ramping Data

Straight ramping



Helical ramping



3PK(H)T 06

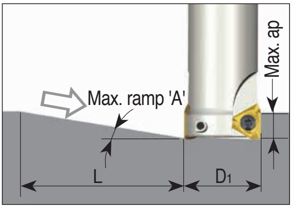
Cutter dia.(D_1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø12	3.7	4.7	73	19.5		1.3
					24	2.1
Ø14	2.8	4.7	96	23.5		1.2
					28	1.8
Ø16	2.3	4.7	117	27.5		1.2
					32	1.7
Ø17	2.0	4.7	135	29.5		1.2
					34	1.6
Ø18	2.0	4.7	135	31.5		1.3
					36	1.7
Ø20	1.6	4.7	168	35.5		1.2
					40	1.5
Ø21	1.5	4.7	180	37.5		1.2
					42	1.5
Ø22	1.5	4.7	180	39.5		1.2
					44	1.5
Ø25	1.5	4.7	180	45.5		1.4
					50	1.7
Ø30	1.2	4.7	224	55.5		1.4
					60	1.7
Ø32	1.2	4.7	224	59.5		1.5
					64	1.8
Ø35	1.0	4.7	269	65.5		1.4
					70	1.6
Ø40	0.7	4.7	385	75.5		1.2
					80	1.3

3PK(H)T 10

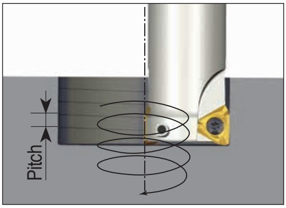
Cutter dia.(D_1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø16	7.0	7.0	57	24.7		2.8
					32	5.2
Ø20	3.3	7.0	121	33.9		2.1
					40	3.1
Ø21	3.2	7.0	125	35.9		2.2
					42	3.1
Ø22	3.2	7.0	125	37.9		2.4
					44	3.3
Ø25	2.8	7.0	143	43.5		2.4
					50	3.3
Ø26	2.6	7.0	154	45.9		2.4
					52	3.1
Ø30	2.0	7.0	201	53.9		2.2
					60	2.8
Ø32	1.8	7.0	223	57.5		2.1
					64	2.7
Ø33	1.7	7.0	236	59.9		2.1
					66	2.6
Ø40	1.3	7.0	309	73.7		2.0
					80	2.4
Ø50	1.0	7.0	401	93.7		2.0
					100	2.3
Ø63	0.8	7.0	502	119.7		2.1
					126	2.3

Ramping Data

Straight ramping



Helical ramping



3PK(H)T 15

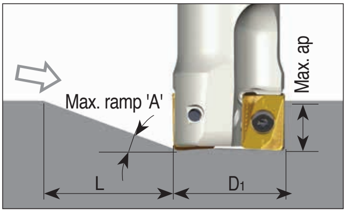
Cutter dia.(D_1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø32	3.2	11.0	197	53.5		3.2
					64	4.8
Ø33	3.1	11.0	203	55.5		3.3
					66	4.8
Ø35	3.1	11.0	203	59.5		3.5
					70	5.1
Ø40	2.0	11.0	315	70.1		2.8
					80	3.7
Ø50	1.5	11.0	420	90.1		2.8
					100	3.5
Ø63	1.1	11.0	573	116.1		2.7
					126	3.2
Ø80	0.8	11.0	788	150.3		2.6
					160	3.0
Ø100	0.6	11.0	1051	190.5		2.5
					200	2.8
Ø125	0.5	11.0	1261	240.3		2.7
					250	2.9
Ø160	0.3	11.0	2102	310.3		2.1
					320	2.2
Ø200	0.2	11.0	3153	390.3		1.8
					400	1.9

3PK(H)T 19

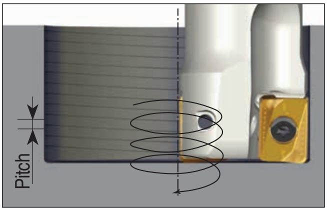
Cutter dia.(D_1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø40	3.6	15.0	239	66.7		4.5
					80	6.7
Ø50	2.2	15.0	391	87.9		3.9
					100	5.1
Ø63	1.7	15.0	506	113.9		4
					126	5
Ø80	1.3	15.0	661	147.9		4.1
					160	4.8
Ø100	1.0	15.0	860	187.9		4.1
					200	4.7
Ø125	0.8	15.0	1075	237.9		4.2
					250	4.7
Ø160	0.6	15.0	1433	307.9		4.1
					320	4.5
Ø200	0.4	15.0	2150	387.9		3.5
					400	3.7
Ø250	0.3	15.0	2866	487.9		3.3
					500	3.5

Ramping Data

Straight ramping



Helical ramping



ANH(M)X 11

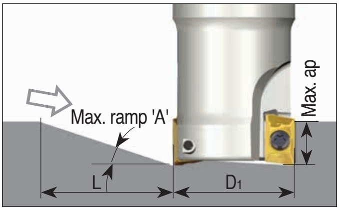
Cutter dia.(D1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø25	1.5	11.0	420	30		0.3
					50	1.7
Ø26	1.4	11.0	450	32		0.4
					52	1.7
Ø32	1.1	11.0	573	44		0.6
					64	1.6
Ø33	1.0	11.0	631	46		0.6
					66	1.5
Ø40	0.8	11.0	788	60		0.7
					80	1.5
Ø50	0.6	11.0	1051	80		0.8
					100	1.4
Ø63	0.4	11.0	1576	106		0.8
					126	1.2
Ø80	0.3	11.0	2102	140		0.8
					160	1.1
Ø100	0.2	11.0	3153	180		0.7
					200	0.9
Ø125	0.2	11.0	3153	230		1.0
					250	1.2

ANH(M)X 16

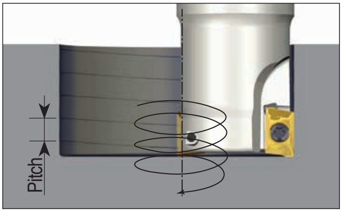
Cutter dia.(D1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø32	1.2	15.0	716	44		0.7
					64	1.8
Ø33	1.0	15.0	560	46		0.6
					66	1.5
Ø40	0.9	15.0	955	60		0.8
					80	1.7
Ø50	0.8	15.0	1075	80		1.1
					100	1.9
Ø63	0.6	15.0	1433	106		1.2
					126	1.8
Ø80	0.45	15.0	1911	140		1.3
					160	1.7
Ø100	0.35	15.0	2457	180		1.3
					200	1.6
Ø125	0.25	15.0	3439	230		1.2
					250	1.5
Ø160	0.15	15.0	5732	300		1.0
					320	1.1
Ø200	0.1	15.0	8599	380		0.8
					400	0.9

Ramping Data

Straight ramping



Helical ramping

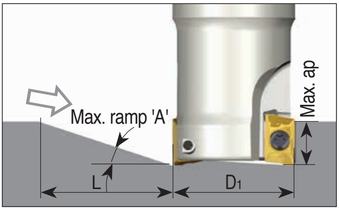


AXMT 06

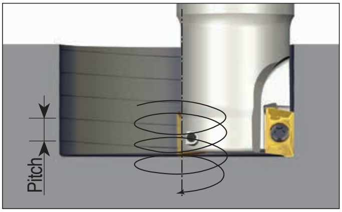
Cutter dia.(D_1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø8	1.5	5.0	191	9		0.1
					16	0.6
Ø10	5.0	5.0	57	13		0.7
					20	2.3
Ø11	5.5	5.0	52	15		1.0
					22	2.8
Ø12	6.0	5.0	48	17		1.4
					24	3.4
Ø13	5.5	5.0	52	19		1.5
					26	3.3
Ø14	5.0	5.0	57	21		1.6
					28	3.3
Ø15	4.5	5.0	64	23		1.7
					30	3.1
Ø16	4.0	5.0	72	25		1.7
					32	3.0
Ø17	3.9	5.0	73	27		1.8
					34	3.1
Ø18	5.0	5.0	57	29		2.6
					36	4.2
Ø19	5.0	5.0	57	31		2.8
					38	4.4
Ø20	3.0	5.0	95	33		1.8
					40	2.8
Ø21	6.0	5.0	48	35		3.9
					42	5.9
Ø25	2.0	5.0	143	43		1.7
					50	2.3
Ø32	1.5	5.0	191	57		1.7
					64	2.2
Ø40	1.2	5.0	239	73		1.8
					80	2.2

Ramping Data

Straight ramping



Helical ramping



APKT 09

Cutter dia.(D_1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø10	7.5	9.0	68	14		1.4
					20	3.5
Ø12	7.3	9.0	70	16		1.4
					24	4.1
Ø14	6.0	9.0	86	18		1.1
					28	3.9
Ø16	4.9	9.0	105	21.08		1.2
					32	3.7
Ø17	4.4	9.0	117	23.08		1.2
					34	3.5
Ø18	4.0	9.0	129	25.08		1.3
					36	3.4
Ø20	3.4	9.0	152	29.08		1.4
					40	3.2
Ø21	3.1	9.0	166	31.08		1.5
					42	3.0
Ø22	2.8	9.0	184	33.08		1.4
					44	2.9
Ø25	1.8	9.0	287	39.08		1.2
					50	2.1
Ø26	2.0	9.0	258	41.08		1.4
					52	2.4
Ø30	2.2	9.0	234	49.08		2.0
					60	3.1
Ø32	2.0	9.0	258	53.08		2.0
					64	3.0
Ø33	1.7	9.0	303	55.08		1.7
					66	2.6
Ø40	1.5	9.0	344	69.08		2.0
					80	2.8
Ø50	1.1	9.0	469	89.08		2.0
					100	2.6
Ø63	0.8	9.0	645	115.08		1.9
					126	2.3
Ø80	0.5	9.0	1032	149.08		1.6
					160	1.9

Ramping Data

CHASEMILL

APKT 12

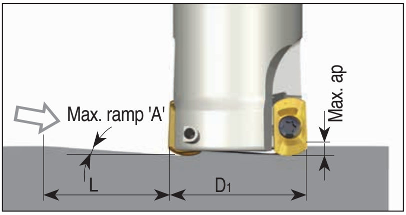
Cutter dia.(D1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø16	12.5	12.0	54	17.5		0.5
					32	9.5
Ø18	9.7	12.0	70	20.9		1.3
					36	8.2
Ø20	6.8	12.0	101	24.9		1.6
					40	6.4
Ø21	6.2	12.0	111	26.9		1.7
					42	6.1
Ø25	8.0	12.0	85	34.9		3.7
					50	9.4
Ø26	7.5	12.0	91	36.9		3.8
					52	9.1
Ø32	5.0	12.0	137	48.9		3.9
					64	7.5
Ø33	4.6	12.0	149	50.9		3.8
					66	7.1
Ø40	3.5	12.0	196	64.9		4.1
					80	6.5
Ø50	2.5	12.0	275	84.9		4.8
					100	5.8
Ø63	1.7	12.0	405	110.9		4.5
					126	5.0
Ø80	1.3	12.0	529	144.9		4.6
					160	4.8

APKT 17

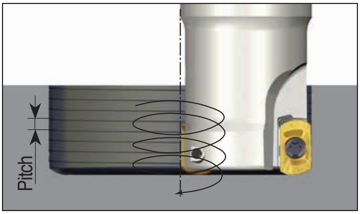
Cutter dia.(D1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø20	8.0	16.1	115	22		0.7
					40	7.5
Ø25	5.0	16.1	184	30.6		1.3
					50	5.8
Ø26	4.0	16.1	230	32.6		1.2
					52	4.9
Ø32	9.0	16.1	102	44.6		5.3
					64	13.5
Ø33	9.0	16.1	102	46.6		5.7
					66	13.9
Ø40	5.0	16.1	184	60.6		4.8
					80	9.3
Ø50	4.4	16.1	209	80.6		6.3
					100	10.3
Ø63	3.2	16.1	288	106.6		6.5
					126	9.4
Ø80	2.3	16.1	401	140.6		6.5
					160	8.6
Ø100	1.8	16.1	513	180.6		6.8
					200	8.4
Ø125	1.4	16.1	659	230.6		6.9
					250	8.1
Ø160	1.0	16.1	923	300.6		6.5
					320	7.5
Ø200	0.7	16.1	1318	380.6		5.9
					400	6.5

CHASEMILL

Straight ramping



Helical ramping

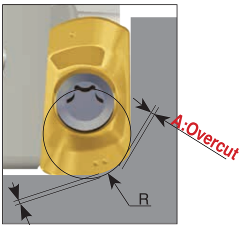


AXMT 0602R-HF

Cutter dia.(D_1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø8	0.3	0.5	96	14		0.1
					16	0.1
Ø11	0.5	0.5	57	14		0.1
					20	0.2
Ø13	1.0	0.5	29	18		0.3
					22	0.5
Ø15	2.3	0.5	12	18		0.5
					24	0.5
Ø17	4.5	0.5	6	18		0.5
					26	0.5
Ø19	3.5	0.5	8	18		0.5
					28	0.5
Ø21	3.0	0.5	10	26		0.5
					30	0.5
Ø32	2.8	0.5	10	26		0.5
					32	0.5
Ø17	2.5	0.5	11	26		0.5
					34	0.5
Ø18	2.3	0.5	12	26		0.5
					36	0.5
Ø19	2.2	0.5	13	26		0.5
					38	0.5
Ø20	1.9	0.5	15	34		0.5
					40	0.5
Ø21	1.7	0.5	17	34		0.5
					42	0.5
Ø25	1.4	0.5	20	44		0.5
					50	0.5
Ø32	1.0	0.5	29	58		0.5
					64	0.5
Ø40	0.7	0.5	41	74		0.5
					80	0.5

Programming technical data

When CNC programming specify tools with 'R' for the each insert, this will result un-machined material thickness of approximately 'B' mm along the corner.
When applying CNC program with 'R', over-cut area is 'A' mm. To avoid over-cut, please add to set up roughing stock'A' mm. For other program R data, please refer to diagram below.



	R Program	A Over cut	B Un-machined material thickness
AXMT 0602R-HF	0.9	0	0.22
	1.0	0.01	0.19
	1.5	0.16	0.05
	2.0	0.35	0
APKT 09T3R-HF	1.5	0	0.47
	1.7	0	0.29
	2.0	0.04	0.3
	2.5	0.18	0.15
	3.0	0.36	0.04
APKT 1204R-HF	2	0	0.57
	2.5	0.07	0.42
	3	0.21	0.28
	3.5	0.39	0.15
	4	0.58	0.06

:Recommended program 'R'

APKT 09T3R-HF

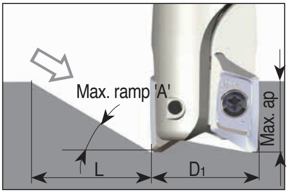
Cutter dia.(D1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø30	1.8	1.0	32	50		1.0
					60	1.0
Ø32	1.6	1.0	36	54		1.0
					64	1.0
Ø33	1.5	1.0	38	56		1.0
					66	1.0
Ø40	1.2	1.0	48	70		1.0
					80	1.0
Ø50	0.9	1.0	64	90		1.0
					100	1.0
Ø63	0.5	1.0	115	116		1.0
					126	1.0
Ø80	0.4	1.0	143	150		1.0
					160	1.0
Ø16	3.8	1.0	15	22		1.0
					32	1.0
Ø17	3.5	1.0	16	24		1.0
					34	1.0
Ø18	3.4	1.0	17	26		1.0
					36	1.0
Ø20	3.0	1.0	19	30		1.0
					40	1.0
Ø21	2.3	1.0	25	32		1.0
					42	1.0
Ø22	2.0	1.0	29	34		1.0
					44	1.0
Ø25	2.1	1.0	27	40		1.0
					50	1.0
Ø26	2.0	1.0	29	42		1.0
					52	1.0

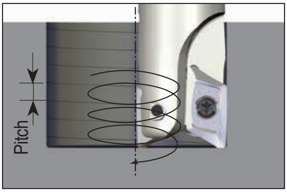
APKT 1204R-HF

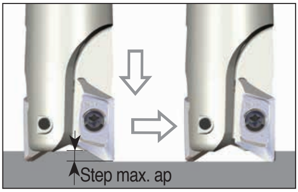
Cutter dia.(D1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø16	3.8	1.2	18	21		0.8
					32	1.2
Ø18	4.0	1.2	17	24		1.1
					36	1.2
Ø20	4.0	1.2	17	27		1.2
					40	1.2
Ø21	3.5	1.2	20	29		1.2
					42	1.2
Ø25	2.5	1.2	27	37		1.2
					50	1.2
Ø26	2.3	1.2	30	39		1.2
					52	1.2
Ø32	1.7	1.2	40	51		1.2
					64	1.2
Ø33	1.7	1.2	40	53		1.2
					66	1.2
Ø40	1.5	1.2	46	67		1.2
					80	1.2
Ø50	1.1	1.2	63	86		1.2
					100	1.2
Ø63	1.0	1.2	69	112		1.2
					126	1.2
Ø80	0.8	1.2	86	146		1.2
					160	1.2

CHASEALU

Straight ramping	Helical ramping	Step milling







XECT16 0.4R-1.6R

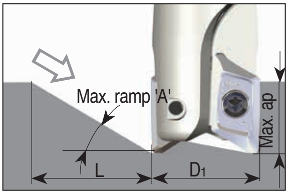
Cutter dia.(D_1)	Straight ramp down			Helical ramp down			Step down
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.	Max. ap
Ø25	22.0	16.0	40	29.1		4.4	4.2
					50	13.6	4.2
Ø32	16.5	16.0	54	43.1		8.8	4
					64	13.6	4
Ø40	11.5	16.0	79	59.1		10.4	4
					80	13.6	4
Ø50	9.5	16.0	96	79.1		13.0	4
					100	13.6	4
Ø63	7.0	16.0	130	105.1		13.6	4
					126	13.6	4
Ø80	5.0	16.0	183	139.1		13.6	4
					160	13.6	4
Ø100	3.5	16.0	262	179.1		12.9	4
					200	13.6	4
Ø125	2.5	16.0	367	229.1		12.1	4
					250	13.6	4

XECT16 2.0R

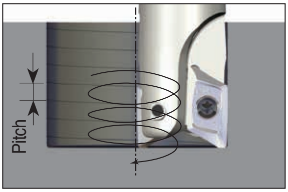
Cutter dia.(D_1)	Straight ramp down			Helical ramp down			Step down
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.	Max. ap
Ø25	22.0	15.5	38	29.1		4.4	3.7
					50	13.2	3.7
Ø32	16.0	15.5	54	43.1		8.5	3.5
					64	13.2	3.5
Ø40	11.0	15.5	80	59.1		9.9	3.5
					80	13.2	3.5
Ø50	9.0	15.5	98	79.1		12.3	3.5
					100	13.2	3.5
Ø63	6.5	15.5	136	105.1		12.8	3.5
					126	13.2	3.5
Ø80	4.5	15.5	197	139.1		12.4	3.5
					160	13.2	3.5
Ø100	3.0	15.5	296	179.1		11.1	3.5
					200	13.2	3.5
Ø125	2.0	15.5	444	229.1		9.7	3.5
					250	11.7	3.5

Ramping Data

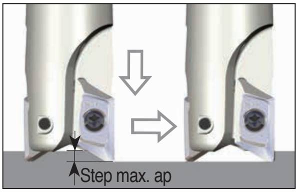
Straight ramping



Helical ramping



Step milling



XECT16 3.0R-3.2R

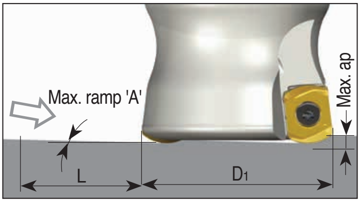
Cutter dia.(D_1)	Straight ramp down			Helical ramp down			Step down
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.	Max. ap
Ø25	21.0	14.5	38	29.1		4.2	2.5
					50	12.3	2.5
Ø32	15.0	14.5	54	43.1		7.9	3
					64	12.3	3
Ø40	10.0	14.5	82	59.1		9.0	3
					80	12.3	3
Ø50	8.0	14.5	103	79.1		10.9	3
					100	12.3	3
Ø63	6.0	14.5	138	105.1		11.8	3
					126	12.3	3
Ø80	4.0	14.5	207	139.1		11.0	3
					160	12.3	3
Ø100	2.5	14.5	332	179.1		9.2	3
					200	11.7	3
Ø125	1.5	14.5	554	229.1		7.3	3
					250	8.7	3

XECT16 4.0R-5.0R

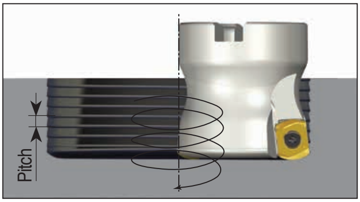
Cutter dia.(D_1)	Straight ramp down			Helical ramp down			Step down
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.	Max. ap
Ø25	18.5	14.5	43	29.1		3.7	2.3
					50	12.3	2.3
Ø32	13.5	14.5	60	43.1		7.1	2.5
					64	12.3	2.5
Ø40	8.5	14.5	97	59.1		7.6	2.5
					80	12.3	2.5
Ø50	7.0	14.5	118	79.1		9.5	2.5
					100	12.3	2.5
Ø63	5.5	14.5	151	105.1		10.8	2.5
					126	12.3	2.5
Ø80	3.5	14.5	237	139.1		9.7	2.5
					160	12.3	2.5
Ø100	2.5	14.5	332	179.1		9.2	2.5
					200	11.7	2.5
Ø125	1.5	14.5	554	229.1		7.3	2.5
					250	8.7	2.5

Ramping Data

Straight ramping



Helical ramping



BLMP 06

Cutter dia.(D_1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø16	3.0	0.7	13	23		0.7
					32	0.7
Ø17	2.7	0.7	15	25		0.7
					34	0.7
Ø18	2.5	0.7	16	27		0.7
					36	0.7
Ø20	1.5	1.0	38	31		0.8
					40	1.0
Ø21	1.5	1.0	38	33		0.8
					42	1.0
Ø25	1.4	1.0	41	41		1.0
					50	1.0
Ø26	1.3	1.0	44	43		1.0
					52	1.0
Ø30	1.1	1.0	52	51		1.0
					60	1.0
Ø32	1.0	1.0	57	55		1.0
					64	1.0
Ø33	1.0	1.0	57	57		1.0
					66	1.0
Ø40	0.9	1.0	64	71		1.0
					80	1.0
Ø50	0.6	1.0	96	91		1.0
					100	1.0
Ø63	0.5	1.0	115	117		1.0
					126	1.0

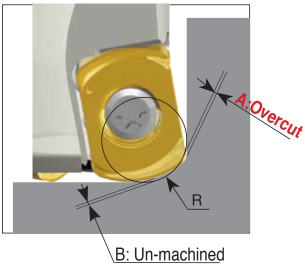
BLMP 09

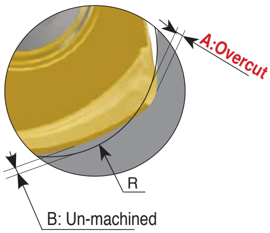
Cutter dia.(D1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø25	2.2	1.5	39	42		1.5
					50	1.5
Ø26	2.2	1.5	39	44		1.5
					52	1.5
Ø30	2.0	1.5	43	52		1.5
					60	1.5
Ø32	2.0	1.5	43	56		1.5
					64	1.5
Ø33	2.0	1.5	43	58		1.5
					66	1.5
Ø40	1.5	1.5	57	72		1.5
					80	1.5
Ø42	1.5	1.5	57	76		1.5
					84	1.5
Ø50	1.0	1.5	86	92		1.5
					100	1.5
Ø52	1.0	1.5	86	96		1.5
					104	1.5
Ø63	0.9	1.5	96	118		1.5
					126	1.5
Ø66	0.9	1.5	96	124		1.5
					132	1.5
Ø80	0.8	1.5	107	152		1.5
					160	1.5
Ø100	0.7	1.5	123	192		1.5
					200	1.5

Programming technical data

When CNC programming specify tools with 'R' for the each insert, this will result un-machined material thickness of approximately 'B' mm along the corner.

When applying CNC program with 'R', over-cut area is 'A' mm. To avoid over-cut, please add to set up roughing stock 'A' mm. For other program R data, please refer to diagram below.





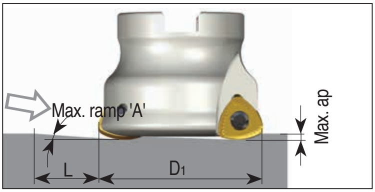
	R Program	A Over cut	B Un-machined material thickness
BLMP 06	2.0	0	0.42
	2.5	0.12	0.26
	3.0	0.29	0.17
BLMP 09	2.5	0	0.61
	3.0	0.09	0.45
	3.5	0.24	0.30
	4.0	0.41	0.17
	3.0	0.36	0.04

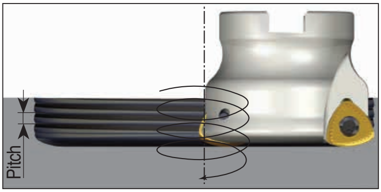
:Recommended program 'R'

Ramping Data

CHASE2FEED

Straight ramping	Helical ramping





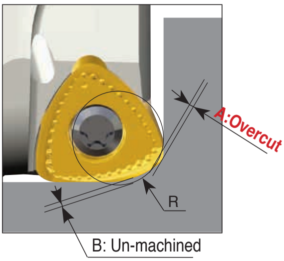
BLMP 12

Cutter dia.(D_1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø32	2.0	2.0	57	41.6		0.9
					64	2.0
Ø33	2.0	2.0	57	43.6		1.0
					66	2.0
Ø35	1.8	2.0	64	47.6		1.1
					70	2.0
Ø40	1.5	2.0	76	57.6		1.2
					80	2.0
Ø42	1.3	2.0	88	61.6		1.2
					84	2.0
Ø50	1.1	2.0	104	77.6		1.4
					100	2.0
Ø52	1.0	2.0	115	81.6		1.4
					104	2.0
Ø63	0.8	2.0	143	103.6		1.5
					126	2.0
Ø66	0.7	2.0	164	109.6		1.4
					132	2.0
Ø80	0.5	2.0	229	137.6		1.3
					160	1.9
Ø100	0.4	2.0	287	177.6		1.4
					200	1.9
Ø125	0.4	2.0	382	227.6		1.4
					250	1.7

Programming technical data

When CNC programming specify tools with 'R' for the each insert, this will result un-machined material thickness of approximately 'B' mm along the corner.

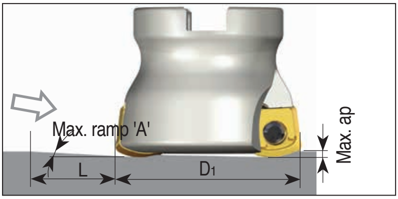
When applying CNC program with 'R', over-cut area is 'A' mm. To avoid over-cut, please add to set up roughing stock 'A' mm. For other program R data, please refer to diagram below.



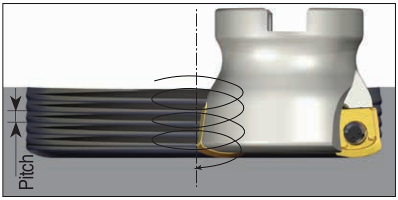
	R Program	A Over cut	B Un-machined material thickness
BLMP 12	3.0	0	1.15
	3.5	0	1.00
	4.0	0.03	0.84
	4.5	0.14	0.70
	5.0	0.29	0.57

:Recommended program 'R'

Straight ramping



Helical ramping



XDMX 08

Cutter dia.(D_1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø20	1.5	1.0	38	26		0.4
					40	1.0
Ø25	0.9	1.0	64	36		0.5
					50	1.0
Ø32	0.5	1.0	115	50		0.4
					64	0.7
Ø40	0.4	1.0	143	66		0.5
					80	0.7
Ø50	0.3	1.0	191	86		0.5
					100	0.7

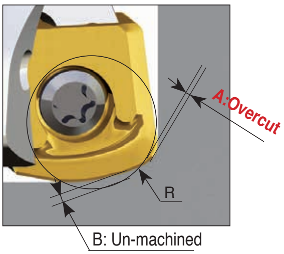
XDMX 13

Cutter dia.(D_1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø32	2.5	2.0	46	40		0.9
					64	1.0
Ø40	1.7	2.0	67	56		1.3
					80	1.9
Ø50	1.3	2.0	88	76		1.6
					100	1.9
Ø63	0.8	2.0	143	102		1.5
					126	2.3
Ø80	0.5	2.0	229	136		1.3
					160	1.9
Ø100	0.4	2.0	287	176		1.4
					200	1.9
Ø125	0.2	2.0	573	226		0.9
					250	1.2

Programming technical data

When CNC programming specify tools with 'R' for the each insert, this will result un-machined material thickness of approximately 'B' mm along the corner.

When applying CNC program with 'R', over-cut area is 'A' mm. To avoid over-cut, please add to set up roughing stock 'A' mm. For other program R data, please refer to diagram below.

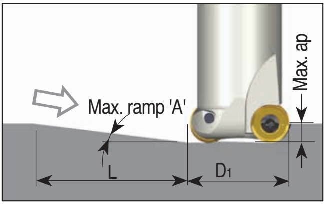


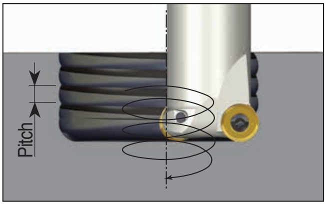
	R Program	A Over cut	B Un-machined material thickness
XDMX 08	2.8	0	0.49
	3.0	0.01	0.44
	3.5	0.14	0.31
	4.0	0.32	0.19
XDMX 13	3.0	0	0.87
	3.5	0.01	0.72
	4.0	0.12	0.58
	4.5	0.27	0.45
	5.0	0.45	0.33
	6.0	0.83	0.14

:Recommended program 'R'

Ramping Data

Straight ramping	Helical ramping





RNMU 1004S-M ,RNMU 1004-ML: 8 corners

Cutter dia.(D_1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø25	1.1	5.0	261	33		0.4
					50	1.3
Ø26	1.1	5.0	261	35		0.5
					52	1.3
Ø32	0.9	5.0	318	47		0.6
					64	1.3
Ø33	0.9	5.0	318	49		0.7
					66	1.4
Ø40	0.9	5.0	318	63		1.0
					80	1.7
Ø42	0.9	5.0	318	67		1.0
					84	1.8
Ø50	0.7	5.0	409	83		1.1
					100	1.6
Ø52	0.8	5.0	358	87		1.3
					104	1.9

RNMU 1205S-M ,RNMU 1205-ML: 8 corners

Cutter dia.(D_1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø32	1.4	6.0	246	42		0.7
					64	2.1
Ø33	1.4	6.0	246	44		0.7
					66	2.2
Ø40	1.3	6.0	265	58		1.1
					80	2.4
Ø50	1.0	6.0	344	78		1.3
					100	2.3
Ø52	1.0	6.0	344	82		1.4
					104	2.4
Ø63	1.0	6.0	344	104		1.9
					126	2.9
Ø66	1.0	6.0	344	110		2.0
					132	3.1
Ø80	0.9	6.0	382	138		2.4
					160	3.4
Ø100	0.7	6.0	491	178		2.5
					200	3.3

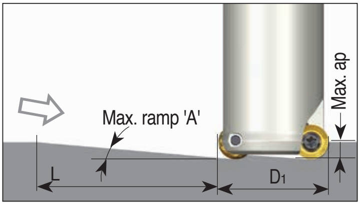
Ramping Data

RNMU 1606S-M: 8 corners

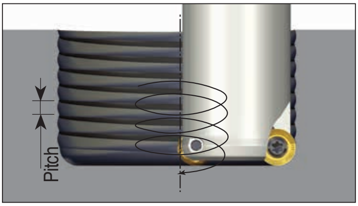
Cutter dia.(D_1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø40	1.4	8.0	328	52		0.8
					80	2.6
Ø42	1.4	8.0	328	56		0.9
					84	2.7
Ø50	1.3	8.0	353	72		1.3
					100	3.0
Ø52	1	8.0	459	76		1.1
					104	2.4
Ø63	1	8.0	459	98		1.6
					126	2.9
Ø66	1	8.0	459	104		1.8
					132	3.1
Ø80	1	8.0	459	132		2.4
					160	3.7
Ø100	0.9	8.0	510	172		3.0
					200	4.2
Ø125	0.9	8.0	510	222		4.1
					250	5.2

Ramping Data

Straight ramping



Helical ramping



RDMX-05

Cutter dia.(D1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø8	7	2.5	20	8.5		0.2
					16	2.1
Ø10	14	2.5	10	12		1.3
					20	2.1
Ø12	9	2.5	16	16		1.7
					24	2.1

RDMX-07

Cutter dia.(D1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø15	17	3.5	11	18		2.4
					30	3.0
Ø16	15	3.5	13	20		2.9
					32	3.0
Ø17	14.5	3.5	14	22		1.6
						3.4
Ø20	14	3.5	14		34	3.0
				28		3.0
Ø25	8	3.5	25		40	3.0
				38		3.0
Ø30	5	3.5	40		50	3.0
				48		3.0
Ø32	5	3.5	40		60	3.0
				52		3.0

RXM(H)X-10

Cutter dia.(D1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø20	20	5.0	14	22		1.9
					40	4.3
Ø25	15	5.0	19	32		5.0
					50	4.3
Ø32	12	5.0	24	46		1.6
					64	4.3
Ø42	8	5.0	36	66		4.3
					84	4.3
Ø50	6.5	5.0	44	82		4.3
					100	4.3
Ø52	6	5.0	48	86		4.3
					104	4.3

RXM(H)X-12

Cutter dia.(D1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø25	20	6.0	16	28		2.9
					50	5.1
Ø32	15	6.0	22	42		5.1
					64	5.1
Ø35	8	6.0	43	48		4.9
					70	5.1
Ø40	15	6.0	22	58		5.1
					80	5.1
Ø42	7.5	6.0	46	62		5.1
					84	5.1
Ø50	7.5	6.0	46	78		5.1
					100	5.1
Ø52	6	6.0	57	82		5.1
					104	5.1
Ø63	5	6.0	69	104		5.1
					126	5.1
Ø66	5	6.0	69	110		5.1
					132	5.1
Ø80	4	6.0	86	138		5.1
					160	5.1
Ø100	2	6.0	172	178		5.1
					200	5.1
Ø125	2	6.0	172	228		5.1
					250	5.1

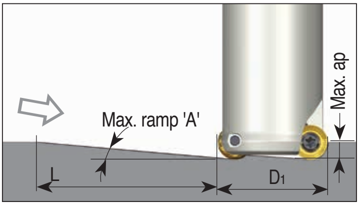
RXMX-16

Cutter dia.(D1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø32	20	8.0	22	34		1.9
					64	6.8
Ø40	15	8.0	30	50		7.1
					80	6.8
Ø42	14	8.0	32	54		8.0
					84	6.8
Ø50	13	8.0	35	70		6.8
					100	6.8
Ø52	10	8.0	45	74		6.8
					104	6.8
Ø80	6	8.0	76	130		6.8
					160	6.8
Ø100	4	8.0	114	170		6.8
					200	6.8
Ø125	3.5	8.0	131	220		6.8
					250	6.8

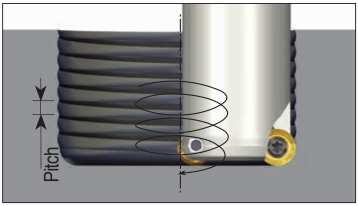
RXMX-20

Cutter dia.(D1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø50	16	10.0	35	62		9.2
					100	8.5
Ø63	11.5	10.0	49	88		8.5
					126	8.5
Ø80	9	10.0	63	122		8.5
					160	8.5
Ø100	7.5	10.0	76	162		8.5
					200	8.5
Ø125	5.5	10.0	104	212		8.5
					250	8.5
Ø160	4	10.0	143	282		8.5
					320	8.5

Straight ramping



Helical ramping



RYM(H)X-08

Cutter dia.(D1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø16	2.5	4.0	92	18		0.2
					32	1.9
Ø17	2.5	4.0	92	20		0.3
					34	2.0
Ø18	2.5	4.0	92	22		0.5
					36	2.1
Ø20	4.0	4.0	57	26		1.1
					40	3.4
Ø21	4.0	4.0	57	28		1.3
					42	3.4
Ø25	4.0	4.0	57	36		2.1
					50	3.4
Ø26	4.0	4.0	57	38		2.2
					52	3.4
Ø32	4.0	4.0	57	50		3.4
					64	3.4
Ø40	7.0	4.0	33	66		3.4
					80	3.4

RYMX-10

Cutter dia.(D1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø20	4.5	5.0	64	22		0.4
					40	4.2
Ø21	4.5	5.0	64	24		0.6
					42	4.4
Ø25	5.0	5.0	57	32		1.6
					50	4.3
Ø26	5.0	5.0	57	34		1.9
					52	4.3
Ø32	5.0	5.0	57	46		3.3
					64	4.3
Ø35	5.0	5.0	57	52		4.0
					70	4.3
Ø40	5.0	5.0	57	62		4.3
					80	4.3
Ø42	5.0	5.0	57	66		4.3
					84	4.3
Ø50	6.5	5.0	44	82		4.3
					100	4.3
Ø52	6.0	5.0	48	86		4.3
					104	4.3
Ø66	4.5	5.0	64	114		4.3
					132	4.3

RYMX-12

Cutter dia.(D_1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø25	6.0	6.0	57	28		0.8
					50	5.1
Ø26	6.0	6.0	57	30		1.1
					52	5.1
Ø32	12.0	6.0	28	42		5.1
					64	5.1
Ø33	12.0	6.0	28	44		5.1
					66	5.1
Ø35	12.0	6.0	28	48		5.1
					70	5.1
Ø40	10.0	6.0	34	58		5.1
					80	5.1
Ø42	12.0	6.0	28	62		5.1
					84	5.1
Ø50	9.0	6.0	38	78		5.1
					100	5.1
Ø52	8.0	6.0	43	82		5.1
					104	5.1
Ø55	8.0	6.0	43	88		5.1
					110	5.1
Ø63	7.0	6.0	49	104		5.1
					126	5.1
Ø66	6.5	6.0	53	110		5.1
					132	5.1
Ø80	4.5	6.0	76	138		5.1
					160	5.1
Ø100	3.5	6.0	98	178		5.1
					200	5.1
Ø125	2.5	6.0	137	228		5.1
					250	5.1

RYMX-16

Cutter dia.(D_1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø32	8.0	8.0	57	34		0.7
					64	6.8
Ø40	9.5	8.0	48	50		4.5
					80	6.8
Ø42	9.0	8.0	51	54		5.1
					84	6.8
Ø50	9.0	8.0	51	70		6.8
					100	6.8
Ø52	9.0	8.0	51	74		6.8
					104	6.8
Ø63	8.5	8.0	54	96		6.8
					126	6.8
Ø66	8.5	8.0	54	102		6.8
					132	6.8
Ø80	6.0	8.0	76	130		6.8
					160	6.8
Ø100	5.0	8.0	91	170		6.8
					200	6.8
Ø125	3.5	8.0	131	220		6.8
					250	6.8
Ø160	3.5	8.0	131	290		6.8
					320	6.8

RYMX-20

Cutter dia.(D1)	Straight ramp down			Helical ramp down		
	Max. ramp (A°)	Max. ap (mm)	Min. length (L)	Min. dia.	Max. dia.	Max. pitch/rev.
Ø50	8.0	10.0	71	62		4.5
					100	8.5
Ø63	12.5	10.0	45	88		8.5
					126	8.5
Ø80	8.5	10.0	67	122		8.5
					160	8.5
Ø100	6.5	10.0	88	162		8.5
					200	8.5
Ø125	4.5	10.0	127	212		8.5
					250	8.5
Ø160	4.0	10.0	143	282		8.5
					320	8.5
Ø200	2.5	10.0	229	362		8.5
					400	8.5
Ø250	2.4	10.0	239	462		8.5
					500	8.5

Recommended Cutting Condition

MILL•RUSH - 3P TE90 and 3P TF90 using 3PK(H)T inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85-175	180-300	TT9080
High carbon steel	175-225	130-280	TT9080
Alloy steel	275-325	120-250	TT9080
Tool steel	-	80-200	TT9080
Stainless 300 series	-	80-170	TT8020
Stainless 400 series	-	100-210	TT8020
High-temp alloy inconel	-	30-100	TT8020
Titanium alloy	-	30-80	TT8020
Gray cast iron	190-220	150-400	TT6080
Nodular cast iron	140-200	100-250	TT6080
Aluminum	-	350-500	K10

• Reduce speed by 20% for face mills when slotting

MILL 2 RUSH - 6N TE90 and 6N TF90 using 6NGU inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon cteel	85 - 175	180 - 300	TT9080
High carbon cteel	175 - 225	130 - 280	TT9080
Alloy steel	275 - 325	120 - 250	TT9080
Tool steel	-	80 - 200	TT9080
Stainless 300 series	-	80 - 170	TT8020
Stainless 400 series	-	100 - 210	TT8020
High temp. super alloy	-	30 - 100	TT8020
Titanium alloy	-	30 - 80	TT8020
Gray cast iron	190 - 220	150 - 400	TT6080
Nodular cast iron	140 - 200	100 - 250	TT6080
Aluminum	-	400 - 600	K10

• Reduce speed by 20% for face mills when slotting

MILL 2 RUSH - SCRM90TN using TNM(G)X inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	200 - 300	TT9080
High carbon steel	175 - 225	130 - 280	TT9080
Alloy steel	275 - 325	120 - 250	TT9080
Tool steel	-	80 - 180	TT9080
Stainless 300 series	-	80 - 170	TT9080
Stainless 400 series	-	100 - 210	TT9080
Gray cast iron	190 - 220	150 - 300	TT6080
Aluminum	140 - 200	100 - 250	TT6080

• Reduce speed by 20% for face mills when slotting

CHASE2MILL -TE90AN and TFM90AN using ANH(M)X inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon cteel	85 - 175	180 - 300	TT7080
High carbon cteel	175 - 225	130 - 280	TT9080
Alloy steel	275 - 325	120 - 250	TT9080
Tool steel	-	80 - 200	TT2510
Stainless 300 series	-	80 - 170	TT8080
Stainless 400 series	-	100 - 210	TT8080
High temp. super alloy	-	30 - 100	TT8080
Titanium alloy	-	30 - 80	TT8080
Gray cast iron	190 - 220	150 - 400	TT6080
Nodular cast iron	140 - 200	100 - 250	TT6080
Aluminum	-	400 - 600	K10

• Reduce speed by 20% for face mills when slotting

Recommended Cutting Condition

CHASE2MILL - TFM45AN using ANHX 16 insert

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	180 - 300	TT7080
High carbon steel	175 - 225	130 - 280	TT7080
Alloy steel	275 - 325	120 - 250	TT7080
Tool steel	-	80 - 200	TT7080
Stainless 300 series	-	80 - 170	TT8080
Stainless 400 series	-	100 - 210	TT8080
High temp. super alloy	-	30 - 100	TT8080
Titanium alloy	-	30 - 80	TT8080
Gray cast iron	190 - 220	150 - 400	TT6080
Nodular cast iron	140 - 200	100 - 250	TT6080

• Reduce speed by 20% for face mills when slotting

CHASEMILL - TE90AX, TFM90AX using AXM(C)T 0602 inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	180 - 300	TT9080
High carbon steel	175 - 225	130 - 280	TT9080
Alloy steel	275 - 325	120 - 250	TT9080
Tool steel	-	80 - 200	TT2510
Stainless 300 series	-	80 - 170	TT8080
Stainless 400 series	-	100 - 210	TT8080
High temp. super alloy	-	30 - 100	TT8080
Titanium alloy	-	30 - 80	TT8080
Gray cast iron	190 - 220	150 - 400	TT6080
Nodular cast iron	140 - 200	100 - 250	TT6080
Aluminum	-	350 - 500	K10

• Recommended cutting conditions are just for reference.
• The recommended cutting conditions always refer to optimum conditions.
If machine rigidity, workpiece clamping, or overall length is not ideal, these cutting conditions should be altered accordingly.

