

MillLine

TUNG-TRI

www.tungaloy.com

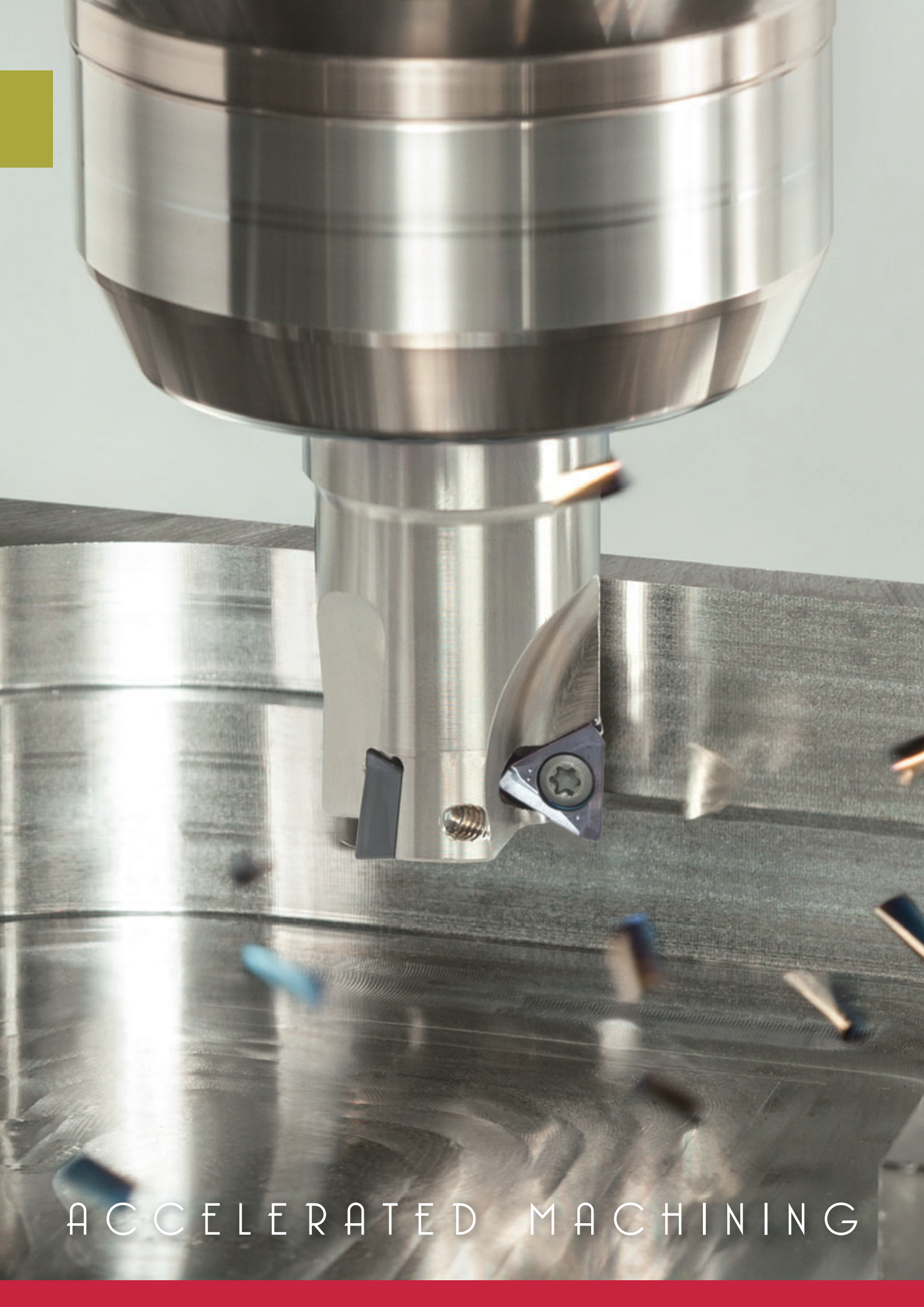
Tungaloy Report No. 421-G

TUNG-TRI

Why settle for 2 cutting edges
while you can have **3 on one insert?**



Member IMC Group
Tungaloy



ACCELERATED MACHINING



Tung-Tri's economical insert with 3 cutting edges and optimized geometry **improves efficiency and productivity** with the square shoulder milling cutter.

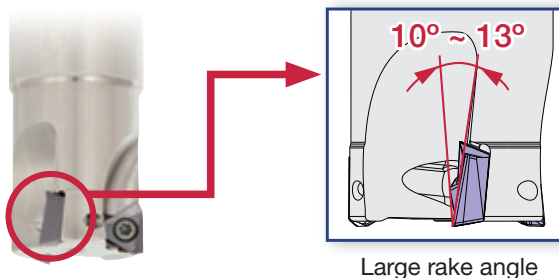
Excellent cutting performance with improved profitability

Economical 3 cutting-edge inserts



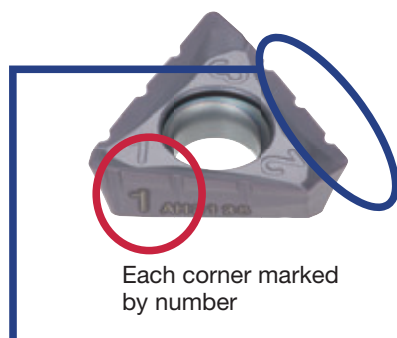
Drastically reduced cutting force

Low cutting force for all depths of cut due to helical cutting edge with large rake angle.



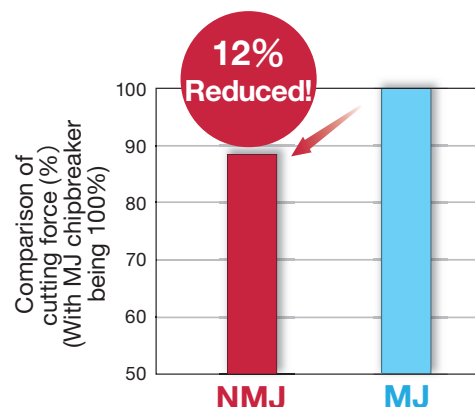
Excellent chip formation

NMJ chipbreaker



Chip splitter help form small chips

- 10% reduction in cutting force compared to MJ chipbreaker due to split chips.
- Suitable for machining with large width of cut due to split chips.