CHASEMILL - AXMT 0602R-HF insert

Material	Hardness (HB)	D.O.C (mm)	Speed (m/min)	Best grades	Feed (mm/tooth)
Carbon steel / Alloy steel	- 375	0.4	100 - 180	TT9080	0.7 - 0.8
Prehardened steel / Die and mold steel	375 - 480	0.4	100 - 180	TT2510	0.5 - 0.6
Hardened steel	480 -	0.3	80 - 130	TT2510	0.4 - 0.5
Stainless steel	-	0.4	90 - 180	TT8080	0.6 - 0.7
Cast iron	140 - 220	0.5	130 - 230	TT9080	0.7 - 0.8

• Reduce speed by 20% for face mills when slotting

CHASEMILL - 2S-TE90AP, 2S-TFM90AP using APK(C)T 09 inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	180 - 300	TT7080
High carbon steel	175 - 225	130 - 280	TT9080
Alloy steel	275 - 325	120 - 250	TT9080
Tool steel	-	80 - 200	TT2510
Stainless 300 series	-	80 - 170	TT8080
Stainless 400 series	-	100 - 210	TT8080
High temp. super alloy	-	30 - 100	TT8080
Titanium alloy	-	30 - 80	TT8080
Gray cast iron	190 - 220	150 - 400	TT6080
Nodular cast iron	140 - 200	100 - 250	TT6080
Aluminum	-	350 - 500	K10

• Reduce speed by 20% for face mills when slotting

Recommended Cutting Condition

CHASEMILL - APKT 09T3R-HF insert

Material	Hardness (HB)	D.O.C (mm)	Speed (m/min)	Best grades	Feed (mm/tooth)
Carbon steel / Alloy steel	- 375	0.5 - 0.7	100 - 180	TT9080, TT8080	0.7 - 1.0
Prehardened steel / Die and mold steel	375 - 480	0.3 - 0.6	100 - 180	TT8080, TT9080	0.5 - 0.7
Hardened steel	480 -	0.3 - 0.6	80 - 150	TT9080, TT8080	0.4 - 0.6
Stainless steel	-	0.5 - 0.7	90 - 150	TT8080, TT9080	0.6 - 1.0
Cast iron	140 - 220	0.5 - 0.8	120 - 220	TT9080, TT8080	0.7 - 1.0

• Reduce speed by 20% for face mills when slotting

CHASEMILL - TE90AP, TFM90AP using APK(C)T 12 and APKT 17 inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	180 - 300	TT7080
High carbon steel	175 - 225	130 - 280	TT9080
Alloy steel	275 - 325	120 - 250	TT9080
Tool steel	-	80 - 200	TT2510
Stainless 300 series	-	80 - 170	TT8080
Stainless 400 series	-	100 - 210	TT8080
High temp. super alloy	-	30 - 100	TT8080
Titanium alloy	-	30 - 80	TT8080
Gray cast iron	190 - 220	150 - 400	TT6080
Nodular cast iron	140 - 200	100 - 250	TT6080
Aluminum	-	400 - 600	K10

• Reduce speed by 20% for face mills when slotting

CHASEMILL - APKT 1204R-HF insert

Material	Hardness (HB)	D.O.C (mm)	Speed (m/min)	Best grades	Feed (mm/tooth)
Carbon steel / Alloy steel	- 375	0.5 - 0.8	100 - 180	TT9080	0.7 - 1.2
Prehardened steel / Die and mold steel	375 - 480	0.3 - 0.7	100 - 180	TT9080	0.5 - 0.8
Hardened steel	480 -	0.3 - 0.6	80 - 150	TT9080	0.4 - 0.6
Stainless steel	-	0.5 - 0.7	90 - 150	TT9080	0.6 - 1.0
Cast iron	140 - 220	0.5 - 1.0	120 - 220	TT9080	0.7 - 1.2

• Reduce speed by 20% for face mills when slotting

CHASEALU - TE90XE and TFM90XE using XECT 16 insert

Material			Hardness (HB)	Speed (m/min)	Best grades
Aluminum-wrought alloy		Not cureable	60	300 - 5000	K10
		Cured	100	200 - 2000	K10
Aluminum-cast alloy	<=12% Si	Not cureable	75	200 - 2000	K10
		Cured	90	200 - 1500	K10
	>12% Si	High temperature	130	200 - 1000	K10
Copper alloys	>1% Pb	Free cutting	110	200 - 800	K10
		Brass	90	300 - 1000	K10
		Electrolitic copper	100	300 - 800	K10
Non-metallic		Duroplastics, fiber plastics	-	100 - 500	K10
		Hard rubber	-	100 - 300	K10

Contents

Recommended Cutting Condition

CHASEQUAD - Spot face, counterbore, plunging, and drill - mill series TSF and TDM using XOMT 06, SPMG(T) 09, SPMG(T) 11 & SPMG(T) 14 inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	180 - 300	TT7080
High carbon steel	175 - 225	130 - 280	TT7080
Alloy steel	275 - 325	120 - 250	TT7080
Tool steel	-	80 - 200	TT7080
Stainless 300 series	-	80 - 170	TT8080
Stainless 400 series	-	100 - 210	TT9080
Gray cast iron	190 - 220	150 - 400	TT6800
Nodular cast iron	140 - 200	100 - 250	TT6080

• Reduce feed by 25% for face mills 18mm and under at D.O.C > 3.8mm

CHASE2QUAD - TFM90SNS, TQ90SNS using SNEX 1204,SNET 1205 inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Gray cast iron	190 - 220	150 - 280	TT6080
Nodular cast iron	140 - 200	130 - 250	TT6080
Gray / Ductile / Nodular cast iron	140 - 200	400 - 800	KB90
Alloy steel	275 - 325	135 - 200	TT9080
Carbon steel	85 - 225	150 - 350	TT9080

• Recommended cutting conditions are just for reference.
• The recommended cutting conditions always refer to optimum conditions.
If machine rigidity, workpiece clamping, or overall length is not ideal, these cutting conditions should be altered accordingly.

CHASE2QUAD - TFM90/88SN using SNGX 13 insert

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	180 - 300	TT7080
High carbon steel	175 - 225	130 - 280	TT7080
Alloy steel	275 - 325	120 - 250	TT7080
Tool steel	-	80 - 200	TT7080
Stainless 300 series	-	80 - 170	TT8080
Stainless 400 series	-	100 - 210	TT9080
Gray cast iron	190 - 220	150 - 400	TT6080
Nodular cast iron	140 - 200	100 - 250	TT6080
Gray / Nodular cast iron	140 - 200	400 - 800	AS10

• Reduce speed by 20% for face mills when slotting

CHASE2QUAD - TFM75SN using SNG(M)X 13 inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	180 - 300	TT7800
High carbon steel	175 - 225	130 - 280	TT7800
Alloy steel	275 - 325	120 - 250	TT9080
Tool steel	-	80 - 200	TT9080
Stainless 300 series	-	80 - 170	TT8080
Stainless 400 series	-	100 - 210	TT9080
Gray cast iron	190 - 220	150 - 400	TT6800
Nodular cast iron	140 - 200	100 - 250	TT6080

• Reduce speed by 20% when channel milling • In order of preference, uncoated carbide reduce speed 20%

Recommended Cutting Condition

CHASE2QUAD - TFM45SN using SNG(M)X 13 inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	180 - 300	TT7080
High carbon steel	175 - 225	130 - 280	TT7080
Alloy steel	275 - 325	120 - 250	TT7080
Tool steel	-	80 - 200	TT7080
Stainless 300 series	-	80 - 170	TT8080
Stainless 400 series	-	100 - 210	TT9080
Gray cast iron	190 - 220	150 - 400	TT6800
Nodular cast iron	140 - 200	100 - 250	TT6080
Aluminum	-	400 - 600	K10

• Reduce speed by 20% when channel milling • In order of preference, uncoated carbide reduce speed 20%

CHASE2QUAD - TFM45SNS/TFM45SNW/TQ45SNW using SNM(H)X 16 inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	180 - 300	TT7080
High carbon steel	175 - 225	130 - 280	TT7080
Alloy steel	275 - 325	120 - 250	TT7080
Tool steel	-	80 - 200	TT7080
Stainless 300 series	-	80 - 170	TT8080
Stainless 400 series	-	100 - 210	TT9080
Gray cast iron	190 - 220	150 - 400	TT6800
Nodular cast iron	140 - 200	100 - 250	TT6080

EXT. flute mills overcut shell mills series - TEF, TES using inserts SDMT 05, SPMG(T) 09, SPMG(T) 11, SPMG(T)14, AXM(C)T 06, APK(C)T 09, APKT 12, APKT 17, ANM(H)X 11 & ANM(H)X 16 inserts

Material	Hardness (HB)	Radial WOC(mm)	Speed (m/min)	Best grades	Feed (mm/tooth)					
					D32	D40	D50	D63	D80	D100
Low carbon steel	85-175	0.5-DIA/2	210-300	TT7080, TT8020	0.12-0.60	0.15-0.75	0.15-0.85	0.15-1.20	0.15-1.40	0.15-1.60
High carbon steel	175-225	0.5-DIA/2	120-210	TT7080, TT8020	0.12-0.60	0.15-0.75	0.15-0.85	0.15-1.20	0.15-1.40	0.15-1.60
Alloy steel	275-325	0.5-DIA/2	90-180	TT8020, TT7080	0.10-0.40	0.12-0.55	0.12-0.75	0.12-1.05	0.12-1.24	0.12-1.40
Tool steel	200-250	0.5-DIA/2	75-140	TT8020, TT7080	0.10-0.40	0.12-0.55	0.12-0.75	0.12-1.05	0.12-1.24	0.12-1.40
Stainless 300 series	-	0.5-DIA/2	120-180	TT8020, TT7080	0.10-0.40	0.12-0.55	0.12-0.75	0.12-1.05	0.12-1.24	0.12-1.40
Stainless 400 series	-	0.5-DIA/2	120-210	TT8020, TT7080	0.12-0.60	0.15-0.75	0.15-0.85	0.15-1.20	0.15-1.40	0.15-1.60
High temp. Super alloy	-	0.5-DIA/2	22-45	TT8020, TT7080	0.10-0.40	0.12-0.55	0.12-0.75	0.12-1.05	0.12-1.24	0.12-1.40
Titanium alloy	-	0.5-DIA/2	36-54	TT8020	0.10-0.40	0.12-0.55	0.12-0.75	0.12-1.05	0.12-1.24	0.12-1.40
Gray cast iron	190-220	0.5-DIA/2	120-210	TT6080	0.60-0.12	0.15-0.75	0.15-0.85	0.15-1.20	0.15-1.40	0.15-1.60
Nodular cast iron	140-200	0.5-DIA/2	120-210	TT6080	0.12-0.60	0.15-0.75	0.15-0.85	0.15-1.20	0.15-1.40	0.15-1.60
Aluminum	-	0.5-DIA/2	450+	K10	0.25-1.00	0.25-1.00	0.25-1.25	0.25-1.50	0.25-1.75	0.25-2.00

• Feed adjusted to compensate for radial chip thinning
• Decrease speed 20% when width of cut (WOC) exceeds DIA/1.3 (3/4 of cutter DIA) or consider using single stage End Mills or Face Mills - TE90AP, TFM90AP: Insert APKT1705 in multiple passes to desired depth

CHASE2PLUNGE - TPM using PLNG09 insert

Material	Hardness (HB)	Speed (m/min)	Best Grades
Carbon steel	85 - 225	130-300	TT9080
Alloy steel	275 - 375	120-250	TT9080
Alloy steel	375 - 480	60-140	TT9080
Pre-hardened steel	250 - 470	50-200	TT2510
Hardened steel	480 -	50-110	TT2510
Stainless 300 series	-	80-170	TT8020
Stainless 400 series	-	100-210	TT8020
High temp. alloy	-	30-100	TT8020
Inconel	-	20-60	TT8020
Titanium alloy	-	30-80	TT8020
Cast iron	140 - 220	150-400	TT9080

Recommended Cutting Condition

CHASE2FEED - TEBL and TFMBL using BLMP inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Carbon steel	85 - 225	130 - 300	TT9080
Alloy steel	275 - 375	120 - 250	TT9080
Alloy steel	375 - 480	60 - 140	TT9080
Pre-hardened steel	250 - 470	50 - 200	TT2510
Hardened steel	480 -	50 - 110	TT2510
Stainless 300 series	-	80 - 170	TT8020
Stainless 400 series	-	100 - 210	TT8020
High temp. alloy	-	30 - 100	TT8020
Inconel	-	20 - 60	TT8020
Titanium alloy	-	30 - 80	TT8020
Cast iron	140 - 220	150 - 400	TT9080

CHASE2FEED - XDMX insert

Material	Hardness (HB)	Speed (m/min)	Best grades
Carbon steel	85 - 225	130 - 300	TT9080
Alloy steel	275 - 375	120 - 250	TT9080
Alloy steel	375 - 480	60 - 140	TT9080
Pre-hardened steel	250 - 470	50 - 200	TT9080
Hardened steel	480 -	50 - 110	TT9080
Stainless steel	-	80 - 210	TT8080
High temp. super alloy	-	30 - 100	TT8080
Titanium alloy	-	30 - 80	TT8080
Cast iron	140 - 220	150 - 400	TT6080

CHASE2MOLD - RNMU 10 insert

Material	Hardness (HB)	Speed (m/min)	Best grades	Feed (mm/tooth)					
				RNMU 1004-ML	RNMU 1004S-M				
					Max. ap(1mm)	Max. ap(2mm)	Max. ap(3mm)	Max. ap(4mm)	Max. ap(5mm)
Low carbon steel	85 - 175	180 - 300	TT9080	0.07 - 0.55	0.07 - 0.50	0.07 - 0.40	0.07 - 0.30	0.07 - 0.25	0.07 - 0.20
High carbon steel	175 - 225	130 - 280	TT9080	0.06 - 0.50	0.07 - 0.45	0.07 - 0.35	0.07 - 0.30	0.07 - 0.25	0.07 - 0.20
Alloy steel	275 - 375	120 - 250	TT9080	0.05 - 0.45	0.07 - 0.45	0.07 - 0.35	0.07 - 0.30	0.07 - 0.25	0.07 - 0.20
Alloy steel	375 - 480	60 - 140	TT9080	0.05 - 0.40	0.07 - 0.45	0.07 - 0.40	0.07 - 0.30	0.07 - 0.25	0.07 - 0.20
Tool steel	250 - 470	50 - 200	TT9080	0.05 - 0.35	0.07 - 0.40	0.07 - 0.35	0.07 - 0.30	0.07 - 0.25	0.07 - 0.20
Tool steel	480 -	50 - 110	TT9080	0.05 - 0.30	0.07 - 0.35	0.07 - 0.35	0.07 - 0.30	0.07 - 0.25	0.07 - 0.20
Stainless 300 series	-	80 - 170	TT8020	0.07 - 0.45	0.07 - 0.50	0.07 - 0.40	0.07 - 0.30	0.07 - 0.25	0.07 - 0.20
Stainless 400 series		100 - 210	TT8020	0.07 - 0.45	0.07 - 0.50	0.07 - 0.40	0.07 - 0.30	0.07 - 0.25	0.07 - 0.20
High temp. super alloy		30 - 100	TT8020	0.05 - 0.35	0.07 - 0.30	0.07 - 0.30	0.07 - 0.30	0.07 - 0.25	0.07 - 0.20
Inconel	-	20 - 60	TT8020	0.05 - 0.30	0.07 - 0.30	0.07 - 0.30	0.07 - 0.30	0.07 - 0.25	0.07 - 0.20
Titanium alloy	-	30 - 80	TT8020	0.05 - 0.40	0.07 - 0.40	0.07 - 0.35	0.07 - 0.30	0.07 - 0.25	0.07 - 0.20
Cast iron	140 - 220	150 - 400	TT9080	0.12 - 0.50	0.07 - 0.50	0.07 - 0.40	0.07 - 0.30	0.07 - 0.25	0.07 - 0.20

Recommended Cutting Condition

CHASE2MOLD - RNMU 12 insert

Material	Hardness (HB)	Speed (m/min)	Best grades	Feed (mm/tooth)					
				RNMU 1205-ML	RNMU 1205S-M				
					Max. ap(2mm)	Max. ap(3mm)	Max. ap(4mm)	Max. ap(5mm)	Max. ap(6mm)
Low carbon steel	85 - 175	180 - 300	TT9080	0.13 - 0.60	0.13 - 0.60	0.13 - 0.55	0.13 - 0.50	0.13 - 0.40	0.13 - 0.25
High carbon steel	175 - 225	130 - 280	TT9080	0.13 - 0.55	0.13 - 0.55	0.13 - 0.50	0.13 - 0.45	0.13 - 0.30	0.13 - 0.25
Alloy steel	275 - 375	120 - 250	TT9080	0.13 - 0.50	0.13 - 0.50	0.13 - 0.45	0.13 - 0.35	0.13 - 0.30	0.13 - 0.25
Alloy steel	375 - 480	60 - 140	TT9080	0.13 - 0.40	0.13 - 0.40	0.13 - 0.40	0.13 - 0.35	0.13 - 0.30	0.13 - 0.25
Tool steel	250 - 470	50 - 200	TT9080	0.10 - 0.35	0.10 - 0.35	0.10 - 0.35	0.10 - 0.30	0.10 - 0.30	0.10 - 0.25
Tool steel	480 -	50 - 110	TT9080	0.10 - 0.30	0.10 - 0.30	0.10 - 0.30	0.10 - 0.25	0.10 - 0.25	0.10 - 0.25
Stainless 300 series	-	80 - 170	TT8020	0.13 - 0.50	0.13 - 0.50	0.13 - 0.50	0.13 - 0.40	0.13 - 0.30	0.13 - 0.25
Stainless 400 series		100 - 210	TT8020	0.13 - 0.50	0.13 - 0.50	0.13 - 0.50	0.13 - 0.40	0.13 - 0.30	0.13 - 0.25
High temp. super alloy		30 - 100	TT8020	0.10 - 0.35	0.10 - 0.35	0.10 - 0.30	0.10 - 0.30	0.10 - 0.25	0.10 - 0.25
Inconel	-	20 - 60	TT8020	0.10 - 0.30	0.10 - 0.30	0.10 - 0.30	0.10 - 0.30	0.10 - 0.25	0.10 - 0.25
Titanium alloy	-	30 - 80	TT8020	0.10 - 0.40	0.10 - 0.40	0.10 - 0.40	0.10 - 0.35	0.10 - 0.30	0.10 - 0.25
Cast iron	140 - 220	150 - 400	TT9080	0.13 - 0.50	0.13 - 0.50	0.13 - 0.50	0.13 - 0.45	0.13 - 0.35	0.13 - 0.25

CHASE2MOLD - RNMU 16 insert

Material	Hardness (HB)	Speed (m/min)	Best grades	Feed (mm/tooth)				
				RNMU 1606-ML	RNMU 1606S-M			
					Max. ap(2mm)	Max. ap(4mm)	Max. ap(6mm)	Max. ap(8mm)
Low carbon steel	85 - 175	180 - 300	TT9080	0.10 - 0.80	0.10 - 0.80	0.10 - 0.60	0.10 - 0.40	0.10 - 0.35
High carbon steel	175 - 225	130 - 280	TT9080	0.10 - 0.70	0.10 - 0.70	0.10 - 0.60	0.10 - 0.40	0.10 - 0.35
Alloy steel	275 - 375	120 - 250	TT9080	0.10 - 0.70	0.10 - 0.70	0.10 - 0.60	0.10 - 0.45	0.10 - 0.35
Alloy steel	375 - 480	60 - 140	TT9080	0.10 - 0.60	0.10 - 0.60	0.10 - 0.50	0.10 - 0.40	0.10 - 0.35
Tool steel	250 - 470	50 - 200	TT9080	0.10 - 0.50	0.10 - 0.60	0.10 - 0.50	0.10 - 0.40	0.10 - 0.35
Tool steel	480 -	50 - 110	TT9080	0.10 - 0.45	0.10 - 0.60	0.10 - 0.50	0.10 - 0.40	0.10 - 0.35
Stainless 300 series	-	80 - 170	TT8020	0.10 - 0.70	0.10 - 0.70	0.10 - 0.60	0.10 - 0.40	0.10 - 0.35
Stainless 400 series		100 - 210	TT8020	0.10 - 0.70	0.10 - 0.70	0.10 - 0.60	0.10 - 0.40	0.10 - 0.35
High temp. super alloy		30 - 100	TT8020	0.10 - 0.50	0.10 - 0.50	0.10 - 0.45	0.10 - 0.40	0.10 - 0.35
Inconel	-	20 - 60	TT8020	0.10 - 0.40	0.10 - 0.50	0.10 - 0.45	0.10 - 0.40	0.10 - 0.35
Titanium alloy	-	30 - 80	TT8020	0.10 - 0.60	0.10 - 0.70	0.10 - 0.60	0.10 - 0.40	0.10 - 0.35
Cast iron	140 - 220	150 - 400	TT9080	0.10 - 0.80	0.10 - 0.80	0.10 - 0.60	0.10 - 0.40	0.10 - 0.35

CHASEMOLD - RDMX, RXMX, RXHX, RYMX, RYHX inserts

Material	Hardness (HB)	Speed (m/min)	Best grades	Feed (mm/tooth)						
				D05	D07	D08	D10	D12	D16	D20
				Max. ap(2.5mm)	Max. ap(3.5mm)	Max. ap(4mm)	Max. ap(5mm)	Max. ap(6mm)	Max. ap(8mm)	Max. ap(10mm)
Low carbon steel	85 - 175	180 - 300	TT9080	0.08 - 0.25	0.09 - 0.26	0.10 - 0.30	0.12 - 0.44	0.13 - 0.60	0.16 - 0.65	0.20 - 0.70
High carbon steel	175 - 225	130 - 280	TT9080	0.08 - 0.25	0.09 - 0.26	0.10 - 0.30	0.12 - 0.40	0.13 - 0.55	0.16 - 0.60	0.20 - 0.65
Alloy steel	275 - 375	120 - 250	TT9080	0.07 - 0.23	0.09 - 0.23	0.10 - 0.25	0.12 - 0.34	0.13 - 0.50	0.15 - 0.55	0.15 - 0.55
Alloy steel	375 - 480	60 - 140	TT9080	0.07 - 0.20	0.09 - 0.30	0.10 - 0.40	0.12 - 0.35	0.13 - 0.40	0.15 - 0.41	0.15 - 0.41
Tool steel	250 - 470	50 - 200	TT9080	0.07 - 0.20	0.09 - 0.30	0.10 - 0.40	0.10 - 0.32	0.10 - 0.35	0.10 - 0.40	0.10 - 0.40
Tool steel	480 -	50 - 110	TT9080	0.05 - 0.15	0.09 - 0.20	0.10 - 0.35	0.10 - 0.25	0.10 - 0.30	0.10 - 0.30	0.10 - 0.30
Stainless 300 series	-	80 - 170	TT8020	0.07 - 0.25	0.09 - 0.30	0.10 - 0.40	0.12 - 0.45	0.13 - 0.50	0.15 - 0.55	0.15 - 0.55
Stainless 400 series	-	100 - 210	TT8020	0.07 - 0.35	0.09 - 0.30	0.10 - 0.40	0.12 - 0.45	0.13 - 0.50	0.15 - 0.55	0.15 - 0.55
High temp. super alloy	-	30 - 100	TT8020	0.05 - 0.17	0.09 - 0.25	0.10 - 0.35	0.10 - 0.30	0.10 - 0.35	0.10 - 0.40	0.10 - 0.40
Titanium alloy	-	30 - 80	TT8020	0.05 - 0.25	0.09 - 0.32	0.10 - 0.38	0.10 - 0.35	0.10 - 0.40	0.10 - 0.65	0.10 - 0.65
Cast iron	140 - 220	150 - 400	TT6080	0.08 - 0.30	0.09 - 0.40	0.10 - 0.50	0.12 - 0.44	0.13 - 0.50	0.15 - 0.65	0.15 - 0.65
Aluminum	-	400 - 1500	K10	-	-	-	0.20 - 0.60	0.20 - 0.60	0.20 - 0.60	0.20 - 0.60

Recommended Cutting Condition

CHASESPEED - TFMRN & TERP using RPGX, RNGX inserts

Material	D.O.C (mm)	Speed (m/min)	Best grades
Inconel	1.0 -	800 - 1000	AS20
Ductile cast iron	1.0 - 4.0	600 - 800	AS20

HEXA2MILL - TFM55AHNS using HNM(C)X 05, HNCX-W inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Gray cast iron	190 - 220	180 - 350	TT6080
Nodular cast iron	140 - 190	150 - 280	TT6080
Nodular cast iron	190 - 280	130 - 250	TT6080
Low carbon steel	85 - 175	150 - 300	TT9080
High carbon steel	175 - 225	130 - 230	TT9080
Alloy steel	275 - 325	120 - 200	TT9080
Stainless 400 series	-	100 - 180	TT9080
Gray / Nodular cast iron	140 - 200	400 - 800	AS10

• Reduce speed by 20% when channel milling • In order of preference, uncoated carbide reduce speed 20%

HEXA2MILL - TFM45HN, TFM45HNS,TQ45HN using HNHX 10 insert

Material	Hardness (HB)	Speed (m/min)	Best grades
Gray cast iron	190 - 220	150 - 350	TT6080
Nodular cast iron	140 - 190	130 - 280	TT6080
Nodular cast iron	190 - 280	130 - 250	TT6080
Low carbon steel	85 - 175	150 - 300	TT9080
High carbon steel	175 - 225	130 - 230	TT9080
Alloy steel	275 - 325	120 - 200	TT9080
Gray / Nodular cast iron	140 - 220	400 - 800	AS10

• Reduce speed by 20% when channel milling • In order of preference, uncoated carbide reduce speed 20%

HEXA2MILL - TFM15HNS using HNHX 10-M insert

Material	Hardness (HB)	Speed (m/min)	Best grades
Gray cast iron	190 - 220	150 - 350	TT6080
Nodular cast iron	140 - 190	130 - 280	TT6080
Nodular cast iron	190 - 280	130 - 250	TT6080
Low carbon steel	85 - 175	150 - 300	TT9080
High carbon steel	175 - 225	130 - 230	TT9080
Alloy steel	275 - 325	120 - 200	TT9080

• Reduce speed by 20% when channel milling • In order of preference, uncoated carbide reduce speed 20%

Recommended Cutting Condition

CHASE2HEPTA - 14D-F45XN using XNMU 06, XNHU 06 inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Gray cast iron	190 - 220	150 - 380	TT6080
Nodular cast iron	140 - 190	130 - 300	TT6080
Nodular cast iron	190 - 280	130 - 270	TT6080
Low carbon steel	85 - 175	150 - 300	TT9080
High carbon steel	175 - 225	130 - 250	TT9080
Alloy steel	275 - 325	120 - 200	TT9080

CHASE2HEPTA - 14D-F45XN, 14D-F45XNW using XNMU,XNHU 09 inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Gray cast iron	190 - 220	150 - 380	TT6080
Nodular cast iron	140 - 190	130 - 300	TT6080
Nodular cast iron	190 - 280	130 - 270	TT6080
Low carbon steel	85 - 175	150 - 300	TT9080
High carbon steel	175 - 225	130 - 250	TT9080
Alloy steel	275 - 325	120 - 200	TT9080
Gray / Nodular cast iron	140 - 220	400 - 800	AS10

- Reduce speed by 20% when channel milling
- In order of preference, uncoated carbide reduce speed 20%

CHASEOCTO - TFM43OFS, TFM43ZOFW

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	180 - 300	TT7080
High carbon steel	175 - 225	130 - 280	TT7080
Alloy steel	275 - 325	120 - 250	TT7080
Tool steel	-	80 - 200	TT7080
Stainless 300 series	-	80 - 170	TT8080
Stainless 400 series	-	100 - 210	TT9080
High temp. super alloy	-	30 - 100	TT8080
Titanium alloy	-	30 - 80	TT8080
Gray cast iron	190 - 220	150 - 400	TT6800
Nodular cast iron	140 - 200	100 - 250	TT6080
Aluminum	-	500 -	K10

- Reduce speed by 20% when channel milling
- In order of preference, uncoated carbide reduce speed 20%

LIONMILL - LM60SC using SCKN 21 insert

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	120 - 250	TT7800
High carbon steel	175 - 225	100 - 200	TT7800
Alloy steel	275 - 325	80 - 160	TT7800
Stainless steel	-	90 - 170	TT7080
Cast iron	14 - 220	80 - 180	TT6800

- Reduce speed by 20% when channel milling

Recommended Cutting Condition

LIONMILL - LM60SC using SCKN 27 insert

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	100 - 230	TT7800
High carbon steel	175 - 225	90 - 180	TT7800
Alloy steel	275 - 325	70 - 150	TT7800
Stainless steel	-	80 - 160	TT7080
Cast iron	14 - 220	70 - 170	TT7800

• Reduce speed by 20% when channel milling

LIONMILL - LM90SE cutter using SEKX 21 insert

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	100 - 230	TT7800
High carbon steel	175 - 225	90 - 180	TT7800
Alloy steel	275 - 325	70 - 150	TT7800
Cast iron	14 - 220	70 - 170	TT6080

LIONMILL - LM75SP using SPKN 12, SPKN 15 inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	180 - 300	TT7080
High carbon steel	175 - 225	130 - 280	TT7080
Alloy steel	275 - 325	120 - 250	TT7080
Tool steel	-	80 - 200	TT7080
Stainless 300 series	-	80 - 170	TT8020
Stainless 400 series	-	100 - 210	TT8020
High temp. super alloy	-	30 - 100	TT8020
Titanium alloy	-	30 - 80	TT8020
Gray cast iron	190 - 220	150 - 400	TT6080
Nodular cast iron	140 - 200	100 - 250	TT6080

• Reduce speed by 20% when channel milling

LIONMILL - LM45SD, LM45SE using SDKN, SEKN inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	180 - 300	TT7080
High carbon steel	175 - 225	130 - 280	TT7080
Alloy steel	275 - 325	120 - 250	TT7080
Tool steel	-	80 - 200	TT7080

• Reduce speed by 20% when channel milling

Recommended Cutting Condition

LIONMILL - LM90TP using TPKN 22 insert

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	180 - 300	TT7080
High carbon steel	175 - 225	130 - 280	TT7080
Alloy steel	275 - 325	120 - 250	TT7080
Tool steel	-	80 - 200	TT7080
Stainless 300 series	-	80 - 170	TT8020
Stainless 400 series	-	100 - 210	TT8020
High temp. super alloy	-	30 - 100	TT8020
Titanium alloy	-	30 - 80	TT8020
Gray cast iron	190 - 220	150 - 400	TT6080
Nodular cast iron	140 - 200	100 - 250	TT6080

- Reduce speed by 20% when channel milling

FINEBALL - NFB & NFR inserts

Material	Hardness (HB)	Max Axial D.O.C.(mm)	Speed (m/min)	Best grades	Feed (mm/tooth)						
					D8	D10	D12	D16	D20	D25	D30(32)
High carbon steel/Alloy steel	180-280	≤0.03D	180-270	TT5515	0.15	0.20	0.20	0.25	0.25	0.30	0.35
Prehardened steel	400-480	≤0.03D	150-250	TT2510	0.15	0.15	0.20	0.20	0.25	0.25	0.30
High Hardened steel	480-830	≤0.02D	100-230	TT2510	0.08	0.08	0.10	0.125	0.15	0.20	0.25
Stainless steel	135-200	≤0.035D	100-250	TT5525	0.10	0.15	0.20	0.20	0.25	0.25	0.30
High temp. super alloy	-	≤0.03D	30-100	TT5525	0.08	0.08	0.10	0.12	0.15	0.18	0.20
Titanium alloy	-	≤0.03D	30-80	TT5525	0.08	0.08	0.10	0.12	0.15	0.18	0.20
Cast iron	140-220	≤0.05D	150-400	TT2510	0.20	0.20	0.25	0.30	0.30	0.35	0.40

- Recommended cutting conditions are just for reference in general machining.
- For carbide shank the feed rate & D.O.C. can be increased 20 - 30% compared to steel shank.