Cutter : TPA15R080M25.4-06 ($\phi D_c = 80$ mm, $z = 6$)
 Insert : TOMT150608PDER-NMJ
 TOMT150608PDER-MJ
 Grade : AH3135
 Workpiece : SCM440 (200HB)
 Cutting speed : $V_c = 100$ m/min
 Feed per tooth : $f_z = 0.10$ mm/t
 Depth of cut : $a_p = 13$ mm
 Width of cut : $a_e = 29$ mm
 Coolant : Wet
 Machine : Vertical M/C, BT50

Good performance on machining

New AJ chipbreaker

Wiper with positive inclination

→ Good surface finish by directing chips away from wall

Large rake angle & high inclination cutting edge

→ Low cutting force and smooth cutting

Lapping treatment

→ Prevent welding on the workpiece material

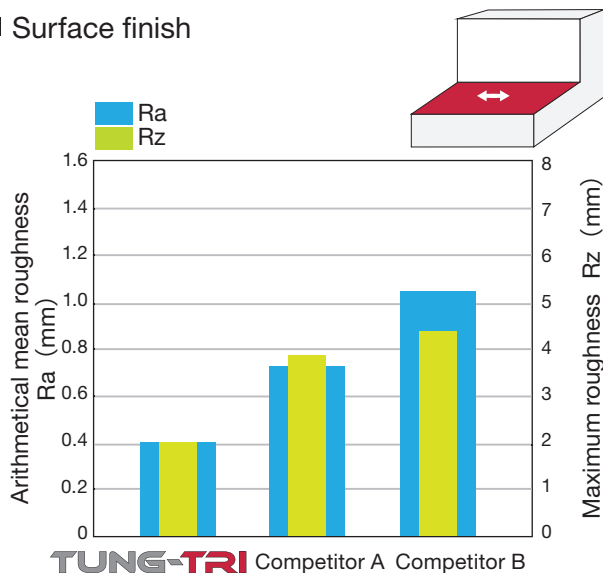
Anti-chatter design

→ The clearance geometry is optimized to enhance insert robustness and vibration-damping for aluminum machining

Cutting edge comparison: cross sections

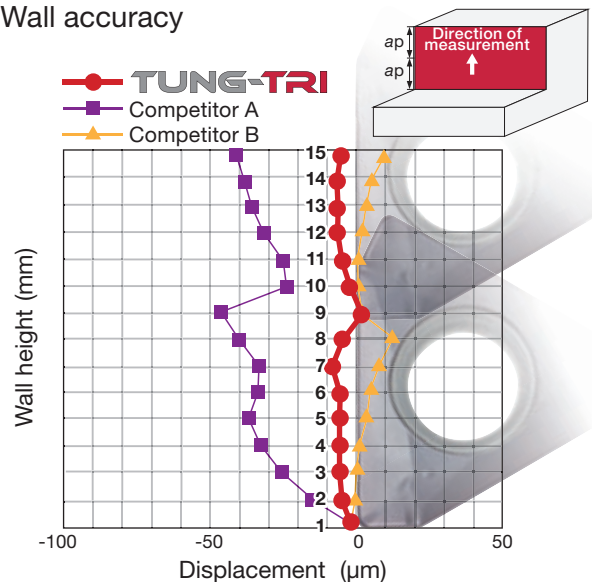


Surface finish



Cutter : EPA10R032M32.0-03N
 Insert : TOGT100408PDFR-AJ
 Grade : KS05F
 Workpiece : A7075 (Alumigo Hard)
 Cutting speed : $V_c = 900$ m/min
 Feed per tooth : $f_z = 0.10$ mm/t
 Depth of cut : $a_p = 2$ mm
 Width of cut : $a_e = 21$ mm
 Coolant : External air
 Machine : Vertical M/C, HSK63A

Wall accuracy



Cutter : EPA10R032M32.0-03N
 Insert : TOGT100408PDFR-AJ
 Grade : KS05F
 Workpiece : A7075 (Alumigo Hard)
 Cutting speed : $V_c = 900$ m/min
 Feed per tooth : $f_z = 0.10$ mm/t
 Depth of cut : $a_p = 8$ mm x 2 pass
 Width of cut : $a_e = 5$ mm
 Coolant : External air
 Machine : Vertical M/C, HSK63A

New coated grade offers long tool life

New grade for steel and stainless steel machining
Dramatically improved chipping and fracture resistance

- Multi-layered coating prevents crack expansion which causes chipping and fracture.
- Exclusive carbide substrate with remarkable impact resistance and toughness.

AH3135

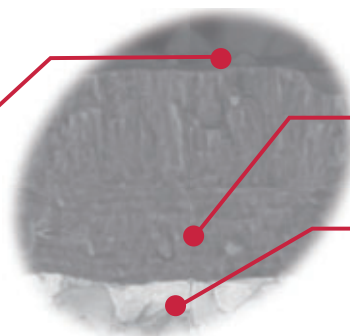


Special Surface Technology

PREMIUMTEC

TUNGALOY

Smooth insert surface prevents chip adhesion!

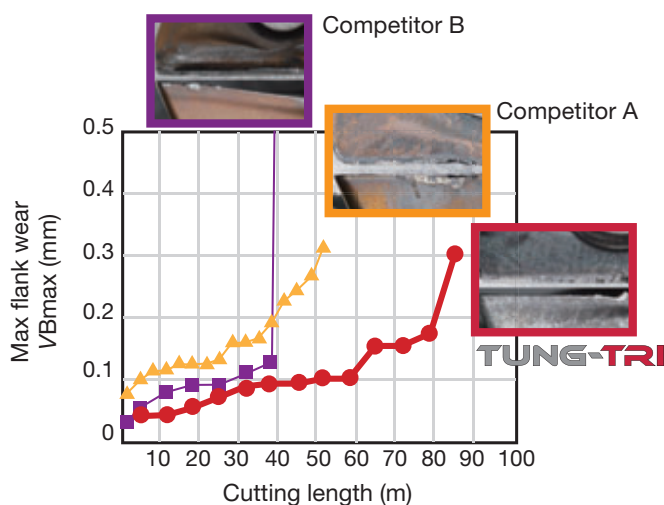


Multi-layered coating with high chipping resistance

Carbide substrate with incredible toughness

Long tool life due to high wear resistance

■ Tool life



Cutter : EPA15R040M32.0-03N
($\phi D_c = 40 \text{ mm}$, $z = 3$)
Insert : TOMT150608PDER-MJ
Grade : AH3135
Workpiece material : S55C (200HB)
Cutting speed : $V_c = 200 \text{ m/min}$
Feed per tooth : $f_z = 0.2 \text{ mm/t}$
Depth of cut : $a_p = 9 \text{ mm}$
Width of cut : $a_e = 13 \text{ mm}$
Coolant : Dry
Machine : Vertical M/C, BT50