DUETBALL - 2F using 2FB insert

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	200 - 350	TT9080
High carbon steel	175 - 225	180 - 320	TT9080
Alloy steel	275 - 325	120 - 250	TT9080
Tool steel	200 - 250	100 - 200	TT9080
Stainless 300 series	-	180 - 280	TT8020
Stainless 400 series	-	200 - 300	TT8020
High temp. Super alloy	-	20 - 80	TT8020
Titanium alloy	-	40 - 110	TT9080
Gray cast iron	190 - 220	240 - 380	TT9080
Nodular cast iron	140 - 200	180 - 280	TT9080

Recommended Cutting Condition

TRIOBALL - 3F using 3FB...P-M, 3FB...C-M inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	180 - 300	TT9080
High carbon steel	175 - 225	130 - 280	TT9080
Alloy steel	275 - 375	120 - 250	TT9080
Alloy steel	375 - 480	60 - 140	TT9080
Tool steel	250 - 470	50 - 200	TT9080
Tool steel	480 -	50 - 110	TT9080
Stainless steel	-	80 - 210	TT8080
High temp. super alloy	-	30 - 100	TT8080
Titanium alloy	-	30 - 80	TT8080
Cast iron	140 - 220	150 - 400	TT9080

CHASE2BALL - TDB50X using 6RBE 50-M insert

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	200 - 350	TT9080
High carbon steel	175 - 225	180 - 320	TT9080
Alloy steel	275 - 325	120 - 250	TT9080
Tool steel	200 - 250	100 - 200	TT9080
Stainless 300 series		180 - 280	TT8020
Stainless 400 series		200 - 300	TT8020
High temp. super alloy		20 - 80	TT8020
Titanium alloy		40 - 110	TT8020
Gray cast iron	190-220	240 - 380	TT6080
Nodular cast iron	140-220	180 - 280	TT6080

Operating guidelines for TOPSLOT- TSM using SLOT insert

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	150 - 300	TT9080
High carbon steel	175 - 225	130 - 280	TT9080
Alloy steel	275 - 325	120 - 250	TT9080
Tool steel	-	80 - 200	TT9080
Stainless 300 series	-	80 - 170	TT8080
Stainless 400 series	-	100 - 210	TT9080
High temp. super alloy	-	30 - 100	TT8080
Inconel	-	20 - 60	TT8080
Titanium alloy	-	30 - 80	TT8080
Gray cast iron	190 - 220	150 - 400	TT6080
Nodular cast iron	140 - 200	100 - 250	TT6080

Recommended Cutting Condition

Operating guidelines for TOPSLOT - TSM using ZNHT and ZNHU inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	180 - 300	TT7080
High carbon steel	175 - 225	130 - 280	TT7800
Alloy steel	275 - 325	120 - 250	TT9080
Tool steel	-	80 - 200	TT7080
Stainless 300 series	-	80 - 170	TT8080
Stainless 400 series	-	100 - 210	TT9080
High temp. super alloy	-	30 - 100	TT8080
Titanium alloy	-	30 - 80	TT8080
Gray cast iron	190 - 220	150 - 400	TT6080
Nodular cast iron	140 - 200	100 - 250	TT6080
Aluminum	-	500 -	K10

Operating guidelines for TOPSLOT- TSM using TS16 inserts

Material	Hardness (HB)	Speed (m/min)	Best grades
Low carbon steel	85 - 175	180-300	TT9030
High carbon steel	175 - 225	150-280	TT9030
Alloy steel	275 - 325	140-250	TT9030
Tool steel	-	100-200	TT9030
Stainless 300 series	-	100-170	TT9030
Stainless 400 series	-	120-210	TT9030
High temp. super alloy	-	40-100	TT9030
Titanium alloy	-	20-60	TT9030
Gray cast iron	-	40-80	TT9030
Nodular cast iron	190 - 220	180-400	TT9030
Aluminum	140 - 200	120-250	TT9030

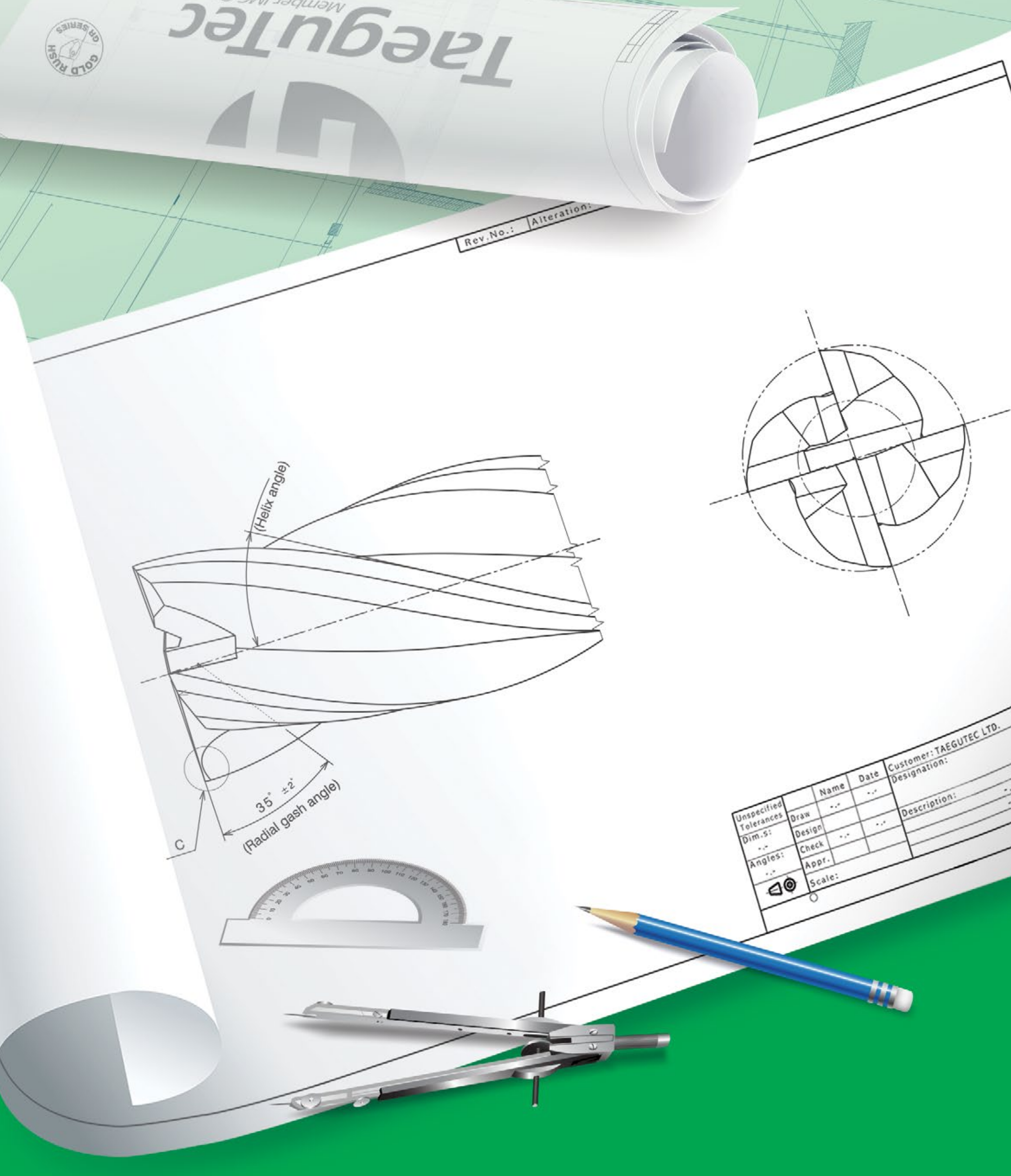
Operating guidelines for TSC slotting cutters

Material		Hardness (HB)	Speed (m/min)	Best grades
Carbon steel	0.2%C	150	171 - 232	TT8020
	0.45%C	190	120 - 201	TT8020
	0.83%C	250	90 - 171	TT8020
Alloy steel		up to 200	120 - 181	TT8020
		200 - 250	101 - 161	TT8020
		275 - 325	81 - 131	TT8020
		325 - 375	70 - 111	TT8020
		375 - 425	55 - 96	TT8020
		425 - 475	46 - 81	TT8020
Stainless steel	Ferritic	135 - 175	171 - 221	TT8020
		175 - 225	131 - 201	TT8020
	Martensitic	275 - 325	101 - 151	TT8020
		375 - 425	46 - 70	TT8020
	Austenitic	135 - 175	101 - 151	TT8020
Cast iron	Carbon	up to 150	90 - 161	TT8020
		150 - 200	76 - 131	TT8020
	Alloyed	200 - 250	61 - 110	TT8020
		250 - 300	46 - 81	TT8020

Recommended Cutting Condition

Operating guidelines for TSC slotting cutters

Material		Hardness (HB)	Speed (m/min)	Best grades
Malleable iron	Ferritic Pearlitic	110 - 145 200 - 250	80 - 110 70 - 96	K10 K10
Cast iron, Low tensile, grey		180	110 - 140	K10
Cast iron, high tensile, grey, alloy		250	70 - 100	K10
Nodular iron	Ferritic Pearlitic	160 250	70 - 110 55 - 80	K10 K10
Chilled cast iron		400	10 - 20	K10
Nickel base alloys Inconel 600 Hastelloy C		175 - 225	15 - 37	K10
Titanium alloys 6AL4V		300 - 350	27 - 55	K10
Wrought aluminum 2024, 6061, 7075		30 - 80	380 - 777	K10
Cast aluminum 308, 356,380		50 - 100	305 - 625	K10



TECHNICAL GUIDE

-Solid End Mills

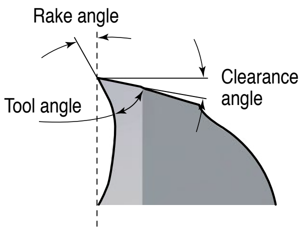
Contents

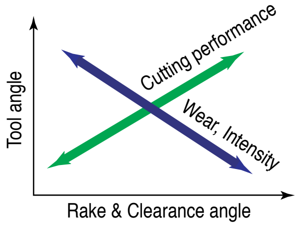
Technical Guide

Selection of grade by materials

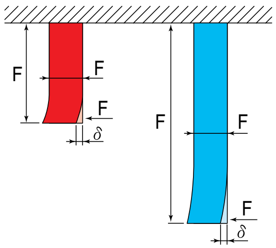
Materials	Applications grade of end mill
Hardened steels (Hardness<65 HRC)	TT5505
Pre-hardened steels, Alloy steels, Carbon steels (Hardness<55 HRC) Stainless steels, Ti-alloy, Super alloy	TT5515 / TT5525
Non ferrous material (Al-alloy, Cu-alloy)	TT9020, UF10N, UF10
Graphite and CFRP	TT6050

Feature of cutting angle





Effect of cutting length

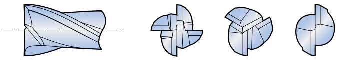


It is necessary to keep the tool overhang to the minimum possible.
Rigidity can vary along the cutter length or the length of cut by a factor of three.
The shorter the overhang, the better the rigidity and smaller the deflection.

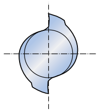
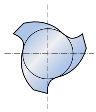
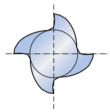
$$\delta = \frac{P \cdot L^3}{3 \cdot E \cdot I}$$

δ : Deflection of end mill
P : Cutting resistance
L : Overhang
E : Modulus of elasticity
I : Moment of inertia

Features of end mills type

Type	Shape	Feature
Square type without center hole		Used for general machining including - slotting, side-milling, boring, plunging
Square type with center hole		Used for general machining including - slotting, side-milling, boring
Square type with corner radius		Used for high speed milling and radius milling
Ball type		Used for contour or copy milling

Number of flutes and section area (based on Ø10)

No. of cutting edges	2	3	4
Section shape			
Core diameter	60%	60%	60%
Cross section mass	$42mm^2$	$44mm^2$	$47mm^2$
Section ratio	53.50%	56%	60%

■ 2 flute design
- Large chip gullet
- Easy chip evacuation
- Recommended for slot milling applications
- Strong design for heavy duty milling applications

■ 3 flute design
- Large section area - better rigidity than 2 flute cutters
- 3 flutes provide high quality surface finish

■ 4 flute design
- 4 flute and multi flute cutters provide highest rigidity
- Provides high quality surface finish
- Recommended for profiling, side milling and shallow slotting

Technical Guide

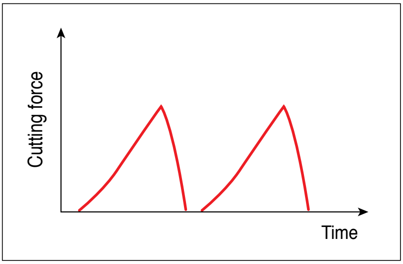
Helix angle effects

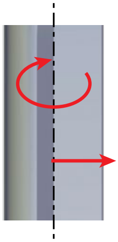
Helix angle	Cutting torque	Bending force	Surface finish	Rake wear	Relief wear	Breakage
Low	↓	↓	↓	↑	↑	↓
High	↑	↑	↑	↓	↓	↑

Helix angle

Advantage of helix flute : Increase feed rate and depth of cut by low feed force

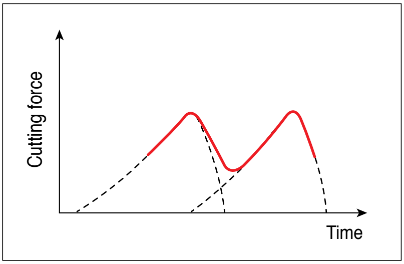
■ Straight flute

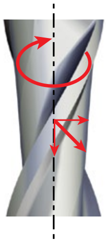




- High fluctuate of cutting force
- Interrupted machining

■ Helix flute

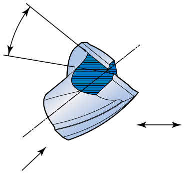
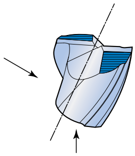
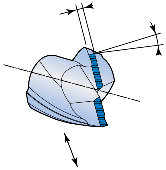




- Low fluctuate of cutting force

Technical Guide

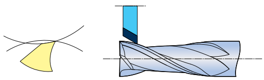
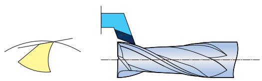
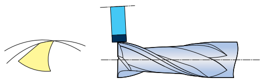
Regrinding of end teeth

Gash	2nd relief	1st relief
		
• Use plain wheel • Gash angle: 30 - 45º	• Use cup wheel • Relief angle: 15 - 25º	• Use cup wheel • Relief angle: 6 - 15º • Width: 0.5 - 2mm

Evaluation reference for regrinding

Application	Dia. of end mill (mm)	Max. flank wear
Finishing	- Ø10 Ø11 - Ø30 Ø31 - Ø50	0.05 - 0.10 0.10 - 0.25 0.20 - 0.35
Roughing	- Ø10 Ø11 - Ø30 Ø31 - Ø50	0.08 - 0.15 0.15 - 0.35 0.30 - 0.45

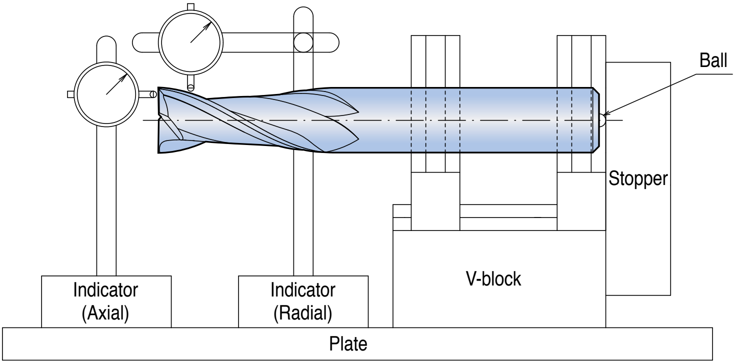
Regrinding of peripheral relief angle

Concave	Flat	Eccentric
		
• For precise outer diameter of end mill • Use flat wheel	• Good machinability • 2nd relief angle required • For taper of ball end mill	• Reliable cutting edge & excellent surface finish • Recommended method

▶ Inspection of cutter run-outs & surface roughness

Solid carbide cutters perform best when the cutting edge of each tooth runs true with the cutter axis.
When each tooth runs true the work load will be shared and this will optimize performance.
Radial and axial run out should be checked using a DTI after each regrind.
Put the cutter in a V-block and measure both the peripheral and end tooth run out,
also ensure that the cutter is rotated so that each tooth is checked in several positions.
If the cutter has centre holes, these can be used to check the cutter between centres.
Please refer to the tables on each page of this catalogue for tolerances and permissible run out.

Use a "Profilemeter" to check ground surface finish - maximum surface roughness permissible is Rmax6.3. Rough or uneven surface finish of a ground cutter can effect the surface finish of the workpiece and cause premature failure and chipping of the helical cutting edge.



Parameters for end mill operation

Factor	Instruction and advice
Rigidity of machine	• Use a rigid machine whenever possible • If rigidity is poor - adjust cutting conditions accordingly
Chuck and end mill run-out	• Use rigid and high quality chucking system • Check and minimise end mill run-out
Workpiece clamping	• Ensure workpiece is firmly and securely clamped • If this cannot be achieved or if vibrations occur - reduce cutting conditions accordingly
Cutting fluid and chip evacuation	• Maximise coolant flow whenever possible • Always use flood coolant for heavy roughing applications • Please refer to manual for (dry machining conditions - HSM applications) - on hardened steels • Use "air blow" for HSM applications • Always ensure good evacuation of chips from the working area
End mill selection	• Please ensure the correct cutter is selected - see technical data for detailed information and selection of correct cutter for task, application and material to be machined • Refer to page 115 for more details
Cutting conditions	• Please refer to recommended cutting condition data in this catalogue • The recommended cutting conditions always refer to optimum conditions - if machine rigidity or work piece clamping is not ideal - these cutting conditions should be altered accordingly
Overhang of end mill from spindle nose	• Always minimise the cutter overhang to the minimum possible • If cutter overhang cannot be reduced - cutting conditions should be altered accordingly

▶ Actual diameter of ball nose end mill

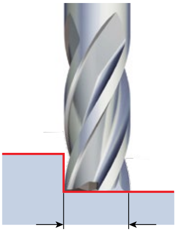
Diameter		Depth of cut (Ad, mm)						
Radius	Dia	0.01	0.02	0.03	0.04	0.05	0.08	0.1
0.1	0.2	0.087	0.12	0.143	0.16	0.173	0.196	0.2
0.2	0.4	0.125	0.174	0.211	0.24	0.265	0.32	0.35
0.3	0.6	0.154	0.215	0.262	0.299	0.332	0.41	0.45
0.4	0.8	0.178	0.25	0.304	0.349	0.387	0.48	0.53
0.5	1	0.199	0.28	0.341	0.392	0.436	0.54	0.6
1	2	0.282	0.398	0.486	0.56	0.624	0.78	0.87
1.5	3	0.346	0.488	0.597	0.688	0.768	0.97	1.08
2	4	0.399	0.564	0.69	0.796	0.889	1.12	1.25
2.5	5	0.447	0.631	0.722	0.891	0.995	1.25	1.4
3	6	0.489	0.692	0.846	0.977	1.091	1.38	1.54
4	8	0.565	0.799	0.978	1.129	1.261	1.59	1.78
5	10	0.632	0.894	1.094	1.262	1.411	1.78	1.99
6	12	0.693	0.979	1.198	1.383	1.546	1.95	2.18
7	14	0.748	1.058	1.295	1.495	1.67	2.11	2.36
8	16	0.8	1.131	1.384	1.598	1.786	2.26	2.52
9	18	0.848	1.199	1.468	1.695	1.895	2.39	2.68
10	20	0.894	1.264	1.548	1.787	1.997	2.52	2.82

Diameter		Depth of cut (Ad, mm)							
Radius	Dia	0.15	0.2	0.3	0.5	0.8	1	2	3
0.1	0.2								
0.2	0.4	0.39	0.4						
0.3	0.6	0.52	0.57	0.6					
0.4	0.8	0.62	0.69	0.77					
0.5	1	0.71	0.8	0.92	1				
1	2	1.05	1.2	1.43	1.73	1.96	2		
1.5	3	1.31	1.5	1.8	2.24	2.65	2.83		
2	4	1.52	1.74	2.11	2.65	3.2	3.46	4	
2.5	5	1.71	1.96	2.37	3	3.67	4	4.9	
3	6	1.87	2.15	2.62	3.32	4.08	4.47	5.66	6
4	8	2.17	2.5	3.04	3.87	4.8	5.29	6.93	7.75
5	10	2.43	2.8	3.41	4.36	5.43	6	8	9.17
6	12	2.67	3.07	3.75	4.8	5.99	6.63	8.94	10.39
7	14	2.88	3.32	4.05	5.2	6.5	7.21	9.8	11.49
8	16	3.08	3.56	4.34	5.57	6.97	7.75	10.58	12.49
9	18	3.27	3.77	4.61	5.92	7.42	8.25	11.31	13.42
10	20	3.45	3.98	4.86	6.24	7.84	8.72	12	14.28

Technical Guide

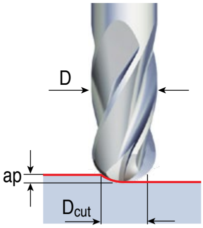
▶ Calculation of actual diameter

▪ Flat end mill



D_{cut} = Diameter

▪ Ball end mill



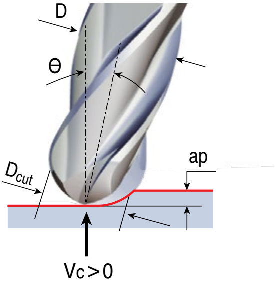
$D_{cut} \neq$ Diameter

$$D_{cut} = 2 \times \sqrt{Ap \times (D-Ap)}$$

▪ Calculation of actual diameter by the tool in clined

- This machining more efficient by eliminating cutting at nearly zero speed
- Tool life improves and better chip evacuation
- Excellent surface finish

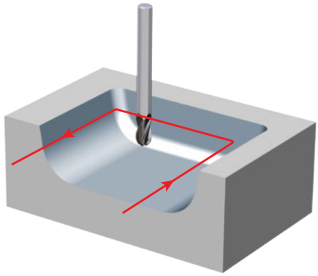
$$D_{cut} = D \times \mathrm{Sin}[\Theta \pm \mathrm{COS}^{-1}(D-2Ap/D)]$$



▶ Operating recommendations

▪ Contour milling

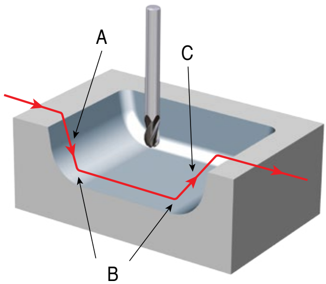
Recommended method
- Controlled easily by a continuous cut
- Enables milling with high speed(HSM) and feed
- Longer tool life
- Higher productivity
- Increased security



▪ Copy milling

Conventional method
- Increased cutting force(Specially point B)
- Decrease feed
- short tool life
- High productivity

Point A: poor chip evacuation
Point B: May cause chipping and vibration
Pojnt C: Increased contact area



Trouble Shooting

Problem	Cause	Solution
Chipping	- Sharp cutting edge	- Chamfer or round the cutting edge to reduce sharp edge
	- Chatter/Vibration	- Reduce RPM
	- Low cutting speed	- Increase RPM - or change to a high helix end mill
	- Excessive overhang	- Reduce tool overhang to minimum possible
	- Unreliable chucking of end mill	- Check run out and change to a more precise system
	- Unstable workpiece	- Try to improve stability and clamping or reduce cutting conditions
Wear	- High cutting speeds	- Check the cutting data - and select the recommended conditions
	- Low feedrate	- Check the cutting data - and select the recommended conditions
	- Incorrect helix on end mill	- Check the recommended cutter for the material being machined
	- Up milling	- Change to Down Mill machining
	- Hard material	- Replace end mill with correct style as recommended or change to TiAlN coated cutter
	- Poor chip evacuation	- Use air-blast or flood coolant to remove chips or replace cutter with a lower number of flutes.
	- Material with low heat conductivity - Too small primary relief angle	- Increase feedrate - use a sharp edged end mill - Change to large relief angle
Tool breakage	- Excessive chipping or wear	- Regrind cutter or replace
	- Excessive feedrate	- Reduce feedrate to recommended conditions
	- Excessive cutting forces	- Check conditions - reduce/increase RPM or feed to the recommended conditions
	- Excessive overhang	- Reduce to minimum possible
Surface finish	- Chatter	- Check recommended data and change cutting conditions
	- Built-up edge	- Increase speed - use higher helix cutter or climb mill and apply flood coolant
	- Tool wear	- Regrind or replace cutter
	- High feed - low speed	- Reduce feedrate and increase RPM to recommended conditions
Accuracy of finished workpiece	- Cutting condition	- Start with the recommended cutting conditions
	- Excessive feedrate	- Reduce as required to achieve the required surface finish and part accuracy
	- Number of flutes	- Replace high flute number end mill
	- Tool deflection	- Use large diameter and short fluted tool and minimize overhang
	- Poor rigidity	- Change machine holder or cutting conditions
Burrs	- Too much wear on primary relief	- Regrind at earlier stage
	- Incorrect conditions	- Correct milling conditions
	- Improper cutting angle	- Change to correct cutting angle

▶ HSB 2

RPM: rev/min, Feed: mm/min
ap = Axial depth, Pf = Pick feed

				Pre-hardened steels		Hardened steels			
				HRC 35 - HRC 45		HRC 45 - HRC 55		HRC 55 - HRC 65	
D	Neck length	D.O.C(mm) ap	D.O.C(mm) Pf	RPM	Feed	RPM	Feed	RPM	Feed
0.3	1	0.010	0.015	32000	320	28800	288	27200	224
	2	0.006	0.010	32000	280	28800	252	27200	196
	3	0.005	0.007	29000	230	26100	207	24650	161
0.4	1	0.030	0.090	28000	800	25200	720	23800	560
	1.5	0.025	0.075	28000	720	25200	648	23800	504
	2	0.020	0.060	28000	640	25200	576	23800	448
	2.5	0.014	0.042	22400	560	20160	504	19040	392
	3	0.011	0.033	22400	480	20160	432	19040	336
	4	0.007	0.021	17920	400	16128	360	15232	280
0.5	1	0.035	0.105	22300	780	20070	702	18955	546
	1.5	0.032	0.096	22300	702	20070	632	18955	491
	2	0.028	0.084	22300	702	20070	632	18955	491
	2.5	0.025	0.075	17840	562	16056	505	15164	393
	3	0.022	0.066	14272	562	12845	505	12131	393
	4	0.018	0.054	11418	449	10276	404	9705	314
	5	0.014	0.042	11418	449	10276	404	9705	314
	6	0.012	0.036	11418	359	10276	323	9705	252
	7	0.009	0.027	9134	312	14200	380	13400	290
	8	0.007	0.021	11418	370	14200	330	13400	260
0.6	2	0.035	0.105	31800	1200	28600	1080	27000	840
	3	0.028	0.084	25400	960	22800	860	21600	670
	4	0.024	0.072	25400	900	22800	810	21600	630
	5	0.018	0.054	21080	720	19000	650	18000	500
	6	0.013	0.039	21080	660	19000	590	18000	460
	8	0.010	0.030	17900	540	16100	490	15200	380
	10	0.008	0.024	17900	480	16100	430	15200	340
0.8	2	0.060	0.180	27800	1390	25000	1250	23600	970
	3	0.053	0.159	23600	1100	21200	990	20000	770
	4	0.048	0.144	23600	1040	21200	940	20000	730
	5	0.040	0.120	20000	830	18000	750	17000	580
	6	0.035	0.105	20000	760	18000	680	17000	530
	8	0.028	0.084	17500	630	15700	570	14900	440
	10	0.020	0.060	17500	560	15700	500	14900	390
	12	0.016	0.048	15400	490	13800	440	13100	340

▶ HSB 2

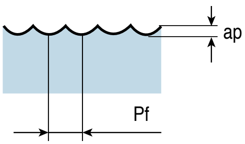
RPM: rev/min, Feed: mm/min
ap = Axial depth, Pf = Pick feed

				Pre-hardened steels		Hardened steels			
				HRC 35 - HRC 45		HRC 45 - HRC 55		HRC 55 - HRC 65	
D	Neck length	D.O.C(mm) ap	D.O.C(mm) Pf	RPM	Feed	RPM	Feed	RPM	Feed
1	3	0.070	0.210	25500	1650	22900	1490	21700	1160
	4	0.058	0.174	21700	1400	19500	1260	18500	980
	5	0.049	0.147	21700	1320	19500	1190	18500	920
	6	0.040	0.120	19100	1160	17200	1040	16200	810
	7	0.040	0.120	19100	1070	17200	960	16200	750
	8	0.035	0.105	16700	990	15000	890	14200	690
	9	0.035	0.105	16700	960	15000	860	14200	670
	10	0.022	0.066	16700	910	15000	820	14200	640
	12	0.016	0.048	14900	820	13400	740	12700	570
	14	0.010	0.030	14900	820	13400	740	12700	570
	16	0.008	0.024	13000	660	11700	590	11000	460
	18	0.008	0.024	13000	580	11700	520	11000	400
	20	0.006	0.018	13000	580	11700	520	11000	400
1.2	4	0.080	0.240	23800	1780	21400	1600	20200	1250
	6	0.055	0.165	20700	1420	18600	1280	17600	990
	8	0.046	0.138	20700	1330	18600	1200	17600	930
	10	0.037	0.111	17600	1150	15800	1040	15000	800
	12	0.030	0.090	17600	920	15800	830	15000	640
1.5	4	0.080	0.240	19100	1910	17200	1720	16200	1330
	6	0.060	0.180	17200	1430	15500	1290	14600	1000
	8	0.050	0.150	17200	1140	15500	1030	14600	800
	10	0.045	0.135	15000	1340	13500	1200	12800	940
	12	0.040	0.120	15000	1150	13500	1000	12800	800
	14	0.034	0.102	12800	960	11500	860	10900	670
	16	0.026	0.078	12800	860	11500	770	10900	600
	18	0.019	0.057	11200	760	10100	680	9500	530
	20	0.010	0.030	11200	570	10100	510	9500	400
2	6	0.140	0.420	16000	1920	14400	1720	13600	1340
	8	0.110	0.330	16000	1920	14400	1720	13600	1340
	10	0.090	0.270	13900	1440	12500	1300	11800	1000
	12	0.065	0.195	13900	1440	12500	1300	11800	1000
	14	0.065	0.195	12100	1340	10900	1200	10300	940
	16	0.058	0.174	12100	1250	10900	1120	10300	880
	18	0.050	0.150	10600	1050	9500	950	9000	740
	20	0.042	0.126	10600	1050	9500	950	9000	740
	25	0.035	0.105	9300	860	8400	770	7900	600
	30	0.027	0.081	9300	860	8400	770	7900	600
2.5	8	0.200	0.600	15200	2130	13700	1910	12900	1490
	10	0.140	0.420	15200	2130	13700	1910	12900	1490
	12	0.100	0.300	13200	1600	11900	1440	11200	1120
	16	0.085	0.255	13200	1600	11900	1440	11200	1120
	20	0.065	0.195	11500	1380	10400	1240	9800	970

▶ HSB 2

RPM: rev/min, Feed: mm/min
ap = Axial depth, Pf = Pick feed

				Pre-hardened steels		Hardened steels			
				HRC 35 - HRC 45		HRC 45 - HRC 55		HRC 55 - HRC 65	
D	Neck length	D.O.C(mm) ap	D.O.C(mm) Pf	RPM	Feed	RPM	Feed	RPM	Feed
3	8	0.250	0.625	15900	2220	14300	2000	13500	1550
	10	0.200	0.500	15900	2220	14300	2000	13500	1550
	12	0.160	0.400	13800	1660	12400	1490	11700	1160
	14	0.160	0.400	13800	1660	12400	1490	11700	1160
	16	0.110	0.275	12400	1440	11200	1300	10600	1000
	18	0.095	0.238	12400	1440	11200	1300	10600	1000
	20	0.080	0.200	11200	1220	10000	1100	9500	850
	25	0.066	0.165	11200	1220	10000	1100	9500	850
	30	0.050	0.125	10000	1100	9000	990	8500	770
	35	0.044	0.110	10000	1100	9000	990	8500	770
	40	0.034	0.085	9000	950	8100	850	7700	660
4	10	0.300	0.750	14000	2380	12600	2140	11900	1660
	12	0.240	0.600	14000	2380	12600	2140	11900	1660
	16	0.180	0.450	12600	1890	11400	1700	10700	1320
	20	0.130	0.325	12600	1890	11400	1700	10700	1320
	25	0.100	0.250	11300	1470	10200	1320	9600	1030
	30	0.080	0.200	11300	1470	10200	1320	9600	1030
	35	0.064	0.160	10200	1120	9200	1000	8700	780
	40	0.055	0.138	10200	1120	9200	1000	8700	780
5	12	0.380	0.950	12700	2410	11400	2170	10800	1690
	30	0.120	0.300	11400	1820	10300	1640	9700	1270
6	15	0.450	1.125	12000	2400	10800	2160	10200	1680
	20	0.240	0.600	12000	2400	10800	2160	10200	1680
	30	0.160	0.400	11000	1980	9900	1780	9400	1380
	35	0.100	0.250	11000	1980	9900	1780	9350	1760
8	15	0.600	1.500	10500	2520	9500	2270	8900	1760
	20	0.450	1.125	10500	2520	9500	2270	8900	1760
	30	0.370	0.925	9500	2090	8600	1880	8100	1460
10	20	0.750	1.875	9500	2660	8600	2390	8100	1860
	25	0.600	1.500	9500	2660	8600	2390	8100	1860
	35	0.400	1.000	8500	2120	7600	1900	7200	1480
12	25	0.900	2.250	8000	2720	7200	2450	6800	1900
	40	0.650	1.625	8000	2720	7200	2450	6800	1900

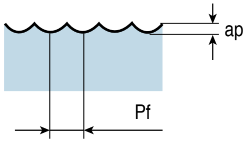


- These recommended cutting conditions indicate just reference.
- In actual machining, the condition should be adjusted according to milling shape, purpose and the machine type.
- Use the appropriate coolant for the work material and machining shape.
  (Recommend to use oil mist coolant for machining hardened steel.)
- Reduce both spindle speed and feed at same rate for chattering.

▶ HSB 4

RPM: rev/min, Feed: mm/min
ap = Axial depth, Pf = Pick feed

			Pre-hardened steels		Hardened steels			
			HRC 35 - HRC 45		HRC 45 - HRC 55		HRC 55 - HRC 65	
D	D.O.C(mm)		RPM	Feed	RPM	Feed	RPM	Feed
	ap	Pf						
4	0.300	0.750	14000	3570	12600	3213	11900	2499
5	0.380	0.950	12700	3615	11400	3254	10800	2531
6	0.450	1.125	12000	3600	10800	3240	10200	2520
8	0.450	1.125	10500	3780	9500	3402	8900	2646
10	0.600	1.500	9500	3990	8600	3591	8100	2793
12	0.900	2.250	8000	4080	7200	3672	6800	2856



- These recommended cutting conditions indicate just reference.
- In actual machining, the condition should be adjusted according to milling shape, purpose and the machine type.
- Use the appropriate coolant for the work material and machining shape.
  (Recommend to use oil mist coolant for machining hardened steel.)
- Reduce both spindle speed and feed at same rate for chattering.

▶ HSF 2 / HSR 2

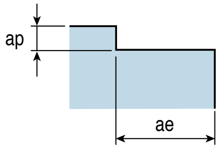
RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Workpiece materials		Pre-hardened steels				Hardened steels							
		HRC 35 - HRC 45				HRC 45 - HRC 55				HRC 55 - HRC 65			
D	Neck length	RPM	Feed	D.O.C(mm) ap	D.O.C(mm) ae	RPM	Feed	D.O.C(mm) ap	D.O.C(mm) ae	RPM	Feed	D.O.C(mm) ap	D.O.C(mm) ae
0.3	1	31847	382	0.008	0.12	28662	287	0.004	0.09	25478	229	0.004	0.07
	2	27070	268	0.006		24363	201	0.003		21656	161	0.003	
	3	23885	229	0.004		21497	172	0.002		19108	138	0.002	
0.4	1	31847	637	0.016	0.2	28662	478	0.008	0.12	25478	382	0.008	0.08
	1.5	29459	573	0.014		26513	430	0.007		23567	344	0.007	
	2.5	27070	446	0.012		24363	334	0.006		21656	268	0.006	
	3	24522	382	0.010		22070	287	0.005		19618	229	0.005	
	4	19586	318	0.007		17627	239	0.004		15669	191	0.004	
0.5	1	31847	637	0.016	0.25	28662	478	0.008	0.15	25478	382	0.008	0.1
	1.5	29459	573	0.014		26513	430	0.007		23567	344	0.007	
	2.5	27070	446	0.012		24363	334	0.006		21656	268	0.006	
	3	24522	382	0.010		22070	287	0.005		19618	229	0.005	
	4	19586	318	0.007		17627	239	0.004		15669	191	0.004	
0.6	2	31847	828	0.016	0.3	28662	621	0.008	0.18	25478	497	0.008	0.12
	4	22293	538	0.013		20064	404	0.007		17834	323	0.007	
	6	19108	414	0.010		17197	311	0.005		15287	248	0.005	
0.8	2	31847	955	0.016	0.4	28662	717	0.008	0.24	25478	573	0.008	0.16
	4	23885	621	0.013		21497	466	0.007		19108	373	0.007	
	6	22293	478	0.010		20064	358	0.005		17834	287	0.005	
	8	20701	382	0.008		18631	287	0.004		16561	229	0.004	
1	3	31847	1274	0.015	0.5	28662	955	0.008	0.3	25478	764	0.008	0.2
	4	27070	892	0.013		24363	669	0.007		21656	535	0.007	
	6	25000	764	0.010		22500	573	0.005		20000	459	0.005	
	8	22293	637	0.008		20064	478	0.004		17834	382	0.004	
	10	20701	510	0.006		18631	382	0.003		16561	306	0.003	
1.2	4	26539	1062	0.030	0.6	23885	796	0.015	0.36	21231	637	0.015	0.24
	6	23885	743	0.020		21497	557	0.010		19108	446	0.010	
	8	22558	637	0.010		20303	478	0.005		18047	382	0.005	
	10	19904	531	0.008		17914	398	0.004		15924	318	0.004	
1.5	4	23355	1168	0.035	0.75	21019	876	0.018	0.45	18684	701	0.018	0.3
	6	21019	876	0.030		18917	657	0.015		16815	525	0.015	
	8	19851	701	0.020		17866	525	0.010		15881	420	0.010	
	10	18684	584	0.015		16815	438	0.008		14947	350	0.008	
	12	16348	467	0.010		14713	350	0.005		13079	280	0.005	
2	6	19904	1592	0.050	1	17914	1194	0.025	0.6	15924	955	0.025	0.4
	8	17914	1274	0.040		16123	955	0.020		14331	764	0.020	
	10	16919	1115	0.030		15227	836	0.015		13535	669	0.015	
	12	13933	955	0.020		12540	717	0.010		11146	573	0.010	
	16	12938	717	0.010		11644	537	0.005		10350	430	0.005	
	20	11943	557	0.008		10748	418	0.004		9554	334	0.004	
2.5	8	16561	1490	0.050	1.25	14904	1118	0.025	0.75	13248	894	0.025	0.5
	10	14904	1043	0.040		13414	782	0.020		11924	626	0.020	
	12	14076	894	0.030		12669	671	0.015		11261	537	0.015	
	16	13248	671	0.020		11924	503	0.010		10599	402	0.010	

▶ HSF 2 / HSR 2

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Workpiece materials		Pre-hardened steels				Hardened steels							
		HRC 35 - HRC 45				HRC 45 - HRC 55				HRC 55 - HRC 65			
D	Neck length	RPM	Feed	D.O.C(mm) ap	D.O.C(mm) ae	RPM	Feed	D.O.C(mm) ap	D.O.C(mm) ae	RPM	Feed	D.O.C(mm) ap	D.O.C(mm) ae
3	8	13800	1656	0.060	1.5	12420	1242	0.030	0.9	11040	994	0.030	0.6
	10	12420	1159	0.050		11178	869	0.025		9936	696	0.025	
	12	11730	994	0.040		10557	745	0.020		9384	596	0.020	
	16	11040	745	0.030		9936	559	0.015		8832	447	0.015	
	20	10350	580	0.015		9315	435	0.008		8280	348	0.008	
4	10	11943	1791	0.070	2	10748	1344	0.035	1.2	9554	1075	0.035	0.8
	12	10748	1344	0.060		9674	1008	0.030		8599	806	0.030	
	16	10151	1075	0.050		9136	806	0.025		8121	645	0.025	
	20	9554	896	0.040		8599	672	0.020		7643	537	0.020	
	25	8957	717	0.025		8061	537	0.013		7166	430	0.013	
5	12	9554	1720	0.070	2.5	8599	1290	0.035	1.5	7643	1032	0.035	1
	30	8121	1204	0.050		7309	903	0.025		6497	722	0.025	
6	15	7962	1592	0.070	3	7166	1194	0.035	1.8	6369	955	0.035	1.2
	20	7166	1274	0.055		6449	955	0.028		5732	764	0.028	
8	20	5971	1433	0.120	4	5374	1075	0.060	2.4	4777	860	0.060	1.6
10	25	5732	1490	0.200	5	5159	1118	0.100	3	3822	894	0.100	2
12	28	4777	1605	0.300	6	4299	1204	0.150	3.6	3822	963	0.150	2.4



- These recommended cutting conditions indicate just reference.
- In actual machining, the condition should be adjusted according to milling shape, purpose and the machine type.
- Use the appropriate coolant for the work material and machining shape. (Recommend to use oil mist coolant for machining hardened steel.)
- For slotting, recommend reciprocating milling by adjusting feed & ap in below 50% of recommended milling condition.
- Reduce both spindle speed and feed at same rate for chattering.

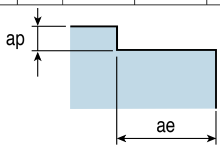
Recommended Cutting Conditions

HARDMILL

▶ HSF 4 / HSR 4

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

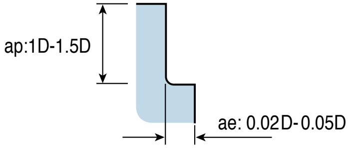
Workpiece materials		Pre-hardened steels				Hardened steels							
		HRC 35 - HRC 45				HRC 45 - HRC 55				HRC 55 - HRC 65			
D	Neck length	RPM	Feed	D.O.C(mm) ap	D.O.C(mm) ae	RPM	Feed	D.O.C(mm) ap	D.O.C(mm) ae	RPM	Feed	D.O.C(mm) ap	D.O.C(mm) ae
1	3	31847	2548	0.060	0.5	28662	1911	0.036	0.2	25478	1529	0.018	0.1
	4	27070	1783	0.050		24363	1338	0.030		21656	1070	0.015	
	6	25000	1529	0.040		22500	1146	0.024		20000	917	0.012	
	8	22293	1274	0.030		20064	955	0.018		17834	764	0.009	
	10	20701	1019	0.020		18631	764	0.012		16561	611	0.006	
1.5	4	23355	2335	0.070	0.7	21019	1752	0.042	0.3	18684	1401	0.021	0.15
	6	21019	1752	0.060		18917	1314	0.036		16815	1051	0.018	
	8	19851	1401	0.050		17866	1051	0.030		15881	841	0.015	
	10	18684	1168	0.040		16815	876	0.024		14947	701	0.012	
	12	16348	934	0.040		14713	701	0.024		13079	561	0.012	
	16	12845	701	0.030		11561	525	0.018		10276	420	0.009	
2	6	19904	3185	0.080	1	17914	2389	0.048	0.4	15924	1911	0.024	0.2
	8	17914	2548	0.070		16123	1911	0.042		14331	1529	0.021	
	10	16919	2229	0.060		15227	1672	0.036		13535	1338	0.018	
	12	13933	1911	0.050		12540	1433	0.030		11146	1146	0.015	
	16	12938	1433	0.050		11644	1075	0.030		10350	860	0.015	
	20	11943	1115	0.040		10748	836	0.024		9554	669	0.012	
3	8	13800	3312	0.160	1.5	12420	2484	0.096	0.6	11040	1987	0.048	0.3
	10	12420	2318	0.140		11178	1739	0.084		9936	1391	0.042	
	12	11730	1987	0.120		10557	1490	0.072		9384	1192	0.036	
	16	11040	1490	0.100		9936	1118	0.060		8832	894	0.030	
	20	10350	1159	0.080		9315	869	0.048		8280	696	0.024	
4	10	11943	3583	0.250	2	10748	2687	0.150	0.8	9554	2150	0.075	0.4
	12	10748	2687	0.220		9674	2015	0.132		8599	1612	0.066	
	16	10151	2150	0.180		9136	1612	0.108		8121	1290	0.054	
	20	9554	1791	0.140		8599	1344	0.084		7643	1075	0.042	
	25	8957	1433	0.100		8061	1075	0.060		7166	860	0.030	
5	15	9554	3439	0.200	2.5	8599	2580	0.120	1	7643	2064	0.060	0.5
	30	8121	2408	0.150		7309	1806	0.090		6497	1445	0.045	
6	15	7962	3185	0.300	3	7166	2389	0.180	1.2	6369	1911	0.090	0.6
	20	7166	2548	0.250		6449	1911	0.150		5732	1529	0.075	
	30	5573	2070	0.200		5016	1553	0.120		4013	1242	0.060	
8	20	5971	2866	0.500	4	5374	2150	0.300	1.6	4777	1720	0.150	0.8
	30	5374	2293	0.400		4837	1720	0.240		4299	1376	0.120	
	40	4777	1863	0.300		4299	1397	0.180		3822	1118	0.090	
10	25	5732	2981	0.800	5	5159	2236	0.480	2	4586	1789	0.240	1
	35	5159	2683	0.600		4643	2012	0.360		4127	1610	0.180	
	45	4586	2385	0.500		4127	1789	0.300		3669	1431	0.150	
12	30	4777	3210	1.000	6	4299	2408	0.600	2.4	3822	1926	0.300	1.2
	40	4299	2889	0.800		3869	2167	0.480		3439	1734	0.240	
	50	3822	2568	0.600		3439	1926	0.360		3057	1541	0.180	



▶ HSF 6 / HSR 6

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Material	Pre-hardened steels		Hardened steels			
Hardness	HRC 35 - HRC 45		HRC 45 - HRC 55		HRC 55 - HRC 65	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
6	7962	2389	7166	1791	6369	1433
8	5971	2150	5374	1612	4777	1290
10	5732	2064	5159	1548	4586	1238
12	4777	2006	4299	1505	3822	1204



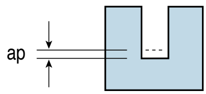
- These recommended cutting conditions indicate just reference.
- In actual machining, the condition should be adjusted according to milling shape, purpose and the machine type.
- Use the appropriate coolant for the work material and machining shape.
  (Recommend to use oil mist coolant for machining hardened steel.)
- Reduce both spindle speed and feed at same rate for chattering.

RIB 2

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Material	Carbon steels Alloy steels, Cast iron			Alloy steels Tool steels, Pre-hardened steels			Hardened steels		
Hardness	-HRC 30			HRC 30-HRC 45			HRC 45-HRC 55		
Diameter	RPM	Feed	ap(mm)	RPM	Feed	ap(mm)	RPM	Feed	ap(mm)
0.4	31000-40000	175-490	0.018-0.036	22500-28500	88-270	0.018-0.036	14300-18000	88-175	0.004-0.007
0.5	31000-40000	175-490	0.023-0.045	22500-28500	88-270	0.023-0.045	14300-18000	88-175	0.005-0.009
0.6	31000-40000	225-630	0.027-0.054	22500-28500	110-350	0.027-0.054	14300-18000	110-225	0.005-0.011
0.8	31000-40000	225-630	0.036-0.072	22500-28500	110-350	0.036-0.072	14300-18000	110-225	0.007-0.014
1.0	29000-36500	250-700	0.045-0.090	20500-26000	125-390	0.045-0.090	13000-16300	125-250	0.009-0.018
1.2	24000-30500	250-780	0.055-0.100	17000-21500	125-390	0.055-0.100	10800-13700	125-250	0.010-0.022
1.4	21000-26000	250-780	0.062-0.125	15000-18000	125-390	0.062-0.125	9400-11700	125-250	0.012-0.025
1.5	19000-24000	250-780	0.070-0.135	13500-17500	125-390	0.070-0.135	8700-10700	125-250	0.014-0.028
1.6	18000-23500	250-780	0.075-0.145	13200-16500	125-390	0.075-0.145	8300-10400	125-250	0.015-0.030
1.8	17000-21500	250-780	0.080-0.160	12000-15000	125-390	0.080-0.160	7400-9400	125-250	0.016-0.032
2.0	15500-19000	250-780	0.090-0.180	11000-13500	125-390	0.090-0.180	6900-8600	125-250	0.018-0.035
3.0	10500-13000	250-780	0.135-0.270	7000-9000	125-390	0.135-0.270	4600-5700	125-250	0.028-0.055

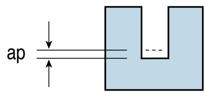
(Depth of cut per pass)



RIF 2

Material	Carbon steels Alloy steels, Cast iron			Alloy steels Tool steels, Pre-hardened steels			Hardened steels		
Hardness	- HRC 30			HRC 30 - HRC 45			HRC 45 - HRC 55		
Diameter	RPM	Feed	ap(mm)	RPM	Feed	ap(mm)	RPM	Feed	ap(mm)
0.4	31000-40000	200-440	0.007-0.018	22500-28000	85-340	0.007-0.018	14300-17000	30-90	0.004-0.008
0.5	31000-40000	200-440	0.009-0.022	22500-28000	85-340	0.009-0.022	14300-17000	30-90	0.004-0.009
0.6	31000-40000	250-570	0.011-0.026	22500-28000	110-430	0.011-0.026	14300-17000	40-110	0.005-0.011
0.7	31000-40000	250-570	0.012-0.031	22500-28000	110-430	0.012-0.031	14300-17000	40-110	0.006-0.013
0.8	27000-35000	280-630	0.014-0.035	19500-24500	120-480	0.014-0.035	12500-14800	45-125	0.007-0.015
0.9	25000-31500	280-720	0.030-0.060	17500-22500	160-540	0.030-0.060	11000-12500	55-130	0.008-0.016
1.0	22500-28000	280-810	0.045-0.090	15700-20000	190-600	0.045-0.090	10000-12500	65-130	0.009-0.018
1.2	18500-22500	280-900	0.055-0.100	13000-16500	190-600	0.055-0.100	8300-10500	65-130	0.010-0.022
1.4	16000-20000	280-900	0.062-0.125	11500-14000	190-600	0.062-0.125	7200-9000	65-130	0.012-0.025
1.5	14500-18500	280-900	0.070-0.135	10500-13500	190-600	0.070-0.135	6700-8200	65-130	0.014-0.028
1.6	14000-18000	280-900	0.075-0.145	10200-12800	190-600	0.075-0.145	6400-8000	65-130	0.015-0.030
1.8	13000-16500	280-900	0.080-0.160	9200-11500	190-600	0.080-0.160	5700-7200	65-130	0.016-0.032
2.0	12000-14500	280-900	0.090-0.180	8300-10500	190-600	0.090-0.180	5300-6600	65-130	0.018-0.035
2.5	9500-12000	280-900	0.112-0.235	6700-8500	190-600	0.112-0.235	4300-5300	65-130	0.022-0.045
3.0	8000-10000	280-900	0.135-0.270	5500-7000	190-600	0.135-0.270	3500-4400	65-130	0.028-0.055

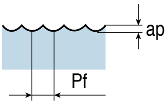
(Depth of cut per pass)



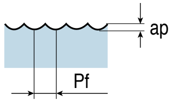
SMB 2

RPM: rev/min, Feed: mm/min
ap = Axial depth, Pf = Pick feed

Material	Carbon steels, Alloy steels Pre-hardened steels, Cast iron		Hardened steels	
Hardness	HRC30 - HRC45		HRC45 - HRC55	
Diameter	RPM	Feed	RPM	Feed
0.6	32000	520	32000	360
0.8	28000	560	28000	330
1.0	26000	560	26000	340
1.2	24500	570	24500	350
1.5	22000	600	22000	370



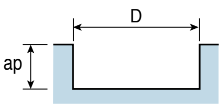
D<1
ap: 0.05×D Pf: 0.15×D
D≥1
ap: 0.075×D Pf: 0.15×D



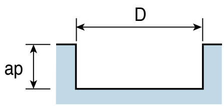
ap: 0.025×D
Pf: 0.1×D

HMF 2

Material	Alloy steels, Tool steels Pre-hardened steels		Hardened steels	
Hardness	HRC30 - HRC45		HRC45 - HRC55	
Diameter	RPM	Feed	RPM	Feed
0.4	35000	175	35000	70
0.8	28000	280	20000	140
1.0	20000	360	14000	140
1.2	16000	400	13000	155
1.5	13000	450	10000	190



D<1
ap: 0.1xD
D≥1
ap: 0.2xD



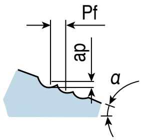
D<1
ap: 0.05xD
D≥1
ap: 0.1xD

Recommended Cutting Conditions

AMB 2...T

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth, Pf = Pick feed

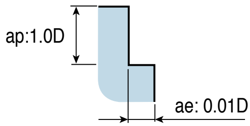
Material	Alloy steels, Tool steels, Pre-hardened steels				Hardened steels			
Hardness	HRC40 - HRC45 (α ≤ 15)		HRC40 - HRC45 (α > 15)		HRC45 - HRC65 (α ≤ 15)		HRC45 - HRC65 (α > 15)	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
2	22000	750	21850	620	22000	630	21850	460
4	22000	1440	21850	1270	18500	1270	14400	580
6	22000	2300	16100	1550	14500	1550	10900	620
8	16700	2800	12100	1550	11000	1550	8050	730
10	13800	2990	9800	1550	8600	1550	6550	830
12	11000	2650	7800	1550	7200	1550	5400	830



ap : 0.05D
Pf : 0.2D(D>2)
0.1D(D≤2)

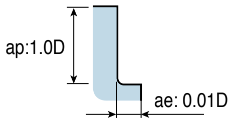
AMF 2...T / AMR 2...T-R

Material	Alloy steels, Tool steels, Pre-hardened steels		Hardened steels			
Hardness	- HRC45		HRC45 - HRC55		HRC55 - HRC65	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
3	28700	900	17800	600	9200	300
4	21800	900	13550	600	7130	320
6	14900	850	9100	600	4830	320
8	11400	850	6900	550	3620	300
10	9100	850	5500	550	2870	300
12	7600	830	4600	550	2410	300



AMF 4...T / AMR 4...T-R

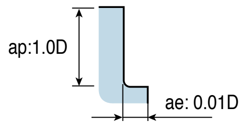
Material	Alloy steels, Tool steels, Pre-hardened steels		Hardened steels			
Hardness	- HRC45		HRC45 - HRC55		HRC55 - HRC65	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
3	28700	1700	17800	980	9200	460
4	21800	1790	13550	920	7130	495
6	14900	1700	9100	910	4830	480
8	11400	1660	6900	910	3620	480
10	9100	1660	5500	920	2870	480
12	7600	1660	4600	910	2410	470



▶ AMR 6...T-R

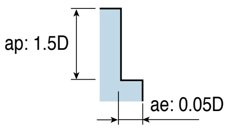
RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

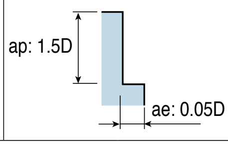
Material	Alloy steels, Tool steels, Pre-hardened steels		Hardened steels			
Hardness	- HRC45		HRC45 - HRC55		HRC55 - HRC65	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
6	4300	500	2800	120	1500	80
8	3500	520	2200	150	1100	80
10	2800	400	1800	120	900	70
12	2200	320	1500	110	800	70

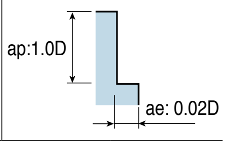


▶ SEH 6...T

Material	Alloy steels, Tool steels, Pre-hardened steels		Hardened steels			
Hardness	- HRC45		HRC45 - HRC55		HRC55 - HRC65	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
6	3900	1250	1600	200	1100	130
8	3000	1250	1200	200	900	130
10	2400	1250	1000	200	700	130
12	2000	1000	900	200	600	110
16	1500	800	900	150	450	70
20	1200	700	500	120	300	60

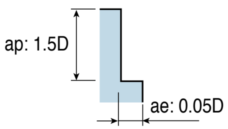


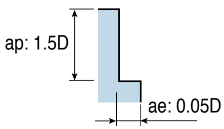


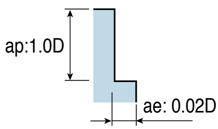


▶ SEH 6...T (For high speed machining)

Material	Alloy steels, Tool steels, Pre-hardened steels		Hardened steels			
Hardness	- HRC45		HRC45 - HRC55		HRC55 - HRC65	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
6	17000	6100	8400	3000	4200	1500
8	13000	6100	6300	3000	3200	1500
10	1000	6000	5000	3000	2500	1500
12	8400	5000	4200	2500	2100	1300
16	6300	4000	3200	1900	1600	1000
20	5000	3100	2500	1470	1300	800





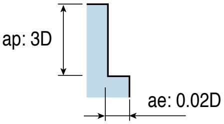


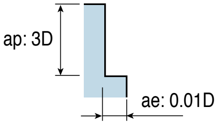
Recommended Cutting Conditions

▶ SEH 6...XLT

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Material	Alloy steels, Tool steels, Pre-hardened steels		Hardened steels			
Hardness	- HRC45		HRC45 - HRC55		HRC55 - HRC65	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
6	1700	360	1400	250	1110	200
8	1300	340	1100	240	850	180
10	1000	300	900	230	680	160
12	900	280	700	210	580	150
16	650	240	550	170	450	130
20	500	200	450	150	330	120

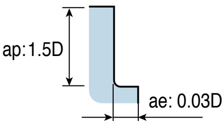


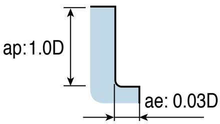


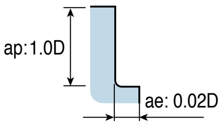
※ (HRC60 ↑
Rd: 0.005D)

▶ SEH 6...T-R (Corner radius type)

Material	Alloy steels, Tool steels, Pre-hardened steels		Hardened steels			
Hardness	- HRC45		HRC45 - HRC55		HRC55 - HRC65	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
6	16800	6100	8400	3100	4200	1520
8	12600	6100	6300	3100	3200	1520
10	10000	6000	5000	3100	2600	1520
12	8400	5000	4200	2600	2100	1300
16	6300	3800	3200	2000	1600	1000
20	5000	3000	2600	1500	1300	760





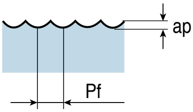


Recommended Cutting Conditions

▶ SBE 2...S

RPM: rev/min, Feed: mm/min
ap = Axial depth, Pf = Pick feed

Material	Carbon steels, Alloy steels Cast iron		Alloy steels, Tool steels Pre-hardened steels		Hardened steels	
Hardness	- HRC30		HRC30 - HRC45		HRC45 - HRC55	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
2	15000	730	11500	500	5000	150
3	13000	680	11000	460	4500	150
4	10000	740	8400	530	4200	180
5	9000	820	7300	580	3700	180
6	8500	1000	7000	830	3200	190
8	7100	1300	5800	920	2500	220
10	6400	1600	5000	1020	2000	230
12	5800	1700	4600	1100	1800	250
16	4800	1700	3800	1000	1350	250
20	4100	1680	3300	1000	1110	250

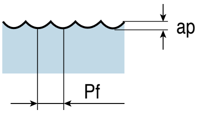


ap: D1 - D6=0.2mm
D8 - D20=0.3mm
Pf: 0.2×D

ap: D1 - D6=0.2mm
D8 - D20=0.3mm
Pf: 0.1×D

▶ SBE 2...S (For high speed machining)

Material	Carbon steels, Alloy steels, Tool steels Pre-hardened steels		Hardened steels	
Hardness	- HRC45		HRC45 - HRC55	
Diameter	RPM	Feed	RPM	Feed
2	21000	1480	21000	940
3	21000	2000	17000	1000
4	21000	3000	13800	1160
5	21000	3600	12000	1200
6	21000	4000	10500	1250
8	16700	4000	8360	1250
10	14000	3900	7000	1200
12	12200	3900	6100	1200
16	9600	3500	4800	1000
20	8000	3180	4000	900

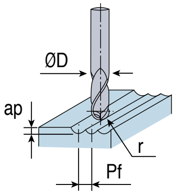


ap: D1- D6=0.2mm
D8- D20=0.3mm
Pf: 0.05×D

▶ SBE 2...T / SBE 2...LT / SBO 2 / BES 2

RPM: rev/min, Feed: mm/min
ap = Axial depth, Pf = Pick feed

Material	Carbon steels Cast iron		Alloy steels Tool steels		Alloy steels, Tool steels Pre-hardened steels		Hardened steels	
Hardness	- HRC30		- HRC30		HRC30 - HRC45		HRC45 - HRC55	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
2	21000	360	13000	210	11000	150	7000	130
4	10500	780	6600	340	5500	290	3500	150
6	7000	880	4400	440	3600	330	2300	165
8	5300	980	3300	500	2700	360	1800	200
10	4200	1100	2600	500	2200	360	1400	220
12	3500	1200	2200	540	1900	420	1700	230
14	2900	1200	1850	540	1600	420	1450	230
16	2600	1450	1650	580	1400	400	880	220
18	2300	1500	1400	580	1250	400	780	220
20	2100	1500	1300	580	1100	360	720	200

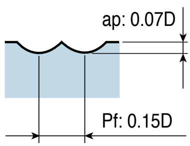


ap: 0.07D
Pf: 0.15D

※ Reduce feed by 30% for SBE 2....LT

▶ SBE 2...T / SBE 2...LT (Uncoated - UF10N)

Material	Carbon steels Alloy steels, Tool steels				Cast iron		Aluminum alloys	
Hardness	- HRC30		HRC30 - HRC40					
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
2	5200	90	4400	45	7300	150	21500	280
3	3500	100	2900	45	4900	160	14300	280
4	2600	100	2100	45	3600	200	10900	280
5	2100	105	1700	45	2900	230	8800	330
6	1700	100	1430	45	2400	250	7260	330
8	1270	95	1100	45	1800	320	5500	380
10	1000	95	870	45	1430	320	4300	380
12	870	85	730	45	1200	320	3600	440
14	750	85	620	45	1000	325	3000	440
16	650	85	540	45	920	325	2700	380
18	580	85	480	45	810	325	2400	380
20	500	85	430	45	730	290	2100	380

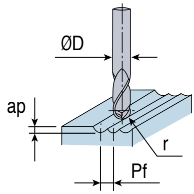


※ Reduce feed by 30% for SBE 2....LT

▶ SBE 4...T / BES 4

RPM: rev/min, Feed: mm/min
ap = Axial depth, Pf = Pick feed

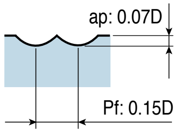
Material	Carbon steels Cast iron		Alloy steels Tool steels		Alloy steels, Tool steels Pre-hardened steels		Hardened steels	
Hardness	- HRC30		- HRC30		HRC30 - HRC45		HRC45 - HRC55	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
6	10000	1300	6600	660	5700	430	3200	180
8	7700	1650	4900	750	4300	460	2400	200
10	6200	1750	3900	750	3500	460	1800	220
12	5100	1900	3300	810	3000	630	1600	220
16	3800	2300	2400	870	2200	600	1200	200
18	3800	2300	2100	870	2000	600	1000	200
20	3100	2500	1900	930	1750	600	800	180



ap: 0.07D
Pf: 0.15D

▶ SBE 4...T (Uncoated - UF10N)

Material	Carbon steels, Alloy steels, Tool steels				Cast iron		Aluminum alloys	
Hardness	- HRC30		HRC30 - HRC40					
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
2	5200	140	4400	70	7300	230	21500	420
3	3500	150	2900	70	4900	240	14300	420
4	2600	150	2100	70	3600	300	10900	420
5	2100	160	1700	70	2900	350	8800	500
6	1700	150	1430	70	2400	380	7260	500
8	1270	140	1100	70	1800	480	5500	570
10	1000	140	870	70	1430	480	4300	570
12	870	130	730	70	1200	480	3600	660
14	750	130	620	70	1000	490	3000	660
16	650	130	540	70	920	490	2700	570
18	580	130	480	70	810	490	2400	570
20	500	130	430	70	730	440	2100	570

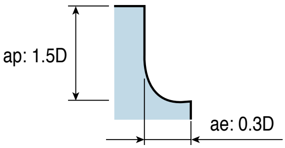


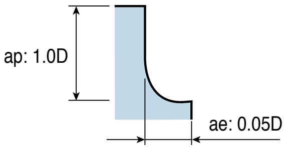
Recommended Cutting Conditions

▶ REB ...L

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Material	Carbon steels Alloy steels, Tool steels						Stainless steels Titanium alloys		Aluminum alloys	
Hardness	- HRC20		HRC20 - HRC30		HRC30 - HRC40					
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
6	15600	2,20	12400	840	8400	570	3400	260	2400	190
8	11600	2320	9200	840	6300	570	2400	240	1800	180
10	9200	2320	7600	840	5100	570	2000	290	1300	190
12	8000	2400	6000	800	4200	570	1680	260	1200	190
14	6800	2400	5200	840	3600	570	1400	200	900	130
16	6000	2400	4800	760	3300	510	1200	160	800	110
18	5200	2320	4400	720	2700	420	1100	150	700	100
20	4800	2160	3600	560	2400	360	1000	150	660	100

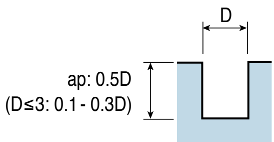




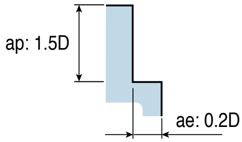
▶ TSE 2...M / HES 2...T-R

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Material	Carbon steels Alloy steels, Cast iron		Alloy steels, Tool steels Pre-hardened steels		Hardened steels		Stainless steels	
Hardness	- HRC30		HRC30 - HRC45		HRC45 - HRC55			
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
1	19000	115	11000	65	9800	35	9500	55
1.5	13000	115	8100	75	6400	40	6700	65
2	10000	170	6800	115	5300	50	5700	85
4	6800	270	4200	170	3100	60	3500	135
6	5000	320	3000	190	2100	80	2600	160
8	3800	340	2300	180	1700	120	1900	170
10	2900	300	1800	140	1400	90	1500	145
12	2500	250	1500	120	1200	80	1200	115
14	2200	200	1300	100	1000	70	1050	90
16	1900	180	1100	90	880	60	950	85
18	1700	160	1000	85	780	50	840	75
20	1500	150	950	75	700	45	760	70



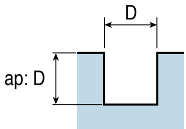
Material	Carbon steels Alloy steels, Cast iron		Alloy steels, Tool steels Pre-hardened steels		Hardened steels		Stainless steels	
Hardness	- HRC30		HRC30 - HRC45		HRC45 - HRC55			
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
4	6800	340	4200	210	3100	75	3500	170
6	5000	400	3000	240	2100	100	2600	200
8	3800	430	2300	220	1700	145	1900	210
10	2900	370	1800	180	1400	115	1500	180
12	2500	310	1500	150	1200	100	1200	145
14	2200	250	1300	130	1000	90	1050	115
16	1900	220	1100	110	880	75	950	105
18	1700	195	1000	105	780	65	840	95
20	1500	190	950	95	700	55	760	90



▶ TSE 2...M (Uncoated - UF10)

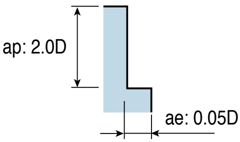
RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

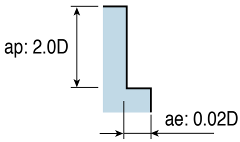
Material	Carbon steels Alloy steels, Tool steels						Stainless steels Titanium alloys		Cast iron		Aluminum alloys		Copper, Brass Non-ferrous	
Hardness	- HRC20		HRC20 - HRC30		HRC30 - HRC40									
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
2	5500	80	4800	70	3800	55	3100	50	6500	150	16000	320	12000	240
3	4100	90	3400	75	2600	60	2300	60	4200	150	11000	320	8000	240
4	3200	120	2700	120	2000	80	1900	80	3200	150	8000	320	6000	240
5	2700	160	2200	120	1600	95	1500	90	2500	150	6400	320	4800	240
6	2300	180	1900	140	1300	85	1300	90	2100	180	5300	340	4000	260
8	1700	170	1400	140	1000	100	1000	100	1600	190	4000	340	3000	260
10	1300	150	1000	120	800	80	800	90	1300	200	3200	340	2400	260
12	1000	120	800	95	660	65	660	75	1000	210	2600	340	2000	260
14	900	110	700	80	570	60	500	55	900	220	2300	340	1700	260
16	700	75	600	70	500	60	450	50	800	225	2000	340	1500	260
20	550	65	500	60	400	50	400	45	640	240	1600	340	1200	260



▶ TSE 4...M

Material	Carbon steels Alloy steels, Cast iron		Alloy steels, Tool steels Pre-hardened steels		Hardened steels	
Hardness	- HRC30		HRC30 - HRC45		HRC45 - HRC55	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
2	9000	220	5000	100	3200	50
3	6200	250	3600	120	2200	60
4	5000	300	3000	130	1800	70
5	4300	380	2500	160	1600	75
6	3800	420	2200	190	1400	90
8	2800	480	1600	200	1100	90
10	2400	480	1400	200	800	90
12	2000	380	1200	180	700	80
16	1700	350	900	140	600	70
20	1200	250	700	100	480	50



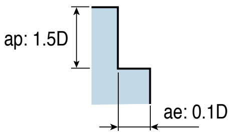


Recommended Cutting Conditions

▶ TSE 4...M (Uncoated - UF10)

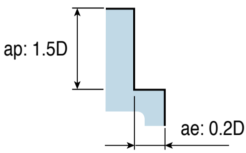
RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Material	Carbon steels Alloy steels, Tool steels						Stainless steels Titanium alloys		Cast iron		Aluminum alloys		Copper, Brass Non-ferrous	
Hardness	- HRC20		HRC20 - HRC30		HRC30 - HRC40									
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
2	5500	140	4800	120	3800	100	3100	80	6500	450	16000	960	12000	720
3	4100	150	3400	130	2600	100	2300	80	4200	450	11000	960	8000	720
4	3200	250	2700	200	2000	130	1900	110	3200	450	8000	960	6000	720
5	2700	260	2200	210	1600	140	1500	125	2500	450	6400	960	4800	720
6	2300	280	1900	240	1300	150	1300	130	2100	540	5300	1020	4000	780
8	1700	280	1400	240	1000	140	1000	140	1600	570	4000	1020	3000	780
10	1300	250	1000	220	800	130	800	125	1300	600	3200	1020	2400	780
12	1000	220	800	190	660	110	660	100	1000	630	2600	1020	2000	780
14	900	200	700	150	570	90	500	80	900	660	2300	1020	1700	780
16	700	160	600	130	500	80	450	70	800	680	2000	1020	1500	780
20	550	120	500	110	400	65	400	60	640	720	1600	1020	1200	780



▶ HES 2...LT / HES 2...XLT / HES 2...LT-R

Material	Carbon steels Alloy steels, Cast iron		Alloy steels, Tool steels Pre-hardened steels		Hardened steels		Stainless steels	
Hardness	- HRC30		HRC30 - HRC45		HRC45 - HRC55			
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
4	6800	272	4200	190	3100	70	3500	160
6	5000	320	3000	200	2100	80	2600	180
8	3800	330	2300	190	1700	90	1900	180
10	2900	300	1800	170	1400	85	1500	160
12	2500	260	1500	160	1200	80	1200	130
14	2200	200	1300	120	1000	70	1050	100
16	1900	180	1100	100	880	70	950	90
18	1700	170	1000	90	780	60	840	80
20	1500	100	950	80	700	50	760	70

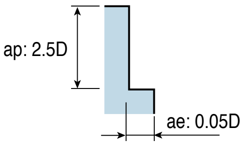


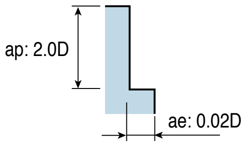
Recommended Cutting Conditions

▶ HES 4...LT / HES 4...XLT / HES 4...LT-R

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

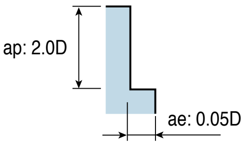
Material	Carbon steels Alloy steels, Cast iron		Alloy steels, Tool steels Pre-hardened steels		Hardened steels	
Hardness	- HRC30		HRC30 - HRC45		HRC45 - HRC55	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
2	9000	160	5000	70	3200	30
3	6200	180	3600	80	2300	30
4	5000	200	3000	90	1800	30
5	4300	220	2600	120	1600	35
6	3800	250	2100	160	1400	40
8	2800	300	1600	160	1100	40
10	2400	300	1400	160	900	40
12	2000	220	1200	150	700	30
16	1700	210	900	120	600	30
20	1200	180	700	80	450	25

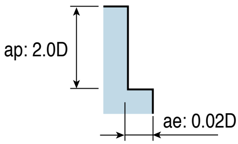




▶ HES 4...T-R

Material	Carbon steels Alloy steels, Cast iron		Alloy steels, Tool steels Pre-hardened steels		Hardened steels	
Hardness	- HRC30		HRC30 - HRC45		HRC45 - HRC55	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
2	9000	220	5000	100	3200	50
3	6200	250	3600	120	2200	60
4	5000	300	3000	130	1800	70
5	4300	380	2500	160	1600	75
6	3800	420	2200	190	1400	90
8	2800	480	1600	200	1100	90
10	2400	480	1400	200	800	90
12	2000	380	1200	180	700	80
16	1700	350	900	140	600	70
20	1200	250	700	100	480	50





Contents

HFM 2 / HFM 4

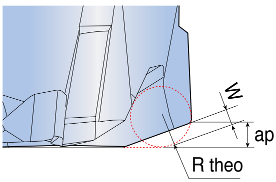
Speed: m/min, RPM: rev/min, Feed: mm/min, mm/tooth
ap = Axial depth, ae = Radial depth

Material	Carbon steels, Alloy steels, Cast iron			Alloy steels, Tool steels, Pre-hardened steels		
Hardness	- HRC30			HRC30 - HRC45		
Diameter	Speed(m/min)	Feed(mm/tooth)	ap(mm)	Speed(m/min)	Feed(mm/tooth)	ap(mm)
4	120 - 180	0.2 - 0.4	0.3	90 - 150	0.1 - 0.3	0.2
6		0.3 - 0.6	0.5		0.3 - 0.5	0.3
8		0.4 - 0.7	0.5		0.3 - 0.6	0.4
10		0.5 - 0.9	0.7		0.4 - 0.8	0.5
12		0.5 - 1.0	0.8		0.4 - 1.0	0.5

• Overhang of end mill is over 5D, reduced by 20~30% of each cutting conditions (RPM, Feed, ap)

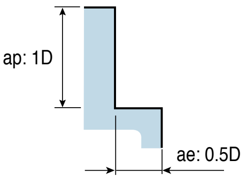
Program Tip - HFM 2 / HFM 4

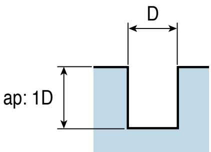
Un-machined material thickness(W)		
Designation	R theo	W
HFM 2040	0.32	0.21
HFM 2060	0.35	0.40
HFM 2080	0.50	0.50
HFM 2100	0.65	0.70
HFM 2120	1.20	0.80
HFM 4060	0.70	0.35
HFM 4080	0.90	0.45
HFM 4100	1.00	0.50
HFM 4120	1.40	0.70



CFM 4...M

Material	Carbon steels Alloy steels		Pre-hardened steels (SKT4,NAK80...)		Hardened steels (SKD61,STAVAX...)		Stainless steels	
Hardness	- HRC30		HRC30 - HRC45		HRC45 - HRC55			
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
6	7962	1274	7166	955	2389	318	5732	917
8	5971	1433	5374	1075	1791	358	4299	1032
10	4777	1338	4299	1003	1433	334	3439	963
12	4512	1444	4061	1083	1354	361	3248	1039
16	3384	1218	3045	914	1015	305	2436	975
20	2866	1261	2580	946	860	315	2064	1238
25	2293	1192	2064	894	688	298	1651	991





• Feed information is for side milling.
• For slotting, reduce feed by 20%

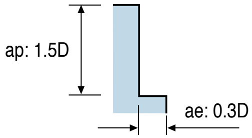
Recommended Cutting Conditions

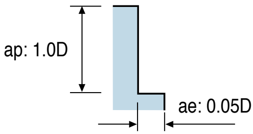
APEXMILL

▶ REL....L

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

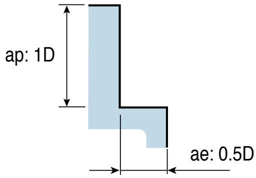
Material	Carbon steels, Alloy steels, Tool steels						Stainless steels Titanium alloys		Aluminum alloys	
Hardness	- HRC20		HRC20 - HRC30		HRC30 - HRC40					
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
6	15600	2320	12400	840	8400	570	3400	260	2400	190
8	11600	2320	9200	840	6300	570	2400	240	1800	180
10	9200	2320	7600	840	5100	570	2000	290	1300	190
12	8000	2400	6000	800	4200	570	1680	260	1200	190
14	6800	2400	5200	840	3600	570	1400	200	900	130
16	6000	2400	4800	760	3300	510	1200	160	800	110
18	5200	2320	4400	720	2700	420	1100	150	700	100
20	4800	2160	3600	560	2400	360	1000	150	660	100

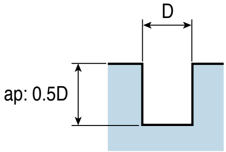




▶ FSM 4...M

Material	Carbon steels Alloy steels		Pre-hardened steels (SKT4,NAK80…)		Hardened steels (SKD61,STAVAX...)		Stainless steels	
Hardness	- HRC30		HRC30 - HRC45		HRC45 - HRC55			
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
6	7962	2548	7166	1911	2389	637	5732	917
8	5971	2389	5374	1791	1791	597	4299	1032
10	4777	2484	4299	1863	1433	621	3439	963
12	4512	2887	4061	2166	1354	722	3248	1039
16	3384	2436	3045	1827	1015	609	2436	975
20	2866	2293	2580	1720	860	573	2064	1238
25	2293	2018	2064	1513	688	504	1651	991





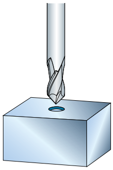
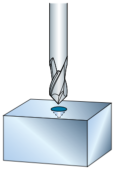
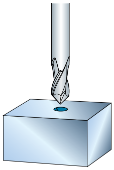
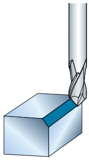
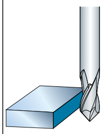
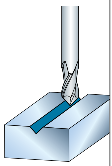
- Feed information is for side milling.
- For slotting, reduce feed by 20%

Recommended Cutting Conditions

APEXMILL

▶ CEM 2

Speed V: m/min,   Feed f: mm/rev

Material	Chamfer boring	Centering	Drilling	Chamfer milling	Side milling	V-slot milling
Chamfer angle						
CEM 2...-C60(60°)	●	×	×	●	●	×
CEM 2...(90°)	●	△ 1)	×	●	●	●
CEM 2...-C120(120°)	●	●	●	●	●	●

- '●': recommended , '×': not recommended
- 1) Centering of CEM 2…(90°) is only applicable on cast iron & non-ferrous material

Chamfer-boring, Drilling, Centering				
Material	V (m/min)	f (mm/rev)		
		Ø4 - Ø6	Ø8 - Ø12	Ø16 - Ø20
Cast iron	30 - 60	0.08 - 0.10	0.10 - 0.20	0.15 - 0.20
Aluminum alloys	40 - 80	0.08 - 0.15	0.10 - 0.20	0.15 - 0.20
Carbon steels	30 - 60	0.03 - 0.06	0.05 - 0.09	0.07 - 0.15
Alloy steels	20 - 40	0.02 - 0.04	0.03 - 0.06	0.06 - 0.15

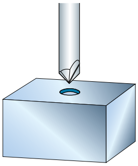
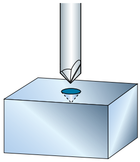
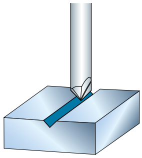
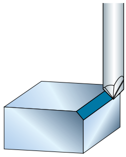
Chamfer milling, Side milling				
Material	V (m/min)	f (mm/rev)		
		Ø4 - Ø6	Ø8 - Ø12	Ø16 - Ø20
Cast iron	30 - 60	0.03 - 0.06	0.05 - 0.10	0.07 - 0.15
Aluminum alloys	40 - 80	0.04 - 0.08	0.06 - 0.12	0.08 - 0.17
Carbon steels	30 - 60	0.03 - 0.05	0.04 - 0.07	0.05 - 0.09
Alloy steels	20 - 40	0.02 - 0.04	0.03 - 0.05	0.04 - 0.06

V-slot milling				
Material	V (m/min)	f (mm/rev)		
		Ø4 - Ø6	Ø8 - Ø12	Ø16 - Ø20
Cast iron	30 - 60	0.02 - 0.04	0.04 - 0.06	0.06 - 0.08
Aluminum alloys	40 - 80	0.04 - 0.06	0.05 - 0.08	0.08 - 0.15
Carbon steels	30 - 60	0.02 - 0.04	0.03 - 0.05	0.05 - 0.10
Alloy steels	20 - 40	0.01 - 0.02	0.02 - 0.04	0.04 - 0.06

- Chamfer end mill with coating, cutting speed can be increased by 30 - 50%
- Recommended depth of cut: under 0.5D

ECEM 2... / ECEM 4...