Specification

Application	Grade	Substrate			Coating layer		Features
	Application code	Relative density	Hardness HRA	T.R.S. (GPa)	Main Composition	Thickness (μm)	
Steel Stainless	AH3135	14.0	89.5	2.8	(Ti, Al)N Multi-layer	4	First choice for steel and stainless steel Improved chipping and fracture resistances
	P30 - P40						
Cast Iron Superalloys	AH120	14.5	90.8	2.8	(Ti, Al)N	3	General purpose grade for varieties of materials Well-balanced performance
	K15 - K30						
Cast Iron	T1215	14.8	91.5	1.7	TiCN-Al ₂ O ₃	10	First choice for cast iron Improved wear resistance
	K10 - K25						
Non-ferrous	KS05F	15	93	2.9	Uncoated	-	For non-ferrous applications Excellent chipping resistance and cutting edge sharpness
	N05 - N15						

New
New

Rich grade lineup for every kind of material

- A total of four grades, including new CVD grade

AH3135



Steel Stainless

- PVD grade for high fracture resistance
- Most suitable for steel and stainless steel in general cutting parameters

AH120



Steel Cast Iron

- PVD grade with a well-balanced wear and fracture resistance
- Ideal for general machining of steel and stainless steel

New

KS05F



Non-ferrous

- Non-coated carbide grade featuring sharp cutting edge and toughness, while reducing built-up edge formation
- Most suited for non-ferrous materials

New

T1215



Cast Iron

- CVD grade with outstanding wear and chipping resistance
- Best for cast iron at high-speed machining

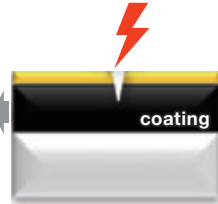
Special Surface Technology

PREMIUMTEC

TUNGALOY

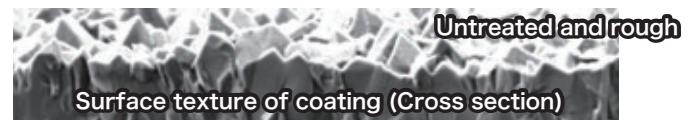


Indentation test on coating

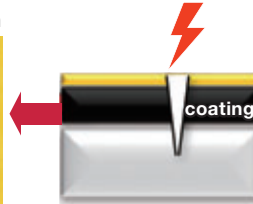


PremiumTec controls tensile residual stress and improves crack resistance.

Conventional item



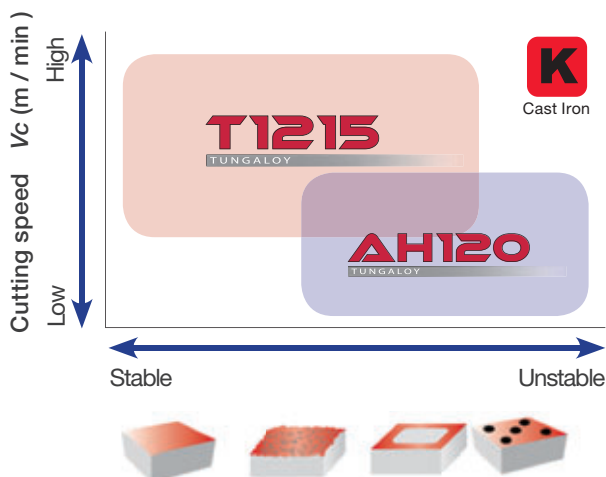
Indentation test on coating



CVD coat by nature has high tensile residual stress allowing crack propagation easily.

PremiumTec treatment enhances both smoothness and toughness on coating surface, improving resistance to chipping, build-up edge, and fracture.

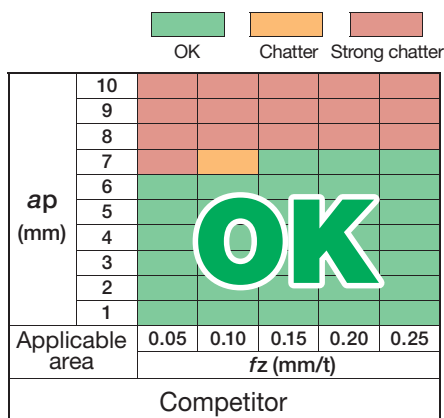
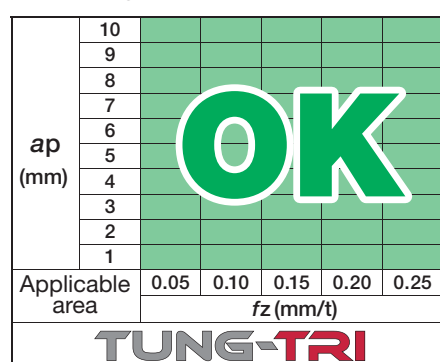
Application area



Applicable for a wide range of cutting conditions

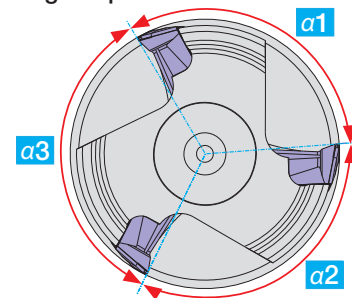
Insert positioning in irregular pitch, combined with uniquely designed flank face of inserts, prevents chattering during machining.

Cutting performance



OK Chatter Strong chatter

Irregular pitch



$\alpha 1 \neq \alpha 2 \neq \alpha 3$

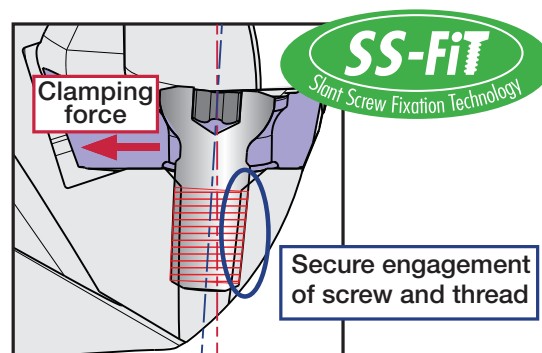
Cutter : EPA10R032M32.0-03N
 (øDc = 32 mm, z = 3)
 Insert : TOMT100404PDER-MJ
 Grade : AH3135
 Workpiece : S55C / C55 (200 HB)
 Cutting speed : Vc = 150 m/min
 Width of cut : ae = 32 mm
 Machine : Vertical M/C, BT50

High reliability

Significant increase in clamping rigidity due to large-sized screws and "SS-FiT" technology

Screw size

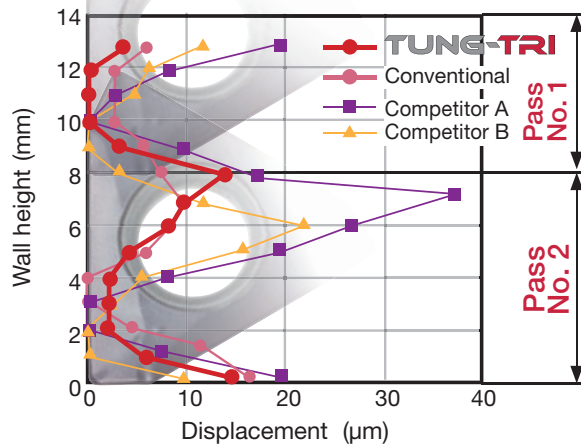
Inserts	TUNG-TRI	Competitor
TOMT06	M2.5	M1.8
TOMT10	M3.5	M2.5
TOMT15	M4.5	M4



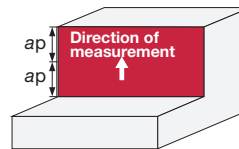
Excellent wall accuracy

High wall accuracy due to helical cutting edge with low cutting force

Wall accuracy



Cutter : EPA10R032M32.0-03N ($\phi D_c = 32$ mm, $z = 3$)
 Insert : TOMT100404PDER-MJ
 Grade : AH3135
 Workpiece : S55C / C55 (200HB)
 Cutting speed : $V_c = 150$ m/min
 Feed per tooth : $f_z = 0.1$ mm/t
 Depth of cut : $a_p = 8$ mm x 2 pass
 Width of cut : $a_e = 5$ mm
 Machine : Vertical M/C, BT50



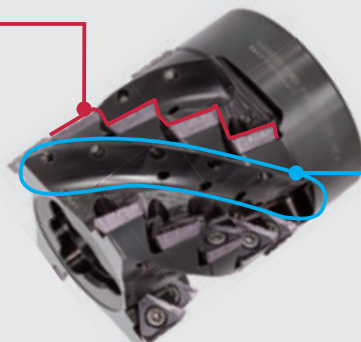
Result amount of displacement

TUNG-TRI : within 15 μm
 Conventional : within 17 μm
 Competitor A : within 22 μm
 Competitor B : within 35 μm

Roughing type

Excellent chattering resistance

- Ideal insert positioning in high helix angle
- Irregular pitch

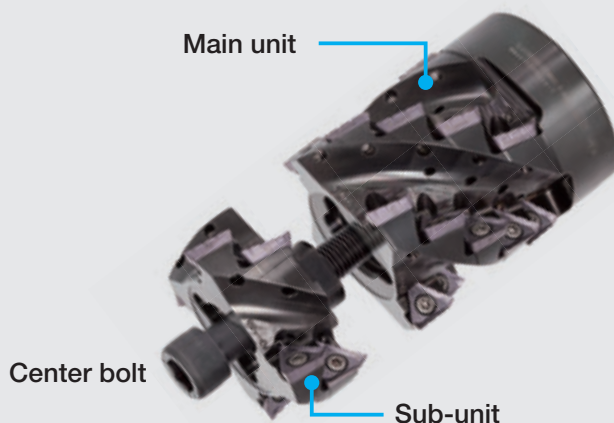


Smooth chip evacuation

- Big chip gullet that is applicable for large width of cut

Main and sub-unit system (TLA15 type)

- Exchangeable sub-units
(A main unit can be used without the sub-unit.)
- Adjustable cutting length
Maximum depth of cut can be increased
(Up to 2 sub-units are applicable on a main unit to increase depth of cut.)



Comparison of application area

- Strong resistance to chattering and low cutting force cover a wide range of applications.
- The application range is remarkably expanded with NMJ chipbreaker.

Cutting performance

		with NMJ chipbreaker			
30	38%	OK			
20	25%				
10	13%				
ae (mm)	ae / øDc (mm)	0.05	0.10	0.15	0.20
Width of cut		fz (mm/t)			

		OK				Strong chatter			
30	38%	OK				Strong chatter			
20	25%								
10	13%	OK				Strong chatter			
ae (mm)	ae / øDc (mm)								
Width of cut		fz (mm/t)				Competitor			