Speed V: m/min, Feed f: mm/rev

Material	Chamfer boring	Centering	V-slot milling	Chamfer milling
Chamfer angle				
ECEM 2... (90°)	●	△[1]	●	●
ECEM 4... (90°)	●	×	×	●

- '●': recommended , '×': not recommended
- [1] Centering of ECEM 2...(90°) is only applicable on cast iron & non-ferrous material

Chamfer-boring, Centering				
Material	V (m/min)	f (mm/rev)		
		Ø4 - Ø6	Ø8 - Ø12	Ø16 - Ø20
Cast iron	30 - 60	0.08 - 0.10	0.10 - 0.20	0.15 - 0.20
Aluminum alloys	40 - 80	0.08 - 0.15	0.10 - 0.20	0.15 - 0.20
Carbon steels	30 - 60	0.03 - 0.06	0.05 - 0.09	0.07 - 0.15
Alloy steels	20 - 40	0.02 - 0.04	0.03 - 0.06	0.06 - 0.15

Chamfer milling				
Material	V (m/min)	f (mm/rev)		
		Ø4 - Ø6	Ø8 - Ø12	Ø16 - Ø20
Cast iron	40 - 70	0.03 - 0.06	0.05 - 0.10	0.07 - 0.15
Aluminum alloys	50 - 120	0.04 - 0.08	0.06 - 0.12	0.08 - 0.17
Carbon steels	40 - 80	0.03 - 0.05	0.04 - 0.07	0.05 - 0.09
Alloy steels	30 - 60	0.02 - 0.04	0.03 - 0.05	0.04 - 0.06

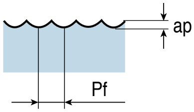
V-slot milling				
Material	V (m/min)	f (mm/rev)		
		Ø4 - Ø6	Ø8 - Ø12	Ø16 - Ø20
Cast iron	30 - 60	0.02 - 0.04	0.04 - 0.06	0.06 - 0.08
Aluminum alloys	50 - 100	0.04 - 0.06	0.05 - 0.08	0.08 - 0.15
Carbon steels	30 - 60	0.02 - 0.04	0.03 - 0.05	0.05 - 0.10
Alloy steels	20 - 40	0.01 - 0.02	0.02 - 0.04	0.04 - 0.06

- Chamfer end mill with coating, cutting speed can be increased by 30 - 50%
- Recommended depth of cut: under 0.5D

▶ EBE 2...S

RPM: rev/min, Feed: mm/min
ap = Axial depth, Pf = Pick feed

Material	Carbon steels, Alloy steels Cast iron		Alloy steels, Tool steels Pre-hardened steels		Hardened steels	
Hardness	- HRC30		HRC30 - HRC45		HRC45 - HRC55	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
3	13000	680	11000	460	4500	150
4	10000	740	8400	530	4200	180
5	9000	820	7300	580	3700	180
6	8500	1000	7000	830	3200	190
8	7100	1300	5800	920	2500	220
10	6400	1600	5000	1020	2000	230
12	5800	1700	4600	1100	1800	250
16	4800	1700	3800	1000	1350	250
20	4100	1680	3300	1000	1110	250

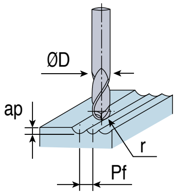


ap: D1 - D6=0.2mm
D8 - D20=0.3mm
Pf: 0.2×D

ap: D1 - D6=0.2mm
D8 - D20=0.3mm
Pf: 0.1×D

▶ EBE 2...M/L

Material	Carbon steels Cast iron		Alloy steels Tool steels		Alloy steels, Tool steels Pre-hardened steels		Hardened steels	
Hardness	- HRC30		- HRC30		HRC30 - HRC45		HRC45 - HRC55	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
3	13900	720	8800	300	7300	250	4600	130
4	10500	780	6600	340	5500	290	3500	150
6	7000	880	4400	440	3600	330	2300	165
8	5300	980	3300	500	2700	360	1800	200
10	4200	1100	2600	500	2200	360	1400	220
12	3500	1200	2200	540	1900	420	1700	230
14	2900	1200	1850	540	1600	420	1450	230
16	2600	1450	1650	580	1400	400	880	220
18	2300	1500	1400	580	1250	400	780	220
20	2100	1500	1300	580	1100	360	720	200



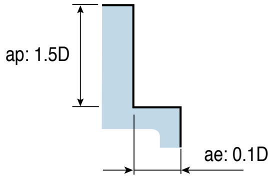
ap: 0.07D
Pf: 0.15D

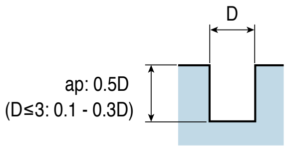
※ Reduce feed by 30% for EBE 2....L

▶ EFE 2...S/M

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Material	Carbon steels Alloy steels		Pre-hardened steels (SKT4,NAK80…)		Stainless steels	
Hardness	- HRC30		HRC30 - HRC45			
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
3	8493	340	7643	255	6115	245
4	6369	357	5732	268	4586	257
5	5732	390	5159	292	4127	281
6	5308	425	4777	318	3822	306
7	4550	455	4095	341	3276	328
8	3981	478	3583	358	2866	344
9	3892	506	3503	380	2803	364
10	3503	490	3153	368	2522	353
12	3185	510	2866	382	2293	367
14	2730	491	2457	369	1965	354
16	2588	518	2329	388	1863	373
18	2300	552	2070	414	1656	397
20	2070	621	1863	466	1490	447



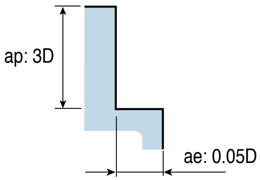


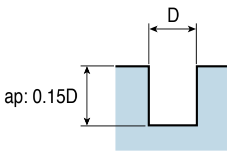
- Feed information is for side milling.
- For slotting, reduce feed by 20%

▶ EFE 2...L

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Material	Carbon steels Alloy steels		Pre-hardened steels (SKT4,NAK80…)		Stainless steels	
Hardness	- HRC30		HRC30 - HRC45			
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
3	8493	340	7643	255	6115	245
4	6369	357	5732	268	4586	257
5	5732	390	5159	292	4127	281
6	5308	425	4777	318	3822	306
8	3981	478	3583	358	2866	344
10	3503	490	3153	368	2522	353
12	3185	510	2866	382	2293	367
14	2730	491	2457	369	1965	354
16	2588	518	2329	388	1863	373
18	2300	552	2070	414	1656	397
20	2070	621	1863	466	1490	447



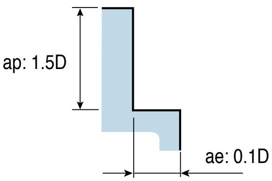


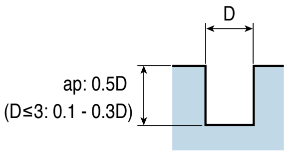
• Feed information is for side milling.
• For slotting, reduce feed by 20%

EFE 3...S/M

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Material	Carbon steels Alloy steels		Pre-hardened steels (SKT4,NAK80…)		Stainless steels	
Hardness	- HRC30		HRC30 - HRC45			
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
3	8493	510	7643	382	6115	367
4	6369	535	5732	401	4586	385
5	5732	585	5159	439	4127	421
6	5308	637	4777	478	3822	459
8	3981	717	3583	537	2866	516
10	3503	736	3153	552	2522	530
12	3185	764	2866	573	2293	550
14	2730	737	2457	553	1965	531
16	2588	776	2329	582	1863	559
18	2300	828	2070	621	1656	596
20	2070	932	1863	699	1490	671





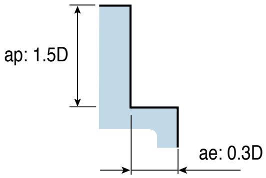
- Feed information is for side milling.
- For slotting, reduce feed by 20%

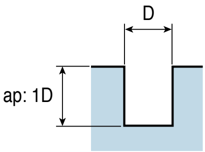
Recommended Cutting Conditions

EFE 4...S/M

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Material	Carbon steels Alloy steels		Pre-hardened steels (SKT4,NAK80…)		Stainless steels	
Hardness	- HRC30		HRC30 - HRC45			
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
3	8493	679	7643	510	6115	489
4	6369	713	5732	535	4586	514
5	5732	780	5159	585	4127	495
6	5308	849	4777	637	3822	611
7	4550	910	4095	682	3276	655
8	3981	955	3583	717	2866	688
9	3892	1012	3503	759	2803	729
10	3503	981	3153	736	2522	706
12	3185	1019	2866	764	2293	734
14	2730	983	2457	737	1965	708
16	2588	1035	2329	776	1863	745
18	2300	1104	2070	828	1656	795
20	2070	1242	1863	932	1490	894



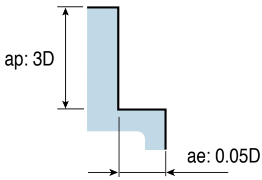


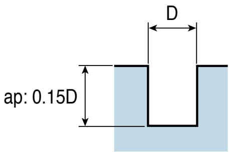
- Feed information is for side milling.
- For slotting, reduce feed by 20%

▶ EFE 4...L

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Material	Carbon steels Alloy steels		Pre-hardened steels (SKT4,NAK80…)		Stainless steels	
Hardness	- HRC30		HRC30 - HRC45			
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
3	8493	679	7643	510	6115	489
4	6369	713	5732	535	4586	514
5	5732	780	5159	585	4127	561
6	5308	849	4777	637	3822	611
8	3981	955	3583	717	2866	688
10	3503	981	3153	736	2522	706
12	3185	1019	2866	764	2293	734
14	2730	983	2457	737	1965	708
16	2588	1035	2329	776	1863	745
18	2300	1104	2070	828	1656	795
20	2070	1242	1863	932	1490	894





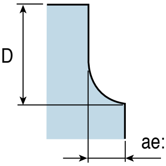
- Feed information is for side milling.
- For slotting, reduce feed by 20%

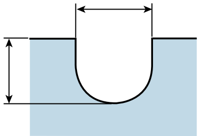
STARMILL

SBT 3...U

RPM: rev/min,   Feed: mm/min
ap = Axial depth,   ae = Radial depth

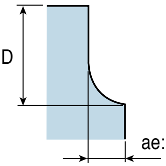
Material	Carbon steels Alloy steels		Pre-hardened steels (SKT4,NAK80…)		Heat resistant alloy (Ti-Alloy,Inconel..)		Stainless steels	
Hardness	- HRC30		HRC30 - HRC45					
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
6	7962	717	7166	537	2389	179	5732	344
8	5971	896	5374	672	1791	224	4299	516
10	4777	860	4299	645	1433	215	3439	619
12	4512	947	4061	711	1354	237	3248	682
16	3384	914	3045	685	1015	228	2436	658
20	2866	946	2580	709	860	236	2064	743

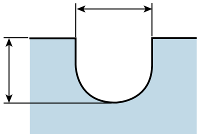




SBT 4...U

Material	Carbon steels Alloy steels		Pre-hardened steels (SKT4,NAK80…)		Heat resistant alloys (Ti-Alloy,Inconel..)		Stainless steels	
Hardness	- HRC30		HRC30 - HRC45					
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
6	7962	955	7166	717	2389	239	5732	459
8	5971	1194	5374	896	1791	299	4299	688
10	4777	1146	4299	860	1433	287	3439	825
12	4512	1263	4061	947	1354	316	3248	910
16	3384	1218	3045	914	1015	305	2436	877
20	2866	1261	2580	946	860	315	2064	991





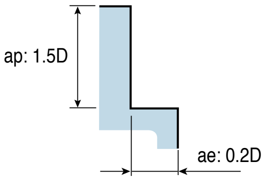
- Feed information is for side milling.
- For slotting, reduce feed by 20%

Recommended Cutting Conditions

SED 3...T

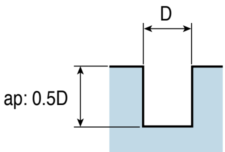
RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Material	Carbon steels Alloy steels		Stainless steels		Titanium alloys		High temp alloys	
Hardness	- HRC30							
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
4	4200	290	3740	230	2070	120	1300	60
6	3000	260	2500	190	1400	95	950	45
8	2200	280	1900	200	1050	105	760	40
10	1800	275	1500	200	900	110	620	40
12	1500	235	1200	160	760	90	500	35
14	1300	210	1100	135	650	75	440	35
16	1100	170	950	125	570	65	380	25
18	1000	160	850	115	500	60	330	25
20	900	180	760	130	450	70	300	20



※ For more than HRC45
- ae ≤ 0.05D
- ap ≤ D

Material	Carbon steels Alloy steels		Stainless steels		Titanium alloys		High temp alloys	
Hardness	- HRC30							
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
4	3900	230	2100	110	2100	80	1550	37
6	2600	170	1400	80	1400	65	1050	30
8	1900	180	1050	90	1000	75	760	30
10	1500	180	900	95	900	80	600	30
12	1200	150	760	80	760	65	500	25
14	1000	115	640	70	640	55	420	20
16	950	110	570	55	570	45	380	19
18	850	100	500	50	500	45	330	17
20	760	115	450	45	450	50	280	16

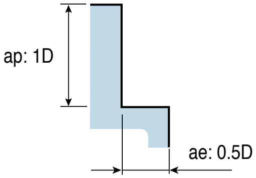


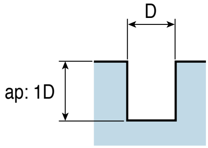
※ For more than HRC45
- ap ≤ 0.05D

▶ SED 4...U / SED 4...U-R/C

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Material	Carbon steels Alloy steels		Pre-hardened steels (SKT4,NAK80…)		Heat resistant alloys (Ti-Alloy,Inconel..)		Stainless steels	
Hardness	- HRC30		HRC30 - HRC45					
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
6	7962	955	7166	717	2389	239	5732	459
8	5971	1194	5374	896	1791	299	4299	688
10	4777	1146	4299	860	1433	287	3439	825
12	4512	1263	4061	947	1354	316	3248	910
16	3384	1218	3045	914	1015	305	2436	877
20	2866	1261	2580	946	860	315	2064	991

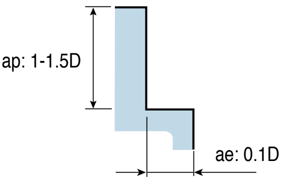




- Feed information is for side milling.
- For slotting, reduce feed by 20%

▶ HES 6...T

Material	Carbon steels Alloy steels		Stainless steels	
Hardness	- HRC30			
Diameter	RPM	Feed	RPM	Feed
6	5500	1870	3850	1270
8	4180	1870	2860	1270
10	3308	1870	2310	1270
12	2750	1540	1980	1100
14	2420	1320	1650	830
16	2100	1210	1430	830
18	1870	1100	1270	720
20	1320	950	1100	650

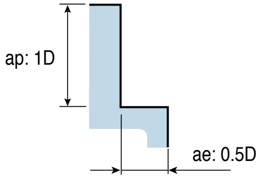


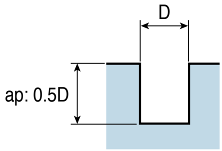
※ For more than HRC45
- ae ≤ 0.05D
- ap ≤ D

▶ REH ...S/M/L

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Material	Carbon steels Alloy steels		Pre-hardened steels (SKT4,NAK80…)		Ti-alloy, Ni-alloy		Stainless steels	
Hardness	- HRC30		HRC30 - HRC45					
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
6	7962	2548	7166	1911	4777	1019	5732	917
8	5971	2389	5374	1791	3583	955	4299	1032
10	4777	2484	4299	1863	2866	994	3439	963
12	4512	2887	4061	2166	2707	1155	3248	1039
16	3384	3045	3045	2284	2030	1218	2436	1218
20	2866	3439	2580	2580	1720	1376	2064	1857



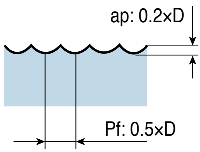


- Feed information is for side milling.
- For slotting, reduce feed by 20%

AEB 2...S

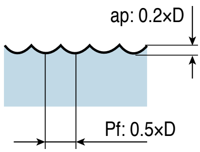
RPM: rev/min, Feed: mm/min
ap = Axial depth, Pf = Pick feed

Material	Aluminum alloys		Copper alloys	
Diameter	RPM	Feed	RPM	Feed
6	18000	1750	5500	440
8	14000	2000	4200	500
10	14000	2350	4200	580
12	14000	3000	4200	750
16	11000	2700	3300	670
20	8000	2200	2200	600



AEB 3...M

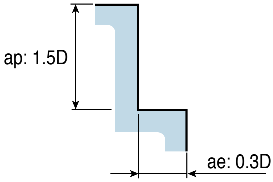
Material	Aluminum alloys		Copper alloys	
Diameter	RPM	Feed	RPM	Feed
2	27000	950	8000	240
3	18000	950	5500	240
4	18000	1250	5500	310
5	18000	1350	5500	340
6	18000	1750	5500	440
8	14000	2000	4200	500
10	14000	2350	4200	580
12	14000	3000	4200	750
16	11000	2700	3300	670



▶ AES 2 / AES 2...R / AES 2...XL

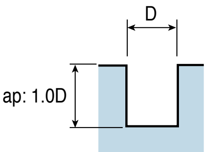
RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Material	Aluminum alloys (< Si 4%)		Aluminum alloys (< Si 8%)		Aluminum alloys (Die casting)		Aluminum alloys (Cu based)	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
4	24000	4800	19900	3980	16000	3200	12000	2400
6	16000	3840	13200	3160	10600	2544	8000	1920
8	12000	3600	9900	2970	8000	2400	6000	1800
10	9500	3420	8000	2880	6300	2260	4800	1720
12	8000	3200	6600	2640	5300	2120	4000	1600
14	6800	2990	5600	2460	4500	1980	3400	1490
16	6000	3000	5000	2500	4000	2000	3000	1500
18	5300	2600	4400	2200	3500	1750	2600	1300
20	4800	2400	4000	2000	3200	1600	2400	1200



※ Reduce feed by 30% for AES 2...XL

Material	Aluminum alloys (< Si 4%)		Aluminum alloys (< Si 8%)		Aluminum alloys (Die casting)		Aluminum alloys (Cu based)	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
4	24000	3840	19900	2980	16000	2240	12000	1440
6	16000	3072	13200	2370	10600	1780	8000	1150
8	12000	2880	9900	2230	8000	1680	6000	1080
10	9500	2730	8000	2160	6300	1580	4800	1030
12	8000	2560	6600	1980	5300	1480	4000	960
14	6800	2390	5600	1845	4500	1380	3400	890
16	6000	2400	5000	1870	4000	1400	3000	900
18	5300	2080	4400	1650	3500	1220	2600	780
20	4800	1920	4000	1500	3200	1260	2400	720

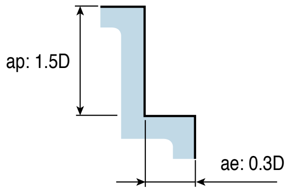


※ Reduce feed by 30% for AES 2...XL

▶ AES 3 / AES 3...R/ML/XL

RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

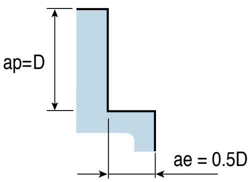
Material	Aluminum alloys (< Si 4%)		Aluminum alloys (< Si 8%)		Aluminum alloys (Die casting)		Aluminum alloys (Cu based)	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
4	24000	4800	19900	3980	16000	3200	12000	2400
6	16000	3840	13200	3160	10600	2544	8000	1920
8	12000	3600	9900	2970	8000	2400	6000	1800
10	9500	3420	8000	2880	6300	2260	4800	1720
12	8000	3200	6600	2640	5300	2120	4000	1600
14	6800	2990	5600	2460	4500	1980	3400	1490
16	6000	3000	5000	2500	4000	2000	3000	1500
18	5300	2600	4400	2200	3500	1750	2600	1300
20	4800	2400	4000	2000	3200	1600	2400	1200

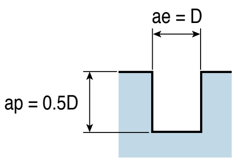


※ Reduce feed by 30% for AES 3...ML/XL

▶ REMA 3 / REMA 3...C / REA 3...L

Material	Aluminum alloys (< Si 4%)		Aluminum alloys (< Si 8%)		Aluminum alloys (Die casting)		Aluminum alloys (Cu based)	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed	RPM	Feed
6	31847	6688	25478	5350	22293	4682	15924	4013
8	23885	8599	19108	6879	16720	6019	11943	5159
10	19108	9172	15287	7338	13376	6420	9554	5503
12	15924	7643	12739	6115	11146	5350	7962	4586
14	13649	7370	10919	5896	9554	5159	6824	4422
16	11943	6449	9554	5159	8360	4514	5971	3869
20	9554	5159	7643	4127	6688	3611	4777	3096





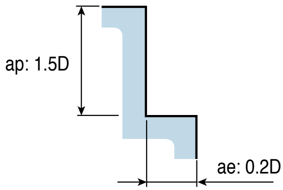
- These recommended cutting conditions indicate just reference.
- In actual machining, the condition should be adjusted according to milling shape, purpose and the machine type.
- Use the appropriate coolant for the work material and machining shape.
  (Recommend to use oil mist coolant for machining hardened steel.)
- Reduce both spindle speed and feed at same rate for chattering.

Recommended Cutting Conditions

AWE 3 / AWE 3...ML

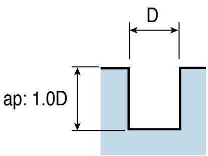
RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

Material	Aluminum alloys (< Si 4%)		Aluminum alloys (< Si 8%)		Aluminum alloys (Cu based)	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
6	16000	1600	13000	1000	13000	1000
8	12000	1800	9900	1200	9900	1200
10	9500	2000	8000	1400	8000	1400
12	8000	2200	6700	1600	6700	1600
14	6800	2300	5700	1700	5700	1700
16	6000	2300	5000	1700	5000	1700
18	5300	2400	4400	1800	4400	1800
20	4800	2400	4000	1800	4000	1800



※ Reduce feed by 20% for AWE 3...ML

Material	Aluminum alloys (< Si 4%)		Aluminum alloys (< Si 8%)		Aluminum alloys (Cu based)	
Diameter	RPM	Feed	RPM	Feed	RPM	Feed
6	13800	1100	11700	900	11700	900
8	10500	1200	8800	1000	8800	1000
10	8500	1300	7000	1050	7000	1050
12	6900	1500	5850	1300	5850	1300
14	5950	1600	5000	1350	5000	1350
16	5200	1600	4400	1350	4400	1350
18	4600	1800	3900	1500	3900	1500
20	4200	1800	3500	1500	3500	1500

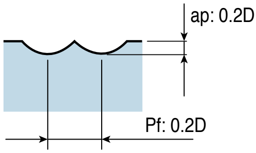


※ Reduce feed by 20% for AWE 3...ML

DMB 2

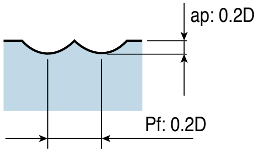
RPM: rev/min, Feed: mm/min
ap = Axial depth, Pf = Pick feed

Material	Graphite	
Diameter	RPM	Feed
0.6	40000	800
0.8	40000	960
1.0	40000	1200
1.2	40000	1440
1.5	40000	1600
2.0	40000	2000



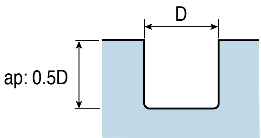
DEB 2...S/L

Material	Graphite	
Diameter	RPM	Feed
3	16000	1450
4	16000	2100
5	15500	2550
6	15000	2950
8	13000	3000
10	11500	3050
12	10500	3150



DMR 2

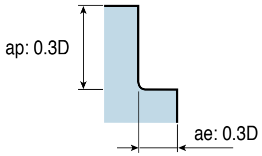
Material	Graphite	
Diameter	RPM	Feed
0.6	40000	640
0.8	40000	800
1.0	40000	950
1.2	40000	1200
1.5	40000	1440
2.0	40000	1600



▶ DER 3...S

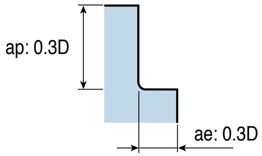
RPM: rev/min, Feed: mm/min
ap = Axial depth, ae = Radial depth

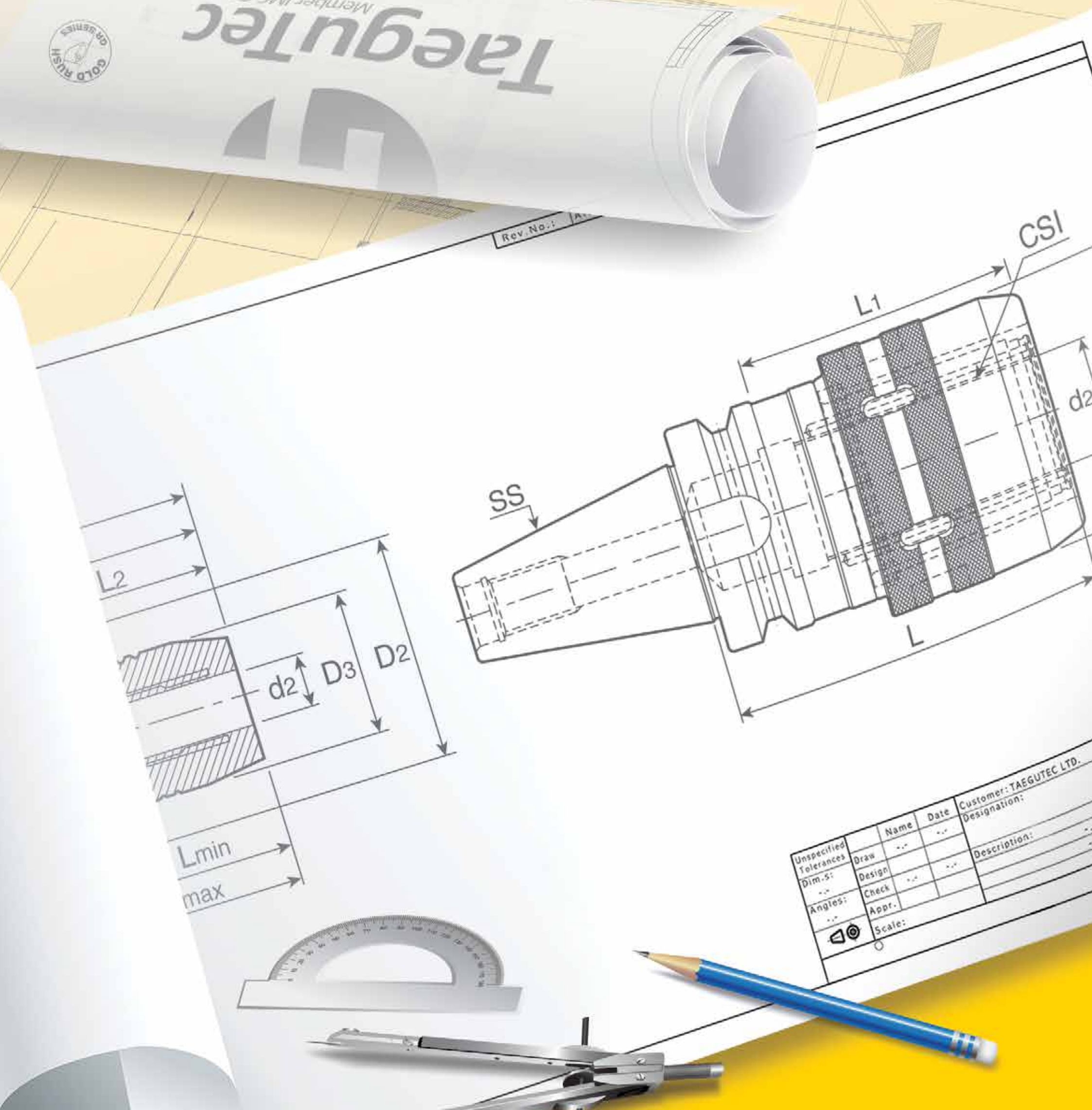
Material	Graphite	
Diameter	RPM	Feed
3	40000	4200
4	40000	6000
5	40000	7200
6	40000	8400
8	32000	8400
10	26000	8600
12	21000	8200



▶ DER 3...L

Material	Graphite	
Diameter	RPM	Feed
4	40000	6000
5	40000	7200
6	40000	8400
8	32000	8400
10	26000	8600
12	21000	8200





TECHNICAL GUIDE

-Tooling System

Contents

Sealed collet

- Application

ER collets are used for applications requiring through coolant, as well as for standard cutting tools such as drills, boring bars, end mills, reamers, taps and special tools.
They provide an effective solution for accurate controled coolant flow.
Front sealing collets are available for advanced high speed machines with through coolant spindles/turrets.
They provide maximum performance, high cutting speeds, extended tool life and high quality surface finish.

- Features

- A revolutionary high precision front sealing collet with 1.00mm collapsibility that has through coolant capability
- Increased machining efficiency
- Extended tool life
- Has powerful gripping and parallel clamping
- Front sealing provides protection from contamination
- Fast chip removal from work piece

- Advantages

- High-pressure coolant supply up to 100 bar
- Eliminates coolant flow interference

- Notes

- For maximum security and clamping power, the cutting tool shank must be inserted into the collet to a minimum depth of 2 X shank diameter
- In sealed collet JET2 the nozzle must be adjusted directly to the flute of the cutting tool
- Suitable for all shank standards

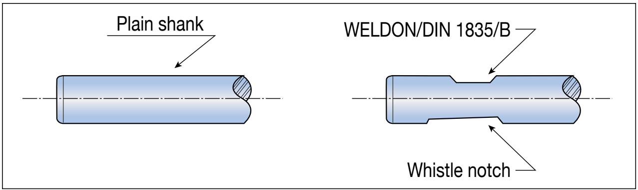
TaeguTec ER coolit sealed collet

- Two types:

Sealed collet JET
For straight shank cutting tools with internal coolant supply

Sealed collet JET 2
With angular double nozzle.
Coolant flow is direct to the cutting edge
- For use with standard straight shank cutting tools (Without coolant hole)

Shank standards



ER - Top clamping nut DIN6499

■ Description

The friction ER Nut has a unique two piece exclusive friction mechanism combining radial and angular self-centering movements.

■ Features

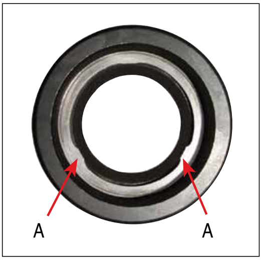
- Unique two piece friction bearing
- Radial and angular float for better concentricity
- Powerful gripping force, 50-100% higher than standard ER nut due to the friction bearing mechanism
- Balanced for higher spindle speed due to unique extractor teeth design
- Compact design: General dimensions and size range are the same as the standard nut sealed design for use with sealed collets.

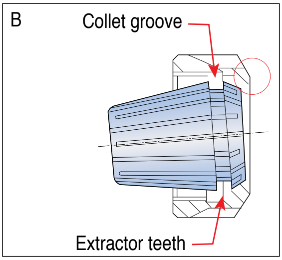
■ Operation

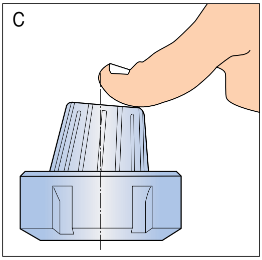
To insert collet: Always assemble the collet into the nut before mounting onto the collet chuck.

■ Inserting procedure

Insert the collet slantwise, fitting the two protruding extractor teeth (A) into the collet groove (B).
Place the two parts onto a clean and horizontal surface.
Press down with your thumb on the back end of the collet until it clicks into place (C).







■ Important

Never insert the collet parallel to the extractor ring. This will chip or break the teeth of the extractor.
When unclamping the nut, the collet will self release from the chuck by means of the extractor teeth.

ER - Top clamping nut DIN6499

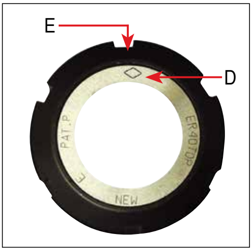
▪ Extracting procedure

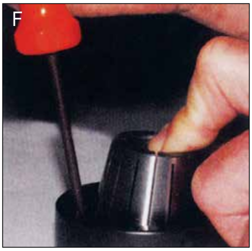
❶ Align the diamond-shaped engraved logo which is on the silver ring (D) to any of the key slots (E) of the nut.

❷ Place the nut with the collet facing down on a clean and horizontal work surface.

❸ Insert a screwdriver vertically between the nut slots and the collet - on the reverse side of the diamond shaped engraved logo (D).

❹ Tilt the screwdriver outwards while helping the extraction by pushing the back of the collet in the opposite direction (F).





Note:
For maximum performance the clamping nut thread and collet taper must be cleaned and oiled before use.
Recommended clamping torque for standard ER & ER-Top clamping nut.

Nut type	Kg × m
ER-11	5
ER-11M	3
ER-16	7
ER-16M	4
ER-20	12
ER-20M	8
ER-25	20
ER-32	22
ER-40	25
ER-50	35

Important:
The torque is calculated to suit the maximum diameter capacity of each collet. The torque should be gradually reduced when used with a smaller shank size.

TSK slim collet chuck

■ Features & advantages
- Excellent accuracy & good gripping power by gentle taper angle (ER collet : 8º, TSK collet : 4º)
- Slim design for deep and cavity machining
- Suitable on high speed machining
- Variety of TSK collets (Normal & coolant type)
- General machining using drill & end mill

■ Application
- General machining using drill & end mill
- High speed machining for mold & die industry
- Accurate machining using reamer & end mill

■ How to assemble the collet with a nut

a. Assembly device
(Provided with the set)

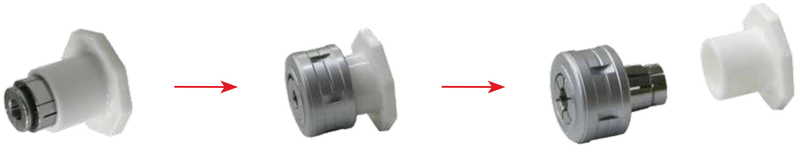
b. Nut

c. Collet

❶ Insert the back end of the collet (c) into the assembly device (a)

❷ Insert the combined part (a+c) in the nut (b)

❸ Pluck out the assembly device (a) from the remaining part (b+c)

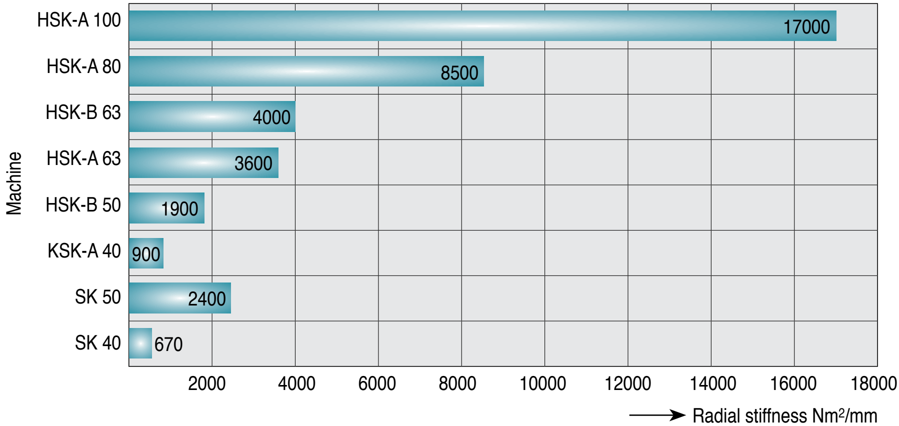


HSK (DIN69893) system

■ Features

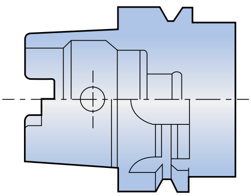
- DIN standard
- For high speed machining
- Size: #32, 40, 50, 63, 100
- For A.T.C. & manual machine
- Double face contact
- High stiffness

Radial stiffness of different machine tool interface

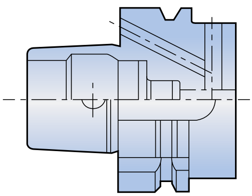


Type

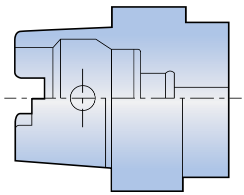
■ A type: Automatic tool change



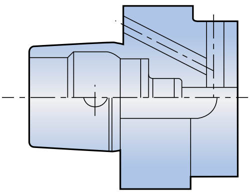
■ B type: With coolant through face



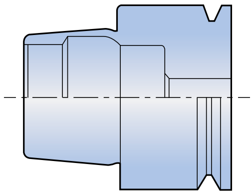
■ C type: Manual clamp



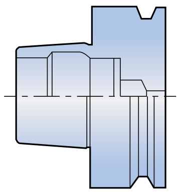
■ D type: With coolant through face



■ E type: Super high speed



■ F type: Ultra high speed

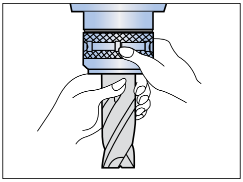


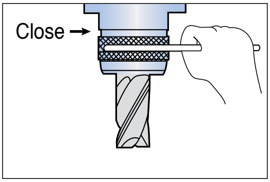
Milling chuck

- Exceptional gripping power and simple operation

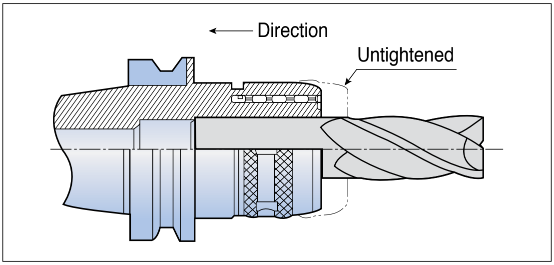
- Torque

Type	Torque (kgf•m)
TMC 25	160
TMC 32	300
TMC 42	500



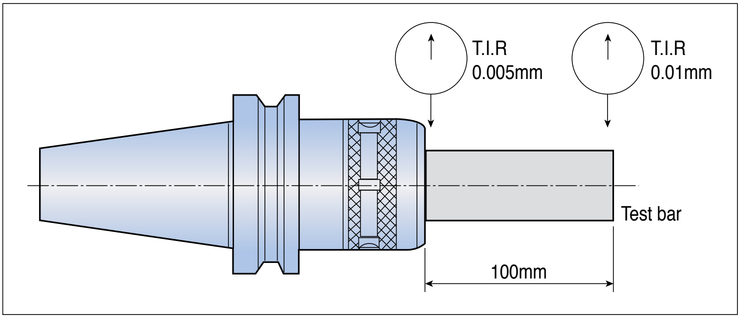


Tighten slightly when collar
is close to body (Avoid hammering)



- Improved accuracy prolongs tool life

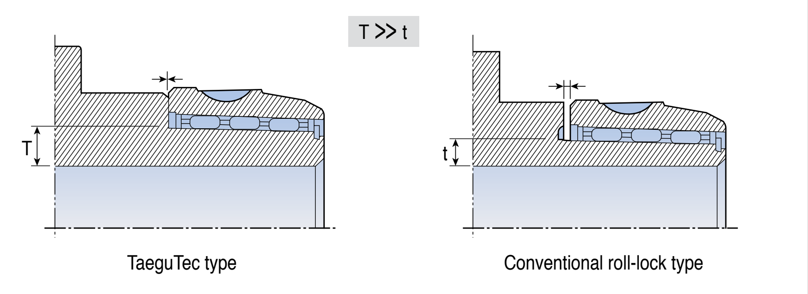
The accuracy and low runout has been achieved by utilizing precise grinding and spiral laser slitting to avoid damage and tool distortion.



Contents

- Improved rigidity

Improved rigidity and body stiffness is achieved by maximising body thickness.
This is again achieved via the laser machined spiral slit.

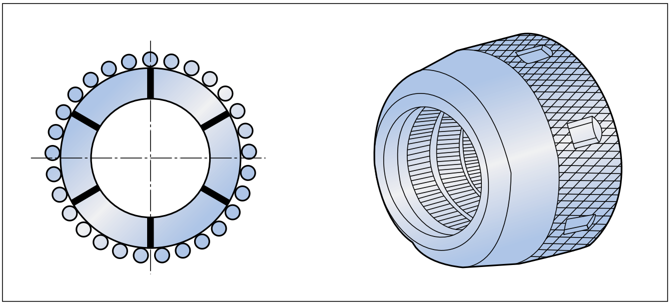


- Excellent durability

Excellent durability through dispersing surface pressure on the roller by maximizing number of rollers in the retainer

Type	TaeguTec	A Co.	B Co.
Ø32	60	55	60
Ø42	75	72	72

< Number of rollers in one row >



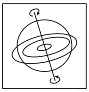
Quick-change system

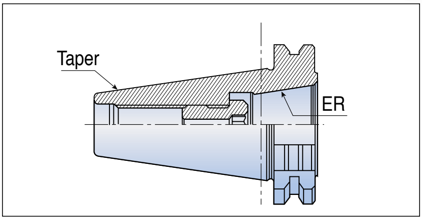
- DIN 69871
  HSK
  BT MAS 403

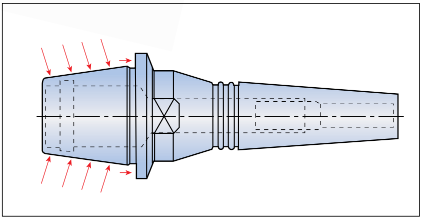
- T-CLICK advantages
- Taper and face contact
- Ideal for high speed machining
- High precision: Low run-out
- Excellent rigidity
- Quick and easy clamping

- Quick-change advantages
- Quick tool change: The taper shank and the holder connect in a quick half turn
- No thermal shock on holder taper
- Flexibility in diameter and length
- Eliminates the use of extension chuck
- No spare parts required
- T-CLICK blanks available to provide custom made tooling
- Shrink clamping for solid carbide tooling
  Tightening torque: 235N•m

G2.5
20,000 RPM







Balanceable collet chuck system

- Direct reading precision rings for high grade balance
- Simple procedure on all types of balancing machines
- Static and dynamic balance

DIN 69871
HSK
BT MAS 403

■ Operating instructions

The following procedure should be adjusted according to the specific type of balancing machine being used.

❶ Loosen the 3 locking screws on the angle reference ring (blue).
Align the two balancing rings (gold-colored) to the ‘0’ position on the angle reference ring.
After the rings are all aligned, tighten the 3 locking screws.

❷ Insert the collet chuck into the spindle and tighten it using the pull stud.
Insert the cutting tool into the collet chuck, adjust to desired projection and clamp it.

❸ Enter the required parameters on the balancing machine: balancing grade (G..), RPM, etc.

❹ Run a test with the assembled collet chuck on the balancing machine.
Read the results for the unbalance angle orientation and the gr x mm unbalance value.

❺ Loosen the 3 locking screws on the angle reference ring and align the two balancing rings with the measured unbalance value. Rotate both balancing rings to the unbalance angle on the angle reference ring (or to the laser mark on balancing machines with a laser indicator). Tighten the locking screws.

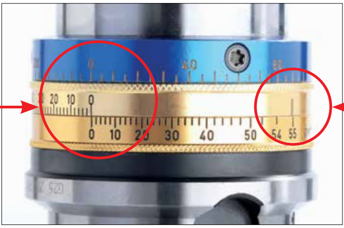
❻ Run a second test with the assembled collet chuck and read the results.

- Note: The reading should be within tolerance or very close.

■ If the necessary balance on the machine has been achieved, the tool is ready for operation.
If the balance is out of tolerance, one of the following procedures should be performed:

- First option
  a) IF unbalance is within 0-3 gr x mm and within ± 20° from original angle,
  THEN increase the original value of gr x mm on the balancing rings according to the reading on the machine, without changing the original angle position.
- Second option
  a) IF unbalance is within 0-3 gr x mm at an angle of approximately 180° from original angle,
  THEN decrease the original value of gr x mm on the balancing rings according to the reading on the machine without changing the original angle position.
- Third option
  a) IF unbalance is less than 1 gr x mm at an angle between 20° to 90° from the original angle,
  THEN rotate both balancing rings approximately 5° towards the indicated direction.
- Fourth option
  a) On some balancing machines it is possible to adjust the unbalance by rotating the peak point marked on the balancing rings to the required angular position.

"0" position balance to G2.5 20K



Peak point

Hydraulic chuck

■ Features & advantages
- Consistent gripping force
- Excellent accuracy (Run-out : within 5㎛)
- Convenient and safe tool change using a clamping screw
- Can use THC straight collets (Normal & coolant type)

■ Application
- Accurate machining
  a) Fine milling, reaming, fine boring
- Drilling: Small diameter using carbide drill
  a) For Al or Cast iron

■ Operation
- Tool mounting
  a) Insert the tool shank between Lmax and Lmin (Fig 1.) and then, turn the clamping screw clockwise until it can no longer rotate.
- Tool releasing
  a) To release the tool from the hydraulic chuck, turn the clamping screw in a counter clock-wise direction approximately 5 or 6 evolutions and remove the tool shank.
- Notice
  a) Eliminate grease, coolant oil and any dirt from the internal bore of the hydraulic chuck and tool shank prior to mounting.
  b) Ensure the minimum chucking length (Lmin) is maintained. (see Fig 1. & Table 1.)
  c) Cylindrical tool shanks available in accordance with h6 tolerance (Table 2.) and Ra min =0.3㎛ (ground) and weldon shanks should be used in collet only.
  d) Remove the end tool from the hydraulic chuck when not in use for long periods of time.
  e) Do not turn the clamping screw prior to tool mounting in the hydraulic chuck.

* Please refer to the backface for information tables.

Figure 1. Tool structure

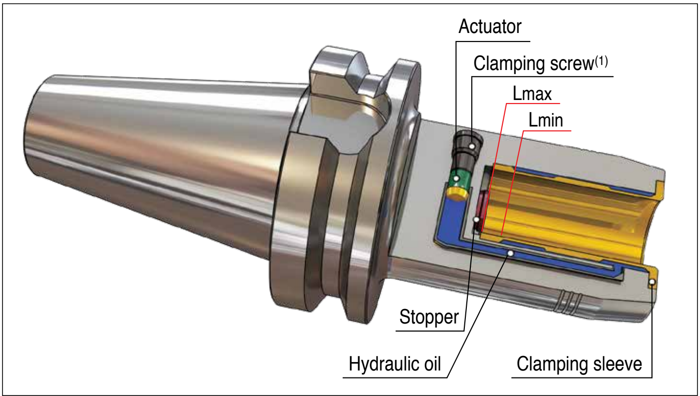


Table 1. Recommended minimum & maximum depth (L) of end tool insertion

Inner bore diameter Ø (mm)	Lmin (mm)	Lmax (mm)
6	27.5	37.5
8	27.5	37.5
10	32.5	42.5
12	37.5	47.5
14	37.5	47.5
16	42.5	52.5
20	42.5	52.5
25	51.0	61.0
32	55.0	65.0

Table 2. h6 tolerance range

Shank size Ø (mm)		h6 tolerance range (㎛)
	3	0
		-6
3	6	0
		-8
6	10	0
		-9
10	18	0
		-11
18	30	0
		-13
30	50	0
		-16

Table 3. Clamping torque

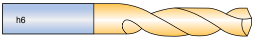
Inner bore diameter Ø (mm)	Clamping torque (N•m)
6	10
8	25
10	40
12	65
14	90
16	120
20	240
25	260
32	450

Thermal T-SHRINK chucking system

T-SHRINK chucking system

The thermal T-SHRINK ER collet chucking system is an enhancement to the existing popular ER system. The T-SHRINK collets utilize the thermal shrink phenomena for rigid clamping of solid carbide cutters. This new system provides higher torque, precision runout and better repeatability. The T-SHRINK collets with their slim design and different projection length allows the user to reach into deeper cavities and perform narrow milling applications. TaeguTec offers a complete system for T-SHRINK ER collets, including a uniquely designed heating unit with a portable heating handle. The unit is equipped with a high-tech temperature control for easy and practical use at the machining center or in the tool room.

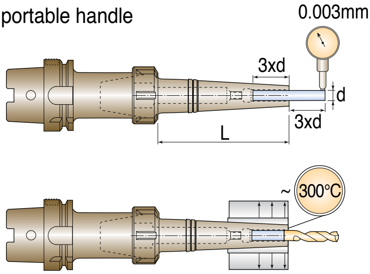
■ For carbide tools only

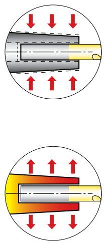


L(mm)	Max. T.I.R
35	7μm
60	9μm
85	10μm

■ Features

- Slim design to maximize effectiveness and application access
- Flexible: Fits into standard ER chucks
- High torque transfer
- Rigid clamping of carbide tools
- High precision: Low run-out
- Perfect repeatability
- Vibration damping
- Coolant JET2 available
- Symmetrical design for high speed machining
- Quick and easy tool changing
- Unique T-SHRINK heating unit with portable handle





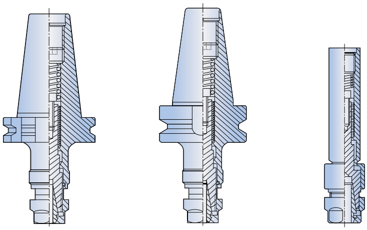
GTI-Tap attachment

■ Description

Short tap chucks for ER collets

■ Application

Axial-float/tension/compression type for CNC milling machines and lathes with reversing motors and rigid tapping



DIN 69871 BT MAS-403 Straight shank

■ Features

- Compensates for machine feed and tap pitch variance
- Floating mechanism compensates for misalignment between tap and workpiece
- Right and left-hands tapping

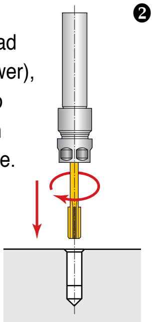
■ Advantages

- Practical and efficient tap holding by the ER spring collet without using drive jaw
- Compact design for minimal clearance applications
- Heavy-duty design for high torque drive ensures the same accuracy as the tap itself

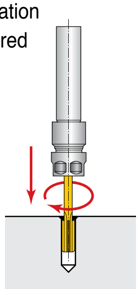
■ Operation

For through and blind hole tapping

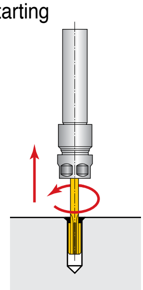
❶ Enter feed rate according to thread pitch (or 1-2% lower), and set spindle to starting point with 0.08mm clearance.



❷ Start spindle forward with right hand rotation until reaching desired depth.



❸ Stop feed and rotation and reverse to starting point.



Adjustable rotary toolholder indexable insert drills

■ Application

For use on machining centres and drilling machines

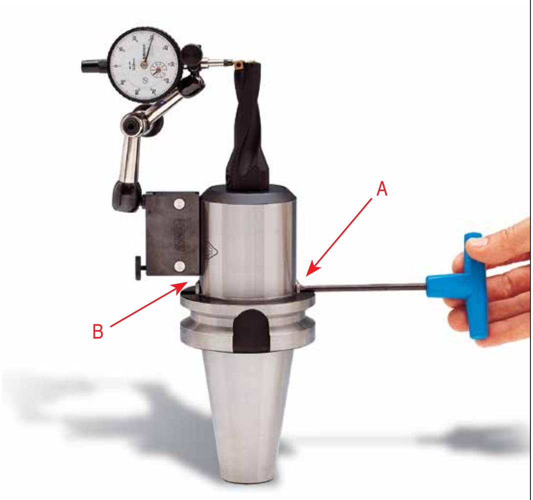
■ Features

- Diameter adjustment range – 0.30mm to +1.30mm
- Guaranteed bore tolerance of ±0.02mm
- Through the shank coolant design or "type B" coolant through the flange
- Coolant pressure up to 70 bar

■ Operation

<u>Best results are achieved on a preset machine or similar device.</u>

- Adjust with screws A or B. Preset should be made on a pre-setter to minus 0.3mm on required diameter
- Tighten the clamp screws A and B
- On the machine, make a test cut, measure the bore diameter and then adjust to required diameter
- Final adjustment to the desired diameter can be made on the machine with dial indicator or on the pre-setter



GYRO - Radial and angular alignment of toolholder

■ Advantages
- Easy adjustment for correcting misalignment between chuck and turret axis (drill and workpiece)
- Precise and efficient tool clamping with ER collets and ER sealed coolit jet collets
- Quick functional adjustment is made on machine by using plug and ring gauge kit

■ Operation

Operating instructions are included with each tool supplied.

■ Notes
- Coolant supply should be minimum 10 bar and maximum 80 bar for small diameter oil hole drills : Ranging from 3-20mm (the normal machine pressure of 4 bar is insufficient)
- Coolant filtration is important to eliminate chips from blocking the drill oil hole
- To ensure maximum performance of the GYRO, the backlash of the turret indexing and support axis mechanism should be checked and re-adjusted according to the machine standard

GYRO - Radial and angular alignment of toolholder

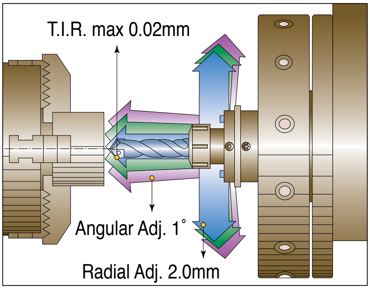
Adjustable toolholder for easy adjustment of radial and angular misalignment

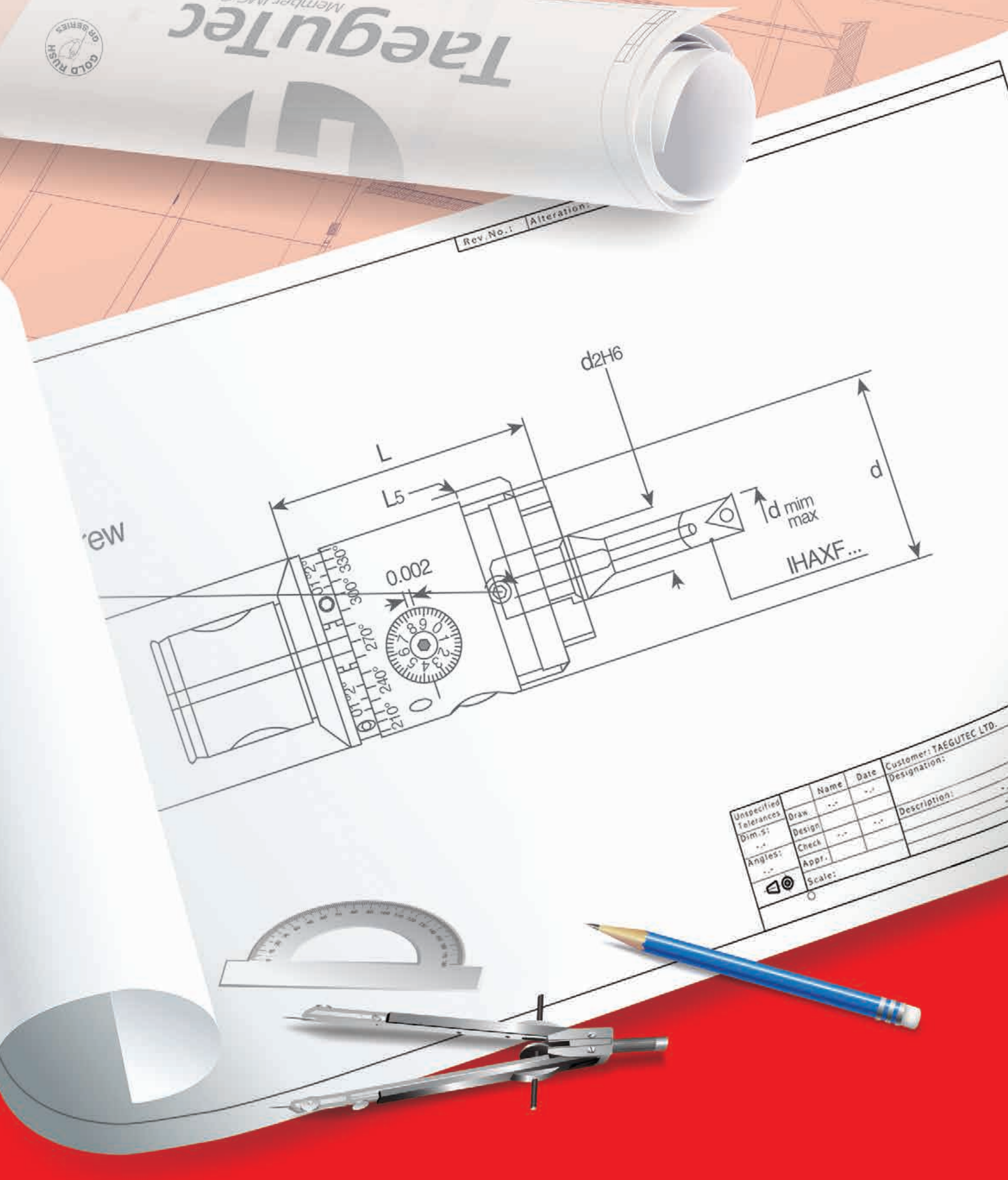
■ Application

Gyro is a rugged and adjustable toolholder to solve drilling, tapping and reaming problems encountered on CNC and turret lathes. Its unique design allows smooth and easy adjustment of radial and angular misalignment between chuck and turret.

Gyro reduces total machining time by making it possible to complete machining of holes in one drilling step and achieve tolerances as close as 0.01mm, thereby eliminating subsequent boring or reaming operations.
- A breakthrough in drilling technology for CNC lathes
- Dramatic increase in tool performance at reduced cost

■ Features
- Enables high precision drilling to a close tolerance of 0.01mm, to be performed as a final boring operation on CNC lathes
- Reduces machining cycle time by completing the bore in one drilling step, eliminating secondary turning and boring operations
- Prolongs tool life tenfold, especially when using HSS, solid and brazed carbide drills, taps and reamers
- Permits increase in speeds and feeds by up to 300%
- Coolant supply through the centre of the unit via the tool shoulder for oil fed drilling





TECHNICAL GUIDE

-MPT(Modular Precision Tooling)

Contents

Operating Instructions

Fine boring head BHF 16-50 and BHE

- Assembly

- When mounting the BHF boring head, the expanding pin should be kept tightly inside the cylindrical body
- Insert the BHF into the shank
- Tighten the pin ❷ by turning clockwise
  The recommended tightening torque guidelines are as follows:

Recommended Torque	(N·m)
BHF MB16 - 16 x 34	2.0 - 2.5
BHF MB20 - 20 x 40	4.0 - 4.5
BHF MB25 - 25 x 50	6.5 - 7.5
BHF MB32 - 32 x 63	7.0 - 8.0
BHF MB40 - 40 x 80	16.0 - 18.0
BHF MB50 - 50 x 60	30.0 - 35.0

- Insert screw ❺ until it completely enters the recess in the sleeve nut or boring bar

- Disassembly

- Loosen the pin ❷ by turning counter-clockwise

- Positioning

- Loosen the screw ❹ before making any slide adjustment
- By turning the graduated dial ❸ counterclockwise,
  set the tool slide ❼ allowance for a 4mm adjustment
- Lock the tool slide by means of screw ❹ , to the desired position
- Lock the screw ❹
- When making any slide adjustment, firstly loosen the screw ❹

- Maintenance

Weekly:
- Lubricate through the oiling nipple ❽ with ISO UN G220 oil

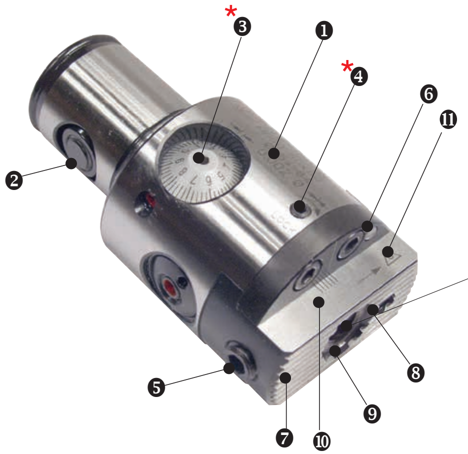
Periodically:
- Clean the conical cylindrical surface and then lubricate
- Grease the expanding pin ❷ with an anti-friction lubricant
- Clean and lubricate the tool slide guideway

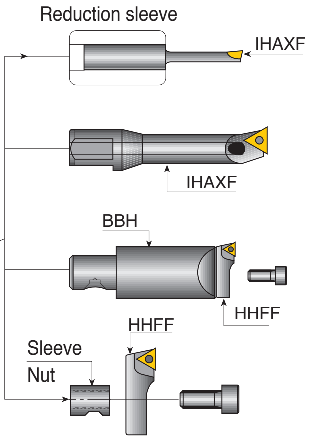
- Important note:

- Toolholder should be firmly affixed to the slide at all times

* Due to back-lash phenomenon, if you pass the required value, turn the dial ❸ in the reverse direction at least one rotation and then re-adjust in the original direction

Operating Instructions





- ❶ Body
- ❷ Expanding pin
- *❸ Graduated dial
- *❹ Slide locking screw
- ❺ Toolholder locking screw
- ❻ Coolant nozzle
- ❼ Slide holder
- ❽ Oiling nipple
- ❾ Tool bore .63H7
- ❿ Slide adjusting range
  Do not exceed the range marks!!
- ⓫ Cutting edge position mark

Operating Instructions

▶ Fine boring head BHF 63-125

■ Assembly

- When mounting the BHF boring head, the expanding pin should be kept tightly inside the cylindrical body
- Insert the BHF into the shank
- Tighten the pin ❷ by turning clockwise

  The recommended tightening torque guidelines are as follows:

Recommended Torque	(N·m)
BHF MB50 - 63 x 87	30 - 35
BHF MB50 - 80 x 94	30 - 35
BHF MB63 - 63 x 87	80 - 90
BHF MB80 - 80 x 94	80 - 90
BHF MB80 - 125 x 94	80 - 90
BHF MB50 - 50 x 60	30.0 - 35.0

- Insert screw ❺ until it completely enters the recess in the sleeve nut or boring bar

■ Disassembly

- Loosen the pin ❷ by turning counter-clockwise

■ Positioning

- Loosen the screw ❹ before making any slide adjustment
- By turning the graduated dial ❸ counterclockwise,
  set the tool slide ❼ allowance for a 4mm adjustment
- Lock the tool slide by means of screw ❹, to the desired position
- Lock the screw ❹
- When making any slide adjustment, firstly loosen the screw ❹

■ Maintenance

Weekly:

- Lubricate through the oiling nipple ❽ with ISO UN G220 oil

Periodically:

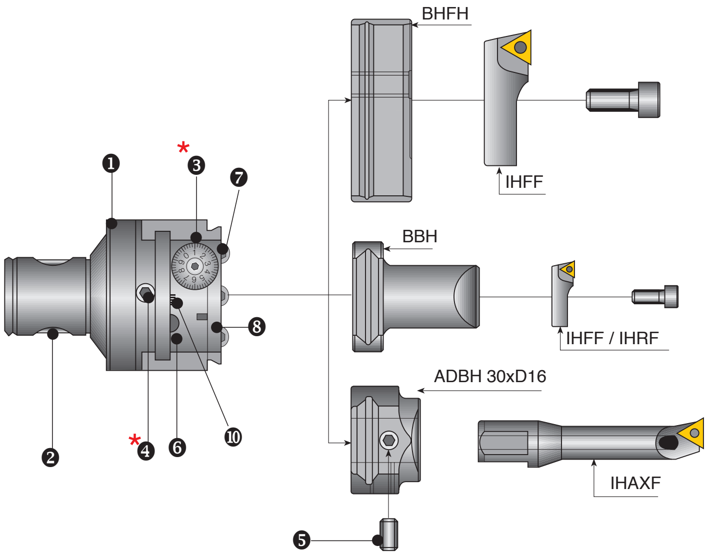
- Clean the conical cylindrical surface and then lubricate
- Grease the expanding pin ❷ with an anti-friction lubricant
- Clean and lubricate the tool slide guideway

■ Important note:

- Toolholder should be firmly affixed to the slide at all times

* Due to back-lash phenomenon, if you pass the required value, turn the dial ❸ in the reverse direction at least one rotation and then re-adjust in the original direction

Operating Instructions



1 Body
2 Expanding pin
*3 Graduated dial
*4 Slide locking screw
5 Toolholder locking screw
6 Coolant nozzle
7 Slide holder
8 Oiling nipple
9 Toolholder locking screws
10 Slide adjusting range
Do not exceed the range marks!!

TECHNICAL GUIDE

-Grades

Contents

Grades Classification

The TaeguTec coated grades are produced from a specialized technical process that incorporates CVD and PVD products that cover a wide cutting range. This range includes grades for high speed machining to heavy rough machining. Such diversity is possible with TaeguTec's high wear resistant ceramic coating layer that has characteristics such as chipping-resistance on hard and/or toughened substrates.

CVD coated products have two main coating layers that are strengthened MT CVD TiCN and a microstructure-controlled Alpha Alumina with specially designed substrate that toughens the cutting edge. The PVD coated products have been developed with a combination of TiAlN, AlTiN and AlTiCrN that is produced with TaeguTec's unique process of controlling the nano-scale structure and residual stresses.

Following the coating process, TaeguTec introduces its 'GOLD-RUSH' concept, this smooth new coating surface with a shiny yellow color gives the cutting edge lower friction and an anti-adhesion to the material during machining.

The best performance in each application is a result of selecting the suitable combination of grade and geometry according to the machining environment. This accounts for the workpiece materials, cutting conditions, coolants and machine.

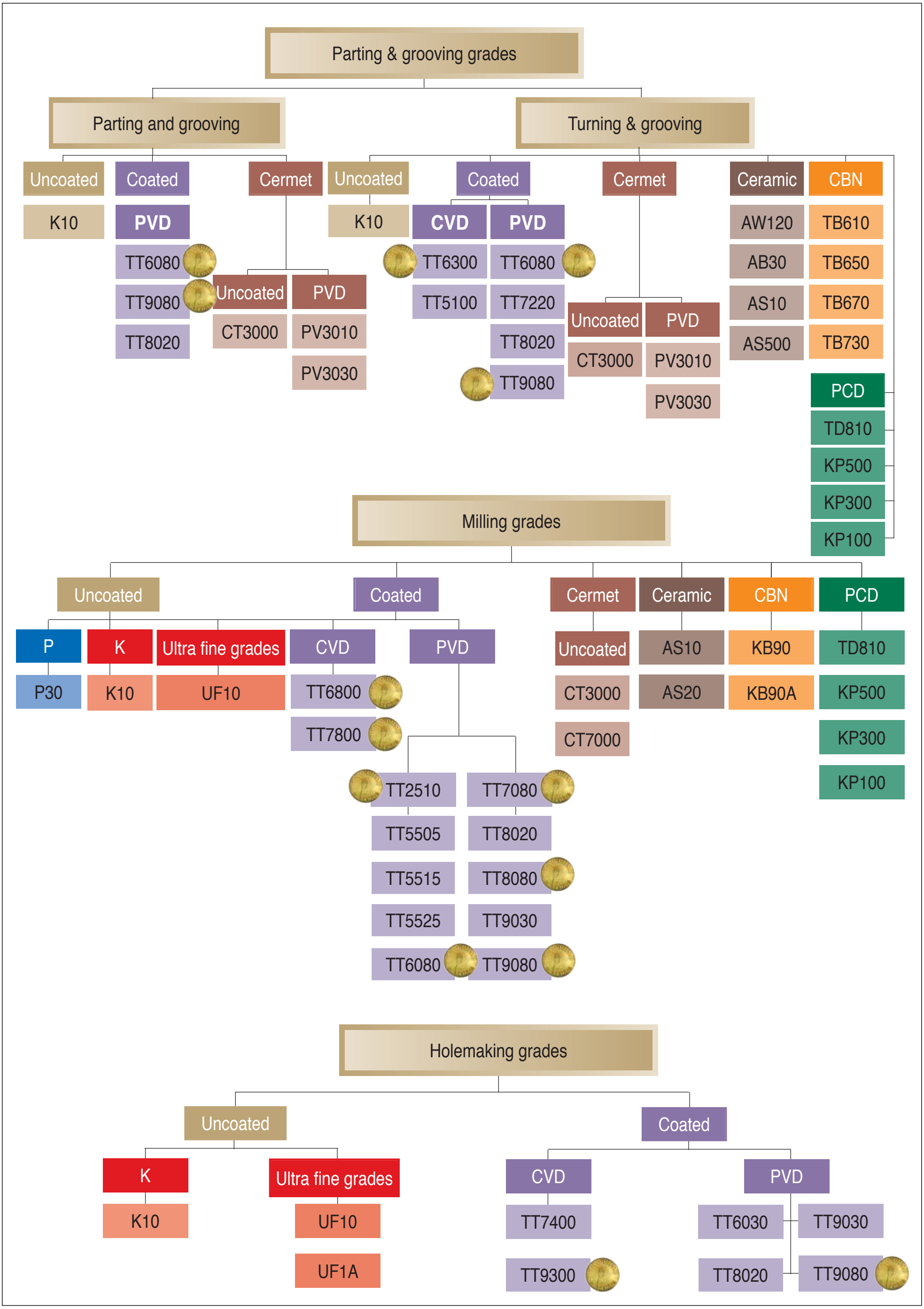
Turning grades

- Uncoated
  - P: P20, P30
  - K: K10
- Coated
  - CVD: BLACK-RUSH TT7005, BLACK-RUSH TT7015, TT7310, TT8115, TT8125, TT8135, TT5100, TT7100, TT9215, TT9225, TT9235
  - PVD: TT5080, TT9080, TT8020
- Cermet
  - Uncoated: CT3000
  - PVD: PV3010, PV3030
- Ceramic
  - Uncoated: AW120, AB20, AB30, TC430, AS500, AS10, AS20
  - CVD: SC10
  - PVD: AB2010
- CBN: TB610, TB650, TB670, TB730, KB90A
- PCD: TD810, KP500, KP300, KP100

Threading grades

- Uncoated
  - P: P30
  - K: UF10
- Coated
  - PVD: TT7010, TT8010, TT9030

Grades Classification



Technical Guide

Grades Recommendation

For turning

Materials	Carbon steel, Alloy steel, Mild steel	Cast iron
Cutting condition	Finish-light / Medium / Rough	High speed / Finish / Medium
ISO	P01 / P10 / P20 / P30 / P40 / P50	K01 / K10 / K20 / K30
Coated	TT5100, TT7100, TT8020, TT8115, TT8125, TT8135	TT7005 BLACK RUSH, TT7005(TT7310) BLACK RUSH
Coated Cermet	PV3010	
Cermet	CT3000	CT3000
Uncoated	P20, P30	K10, K20
Coated Ceramic		SC10
Ceramic		AW120, AB30, AS500, AS10
CBN		TB730, KB90A
PCD		

Materials	Hardened steel	Stainless steel	Heat resistant alloy	Non-ferrous
Cutting condition	Finish / Medium	Finish-light / Medium	Finish / Medium	Finish / Medium
Coated		TT5080, TT9080, TT8020, TT9215, TT9225, TT9235	TT5080, TT8020, TT9215, TT9225, TT9235	
Coated Cermet		PV3010		
Cermet		CT3000		
Uncoated				K10
Coated Ceramic				
Ceramic	AB2010, AB20, AB30		AS20, TC430	
CBN	TB610, TB650, TB670		TB730	TD810
PCD				KP500, KP300

Grades Recommendation

For threading

Materials	Carbon steel, Alloy steel, Mild steel					
Cutting condition	High Speed	Finish-light		Medium	Rough	
ISO		P01	P10	P20	P30	P40
Coated				TT7010	TT8010	
				TT9030		
Cermet						
Uncoated					P30	

Materials	Cast iron			
Cutting condition	High Speed	Finish	Medium	
ISO		K01	K10	K20
Coated			TT9030	
Cermet				
Uncoated			UF10	

Materials	Hardened steel		Stainless steel		Heat resistant alloy		Non-ferrous	
Cutting condition	Finish	Medium	Finish-light	Medium	Finish	Medium	Finish	Medium
Coated		TT7010	TT8010		TT8010			TT9030
		TT9030	TT9030		TT9030			
Cermet								
Uncoated					UF10		UF10	

For parting & grooving

Materials	Carbon steel, Alloy steel, Mild steel						
Cutting condition	High Speed	Finish-light		Medium	Rough		
ISO / ANSI		P01	P10	P20	P30	P40	P50
Coated				TT5100			
				TT9080			
					TT7220		
					TT8020		
Coated			PV3030				
Cermet			CT3000				
Uncoated							
Ceramic							
CBN							
PCD							

Materials	Cast iron				
Cutting condition	High Speed	Finish	Medium		
ISO / ANSI		K01	K10	K20	K30
Coated			TT6080		
		TT6300			
Coated					
Cermet					
Uncoated			K10		
Ceramic		AB30			
CBN		KB90			
PCD					

Materials	Hardened steel		Stainless steel		Heat resistant alloy		Non-ferrous	
Cutting condition	Finish		Finish-light	Medium	Finish	Medium	Finish	Medium
Coated			TT5100					
			TT9080		TT9080			
				TT8020		TT8020		
Coated			PV3030					
Cermet			CT3000					
Uncoated					K10			K10
Coated								
Ceramic	AB30							
CBN	TB610							
PCD		TB650					KP300	
		TB670						

Grades Recommendation

For milling

Materials	Carbon steel, Alloy steel, Mild steel	Cast iron
Cutting condition	High speed / Finish-light / Medium / Rough	High speed / Finish / Medium
ISO	P01 / P10 / P20 / P30 / P40(M40)	K01 / K10 / K20 / K30
Coated	TT2510,TT5505 TT7080 TT5515 TT7800 TT8020 TT8080 TT5525, TT9030, TT9080	TT6080 TT6800
Coated Cermet	CT3000 CT7000	CT7000
Uncoated	P30	K10
Coated Ceramic		AS10
CBN	KB90 KB90A	KB90 KB90A
PCD		

Materials	Hardened steel	Stainless steel	Heat resistant alloy	Non-ferrous
Cutting condition	Finish / Medium	Finish-light / Medium	Finish / Medium	Finish / Medium
Coated	TT2510,TT5505 TT5515 TT6080	TT8020 TT8080 TT5525,TT9030,TT9080 TT7800	TT8020 TT9030,TT9080 TT8080	TT6080 TT8020
Coated Cermet		CT3000 CT7000		
Uncoated				K10,UF10
Coated Ceramic			AS20	
CBN				KP500 KP300
PCD				

Grades Comparison Table

Turning grades

ISO class	TaeguTec	Sandvik	Walter	Seco	Kennametal	Mitsubishi	Sumitomo	Tungaloy	Kyocera	Korloy	Iscar
P	TT8115	GC4205 GC4005	WPP05	TP0500	KCP05	UE6105 UE6005	AC810P AC500G	T9105 T9005	CA5505		
P	TT8115	GC4215 GC4015	WPP10S WPP10	TP1500 TP1000	KCP10 KCP10B KC9110	UE6110 UE6010	AC1000 AC700G	T9115 T9015	CA515 CA5515	NC3010 NC3015	IC8150 IC9150
P	TT8125 TT5100	GC4325 GC4225	WPP20S WPP20	TP2500 TP2000	KCP25 KCP25B KC9125	MC6025 UE6020	AC820P AC2000 ACZ310	T9125 T9025	CA525 CA5525	NC3220 NC3120 NC3020	IC8250 IC9250
P	TT8135 TT7100	GC4235 GC4035 GC2135	WPP30S WPP30	TP3500 TP3000 TP40	KCP30 KCP40 KC9040	UE6135 UH6400	AC830P AC3000	T9135 T9035	CA5535 CR9025	NC3030 NC500H	IC8350 IC9350
M	TT9215	GC2015	WSM10 WAM10	TM2000 TP200	KCM15	MC7015 US7020 VP05RT	AC610M EH10Z	T6120	CA6515	PC8110 NC902	IC6015 IC807
M	TT9225	GC2025	WSM20 WAM20	CP500	KCM25	MC7025 US735	AC630M AC304	T6130 AH630 T6020	CA6525	NC9025	IC6025 IC9300
M	TT9235 TT8020	GC2035 GC30 GC235	WSM30 WAM30	TM4000 TP400	KCM35	UH6400 MP7035	AC3000	AH645 T6030	PR630	NC5330 PC9030	IC3028
K	TT7005	GC3205 GC3005	WKK10S WAK10	TK1001 TK1000	KCK05 KC9315	MC5005 UC5105	AC405K AC410K AC300G	T5105 T5010	CA4505 CA4010	NC6205 NC6105	IC5010 IC4028
K	TT7015 TT7310	GC3210 GC3015	WKK20S WAK20	TK2001 TK2000	KCK15 KCK15B KC9325	MC5015 UC5115	AC415K AC500G	T5115 T5020	CA4515 CA4115 CA4120	NC6210 NC6110	IC5005
K		GC3215	WAK30		KCK20		AC420K	T5125		NC315K	
S H	TT5080	GCS05F GC1105 GC1115	WSM10	TH1000 TH1500 TS2000 TS2500 CP200	KCU10 KC5510 KC5010	VP05RT VP10RT	AC510U EH510Z EH10Z	AH110	PR1005 PR930	PC8110	IC807 IC907
S H	TT9080	GC15 GC1125 GC1025 GC1515 GC1525	WSM20 WSM30	CP500	KCU25 KC5525 KC5025	VP15TF VP20RT	AC520U EH20Z	AH120	PR1025 PR1125 PR1225 PR1425	PC5300 PC9530	IC808 IC908

Grades Comparison Table

Milling grades

ISO class		TaeguTec	Sandvik	Walter	Seco	Kennametal	Mitsubishi	Sumitomo	Tungaloy	Kyocera	Korloy	Iscar
P		TT2510	GC1010 GC1030	WHH15 WXM15	MH1000 F15M MP1500 F30M	KC510M KC522M KC635M	MP8010 VP15TF				PC210F	IC903 IC900
P		TT7080 TT7030	GC4220 GC4230	WKP25 WAM10 WAM20	MP1500 MP2500 T250M				T3130 AH330	PR630 PR660 PR730	PC3600 PC3500 PC3535 PC3525	IC950
P		TT9080 TT9030	GC1030 GC4240	WAM30	F30M MP3000	KC522M KC635M	VP15TF VP20RT	ACP200	AH725 AH730 GH330 AH120	PR9925 PR830	PC5300 NC5330 PC9530	IC808 IC908
P		TT8080 TT8020 TT7800	GC4240 GC1040	WKP35 WXP45 WSP45	F40M T350M	KC725M KC735M KC935M KCPM20	VP30RT FH7020 F7030	ACP300 ACZ350	AH140 T3130 AH130		PC3545	IC830 IC330 IC928
M	S	TT9080 TT9030	GC1030 GC2030 S30T GC1025	WAM30 WXM35	MH1000 MP2500 F30M	KC635M	VP15TF	ACP200	T3130 AH725 AH120	PR730 PR830 PR9925 PR925 PR1025	PC5300 PC9530 NC5330	IC808 IC908
M	S	TT8080 TT8020	GC2040 S40T	WXM35 WSM35 WSP45	F40M MM4500 MS2500	KC725M	F7030 VP30RT MP9030	ACP300 EH20Z EH520Z	AH130 AH140 SH730	PR1225 PR905	PC3545 PC5300	IC830 IC330 IC928
K		TT6800	GC3220 GC4220	WAK15	MK1500 MP1500	KC915M KCK15	MC5020				PC8110	IC5100
K		TT6080	GC1020 GC4230 GC3040 GC4240	WKP25 WKP35	MK2050 MK2000 MK3000	KCK15 KC520M	MP8010 VP15TF F5010	ACK200 ACK300 ACZ310	T1015 T1115 AH120 GH110	PR905 PR510 PR610	PC6510 PC215K PC5300	IC810 IC910