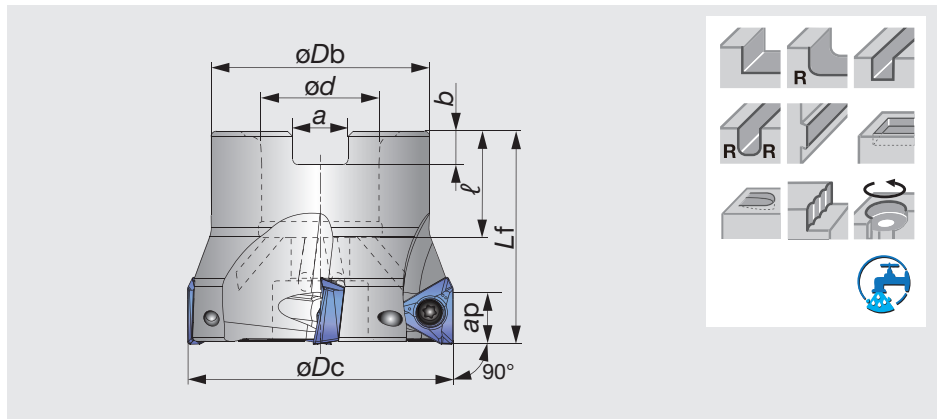
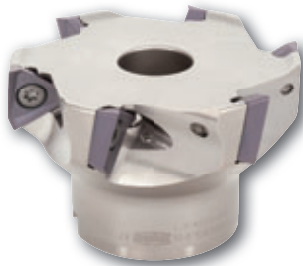
Cutter : TLA15R080L070M31.7-04M
(øDc = 80 mm, z = 4)
Insert : TOMT150608PDER-NMJ,
TOMT150608PDER-MJ
Grade : AH3135
Workpiece : SCM440 (270HB)

Cutting speed : Vc = 100 m/min
Depth of cut : ap = 55 mm
Coolant : Wet
Machine : Vertical M/C, BT50

High precision shoulder square mills with triangular inserts

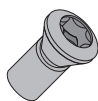
CUTTER - BORE TYPE

Tung-Tri TPA



Designation	Max. ap	ϕDc	z	ϕDb	ϕd	ℓ	L_f	b	a	Kg	C.bolt	Insert
TPA06R032M16.0E05	6	32	5	30	16	18	40	5.6	8.4	0.14	FSHM8-30H	TOMT06...
TPA06R040M16.0E06	6	40	6	35	16	18	40	5.6	8.4	0.22	CM8x30H	TOMT06...
TPA06R050M22.0E08	6	50	8	41	22	20	40	6.3	10.4	0.31	CM10x30H	TOMT06...
TPA10R040M16.0E04	10	40	4	35	16	18	40	5.6	8.4	0.20	CM8x30H	TOMT10...
TPA10R050M22.0E04	10	50	4	41	22	20	40	6.3	10.4	0.31	CM10x30H	TOMT10...
TPA10R063M22.0E06	10	63	6	41	22	20	40	6.3	10.4	0.51	CM10x30H	TOMT10...
TPA10R080M25.4-07	10	80	7	58	25.4	26	50	6	9.5	1.04	CM12x30H	TOMT10...
TPA10R080M27.0E07	10	80	7	50	27	22	50	7	12.4	1.04	CM12x30H	TOMT10...
TPA10R100M31.7-08	10	100	8	70	31.75	32	63	8	12.7	2.02	CM16x40H	TOMT10...
TPA10R100M32.0E08	10	100	8	60	32	28.5	50	8	14.4	2.02	CM16x40H	TOMT10...
TPA15R050M22.0E04	15	50	4	41	22	20	40	6.3	10.4	0.27	FSHM10-40H	TOMT15...
TPA15R063M22.0E05	15	63	5	41	22	20	40	6.3	10.4	0.41	CM10x30H	TOMT15...
TPA15R080M25.4-06	15	80	6	46	25.4	26	50	6	9.5	0.83	CM12x30H	TOMT15...
TPA15R080M27.0E06	15	80	6	50	27	22	50	7	12.4	0.86	CM12x30H	TOMT15...
TPA15R100M31.7-07	15	100	7	60	31.75	32	50	8	12.7	1.30	TMBA-M16H	TOMT15...
TPA15R100M32.0E07	15	100	7	60	32	28.5	50	8	14.4	1.27	TMBA-M16H	TOMT15...
TPA15R125M38.1-08	15	125	8	80	38.1	38	63	10	15.9	2.70	TMBA-M20H	TOMT15...
TPA15R125M40.0E08	15	125	8	71	40	32	63	9	16.4	2.47	TMBA-M20H	TOMT15...
TPA15R160M40.0E10N	15	160	10	100	40	29	63	9	16.4	4.77	-	TOMT15...
TPA15R160M50.8-10N	15	160	10	100	50.8	46	63	11	19	4.40	-	TOMT15...

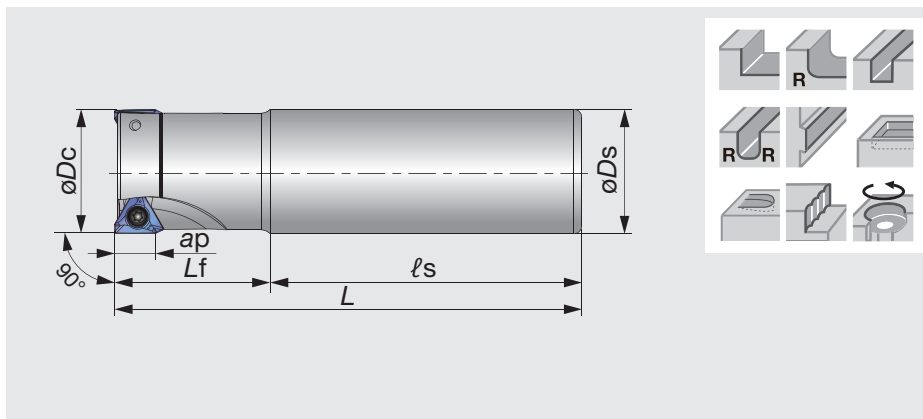
SPARE PARTS



Designation	Clamping Screw	Wrench			Mono block type wrench
		Torx Bit	Grip	Grip	
TPA06	CSTB-2.5	-	-	-	T-8D
TPA10	SR14-562/S	BLDT10/S7	SW6-SD	-	-
TPA15	TS45120I	BT20S	-	H-TB2W	-