Grades Comparison Table

Cermet grades

ISO class	TaeguTec	Sandvik	Kennametal	Sumitomo	Kyocera	Tungaloy	Mitsubishi	Korloy	Seco	NTK	Ceramtec
P01	PV3030 PV3010		KT315	T110A T1000A T1500Z	PV30 TN30 PV7010	GT720 NS710	AP25N NX2525	CC105 CC115 CN1000		T3N	SC35
P10	CT3000	CT5005 CT5015 CT525 GC1525	KT5020 KT125 KT150	T1500A T1200A T2000Z	PV7020 PV7025 PV60 TN6010 TN6020 TN60	GT730 GT530 NS520 NS720	MP3025 UP35N	CN2000 CC125	TP1030 CMP CM	T15 C30 Q50	SC15 SC8015 SC7035 SC40
P20	CT7000	CT530	KT1120 KT175	T3000Z T130Z	TN100M TC60M PV90	NS730 NS530	VP45N NX99 NX3035	CN20 CN30	MP1020 TP1020 C15M	N20 Z15 C50 C7X	SC7015 SC60
P30				T250A T130A		NS740	NX4545			Q50 N40	
M01	PV3010 PV3030		KT315	T110A	PV30 TN30 PV7010	GT720 NS710	AP25N NX2525	CC105 CC115 CN1000		T3N	SC35
M10	CT3000	CT5005 CT5015 CT525 GC1525	KT5020 KT125 KT150	T1500A T1200A T2000Z	PV7020 PV60 TN6010 TN6020 TN60	GT730 GT530 NS520 NS720	MP3025 UP35N	CN2000 CC125	TP1030 CMP CM	T15 C30 Q50	SC15 SC8015 SC7035 SC40
M20	CT7000	CT530	KT1120 KT175	T3000Z T130Z	TN100M TC60M PV90	NS730 NS530	VP45N NX99 NX3035	CN20 CN30	TP1020 C15M	N20 Z15 C50 C7X	SC7015 SC60
M30				T250A T130A		NS740	NX4545			Q50 N40	
K01	PV3030		KT315	T110A T1000A T1500Z	PV30 PV7005 PV7020 PV60	NS710 GT720 NS720 NS520	AP25N NX2525	CN1000	CM	T3N Q15	SC8015
K10	CT3000	CT5015	KT125	T1200A T2000Z	TN60 TN6020	GT730 NS730 NS530		CN2000	C15M	T15 Z15 C7Z	SC7015
K20				T3000Z							

Grade Comparison Table

Ceramic grades

Application	Composition	TaeguTec	Sandvik	Kennametal	Ceramtec	NTK	Kyocera	Sumitomo	Ssang-yong
Cast iron	Al_2O_3	AW120	CC620		SN60 SN80	HC1 HW2	KA30		SZ200 SZ300
	Al_2O_3+TiC	AB30	CC650	KY1615	SH2 SH4	HC2 HC5 HC6	A65	NB90S NB90M	ST100 SD200 TC100 (PVD)
	SiAlON	AS500		KY300 KY1310 KYK10	SL506 SL508 SL606 SL608			SN200K SN2100K	
	Si_3N_4	AS10	CC6090 CC6091	KY1320 KY3500	SL500 SL808	SX1 SX2 SX6	KS500 KS6000 KS6050	NS260	SN26 SN300 SN400 SN500 SN600
	Si_3N_4+CVD	SC10	CC1690	KY3400 KYK25	SL550C SL554C SL654C SL658C SL854C SL858C	SP2 SP9	CS7050	NS260C	
Hardened steel	Al_2O_3+TiCN	AB20			SH2 SH4	HC2 HC5 HC7			ST300 ST500 ST700
	Al_2O_3+TiCN + PVD	AB2010	CC6050	KY4400		ZC4 ZC7	A66N PT600M	NB100C	TC300
Super alloy	Al_2O_3+SiCw	TC430	CC670	KY4300		WA1		WX2000	SW500 SW800
	Si_3N_4+TiN	AS20							
	SiAlON		CC6060 CC6065	KY2100 KY1540 KYS30 KYS25		SX5 SX7 SX9	KS6040		SN800 SN900

Grade Comparison Table

CBN grades

Application		TaeguTec	Tungaloy	Sandvik	Kennametal	Ceramtec	Seco	Sumitomo
Hardened steel	Continuous	TB610	BX310	CB7015	KB1610 KB5610 KB9610	WBN575	CBN10 CBN050C	BNX10 BNC100
	General	TB650	BX530 BX330 BXM20	CB7025	KB1625 KB5625	WBN570 WBN560	CBN100 CBN160C	BN250 BNX20 BNC160 BNC200
		TB670	BX360 BX380 BXC50		KB1630 KB5630	WBN555	CBN150 CBN100P	BN350 BNX25 BN500 BNC300
Cast iron	General	TB730(KB90)	BX930 BX850 BX950 BX470 BX480	CB7050	KB1345 KB9640	WBN735 WBN750	CBN200 CBN400C	BN100 BN700
	Solid CBN	KB90A	BX90S BXC90			WBN100 WBN100C	CBN300 CBN350	BNS800

PCD grades

ISO class	TaeguTec	Iscar	Tungaloy	Sumitomo	Sandvik	Kennametal	Mitsubishi	NTK	Kyocera	Seco
N01-N10	TD810		DX180	DA90		KD1425			KPD230	PCD30M
	KP500	ID8	DX160				MD203			PCD30
N05-N20	KP300	ID5	DX140	DA150	CD10		MD220	PD1	KPD010	PCD20
N15-N30	KP100		DX120 DX110	DA2200 DA1000		KD1400 KD1405	MD230	PD2	KPD001	PCD10 PCD05

Turning Chip Breaker Comparison Table

Negative insert

Description		TaeguTec	Sandvik	Kennametal	Seco	Walter	Valenite
Steel	Double sided	WS	WF, WL	FW	W-MF2	NF	W3
		WT	WMX,WM	MW	W-M3	NM	W6
		FA		FF FS	FF1		F2
		FG	QF	FP FN	MF2	NF3 FP5 NFT	
		FC	PF, LC XF			NS6	
		VF	K		95		
		ML	GP-	GP-K,MS- MS GP		G-NMT, NS4 NS5,G1	
		MP	XM QM	P	MF3	NM4	M2
		MC	SM	MN	MR3	MP3 NM4	
		PC	PM XMR		M3	NM6 MP5	
		MT		MP RP		NS8	M3
		MG-		UN	M4	MG-	
		RT	PR HM	UM RN MG-	M5 MR7, M6	NM5,NM7 NRT, RP5 NM6,NM9	R3
	Single sided	RX	PR	RM		NRF	
		RH	QR MR	RP	R6,RR9 R5,R4,37 RR6	NR6 NR5,NR8 NR7	R6
		HT, HD	HR, 31	RH	R8,56,57 R7	NRR	
		HY, HZ					
Stainless steel	Double sided	EA,SF	MF	FP	MF1	NF4	F5
		EM	MM	MU1, MS1 UP	MF4	NMS NM4	
		ET	MR MM-MR	RP	MR6, MF5 MM-RR6	NR4 NMS	M5
		SU	SF, SGF MX-SM, 23, SM SR, SMR	FH, FX MS, MH, MX			
Cast iron	Double sided	MT	KF,KM	FN	M5		
		MG-		RP		NM5, MK5	
		RT	KR	UN	MR7		

Mitsubishi	Sumitomo	Kyocera	Tungaloy	Korloy	Iscar
SW	LUW, SEW	WP	AFW	LW	
MW	GUW	WQ	ASW	VW,HW	WG
FH	FL,FA	GP, DP, XF	TF	HU	
		XP			SF
		PP	ZF		
SH	SU		ZM,TS, NS,NM	VG,HF,GF	NF
	SE		TSF	VF	
		HQ		VQ	
FY,SA	LU	CJ		VL, VB, HC	
LP		CQ,PQ			
ES	GX,HM		S		
FJ,SY		XQ	CB,17	HA	12
MJ		A3, AH		VP2	PP
	UP	XS			
				HS,GS, VP3	TF
					VL
				HC	
		GS	AS		
MP, MV	GE,GU	PS	TM	VM	
MA	UX,UG	HS		HM,GM	GN
		CS			
	UZ	MG-	38		
MG-		C	DM,MG-	B20,B25	MG-
			33,37		
MH,GJ	ME	GT,PT			
	MU, MX	PH,HT			
GH, RP			TH	HR, GR	NR
HAS,HDS					
		PX			
HZ	MP		TRS		RP
HA	HG	HX	57	GH	NM
HH	HP				
HC5	HF		65		
HX,HBS	HU		TU	VT,HH	
HV,HDS, HXD	HW			VH,B40	
FS	SU	MQ,GU		HA	
MS	EX	MU			
		MS	SS	VP3	
				HS	
	GU	HU	SM	GS	TNM
			HMM, SA		
			CF		
MA	UZ	MG-	CM		
MG-		C		B25	
GH	GZ	ZS, GC	CH	GR	

Turning Chip Breaker Comparison Table

▶ Positive insert

Description	TaeguTec	Sandvik	Kennametal	Seco	Walter	Valenite
Steel	WT	WM	MW	W-F2	PF	
	FA	PF,UF	UF,11,GM	FF1	PF4 PF5	
	SA					
	FG	UM XF	FP LF	F1	PS4 PS5	PM3 PM4
	PC	PM	MP		PF2	
	MT	XM PR,UR XR	MF	F2	PM5 E47, MT-	PM5
	PMR-	PMR-	PMR-		PMR-	
Aluminum	FL	AL	HP	AL	PM2	IL

Mitsubishi	Sumitomo	Kyocera	Tungaloy	Korloy	Iscar
MW					WG
FV	LU FP	XP GK, GP, DP	01,PF,PSF	HFP	38, PF
SMG	FC	CF, GF GQ GR	JS		
SQ,SV	FK SU SC,SK	XQ HQ		VF HMP,C05	SM 16, GT-
			PSS PS		
MQ,MV MT- G	SF,MU	MT-	PM	C25	14, 17 19, MT-
PMR-	UJ	GP,HQ G,PMR-	23		
AZ	AG	AH	AL	AR	AF, AS

Hardness Conversion Table

Vickers 50kg HV	Brinell HB10mm ball LOAD 3000kgf: Standard ball	Brinell HB10mm ball LOAD 3000kgf: Tungsten carbide ball	Rockwell: A scale 60kgf diamond brale HRA	Rockwell: B scale 100kgf 1/16in ball HRB	Rockwell: C scale 150kgf diamond brale HRC	Rockwell: D scale 100kgf diamond brale HRD	Shore's HS	Tensile strength N/mm² (kgf/mm²)
1900			93.1		80.5			
1800			92.6		79.2			
1700			91.9		77.9			
1600			91.3		76.6			
1500			90.5		75.3			
1450			90.1		74.6			
1400			89.6		74.0			
1350			89.1		73.4			
1300			88.7		72.7			
1250			88.3		72.1			
1200			87.9		71.5			
1150			87.5		70.9			
1100			87.1		70.3			
1050			86.6		69.6			
1000			86.2		68.9			
940			85.6		68.0	76.9	97	
920			85.3		67.5	76.5	96	
900			85.0		67.0	76.1	95	
880		(767)	84.7		66.4	75.7	93	
860		(757)	84.4		65.9	75.3	92	
840		(745)	84.1		65.3	74.8	91	
820		(733)	83.8		64.7	74.3	90	
800		(722)	83.4		64.0	74.8	88	
780		(710)	83.0		63.3	73.3	87	
760		(698)	82.6		62.5	72.6	86	
740		(684)	82.2		61.8	72.1	84	
720		(670)	81.8		61.0	71.5	83	
700		(656)	81.3		60.1	70.8	81	
690		(647)	81.1		59.7	70.5		
680		(638)	80.8		59.2	70.1	80	
670		630	80.6		58.8	69.8		
660		620	80.3		58.3	69.4	79	
650		611	80.0		57.8	69.0		
640		601	79.8		57.3	68.7	77	2205(210)
630		591	79.5		56.8	68.3		2020(206)
620		582	79.2		56.3	67.9	75	1985(202)
610		573	78.9		55.7	67.5		1950(199)
600		564	78.6		55.2	67.0	74	1905(194)
590		554	78.4		54.7	66.7		1860(190)
580		515	78.0		54.1	66.2	72	1825(186)
570		535	77.8		53.6	65.8		1795(183)
560		525	77.4		53.0	65.4	71	1750(179)
550	(505)	517	77.0		52.3	64.8		1750(174)
540	(496)	507	76.7		51.7	64.4	69	1660(169)
530	(488)	497	76.4		51.1	66.2		1620(165)
520	(480)	488	76.1		50.5	63.5	67	1570(160)
510	(473)	479	75.7		49.8	62.9		1530(156)
500	(465)	471	75.3		49.1	62.2	66	1459(153)
490	(456)	460	74.9		48.4	61.6		1460(149)
480	488	452	74.5		47.7	61.3	64	1410(144)

• Note: Gray figures come from ASTM E 140 table (Calculated by SAE-ASM-ASTM together)

Vickers 50kg HV	Brinell HB10mm ball LOAD 3000kgf		Rockwell				Shore's HS	Tensile strength N/mm^2 (kgf/mm^2)
	Standard ball	Tungsten carbide ball	A scale 60kgf diamond brale HRA	B scale 100kgf 1/16in ball HRB	C scale 150kgf diamond brale HRC	D scale 100kgf diamond brale HRD		
470	441	442	74.1		46.9	60.7		1570(160)
460	433	433	73.6		46.1	60.1	62	1530(156)
450	425	425	73.3		45.3	59.4		1459(153)
440	415	415	72.8		44.5	58.8	59	1460(149)
430	405	405	72.3		43.6	58.2		1410(144)
420	397	397	71.8		42.7	57.5	57	1370(140)
410	388	388	71.4		41.8	56.8		1330(136)
400	379	379	70.8		40.8	56.0	55	1290(131)
390	369	369	70.3		39.8	55.2		1240(127)
380	360	360	69.8	(110.0)	38.8	54.4	52	1250(123)
370	350	350	69.2		37.7	53.6		1170(120)
360	341	341	68.7	(109.0)	36.6	52.8	50	1130(115)
350	331	331	68.1		35.5	51.9		1095(112)
340	322	322	67.6	(108.0)	34.4	51.1	47	1070(109)
330	313	313	67.0		33.3	50.2		1035(105)
320	303	303	66.4	(107.0)	32.2	49.4	45	1005(103)
310	294	294	65.8		31.0	48.4		980(100)
300	284	284	65.2	(105.5)	29.8	47.5	42	950(97)
295	280	280	64.8		29.2	47.1		935(96)
290	275	275	64.5	(104.5)	28.5	46.5	41	915(94)
285	270	270	64.2		27.8	46.0		905(92)
280	265	265	63.8	(103.5)	27.1	45.3	40	890(91)
275	261	261	63.5		26.4	44.9		875(89)
270	256	256	63.1	(102.0)	25.6	44.3	38	855(87)
265	252	252	62.7		24.8	43.7		840(86)
260	247	247	62.4	(101.0)	24.0	43.1	37	825(84)
255	243	243	62.0		23.1	42.2		805(82)
250	238	238	61.6	99.5	22.2	41.7	36	795(81)
245	233	233	61.2		21.3	41.1		780(79)
240	228	228	60.7	98.1	20.3	40.3	34	765(78)
230	219	219		96.7	(18.0)		33	730(75)
220	209	209		95.0	(15.7)		32	695(71)
210	200	200		93.4	(13.4)		30	670(68)
200	190	190		91.5	(11.0)		29	635(65)
190	181	181		89.5	(8.5)		28	605(62)
180	171	171		87.1	(6.0)		26	580(59)
170	162	162		85.0	(3.0)		25	545(56)
160	152	152		81.7	(0.0)		24	515(53)
150	143	143		78.7			22	490(50)
140	133	133		75.0			21	455(45)
130	124	124		71.2			20	425(44)
127	121			69.8			19	(42)
122	116			67.6			18	(41)
117	111			65.7			15	(39)

• Note: Gray figures come from ASTM E 140 table (Calculated by SAE-ASM-ASTM together)

Material Conversion Table

According to VDI 3323 standard

Material group	AISI/SAE	Material No.	DIN	BS	EN	AFNOR
1	A 366 (1012) 1008	0.0030	C10	040 A 10 045 M 10 1449 10 CS		AF 34 C 10 XC 10
1		1.0028	Ust 34-2 (S250G1T)			A 34-2
1		1.0034	RSt 34-2 (S250G2T)	1449 34/20 HR, HS,CR,CS		A 34-2 NE
1		1.0035	St185 (Fe 310-0) St 33	Fe 310-0 1449 15 HR,HS		A 33
1	A 570 Gr. 33,36	1.0036	S235JRG1 (Fe 360 B) Ust 37-2	Fe 360 B 4360-40 B		
1		1.0037	S235JR (Fe 360 B) St 37-2	Fe 360 B 4360-40 B		E 24-2
1	1115	1.0038	GS-CK16	030A04	1A	
1	A 570 Gr. 40	1.0044	S275JR (Fe 430 B) St44-2	Fe 430 B FN 1449 43/25 HR, HS 4360-43 B		E 28-2
1		1.0045	S355JR	4360-50 B		E 36-2
1	A 570 Gr.50 A 572 Gr.50	1.0050	E295 (Fe 490-2) St 50-2	Fe 490-2 FN 4360-50 B		A 50-2
1	A 572 Gr. 65	1.0060	E335 (Fe 590-2) St 60-2	Fe 60-2 4360-55 E; 55 C		A 60-2
1		1.0060	St 60-2			
1		1.0070	E360 (Fe 690-2) St 70-2	Fe 690-2 FN		A 70-2
1		1.0112	P235S	1501-164-360B LT20		A37AP
1		1.0114	S235JU;St 37-3 U	4360-40C		E 24-3
1	A 284 Gr.D A 573 Gr.58 A 570 Gr 36;C A 611 Gr. C	1.0116	S235J2G3 (Fe 360 D 1) St 37-3	Fe 360 D1 FF 1449 37/23 CR 4360-40 D		E 24-3 E 24-4
1		1.0130	P265S	1501-164-400B LT 20		A 42 AP
1		1.0143	S275J0; St 44-3 U	4360-43C		E 28-3

SS	UNI	UNE	JIS	KS	GOST
	C 10 1 C 10	F.1511 F.151A	S 10C	SM 10C	10
	Fe 330,Fe 330 B FU		SS 330	SS 330	
	Fe 330 B FU				St2sp
1300	Fe 320	Fe 310-0			St0
1311 1312	FE37BFU	AE 235 B Fe 360 B			16D, 18Kp St3Kp
1311	Fe 360 B 1449 37/23 HR	AE 235 B Fe 360 B	STKM 12A;C	STKM 12A;C	
1325	Fe 330,Fe 330 B FU		SS 330	SS 330	
1412	Fe 430 B Fe 430 B FN	AE 275 B Fe 430 B FN	SM 400 A;B;C	SM 400 A;B;C	St4ps; sp
2172	Fe 510 B	AE 355 B			
1550 2172	Fe 490	a 490-2 Fe 490-2 FN	SS 490	SS 490	ST5ps; sp
1650	Fe 60-2 Fe 590	A 590-2 Fe 590-2 FN	SM 570	SM 570	St6ps; sp
	Fe 60-2				
1655	Fe 70-2 Fe 690	A 690-2 Fe 690-2 FN			
	Fe 360 C	AE 235 C			
	Fe 360 C	AE 235 C			
1312 1313	Fe 360 D1 FF Fe 360 C FN Fe 360 D FF Fe 37-2	AE 235 D Fe 360 D1 FF			St3kp; ps; sp 16D
		SPH 265			
1414-01	Fe 430 D	AE 275 D			

Material Conversion Table

▶ According to VDI 3323 standard

Material group	AISI/SAE	Material No.	DIN	BS	EN	AFNOR
1	A 573 Gr. 70 A 611 Gr.D	1.0144	S275J2G3 (Fe 430 D 1) St 44-3	Fe 430 D1 FF 4360-43 C; 43 D		E 28-3 E 28-4
1		1.0149	S275JOH; RoSt 44-2	4360-43C		
1		1.0226	DX51D; St 02 Z	Z2		GC
1	M 1010	1.0301	C10	040 A 10 045 M 10 1449 10 CS		AF 34 C 10 XC 10
1	A 621 (1008)	1.0330	DC 01 St 2; St 12	1449 4 CR 1449 3 CS		 TE
1	A 619 (1008)	1.0333	Ust 3 (DC03G1) Ust 13	1449 2 CR;3 CR		E
1	A 621 (1008)	1.0334	UStW 23 (DD12G1)			SC
1	A 622 (1008)	1.0335	DD13; StW 24	1449 1 HR		3C
1	A 620 (1008)	1.0338	DC04 St4; St 14	1449 1 CR;2 CR		ES
1	A 516 Gr. 65; 55 A 515 Gr. 65;55 A 414 Gr. C A 442 Gr.55	1.0345	P235GH HI	1501 Gr. 141-360 1501 Gr. 161-360; 151-360 1501 Gr. 161-400; 154-360 1501 Gr. 164-360; 161-360		A 37 CP;AP
1	(M) 1020 M 1023	1.0402	C22	055 M 15, 070 M 20 1499 22 HS, CS	2C/2D	AF 42 C 20; XC 25;1 C 22
1	1020	1.0402	C22	050A20	2C/2D	CC20
1	1020;1023	1.0402	C22	055 M 15, 070 M 20	2C	AF 42 C 20; XC 25;1 C 22
1		1.0425	P265GH H II	1501 Gr. 161-400;151-400 1501 Gr. 164-360; 161-400 1501 Gr. 164-400;154-400		A 42 CP; AP
1	A27 65-35	1.0443	GS-45	A1		E 23-45 M
1		1.0539	S355NH;StE 335			TSE 355-4
1		1.0545	S355N; StE 355	4360-50E		E 355 R
1		1.0546	S355NL;TStE 355	4360-50EE		E 355 FP
1		1.0547	S355JOH	4360-50C		TSE 355-3
1		1.0549	S355 NLH;TStE 355			
1		1.0553	S355JO;St 52-3U	4360-50C		E 36-3

SS	UNI	UNE	JIS	KS	GOST
1411, 1412 1414	Fe 430 B, Fe 430 C (FN) Fe 430 D (FF)	AE 275 D Fe 430 D1 FF	SM 400 A;B;C	SM 400 A;B;C	St4kp> ps; sp
1412-04	Fe 430 C	Fe 430 C			
1151 10	FeP 02 G	FeP 02 G			
	C 10 1 C 10	F.1511 F.151.A	S 10C	SM 10C	10
1142	FeP 00 FeP 01	AP 11	SPHD	SPHD	15kp
	FeP 02	AP 02	SPCD	SPCD	
	FeP 12	AP 12	SPHE	SPHE	10kp
	FeP 13	AP 13	SPHE	SPHE	08kp
1147	FeP 04	AP 04	SPCE	SPCE	08jU; JUA
1331 1330	FeE235, Fe 360 1 KW;KG Fe 360 2 KW;KG	A 37 RC I RA II	SGV 410, SGV 450, SGV 48, SPV 450;SPV 480	SGV 410, SGV 450, SGV 480, SPPV 450;SPPV 480	
1450	C 20 C 21, C 25	1 C 22 F.112	S20C	SM 20C	20
1450	C20, C21	F.112	S22C	SM 22C	20
1450	C 20; C 21;C 25	1 C 22F.112	S 20 C;S 22 C	SM 20 C;SM 22C	
1431 1430 1432	Fe 410 1 KW; KG; KT Fe 410 2 KW; KG	A 42 RC I A 42 RC II	SPV 315; SPV 355 SG 295; SGV 410 SGV 450; SGV 480	SPPV 315; SPPV 355 SG 295; SGV 410 SGV 450; SGV 480	16K 20K
1305					
2134-04	Fe 510 B	Fe 355 KGN			
2334-01	FeE 355 KG	AE 355 KG			
2135-01	FeE 355 KT	AE 355 KT			
2172-04	Fe 510 C	Fe 510 C			
2135	Fe 510 D	FeE 355 KTM			
	Fe 510 C				

Material Conversion Table

According to VDI 3323 standard

Material group	AISI/SAE	Material No.	DIN	BS	EN	AFNOR
1	A 633 Gr.C A 588	1.0562	P355N StE 355	1501 Gr.225-490A LT 20		FeE 355 KG N E 355 R/FP; A 510 AP
1		1.0565	P355NH; WStE 355	1501-225-490B LT 20		A 510 AP
1		1.0566	P355NL1; TStE 355	1501-225-490A LT 50		A 510 FP
1	1	1.0570	S355J2G3 St 52-3	Fe 510 D1 FF 1449 50/35 HR>HS 4360-50 D		E 36-3 E 36-4
1	1213	1.0715	9 SMn 28 (1SMn30)	230 M 07		S 250
1	1213	1.0715	9 SMn 28	230 M 07		S 250
1	12 L 13	1.0718	9 SMnPb 28 (11SMnPb30)			S 250 Pb
1	1108 1109	1.0721	10 S 20	(210 M 15)		10S20 10F 2
1	11 L 08	1.0722	10 SPb 20			10PbF 2
1	11 L 08	1.0722	10 SPb 20			10PbF 2
1	1215	1.0736	9 SMn 36 11SMn37)			S 300
1	12 L 14	1.0737	9 SMnPb 36 (11SMnPb37)			
1		1.0972	S315MC; QStE 300 TM	1501-40F30		E 315 D
1		1.0976	S355MC; QStE 360 TM	1501-43F35		E 355 D
1		1.0982	S460MC; QStE 460 TM	1501-50F45		
1		1.0984	S500MC; QStE 500 TM			E 490 D
1		1.0986	S500MC; QStE 500 TM	1501 - 60F55		E 560 D
1	1010	1.1121	CK 10 (C10E)	040 A 10		XC 10
1		1.1121	St 37-1	4360 40 A		
1	1015	1.1141	CK 15 (C15E)	040 A 15 080 M 15	32C	XC 12 XC 15 XC 18
1	1020 1023	1.1151	C22E CK 22	055 M 15 (070 M 20)		2 C 22 XC 18 XC 25
1	D 3	1.2080	X 210 Cr 12	BD 3		Z 200 C 12

SS	UNI	UNE	JIS	KS	GOST
2106	FeE 355 KG;KW	AEE 355 KG;DD	SM 490 A;B;C; YA;YB	SM 490 A;B;C; YA;YB	15GF
2106	FeE 355-2				
2107-01	FeE 355-3				
2132, 2133 2134, 2174	17GS 17G1S	AE 355 D Fe 510, D1 FF	SM 490 A;B;C; YA;YB	SM 490 A;B;C; YA;YB	17GS 17G1S
1912	CF SMn 28	F.2111 - 11 SMn 28	SUM 22	SUM 22	
1912	CF 9 SMn 28	11 SMn 28	SUM 22	SUM 22	
1914	CF 9 SMnPb 28	F.2112-11 SMnPb 28	SUM 22 L SUM 23 L, SUM 24 L	SUM 22 L SUM 23 L, SUM 24 L	
	CF 10 S 20	F. 2121 - 10 S 20			
	CF 10 SPb 20	F.2122-10 SPb 20			
	CF 10 SPb 20	10 SPb 20			
	CF 9 Mn 36	F.2113 - 12 SMn 35	SUM25	SUM25	
2642	FeE 355TM				
2662	FeE 490 TM				
	FeE 560 TM				
1265	C 10, 2 C 10 2 C 15	F-1510-C 10 K	S 9 CK S 10 C	S 9 CK S 10 C	08;10
1300					
1370	C 15 C 16	F.1110-C 15 F.1511-C 16 K	S 15 S 15 CK	SM 15C SM 15CK	15
1450	C 20 C 25	F.1120-C 25 K	S 20 C, S 20 CK S 22 C	SM 20 C, SM20 CK SM22 C	20
2642					

Material Conversion Table

▶ According to VDI 3323 standard

Material group	AISI/SAE	Material No.	DIN	BS	EN	AFNOR
1	A36		St 44-2	4360 43 A		NFA 35-501 E 28
1			StE 320-3Z	1 501 160		
1	A572-60	1.8900	StE 380	4360 55 E		
2	(M) 1025	1.0406	C 25	070 M 26		1 C 25
2		1.0416	GS-38			20-400 M
2	A 537 Cl.1 A 414 Gr. G A 612	1.0473	P355GH	19 Mn 6		A 52 CP
2	1035	1.0501	C 35	080 A 32, 080 A 35 080 M 36, 1449 40 CS		1 C 35 AF 55 C 35 XC 38
2	1045	1.0503	CF 45 (C45G)	060 A 47 080 M 46		XC 42 H 1 TS
2	1040	1.0511	C 40	080 M 40		1 C 40 AF 60 C 40
2		1.0540	C 50			
2	A27 70-36	1.0551	GS-52	A2		280-480 M
2	A148 80-40	1.0553	GS-60	A3		320-560 M
2	A738	1.0577	S355J2G4 (Fe 510 D 2)	Fe 510 D2 FF 1501 Gr.224-460 1501 Gr. 224-490		A 52 FP
2	1140	1.0726	35 S 20	212 M 36	8M	35MF 6
2	1146	1.0727	45 S 20 (46S20)			45 MF 4
2	1035 1041	1.1157	40Mn4	150 M 36	15	35 M 5 40 M 5
2	1025	1.1158	C25E CK 25	(070 M 25)		2 C 25 XC 25
2	1536	1.1166	34Mn5			
2	1330	1.1170	28Mn6	(150 M 28), (150 M 18)		20 M 5, 28 Mn 6
2	1330	1.1170	28Mn6	150 M 5		20 M 5
2	1330	1.1170	28Mn6		14A	20 M 5
2		1.1178	C30E; CK 30	080M30		XC 32

SS	UNI	UNE	JIS	KS	GOST
1411					
1421					
2145	FeE390KG		S 25C	SM 25C	
	C 25 1 C 25				
1306					
2101 2102	Fe E 355-2	A 52 RC I RA II	SGV 410 SGV 450 SGV 480	SGV 410 SGV 450 SGV 480	
1572 1550	C 35 1 C 35	F.113	S35C	SM35C	35
1672	C 43 C 46		S 45 C	SM 45 C	45
	C 40	1 C 40	S 40 C	SM 40 C	
1674	C 50	1 C 50			
1505					
1606					
2107		A 52 RB II AE 355 D			
1957		F.210.G			
1973					
			S 09CK	SMn 433	
C 25	F.1120 - C 25 K	S 25 C S 28 C	S 25 C	SM 25 C	
	TO.B	SMn 433 H			
1421	C 28 Mn	28 Mn 6	SCMn 1	SCMn 1	30G
2145					
	C 28 Mn		SCMn 1	SCMn 1	
	C 30	2 C 30			

Material Conversion Table

According to VDI 3323 standard

Material group	AISI/SAE	Material No. DIN		BS	EN	AFNOR
2	1035	1.1180	C35R Cm 35	080 A 35		3 C 35 XC 32
2	1035 1038	1.1181	C35E CK 35	080 A 35 (080 M 36)		2 C 35, XC 32 XC 38 H 1
2	1035	1.1181	C35E CK 35	080 A 35 (080 M 36)		
2	1042	1.1191	GS- Ck 45	080 A 46		XC 45
2	1049 1050	1.1206	C50E CK 50	080 M 50		2 C 50 XC 48 H 1; XC 50 H 1
2	1050 1055	1.1213	Cf 53 (C53G)	070 M 55		XC 48 H TS
2	4520	1.5423	22Mo4	1503-245-420		
3		1.0050	St50-2			
3	A 516 Gr.70 A 515 Gr. 70 A 414 Gr.F; G	1.0481	P295GH 17 Mn 4	1501 Gr. 224		a 48 Cp;AP
3	1043	1.0503	C35	060 A 47 080 M 46 1449 50 HS, CS		1 C 45 AF 65 C 45
3	1074	1.0614	C 76 D; D 75-2			XC 75
3	1086	1.0616	C 86 D; D 85-2			XC 80
3	1095	1.0618	C 92 D;D 95-2			XC 90
3	1036 1330	1.1165	30Mn5	120 M 36 (150 M 28)		35 M 5
3	1335	1.1167	30Mn5	150 M 36		40 M 5
3	1040	1.1186	C40E CK 40	060 A 40, 080 A 40 080 M 40		2 C 40 XC 42 H 1
3	1045	1.1191	C45E CK 45	080 M 46 060 A 47		2 C 45 XC 42 H 1 XC 45 XC 48 H 1

SS	UNI	UNE	JIS	KS	GOST
1572		F.1130-C 35 K-1			
1550 1572	C35	F.1130-C 35 K	S 35 C	SM 35 C	35
1572	C36		S 35 C	SM 35 C	
1660	C45	F-1140			
1674	C 50				50
1674	C 53		S 50 C	SM 50 C	50
	16 Mo 5 KG; KW	F.2602- 16 Mo 5	SB 450 M	SB 450 M	SB 480 M
	FE50				
	Fe 510 KG;KT;KW Fe 510-2 KG;KT;KW FeE 295	A 47 RC I RA II	SG 365, SGV 410 SGV 450 SGV 480	SG 365, SGV 410 SGV 450 SGV 480	14G2
1672 1650	C 45 1 C 45	F.114	S 45 C	SM 45 C	45
C 85					
		F.8211-30 Mn 5 f.8311-AM 30 Mn 5	SMn 433 H SCMn 2	SMn 433 H SCMn 2	27ChGSNMDTL 30GSL
2120		F. 1203-36 Mn 6 F. 8212-36 Mn 5	SMn 438 (H) SCMn 3	SMn 438 (H) SCMn 3	35G2 35GL
	C 40		S 40 C	SM 40 C	
1672	C 45 C 46	F.1140-C 45 K F.1142-C48 K	S 45 C S 48 C	S 45 C S 48 C	45

Material Conversion Table

According to VDI 3323 standard

Material group	AISI/SAE	Material No. DIN		BS	EN	AFNOR
3	1049	1.1201	C45R Cm 45	080 M 46		3 C 45 XC 42 H 1 XC 48 H 1
3		1.7242	18 CrMo 4			
3	A 387 Gr. 12 Cl	1.7337	16 CrMo 4 4			
3	A 387 Gr. 12 Cl	1.7337	16 CrMo 4 4			
3		1.7362	12 CrMo 19 5	3606-625		Z 10 CD 5.05
3	A572-60		17 MnV 6	436055 E		NFA 35-501 E 36
4	1055	1.0535	C55	070 M 55		1 C 55 AF 70 C 55
4	1060	1.0601	C60	060 A 62 1449 HS,CS	43D	1 C 60 AF 70 C 55
4	1070	1.0603	C67	080 A 67 1449 70HS		XC65
4	1074 1075	1.0605	C75	1449 80 HS		
4	1055	1.1203	C55E CK 55	060 A 57 070 M 55		2 C 5 XC 55 H 1
4	1055	1.1209	C55R Cm 55	070 M 55		3 C 55 XC 55 H 1
4	1060 1064	1.1221	C60E CK 60	060 A 62	43D	2 C 60 XC 60 H 1
4	1070	1.1231	CK 67 (C67E)	060 A 67		XC 68
4	1074 1075 1078	1.1248	CK 75 (C75E)	060 A 78		XC 75
4	1086	1.1269	CK 85 (C85E)			XC 90
4	1095	1.1274	Ck 101 (C101E)			XC 100
4	W 112	1.1663	C 125 W			Y2 120
4						
5		1.0070	St70-2			
5		1.7238	49 CrMo 4			
5		1.7701	51 CrMoV 4			

SS	UNI	UNE	JIS	KS	GOST
1660	C 45	F.1145-C 45K-1 F.1147C 48 K-1	S 50 C	SM 50 C	
18 CrMo 4					
	A 18 CrMo 4 5 KW				
	A 18 CrMo 4 5 KW				
	16 CrMo 20 5				
2142					
1655	C 55 1 C 55		S 55 C	SM 55 C	55
	C 60 1 C 60		S 58 C	SM 58 C	60(G)
	C 67				
	C 75				75
1655	C 55	F.1150-C 55 K	S 55 C	SM 55 C	55
	C 55	F.1155-C 55 K-1			
1655 1678	C 60		S 58 C	SM 58 C	60 60G, 60GA
1770	C 70				65GA 68GA , 70
774	C 75				75(A)
	C 90				85(A)
	C 100	F-5117	SUP 4	SPS 4	
1870					
2223					
	FE70-2				
	51 CrMoV 4				

Material Conversion Table

According to VDI 3323 standard

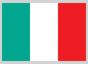
Material group	AISI/SAE	Material No. DIN		BS	EN	AFNOR
6	A573-81 65	1.0116	St 37-3	4360 40 B		E 24-U
6	A515 65	1.0345	H1	1 501 161		A 37 CP
6	5120	1.0841	St 52-3	150 M 19		20 MC 5
6	9255	1.0904	55 Si 7	250A53	45	55S7
6	9254	1.0904	55 Si 7	250 A 53		55 S 7
6	9262	1.0961	60SiCr7	1 501 161		60SC6
6	L3	1.2067	100Cr6	BL3		Y100C6
6	L1	1.2108	90 CrSi 5			
6	L2	1.2210	115CrV3			100C3
6		1.2241	51CrV4			
6		1.2311	40 CrMnMo 7			
6	4135	1.2330	35 CrMo 4	708 A 37		34 CD 4
6		1.2419	105WCr6	BO1		105WC13
6	0 1	1.2510	100 MnCrW 4	BS1		8 MO 8
6	S1	1.2542	45 WCrV7			
6	S1	1.255	60WCrV7			55WC20
6	L6	1.2713	55NiCrMoV6			55NCDV7
6	L6	1.2721	50NiCr13			55 NCV 6
6	O2	1.2842	90MnCrV8	BO2		90 MV8
6	E 50100	1.3501	100 Cr 2			55WC20
6	52100	1.3505	100Cr6	2 S 135 535 A 99	31	100 C 6
6		1.5024	46Si7			45 S 7; Y 46 7;46 SI 7
6	9255	1.5025	51Si7			51 S 7 51 Si 7
6	9255	1.5026	55Si7	251 a 58		55 S 7
6	9260	1.5027	60Si7	251 A 60 251 H 60		60 S 7
6	9260 H	1.5028	65Si7			60 S 7
6		1.5120	38 MnSi 4			

SS	UNI	UNE	JIS	KS	GOST
1312	Fe37-3				
1330					
2172	Fe 52	F-431			
2085	55Si8	56Si7			
2090		F-431			
60SiCr8	60SiCr8				
	100Cr6				
2092	105WCR 5				
	107CrV3KU				
	35 cRmO 8 KU				
2234	35CrMo4	34CrMo4	SCM435TK	SCM435TK	
2140	10WCr6	105WCr5			
2140	10WCr6	105WCr5	SKS 31	STS 31	
2710	45 WCrV8 KU	45WCrSi8			
2710	58WCr9KU				
		F.520.S	SKT 4	STF 4	
2550		f-528			
2258	100Cr6	F.1310 - 100 Cr 6	SUJ2	STB 2	SchCh 15
		F. 1451 - 46 SI 7			
2090	48 Si 7	F.1450-50 Si 7			
	50 Si 7				
2085 2090	55 Si 7	F.1440 - 56 Si 7			55S2
	60 Si 7	F. 1441 - 60 Si 7			60S2
			50 P 7 SUP 6	SPS 6	