CUTTER - SHANK TYPE

Tung-Tri EPA

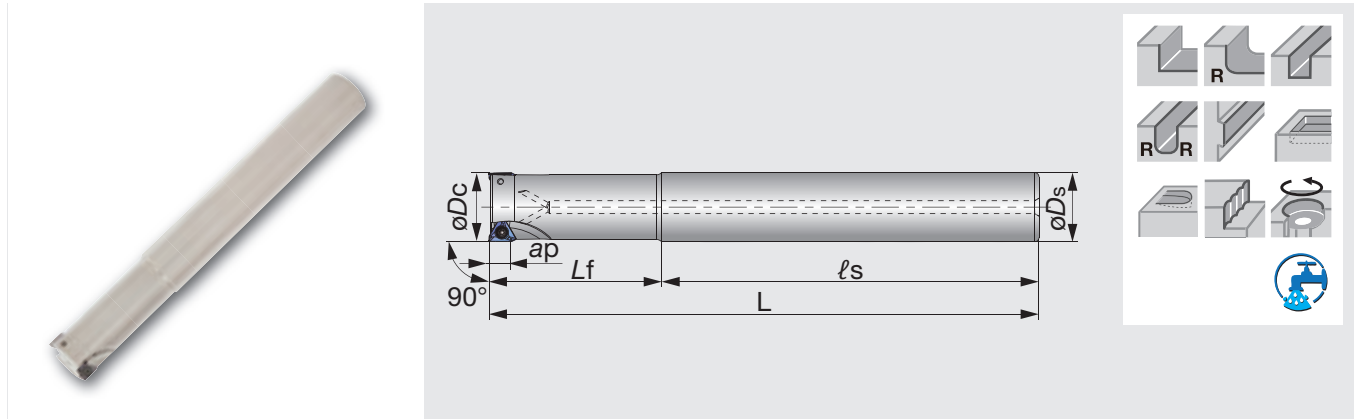


Designation		Clamping Screw	Wrench			Mono block type wrench
			Torx Bit	Grip	Grip	
EPA06	$\varnothing Dc \leq 18 \text{ mm}$	CSTB-2.5S	-	-	-	T-8D
	$\varnothing Dc \geq 20 \text{ mm}$	CSTB-2.5	-	-	-	T-8D
EPA10		SR14-562/S	BLDT10/S7	SW6-SD	-	-
EPA15		TS45120I	BT20S	-	H-TB2W	-

High precision shoulder square long endmills with triangular inserts

CUTTER - LONG SHANK TYPE

Tung-Tri EPA



Designation	Max. ap	ϕD_c	z	ϕD_s	ℓ_s	L_f	L	Kg	Insert
EPA06R016M16.0-02L	6	16	2	16	105	40	145	0.20	TOMT06...
EPA06R018M16.0-02L	6	18	2	16	115	30	145	0.21	TOMT06...
EPA06R020M20.0-02L	6	20	2	20	135	50	185	0.41	TOMT06...
EPA06R022M20.0-02L	6	22	2	20	145	40	185	0.42	TOMT06...
EPA06R025M25.0-02L	6	25	2	25	150	70	220	0.78	TOMT06...
EPA06R028M25.0-02L	6	28	2	25	180	40	220	0.80	TOMT06...
EPA10R025M25.0-02L	10	25	2	25	150	70	220	0.75	TOMT10...
EPA10R028M25.0-02L	10	28	2	25	185	35	220	0.78	TOMT10...
EPA10R032M32.0-02L	10	32	2	32	175	80	255	1.46	TOMT10...
EPA10R035M32.0-02L	10	35	2	32	215	40	255	1.52	TOMT10...
EPA10R040M32.0-02L	10	40	2	32	205	50	255	1.57	TOMT10...
EPA15R040M32.0-02L	15	40	2	32	205	50	255	1.56	TOMT15...
EPA15R050M42.0-02L	15	50	2	42	310	50	360	3.84	TOMT15...

SPARE PARTS

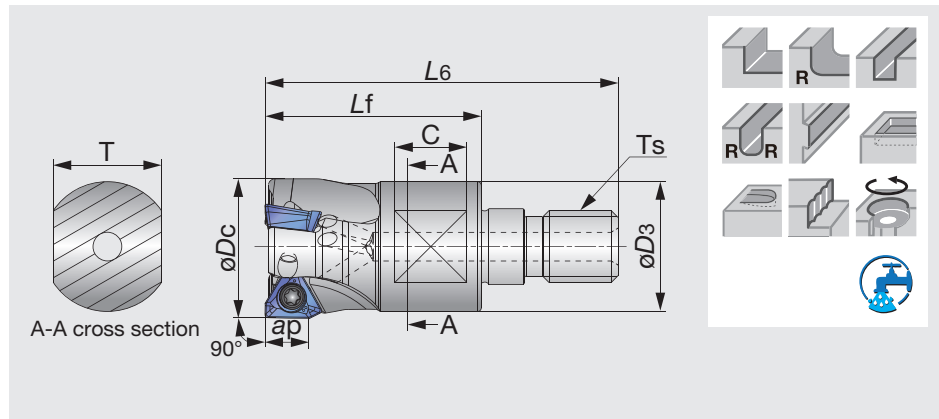


Designation	Clamping Screw	Wrench			Mono block type wrench
		Torx Bit	Grip	Grip	
EPA06	$\phi D_c \leq 18 \text{ mm}$	CSTB-2.5S	-	-	T-8D
	$\phi D_c = 20 \text{ mm}$	CSTB-2.5	-	-	T-8D
EPA10	SR14-562/S	BLDT10/S7	SW6-SD	-	-
EPA15	TS45120I	BT20S	-	H-TB2W	-

High precision shoulder square endmills with TOMT06 inserts.

CUTTER - MODULAR TYPE

Tung-Tri HPA06M



Designation	Max. ap	ϕD_c	L6	Lf	C	T	ϕD_3	Ts	Kg	z	Insert
HPA06R016MM08-02	6	16	42	25	8	10	13	M8	0.03	2	TOMT0603...
HPA06R020MM10-03	6	20	49	30	10	15	18	M10	0.06	3	TOMT0603...
HPA06R025MM12-04	6	25	57	35	10	17	21	M12	0.10	4	TOMT0603...
HPA06R032MM16-05	6	32	63	40	12	22	29	M16	0.20	5	TOMT0603...