Material Conversion Table

According to VDI 3323 standard

Material group	AISI/SAE	Material No.	DIN	BS	EN	AFNOR
6	A 204 Gr.A 4017	1.5415	16Mo3 15 Mo 3	1503-243 B		15 D 3
6	4419	1.5419	20Mo4	1503-243-430		
6	A 350-LF 5	1.5622	14Ni6			16N6
6	3415	1.5732	1 NilCr10			14 NC 11
6	3310; 3314	1.5752	14NilCr14	655M13	36A	12NC15
6		1.6587	17CrNiMo6	820A16		18NCD6
6		1.6657	14NiCrMo134			
6	5515	1.7015	15 Cr 3	523 M 15		12 C 3
6	5132	1.7033	34Cr4	530A32	18B	32C4
6	5140	1.7035	41C r4	530M40	18	42C4
6	5140	1.7045	42Cr41	530 A 40		42 C 4 TS
6	5115	1.7131	16MnCr5	527 M 17		16 MC 5
6		1.7139	16MnCr5			
6	5515	1.7176	55Cr3	527 A 60	48	55 C 3
6	4135; 4137	1.7220	34CrMo4	708 Aa 37		35 CD 4
6	4142	1.7223	41CrMo4			
6	4140	1.7225	42CrMo4	708 M 0		42 CD 4
6		1.7228	55NiCrMoV6G	823M30	33	
6		1.7262	15CrMo5			12 CD 4
6		1.7321	20 mOcR 4			
6	ASTM A182 F-12	1.7335	13CrMo4 4	1501-620Gr27		
6	A 182-F11;12	1.7335	13 CrMo 4 4	1 501 620 Gr. 27		15 CD 4.5
6	ASTM A 182 F.22	1.7380	10CrMo9 10	1501-622gR31; 45		
6	A182 F-22	1.7380	10 CrMo 9 10	1501-622		12 CD 9.10
6		1.7715	14MoV6 3	1503-660-440		
6	A355A	1.8509	41CrAlMo 7	905 M 39	41B	40 CAD 6.12
7	A570.36	1.0038	S235JRG2 (Fe 360 B) RSt 37-2	Fe 360 B FU 1449 27/23 CR 4360-40 B		E 24-2NE
7	3135	1.5710	36NiCr6	640A35		35NC6

 SS	 UNI	 UNE	 JIS	 KS	 GOST
2912	16Mo3(KG;KW)	F. 2601 - 16 Mo 3			
-2512	G 20 Mo 5 G 22 Mo5		SCPH 11	SCPH 11	
14 Ni 6 KG;KT	F.2641 - 15 Ni 6				
16NiCr11	15NiCr11	SNC415(H)			
		SNC815(H)			
	14NiCrMo13				
	14NiCrMo131				
			SCr415(H)	SCr415(H)	
	34Cr4(KB)	35Cr4	SCr430(H)	SCr430(H)	
	41Cr4	42Cr4	SCr440(H)	SCr440(H)	
2245	41Cr4	42Cr4	SCr440	SCr440	
2511	16MnCr5	16MnCr5			
2127					
2253			SUP9(A)	SPS 9(A)	
2234					
	41CrMo4	42CrMo4	SNB 22-1	SNB 22-1	
2244					
2512	653M31				
2216		12CrMo4			
2625					
	14CrMo4 5	14CrMo45			
2216		12CrMo4	SCM415(H)	SCM415(H)	
2218	12CrMo9,10	TU.H			
		13MoCrV6			
2940	41CrAlMo7	41CrAlMo7			
1312	Fe 360 B FN	AE 235 B FN;FU Fe 360 B FN; FU			St3ps; sp

Material Conversion Table

According to VDI 3323 standard

Material group	AISI/SAE	Material No. DIN		BS	EN	AFNOR
7		1.5755	31 NiCr 14	653 M 31		18 NC 13
7	8620	1.6523	2 NiCrMo2	805M20	362	20 NCD 2
7	8740	1.6546	40 NiCrMo 22	311-Tyre 7		
7	4130	1.7218	25CrMo4	CDS 110		25 CD 4
7		1.7733	24 CrMoV 5 5			20 CDV 6
7		1.7755	GS-45 CrMOV 10 4			
7		1.8070	21 CrMoV 5 11			
8	4142	1.2332	47 CrMo 4	708 M 40	19A	42 CD 4
8	A128 (A)	1.3401	G-X120 Mn 12			Z 120 M 12
8	3435	1.5736	36 NiCr 10			30 NC 11
8	9840	1.6511	36CrNiMo4	816M40	110	40NCD3
8	4340	1.6582	35CrNiM 6	817 M 40	24	35 NCD 6
8		1.7361	32 CeMo12	722 M 24	40B	30 CD 12
8	6150	1.8159	50 CrV 4	735 A 50	47	50CrV4
8		1.8161	58 CrV 4			
8		1.8515	32 CrMo 12	722 M 24	40B	30 CD 12
8		1.8523	39CrMoV13 9	897M39	40C	
9		1.4882	X 50 CrMnNiNbN 21 9			Z 50 CMNNb 21.09
9	3135	1.5710	36NiCr6	640A35	111A	35NC6
9		1.5864	35 niCr 18			
9			31 NiCrMo 13 4	830 m 31		
10	A573-81	1.0144	ST 44-3	4360 43 C		E 28-3
10	A 619	1.0347	DCO3 RSt;RRSt 13	1449 3 CR 1449 2 CR		E
10	M 1015 M 1016 M 1017	1.0401	C15	080 M 15 080 M 15 1449 17 CS		AF 37 C12 XC 18
10		1.0570	ST 52-3	4360 50 B		E 36-3
10	12L13	1.0718	9SMnPb28			S250Pb
10	(12L13)	1.0718	9 SMnPb 28			S 250 Pb

SS	UNI	UNE	JIS	KS	GOST
2506	20NiCrMo2	20NiCrMo2	SNCM220(H)	SNCM220(H)	
	40NiCrMo2(KB)	40NiCrMo2	SNCM240	SNCM240	
2225	25CrMo4(KB)	55Cr3	SCM420/430	SCM420/430	
	21 CrMoV 5 11				
	35 NiCr 9				
2244	42CrMo4	42CrMo4	SCM (440)	SCM (440)	
2183	GX120Mn12	F. 8251-AM-X120Mn12	SCMnH 1, SCMn H 11	SCMnH 1, SCMn H 11	110G13L
	36nIcRmO4(KB)	35NiCrMo4	SUP 10	SPS 10	
2541	35NiCrMo6(KB)		SNCM 447	SNCM 447	
2240	30CrMo12	F.124.A			
2230	50CrV4	51CrV4			
2240	32CrMo12	F.124.A			
	36CrMoV12				
			SNC236	SNC236	
2534		f-1270			
1412			SM 400A;B;C	SM 400A;B;C	
	Fep 02	AP 02			08JU
1350	C15 C16 1 C 15	F.111	S 15 C	SM 15 C	
2132	Fe52BFN/Fe52CFN		SM490A;B;C;YA;YB	SM490A;B;C;YA;YB	
1914	CF9SMnPb28	11SMnPb28			
1914	CF 9 SMnPb 28	11 SMnPb 28	SUM 22L	SUM 22L	

Material Conversion Table

According to VDI 3323 standard

Material group	AISI/SAE	Material No.	DIN	BS	EN	AFNOR
10		1.0723	15 S 22 15 S 20	210 A 15 210 M 15		
10		1.2083				
10	H 11	1.2343	x 38 CrMoV 5 1	BH 11		Z 38 CDV 5
10	H 13	1.2344	X 40 CrMoV 5 1	BH 13		Z 40 CDV 5
10	A 2	1.2363	X100 CrMoV 5 1	BA 2		Z 100 CDV 5
10	D 2	1.2379	X 155 CrVMo 12 1	BD2		Z 160 CDV 12
10	HNV3	1.2379	X210Cr12G	BD2		Z160CDV12
10	D 4 (D 6)	1.2436	X 210 CrW 12	BD6		Z 200 CD 12
10	H 21	1.2581	X 30 WCrV 9 3	BH 21		Z 30 WCV 9
10		1.2601	X 165 CrMoV 12			
10	H 12	1.2606	X 37 CrMoW 5 1	BH 12		Z 35 CWDV 5
10	D3	1.3343	S 6-5-2	BM2		Z200C12
10	N08028	1.4563				Z1NCDU31-27-03
10	ASTM A353	1.5662	X8Ni9	1501-509;510		
10	ASM A353	1.5662	X8Ni9	502-650		9 Ni
10	2517	1.5680	12Ni19	12Ni19		Z18N5
10	2515	1.5680	12 Ni 19			Z 18 N 5
11		1.3202	S 12-1-4-5	BT 15		
11		1.3207	S 10-4-3-10	BT 42		Z130WKCDV
11	T15	1.3243	S 6-5-2-5			KCV 06-05-05-04-02
11		1.3246	S 7-4-2-5			Z110 WKCDV 07-05-04
11		1.3247	S 2-10-1-8	BM 42		Z110 DKCWV 09-08-04
11	M 42	1.3249	S 2-9-2-8	BM 34		
11	T 4	1.3255	S 18-1-2-5	BT 4		Z 80 WKCV 18-05-04-0
11	M 2	1.3343	S6-5-2	BM2		Z 85 WDCV
11	M 7	1.3348	S2-9-2			Z 100 DCWV 09-04-02-

SS	UNI	UNE	JIS	KS	GOST
1922		F.210.F	SUM 32	SUM 32	
2314					
	X 37 CrMoV 5 1 KU				
2242	X40CrMoV511KU	F-5318	SKD61	STD61	
2260	X100CrMoV51KU	F-5227	SKD12	STD12	
2310	X165CrMoW12KU	X160CrMoW12KU			
2736					
2312	X215CrW 12 1 KU	F-5213			
	X30WCrV 9 3 KU	F-526	SKD5	STD5	
2310					
	X 35 CrMoW 05 KU	F.537			
2715	X210Cr13KU	X210Cr12	SUH3	STR3	
2584					
	14 Ni 6 KG;KT	XBNiO9			
	X10Ni9	F-2645	SL9N60(53)	SL9N590(520)	
	HS 12-1-5-5	12-1-5-5			
2723	HS 6-5-2-5	6-5-2-5	SKH55	SKH55	
7-4-2-5	HS 7-4-2-5	M 35			
2-10-1-8	HS 2-9-1-8 2-9-2-8	M 41			
2722	HS 652	F-5604	SKH 51	SKH 51	
2782	HS 292	F-5607			

Material Conversion Table

According to VDI 3323 standard

Material group	AISI/SAE	Material No. DIN		BS	EN	AFNOR
11	T 1	1.3355	S 18-0-1	BT 1		Z 80 WCV 18-4-01
11	630	1.4548				Z7CNU17-04
11	HNV 3	1.4718	X45CrSi 9 3	401S45	52	Z45CS9
11	422	1.4935	x20 CrMoWV 12 1			
12	403	1.4000	X6Cr13	403 S 17		Z 6 C 13
12		1.4001	X6Cr14			
12	(410S)	1.4001	X7 Cr 13	(403 S 7)		Z 8 C 13
12	405	1.4002	X6CrA12	405S17		Z8CA12
12	405	1.4002	X6 CrAl 13	405 S 17		Z6CA13
12	416	1.4005	X12CrS 13	416 S 21		Z11 CF 13
12	410; CA-15	1.4006	(G-)X10 Cr 13	410S21	56A	Z10 C 13
12	430	1.4016	X8Cr17	Z8C17		430S15
12	430	1.4016	X6 Cr 17	430 S 15	60	Z 8 C 17
12		1.4027	G-X20Cr14	420 C 29		Z20 C 13M
12		1.4027	G-X 20 Cr 14	420 C 29		Z 20 C 13M
12	420	1.4028	X30 Cr 13	420 S 45		Z 30 C 13
12		1.4086	G-X120Cr29	452C11		
12	430 F	1.4104	X12CrMoS17	420 S 37		Z 10 CF 17
12	440B	1.4112	X90 CrMoV 18			
12	434	1.4113	X6CrMo 17	434 S 17		Z 8 CD 17.01
12		1.4340	G-X40CrNi27 4			
12	S31500	1.4417	X2CrNiM0Si19 5			
12	S31500	1.4417	X2 CrNoMoSi 18 5 3			
12		1.4418	X4 CrNiMo16 5			Z6CND16-04-01
12	XM 8 430 Ti 439	1.4510				Z 4 CT 17
12	430tI	1.4510	X6 CrTi 17			Z 4 CT 17
12		1.4511	X 6 CrNb 17(X 6 CrNb 17			Z 4 CNb 17
12	409	1.4512	X 6 CrTi 12 (X2CrTi12)	LW 19 409 S 19		Z 3 CT 12
12		1.4720	X20CrMo13			

Technical Guide

TaeguTec Member IMC Group

Contents

SS	UNI	UNE	JIS	KS	GOST
	X45CrSi8	F322	SUH1	STR1	
2301	X6Cr13	F.3110	SUS403	STS 403	
		F8401			
2301					
	X6CrAl13				
2302	X6CrAl13				
2380	X12 CrSC13	F-3411	SUS 416	SUS 416	
2302	X12Cr13	F.3401	SUS 410	SUS 410	
2320	X8Cr17	F.3113			
2320	X8Cr17	F.3113	SUS 430	SUS 430	
2304					
2383	X10CrS17	F.3117	SUS430F	STS 430F	
2325	X8CrMo17		SUS434	STS 434	
2376					
2376					
2387					
	X 6 CrTi 17	F.3115-X 5 CrTi 17	SUS 430 LK	STS 430 LX	08 Ch17T
	X 6 CrNb 17	F.3122-X 5 CrNb 17	SUS 430 LK	STS 430 LX	
	X 6 CrTi 17		SUH 409	STR 409	

Material Conversion Table

According to VDI 3323 standard

Material group	AISI/SAE	Material No.	DIN	BS	EN	AFNOR
12	405	1.4724	X10CrA113	403S17		Z10C13
12	430	1.4742	X10CrA118	439S15	60	Z10CAS18
12	HNV6	1.4747	X80CrNiSi20	443S65	59	Z80CSN20.02
12	446	1.4749	x18 cRn 28			
12	446	1.4762	X10CrA124			Z10CAS24
12	EV 8	1.4871	X 53 CrMnNiN 21 9	349 S 54		Z 52 CMN 21.09
12	302		x12 CrNi 18 9	302 S 31		Z 10 CN 18-09
12	429		X10 CrNi 15			
13	420	1.4021	X20Cr13	420S37		Z 20 C 13
13	420	1.4031	X40 Cr 13			Z 40 C 14
13		1.4034	X46Cr13	420 S 45		Z40 C 14
13	431	1.4057	X20CrNi172	431 S 29	57	Z 15 CN 16.02
13		1.4125	X 105 CrMo 17			Z 100 CD 17
13	CA6-NM	1.4313	G-X4 CrNi 13 4	425 C 11		Z 4 CND 13-04 M
13	630	1.4542	X 5 CrNiCuNb 17 4 (X5CrNiCuNb 16-4)			
13		1.4544		S. 524 S. 526		
13	348	1.4546	X5CrNiNb 18-10	347 S 31 2 S. 130 2 S. 143/144/145 S.525/527		
13		1.4922	x20cRmV12-1			
13		1.4923	X22 CrMoV12 1			
14	304	1.4301	X 5 CrNi 18 9	304 S 15		Z 5 CN 18.09
14	303	1.4305	X10 CrNiS 18 9	303 S 21	58M	Z 8 CNF 18-09
14	304L	1.4306	X2CrNi18 9	304S12		Z2CrNi18 10
14	304L	1.4306	X2 CrNi 18 10	304 S 11		Z 3 CN 19-11
14	CF-8	1.4308	X6 CrNi 18 9	304 C 15	58E	Z 6 CN 18-10 M
14	301	1.4310	X12CrN i17 7	301 S 21		Z 12 CN 17.07

SS	UNI	UNE	JIS	KS	GOST
	X10CrA112	F.311			
	X8Cr17	F.3113	SUS430	STS430	
	X80CrSiNi20	F.320B	SUH4	STR4	
2322	X16Cr26		SUH446	STR446	
	X53CrMnNiN21 9		SUH35,SUH36	STR35,STR36	
2330					
2303	14210				
-2304					
	X40Cr14	F.3405	SUS420J2	STS420J2	
2321	X16CrNi16	F.3427	SUS431	STS431	
	X 105 CrMo 17				
2385	(G)X6CrNi304		SCS5	SSC5	
	X 6 CrNiTi 18 11				08Ch 18N12T
	X 6 CrNiNb 18 11				
2317	x20cRmOnl 12 01				
2332;2333					
2346	X10CrNiS18.09	F.3508	SUS303	STS303	
2352	x2cRnl18 11	F.3503	SCS19	SSC19	
2352	X2CrNi18 11				
2333			SUS304L	STS304L	
2331	X2CrNi18 07	F.3517			

Material Conversion Table

According to VDI 3323 standard

Material group	AISI/SAE	Material No.	DIN	BS	EN	AFNOR
14	304 LN	1.4311	X2 CrNiN 18 10	304 S 62		Z 2 CN18.10
14		1.4312	G-X10CrNi18 8	302C25		Z10CN18.9M
14	305	1.4312	X8 CrNi 18 12	305 s 19		
14		1.4332	X2 CrNi 18-8			
14	304	1.4350	X5CrNi18 9	304S15	58E	Z6CN18.09
14	S32304	1.4362	X2 CrNiN 23 4			Z 2 CN 23-04 AZ
14	202	1.4371	X3 CrMnNiN 188 8 7	284 S 16		Z 8 CMN 18- 08-05
14	316	1.4401	X 5 CrNiMo 17 12 2 (X4 CrNiMo 17 -12-2)	316 S 13 316 S 17 316 S 19 316 S 31 316 S 33		Z 3 CND 17 -11-01 Z 6 CND 17-11 Z 6 CND 17-11-02 Z 7 CND 17-11-02 Z 7 CND 17-12-02
14	316L	1.4404	X2 CrNiMo 17 13 2 (X2 CrNiMo 17-12-2) GX 2 CrNiMoN 18-10	316 S 11, 316 S 13 316 S 14, 316 S 31; 316 S 42, S.537;316 C 12, T.75, S. 161		Z 2 CND 17-12 Z 2 CND 18-13 Z 3 CND 17-11-02 Z 3 CND 17-12-02 FF Z 3 CND 18-12-03 Z 3 CND 19.10 M
14	316LN	1.4406	X2 CrNiMoN 17 12 2 (X2CrNiMoN 18-10)	316 S 61 316 S 63		Z2 CND 17-12 AZ
14	CF-8M	1.4408	GX 5 CrNiMoN 7 12 2 G-X 6 CrNiMo 18 10	316 C 16 (LT 196) ANC 4 B		
14		1.4410	G-X10CrNiMo18 9			Z5CNaD20.12M
14	316 Ln	1.4429	X2 CrNiMo 17 -13-3	316 S 62		Z 2 CND 17-13 Az
14	316L	1.4435	X2 CrNiMo18 14 3	316 S 11;316 S 13 316 S 14;316 S 31 LW 22 LWCF 22		Z 3 CND 17-12-03 Z 3 CND 18-14-03
14	316	1.4436	X 5 CrNiMo 17 13 3 (X4CRNIMO 17-13-3	316 S 19; 316 S 31 316 S 33 LW 23 LWCF 23		Z 6 CND 18-12-03 Z 7 CND 18-12-03

SS	UNI	UNE	JIS	KS	GOST
2371	X2CrNiN18 10		SUS304LN	STS304LN	
2332	X5CrNi18 10	F.3551	SUS304	STS304	
2347	X 5 CrNiMo 17 12	F.3534-X 5 CrNiMo 17 12 2	SUS 316	STS 316	
2348	X 2 CrNiMo 17 12 G-X 2 CrNiMo 19 11	F.3533 - X 2 CrNiMo 17 13 2 F.3537 - X 2 CrNiMo 17 13 3	SUS 316 L	STS 316 L	
	X 2 CrNiMoN 17 12	F.3542-X 2 CrNiMoN 17 12 2	SUS316LN	STS316LN	
2343		F.8414-AM-X 7 CrNiMo 20 10	SCS 14	SSC 14	07 Ch 18N10G2S2MSL
2328					
2375	X 2 CrNiMoN 17 13	F.3543-X 2 CrNiMoN 17 13 3	SUS 316 LN	STS 316 LN	
2375	X 2 CrNiMoN 17 13	F.3533-X 2 CrNiMo 17 13 2	SUS 316 L	STS 316 L	O3 Ch 17N14M3
2343	X 5 CrNiMo 117 13 X 8 cRnImO 17 13	F.3543-X 5 CrNiMo 17 12 2 F.3538-X 5 CrNiMo 17 13	SUS 316	STS 316	

Material Conversion Table

According to VDI 3323 standard

Material group	AISI/SAE	Material No. DIN		BS	EN	AFNOR
14	317L	1.4438	X2 CrNiMo 18 16 4 (X2CrNiMo 18-15-4)	317 S 12		Z 2 CND 19-15-04 z 3 cnd 19-15-04
14	(s31726)	1.4439	X2 CrNiMoN 17 13 5			Z 3 CND 18-14-06 AZ
14		1.4440	X 2 CrNiMo 18 13			
14	317	1.4449	X5 CrNiMo 17 13 3	317 S 16		
14	329	1.4449 1.4460	X 4 CrNiMo 27 5 2 (X3CrNiMo27-5-2)			(Z 3 CND 25-07 Az) Z 5 CND 27-05 Az
14	329	1.4460	X8CrNiMo27 5			
14		1.4462	X2CrNiMoN22 5 3	318 S 13		Z 3 CND 22-05 Az (Z 2 CND 24 -08 Az) (Z 3 CND 25-06-03 Az)
14		1.4500	G-X7NiCrMoCuNb25 20			23NCDU25.20M
14	17-7PH	1.4504		316S111		
14	443 444	1.4521	X2CrMoTi18-2	317 S 16		
14	UNS N 08904	1.4539	X1NiCrMoCuN25-20-5			Z 2 NCDU 25-20
14	CN-7M	1.4539	(G-)X1 NiCrMoCu 25 20 5			Z1 NCDU 25-02 M
14	321	1.4541	Z 6 CrNiTi 18-10	321 S 31 321 S 51 (1010;1105) LW 24 LWCF 24		 Z 6 CNT 18-10
14	630	1.4542	X5 CrNiCuNb 17 4 (X5 CrNiChNb 16-4)			Z 7 CNU 15-05 Z 7 CNU 17-04
14	17-4PH	1.4542				Z7CNU17-04
14	S31254	1.4547	X1 CrNiMoN 20 18 7			
14	17-4PH	1.4548				Z7CNU17-04
14	347	1.4550	X6 CrNiNb 18 10	347 S 17	58F	Z 6 CNNb 18.10
14		1.4552	G-X7CrNiNb18 9			Z4CNNb19.10M
14	17-7PH	1.4568		316S111		
14	316tTi	1.4571	X6 CrNiMoTi 17 12 2	320 S 31		Z 6 CNDT 17-12002
14		1.4581	G-X 5 CrNiMoNb	318 C 17		Z 4 CNDNb 18.12 M
14	318	1.4583	X 10CrNiMoNb 18 12	303 S 21		Z15CNS20.12

SS	UNI	UNE	JIS	KS	GOST
2367	X2CrNiMo18 16	f.3539-x 2 cRnlmO 18 16 4	SUS317L	STS317L	
	X 5 CrNiMo 18 15		SUS 317	STS 317	
2324		F.3309-X 8 CrNiMo 17 12 2 F.3552-X 8 CrNiMo 18 16 4	SUS 329 J 1	STS 329 J 1	
2377			SUS 329 J3L	STS 329 J3L	
	Z8CNA17-07	X2CrNiMo1712			
2326		F.3123-X 2 CrMoTiNb 18 2	SUS 444	STS 444	
2562					
2564					
2337	X 6 CrNiTi 18 11	F.3523 - X 6 CrNiTi 18 10	SUS 321	STS 321	06Ch18N10T 08Ch18N10T 09Ch18N10T 12Ch18N10T
			SCS 24 SUS 630	SSC 24 STS 630	
2378					
2338	X6CrNiNb18 11	F.3552	SUS347	STS347	
	Z8CNA17-07	X2CrNiMo1712			
2350					
	x15cRnIsl2 12				

Material Conversion Table

According to VDI 3323 standard

Material group	AISI/SAE	Material No. DIN		BS	EN	AFNOR
14		1.4585	G-X7CrNiMoCuNb18 18			
14		1.4821	X20CrNiSi25 4			Z20CNS25.04
14		1.4823	G-X40CrNiSi27 4			
14	309	1.4828	X15CrNiSi20 12	309 S 24	58C	Z15CNS20.12
14	309S	1.4833	X6 CrNi 22 13	309 S 13		Z 15 CN 24-13
14	310 S	1.4845	X12 CrNi 25 21	310S24		Z 12 CN 25-20
14	321	1.4878	X6 CrNiTi 18 9	32 1 S 20	58B	Z 6 CNT 18-12 (B)
14	Ss30415	1.4891	X5 CrNiNb 18 10			Z20CNS25.04
14	S30815	1.4893	X8 CrNiNb 11			
14	304H	1.4948	X6 CrNi 18 11	304 S 51		Z 5 CN 18-09
14	660	1.498	X5 NiCrTi 25 15			Zz 8 nctv 25-15 b ff
14			X5 NiCrN 35 25			
14	S31753		X2 CrNiMoN 18 13 4			
14			X2 CrNiMoN 25 22 7			
15	CLASS20	0.6010	GG10			Ft10D
15	A48-20B	0.6010	GG-10			Ft 10 D
15	NO 25 B	0.6015	GG 15	Grade 150		Ft 15 D
15	CLASS25	0.6015	GG 15	Grade 150		Ft 15D
15	A48 25 B	0.6015	GG 15	Grade 150		Ft 15 D
15	A48-30B	0.6020	GG-20	Grade 220		Ft 20 D
15	NO 30 B	0.6020	GG 20	Grade 220		Ft 20 D
15	A436 Type 2	0.6660	GGL-NiCr202	L-NiCuCr202		L-NC 202
15	60-40-18	0.7040	GGG 40	SNG 420/12		FCS 400-12
15	No 20 B		GG 10			Ft 10 D
16	CLASS30	0.6020	GG 20	Grade 220		Ft 20D
16	CLASS45	0.6030	GG 30	Grade 300		Ft 30D
16	A48-45 B	0.6030		Grade 350		Ft 30D
16	A48-50	0.6035	GG-35	Grade 350		Ft 35 D
16	A48-60 B	0.6040	GG40	Grade 400		Ft 40 D
16	100/70/03	0.7070	GGG-70	SNG700/2		FGS 700-2

SS	UNI	UNE	JIS	KS	GOST
	X6CrNiMoTi17 12				
		F.8414	SCS17	SSC17	
2361	X6CrNi25 20	F.331	SUH310	STR310	
2337	X6CrNiTi18 11	F.3553	SUS321	STS321	
2372					
2368					
2333					
2570					
110	G 10				
0110-00					
0115-00	G 15	FG 15	FC150	GC150	
115	G 15	FG 15			
01 15-00	G 14	FG 15			
0120-00					
120	G 20		FC200	GC200	
0523-00					
0717-02	GS 370-17	FGE 38-17	FCD400	GCD400-18,15	
110			FC100	GC100	
120	G 20	FG 20			
130	G 30	FG 30	FC300	GC300	
01 30-00					
135	G 35	FG 35	FC350	GC350	
140					
07 37-01	GGG 70	GGG 70	FCD700	GCD700-2	

Material Conversion Table

According to VDI 3323 standard

Material group	AISI/SAE	Material No.	DIN	BS	EN	AFNOR
16		1.4829	X 12 CrNi 22 12			
17		0.7033	GGG35.3			
17		0.7033	GGG-35.3	350/22 L 40		FGS 370/17
17	60-40-18	0.7040	GGG-40	SNG 420/12		FGS 400-12
17	60/40/18	0.7043	GGG-40.3	370/7		FGS 370/17
17	80-55-06	0.7050	GGG50	SNG500/7		FGS 500/7
17	65-45-12	0.7050	GGG-50	SNG 500/7		FGS 500-7
17		0.7652	GGG-NiMn 13 7	S-NiMn 137		S-Mn 137
17	A43D2	0.7660	GGG-NiCr 20 2	Grade S6		S-NC 202
17			GGG 40.3	SNG 370/17		FGS 370-17
18	A48-40 B	0.6025	GG25	Grade260		Ft 25 D
18		0.7060	GGG60	SNG600/3		FGS600-3
18	80/55/06	0.7060	GGG-60	600/3		FGS 600/3
18	A48 40 B					
19		0.8055	GTW55			
19	32510	0.8135	GTS-35-10	B 340/12		MN35-10
19	A47-32510	0.8135	GTS-35-10	B 340/2		Mn 35-10
19	A220-40010	0.8145	GTS-45-06	P 440/7		Mn 450-6
19			GTS-35	B 340/12		
19				8 290/6		MN 32-8
19	32510		GTS-35	B340/12		MN 35-10
20		0.8035	GTM-35	W340/3		MB35-7
20		0.8040	GTW-40	W410/4		MB40-10
20		0.8045				
20		0.8065	GTMW-65			
20	A220-50005	0.8155	GTS-55-04	P 510/4		Mn 550-4
20	50005	0.8155	GTS-55-04	P 510/4		MP 50-5
20	70003	0.8165	GTS-65-02	P 570/3		Mn 650-3
20	90001	0.8170	GTS-70-02	P 690/2		Mn 700-2
20	A220-90001	0.8170	GTS-70-02			Mn 700-2

SS	UNI	UNE	JIS	KS	GOST
0717-15					
0717-15					
0717-02					
0717-15					
0727-02	GGG 50				
	0727-02		FCD 500	GCD 500-7	
0772-00					
0776-00					
0717-12					
125	G 25	FG 25	FC250	GC250	
07 32-03	GGG 60	GGG 60			
0727-03			FCD600	GCD600-3	
		GTW 55			
810		GTS 35			
0815-00					
	0852-00	GMN 45			FCMW370
0810-00					
814			AC4A	AC4A	
08 15			FCMW330	FCMW330	
852		GTM 35			
	GTB40	GTM 40			
	GMB45	GTM 45			
		GTM 65			
0854-00					
0854-00	GMN 55		FCMP490	PMC 490	
0856-00	GMN 65		FCMP590	PMC 590	

Material Conversion Table

▶ According to VDI 3323 standard

Material group	AISI/SAE	Material No.	DIN	BS	EN	AFNOR
20		0.8170	GTS-70-02	IP 70-2		
20	1022 1518	1.1133	20Mn5	120 M 19		20 M 5
20	1035	1.1183	Cf 35 (C35G)	080 A 35		XC 38 H 1 TS
20	400 10		GTS-45	P440/7		
20	70003		GTS-65	P 570/3		MP 60-3
21	Al99	3.0205				
21	1000	3.0255	Al99.5	L31/34/36		A59050C
21		3.3315	AlMg1			
22		3.1325	AlCuMg 1			
22		3.1655	AlCuSiPb			
22		3.2315	AlMgSi1			
21	7050	3.4345	AlZnMgCuO,5	L 86		AZ 4 GU/9051
23		3.2381	G-AlSi 10 Mg			
23		3.2382	GD-AlSi10Mg			
23		3.2581	G-AlSi12			
23		3.3561	G-AlMg 5			
23	ZE 41	3.5101	G-MgZn4sE1Zr1	MAG 5		
23	EZ 33	3.5103	MgSE3Zn27r1	MAG 6		G-TR3Z2
23	AZ 81	3.5812	G-MgAl8Zn1	NMAG 1		
23	AZ 91	3.5912	G-MgAl9Zn1	MAG 7		
24		2.1871	G-AlCu 4 TiMg			
24		3.1754	G-AlCu5Ni1,5			
24		3.2163	G-AlSi9Cu3			
24	4218 B	3.2371	G-AlSi 7 Mg			
24	SC64D	3.2373	G-AlSI9MGWA			A-S7G
24		3.2373	G-AlSi 9 Mg			
24	QE 22	3.5106	G-MgAg3SE2Zr1	mag 12		
24	GD-AlSl12		G-ALMG5	LM5		A-SU12
23-24	A360.2	3.2383	G-AlSi0Mg(Cu)	LM9		

SS	UNI	UNE	JIS	KS	GOST
0862-00	GMN 70		FCMP690	PMC 690	
0864-00					
2132	G 22 Mn 3				
	20 Mn 7	F.1515-20 Mn 6	SMnC 420	SMnC 420	
1572	C 36; C 38		S 35 C	SM 35 C	35
08 52					
858			FCMP540	PMC 540	
811-04					
4231			C4BS	C4BS	
4252					
4253					

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Material Conversion Table

According to VDI 3323 standard

Material group	AISI/SAE	Material No. DIN		BS	EN	AFNOR
23-24	A356-72			2789;1973		NF A32-201
23-24	356.1			LM25		
23-24	A413.2		G-AlSi12	LM6		
23-24	A413.1		G-AlSi 12 (Cu)	LM20		
23-24	A413.0		GD-AlSi12			
23-24	A380.1		GD-AlSi8Cu3	LM24		
26	C93200	2.1090	G-CuSn 7 5 pb			U-E 7 Z 5 pb 4
26	C83600	2.1096	G-CuSn5ZnPb	LG 2		
26	C83600	2.1098	G-CuSn 2 Znpb			
26	C23000	2.1182	G-CuPb15Sn	LB1		U-pb 15 E 8
26	C93800	2.1182	G-CuPb15Sn			Uu-PB 15e 8
27		2.0240	CuZn 15			
27	C27200	2.0321	CuZn 37	cz 108		CuZn 36, CuZn 37
27	C27700	2.0321	CuZn 37	cz 108		CuZn 36, CuZn 37
27		2.0590	G-CuZn40Fe			
27	C 86500	2.0592	G-CuZn 35 Al 1	U-Z 36 N 3		HTB 1
27	C 86200	2.0596	G-CuZn 34 Al 2	HTB 1		U-Z 36 N 3
27	C 18200	2.1293	CuCrZr	CC 102		U-Cr 0.8 Zr
28		2.0060	E-Cu57			
28		2.0375	CuZn36Pb3			
28	C 94100	2.0596	G-CuZn 34 Al 2	HTB 1		U-Z 36 N 3
28	C 63000	2.0966	CuAl 10 Ni 5 Fe 4	Ca 104		U-A 10 N
28	B-148-52	2.0975	G-CuAl 10 Ni			
28	C 90700	2.105	G-CuSn 10	CT1		
28	C 90800	2.1052	G-CuSn 12	pb 2		UE 12 P
28	C 81500	2.1292	G-CuCrF 35	CC1-FF		
28		2.4764	CoCr20W15Ni			
31	N 08800	1.4558	X 2 NiCrAlTi 32 20	NA 15		
31	N 08031	1.4562	X 1 NiCrMoCu 32 28 7			

SS	UNI	UNE	JIS	KS	GOST
4244			A5052	A5052P	
4261					
4260			ADC12	ALDC12	
4247			A6061	A6061P	
4250			A7075	A7075P	
	C 2700				
	C 2720				

Material Conversion Table

According to VDI 3323 standard

Material group	AISI/SAE	Material No.	DIN	BS	EN	AFNOR
31	N 08028	1.4563	X 1 NiCrMoCuN 32 27 4			
31	N 08330	1.4564	X 12 NiCrSi 36 16	NA 17		Z 12 NCS 35.16
31	330	1.4564	X12 NiCrSi 36 16	NA 17		Z 12 NCS 37.18
31		1.4865	G-X40NiCrSi38 18	330 C 40		
31		1.4958	X 5 NiCrAlTi 31 20			
31	AMS 5544	LW2.4668	NiCr19NbMo			NC20K14
32		1.4977	X 40 CoCrNi 20 20			Z 42 CNKDWNb
33	Monel 400	2.4360	NiCu30Fe	NA 13		NU 30
33	5390A	2.4603				NC22FeD
33	Hastelloy C-4	2.4610	NiMo16cR16Ti			
33	Nimonic 75	2.4630	NiCr20Ti	HR 5,203-4		NC 20 T
33		2.4630	NiCr20Ti	HR5,203-4		NC20T
33	Inconel 690	2.4642	NiC29Fe			Nnc 30 Fe
33	Inconel 625	2.4856	NiCr22Mo9Nb	NA 21		NC 22 FeDNb
33	5666	2.4856	NiCr22Mo9Nb			Inconel 625
33	Incoloy 825	2.4858	NiCr21Mo	NA 16		NC 21 Fe DU
34	Monel k-500	2.4375	NiCu30 Al	NA 18		NU 30 AT
34	4676	2.4375	NiCu30Al	3072-76		
34		2.4631	NiCr20TiAl	Hr40;601		NC20TA
34	Inconel 718	2.4668	NiCr19FeNbMo			NC 19 Fe Nb
34	Inconel	2.4694	NiCr16fE7TiAl			
34		2.4955	NiFe25Cr20NbTi			
34	5383	LM2.4668	NiCr19Fe19NbMo	HR8		NC19eNB
34	5391	LW2 4670	S-NiCr13A16MoNb	3146-3		NC12AD
34	5660	LW2.4662	NiFe35Cr14MoTi			ZSNCDT42
34	5537C	LW2.4964	CoCr20W15Ni			KC20WN
34	AMS 5772		C0Cr22W14Ni			KC22WN
35	Inconel X-750	2.4669	NiCr15Fe7TiAl			NC 15 TNb A
35	Hastelloy B	2.4685	G-NiMo28			
35	Hastelloy C	2.4810	G-NiMo30			

SS	UNI	UNE	JIS	KS	GOST
2584					
			SUH330	STR 330	
	XG50NiCr39 19		SCH15	HRSC 15	

Material Conversion Table

According to VDI 3323 standard

Material group	AISI/SAE	Material No. DIN		BS	EN	AFNOR
35	AMS 5399	2.4973	NiCr19Co11MoTi			NC19KDT
35		3.7115	TiAl5Sn2			
36	R 50250	3.7025	Ti 1	2 TA 1		
36	R 52250	3.7225	Ti 1 pd	TP 1		
36	AMS 5397	LW2 4674	NiCo15Cr10MoAlTi			
37		3.7124	TiCu2	2 TA 21-24		
37	R 54620	3.7145	TiAl6Sn2Zr4Mo2Si			
37		3.7165	TiAl6V4	TA 10-13;TA 28		T-A 6 V
37		3.7185	TiAl4Mo4Sn2	TA 45-51; TA 57		
37		3.7195	TiAl 3 V 2.5			
37			TiAl4Mo4Sn4Si0.5			
37	AMS R54520		TiAl5Sn2.5	TA14/17		T-A5E
37	AMS R56400		TiAl6V4	TA10-13/TA28		T-A6V
37	AMS R56401		TiAl6V4ELI	TA11		
38	W 1	1.1545	C105W1	BW 1A		Y1105
38	W210	1.1545	C105W1	BW2		Y120
38		1.2762	75 CrMoNiW 6 7			
38	440C	1.4125	X105 CrMo 17			Z 100 CD 17
38		1.6746	32 nlcRmO 14 5	832 M 31		35 NCD 14
40	Ni- Hard 2	0.9620	G-X 260 NiCr 4 2	Grade 2 A		
40	Ni- Hard 1	0.9625	G-X 330 Ni Cr 4 2	Grade 2 B		
40	Ni- Hard 4	0.9630	G-X 300 CrNiSi 9 5 2			
40		0.9640	G-X 300 CrMoNi 15 2 1			
40	A 532 III A 25% Cr	0.9650	G-X 260 Cr 27	Grade 3 D		
40	A 532 III A 25% Cr	0.9655	G-X 300 CrNMo 27 1	Grade 3 E		
40		1.2419	105 WCr 6	105WC 13		
40	310	1.4841	X15 CrNiSi 25 20	314 S31		Z 15 CNS 25-20
41		0.9635	G-X 300 CrMo 15 3			
41		0.9645	G-X 260 CrMoNi 20 2 1			
41		0.9655	G-X 300 CrNMo 27 1			

SS	UNI	UNE	JIS	KS	GOST
1880	C100KU	F-5118	SK3	STC 105(STC3)	
2900	C120KU	CF.515	SUP4	SPS 4	
	0512-00				
	0513-00				
	0466-00				
		107 WCr 5 KU			

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