SPARE PARTS

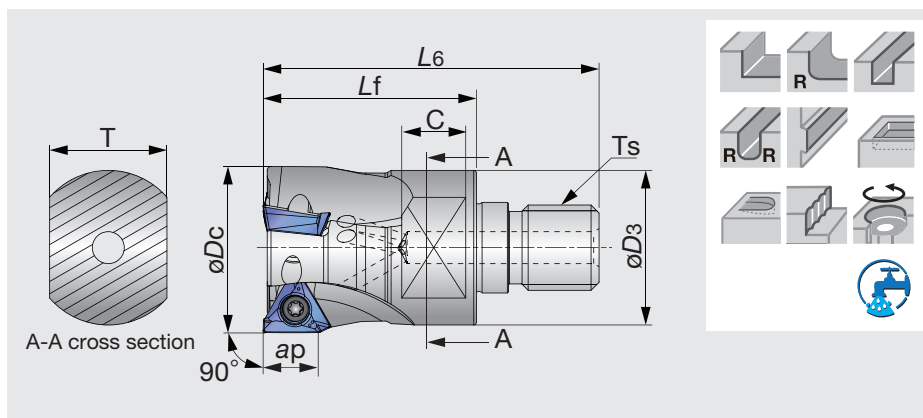


Designation	Clamping Screw	Mono block type wrench
HPA06R016	CSTB-2.5S	T-8D
HPA06R020	CSTB-2.5	T-8D
HPA06R025	CSTB-2.5	T-8D
HPA06R032	CSTB-2.5	T-8D

High precision shoulder square endmills with TOMT10 triangular inserts.

CUTTER - MODULAR TYPE

Tung-Tri HPA10M



Designation	Max. ap	ϕD_c	L_6	L_f	C	T	ϕD_3	T_s	Kg	z	Insert
HPA10R025MM12-02	10	25	57	35	10	17	21	M12	0.09	2	TOMT1004...
HPA10R032MM16-03	10	32	63	40	12	22	29	M16	0.18	3	TOMT1004...

SPARE PARTS

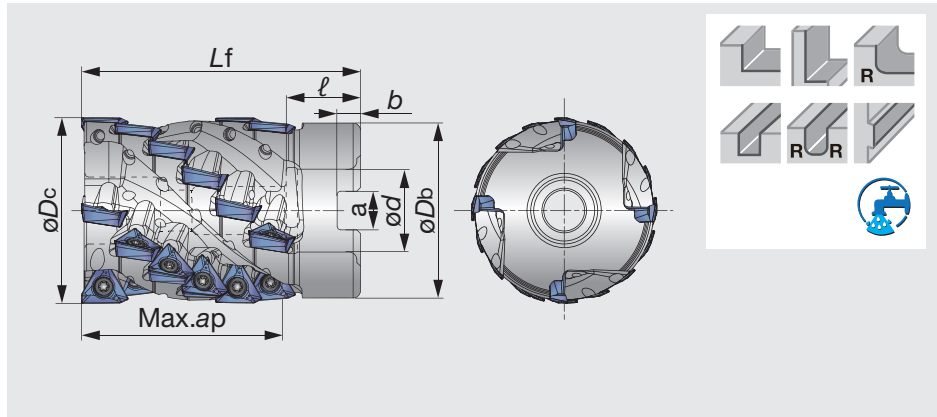


Designation	Clamping Screw	Wrench	
		Torx Bit	Grip
HPA10...	SR14-562/S	BLDT10/S7	SW6-SD

Extended flute square shoulder mills for roughing with TOMT10 triangular inserts

CUTTER - ROUGHING TYPE-BORE

Tung-Tri TLA10



Designation	Max. ap	øDc	Z eff	øDb	ød	ℓ	Lf	b	a	Kg	z	C.bolt	Insert
TLA10R050L054M22.0E04	54	50	4	47	22	20	75	6.3	10.4	0.64	24	CAP-CM10x1.5x55-H	TOMT10...
TLA10R063L054M25.4-04	54	63	4	60	25.4	26	80	6	9.5	1.26	24	CAP-CM12x1.75x50	TOMT10...
TLA10R063L054M27.0E04	54	63	4	60	27	22	80	7	12.4	1.25	24	CAP-CM12x1.75x50	TOMT10...

SPARE PARTS

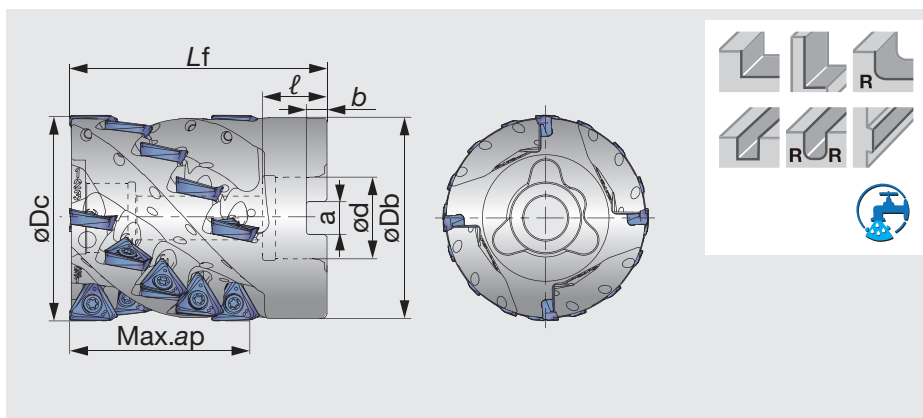


Clamping screw	Wrench
SR 14-562	T-10D

Extended flute square shoulder mills for roughing with TOMT15 triangular inserts

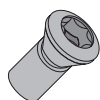
CUTTER - ROUGHING TYPE MAIN UNIT-BORE

Tung-Tri TLA15-M



Designation	Max. ap	øDc	Z eff	øDb	ød	l	Lf	b	a	Kg	z	C.bolt	Insert
TLA15R080L070M31.7-04M	70	80	4	78	31.75	32	100	8	12.7	2.29	20	CM16x75	TOMT15...
TLA15R080L070M32.0E04M	70	80	4	78	32	25	100	8	14.4	2.38	20	CM16x75	TOMT15...
TLA15R100L083M38.1-05M	83	100	5	98	38.1	38	110	10	15.9	4.24	30	CM20x80	TOMT15...
TLA15R100L083M40.0E05M	83	100	5	98	40	32	110	9	16.4	4.26	30	CM20x80	TOMT15...

SPARE PARTS

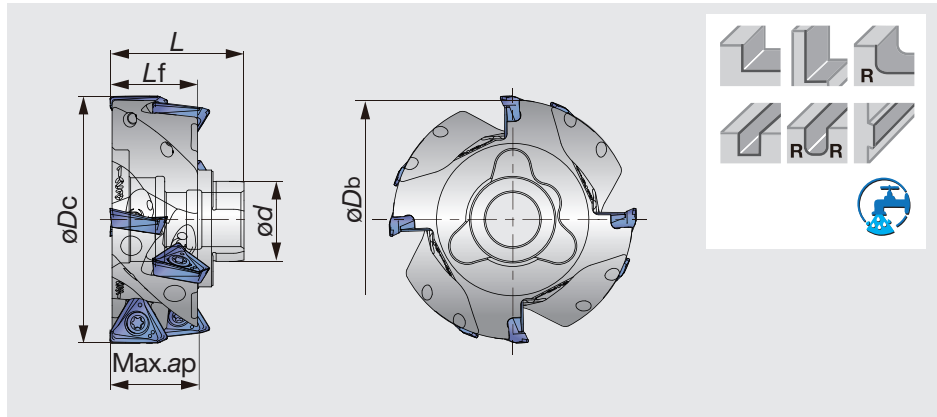


Clamping screw	Wrench	
Torx Bit	Grip	
TS45120I	BT20S	H-TB2W

Sub unit to mount on TLA15 - M type for longer Max.ap reach.

CUTTER - ROUGHING TYPE SUB UNIT

Tung-Tri TLA15-S



Designation	Max. ap	øDc	Z eff	øDb	ød	L	Lf	Kg	z	Insert
TLA15R080L028-04S	28	80	4	77.6	27	43	28.2	0.65	8	TOMT15...
TLA15R100L028-05S	28	100	5	97.2	33	46	28	1.05	10	TOMT15...

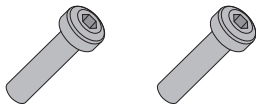
SPARE PARTS



Clamping screw	Wrench	
	Torx Bit	Grip
TS45120I	BT20S	H-TB2W

CENTER BOLT

*Optional parts

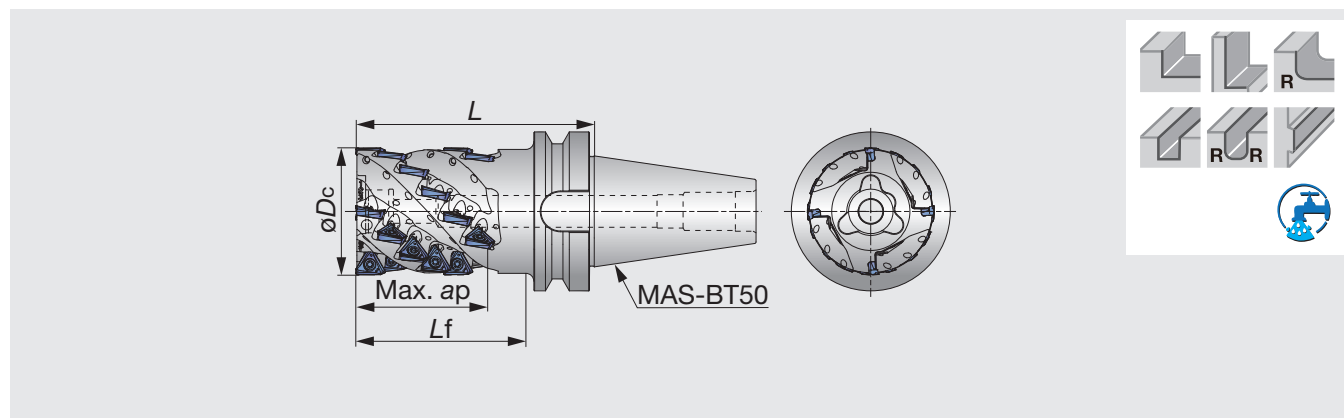


No. of sub-units	1	2
TLA15R080...	CM16x120	CM16x140
TLA15R100...	CM20x120	CM20x150

Extended flute square shoulder mills for roughing with TOMT15 triangular inserts.

CUTTER - ROUGHING TYPE WITH BT50 TAPER

Tung-Tri TLA15-BT



Designation	Max. ap	øDc	Z eff	L	Lf	Kg	z	C.bolt	Insert
TLA15R080L083BT50-04M	83	80	4	150	107	6.29	24	CAP-CM16x2.0x55	TOMT15...
TLA15R100L097BT50-05M	97	100	5	165	126.5	8.92	35	CAP-CM20x2.5x50	TOMT15...

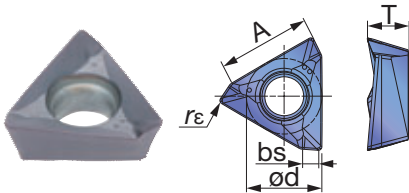
SPARE PARTS



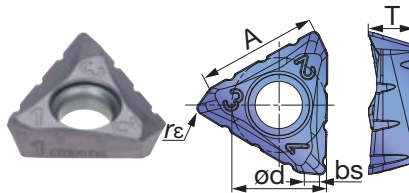
Clamping screw	Wrench	
Torx Bit	Grip	
TS45120I	BT20S	H-TB2W

INSERTS

TOMT-MJ

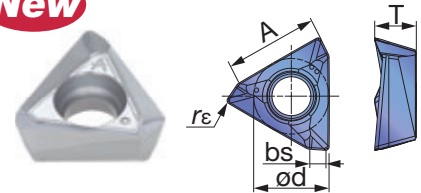


TOMT-NMJ



TOGT-AJ

New



P	Steel	☆	★		
M	Stainless		★		
K	Cast iron	★		★	
N	Non-ferrous				★
S	Superalloys		☆		
H	Hard materials				

★ : First choice
☆ : Second choice

Designation	rε	Max. ap	Coated				A	ød	T	bs
			AH120	AH3135 New	T1215	KS05F				
TOMT060302PDER-MJ	0.2	6	●	●			6.2	5.6	3.2	1.4
TOMT060304PDER-MJ	0.4	6	●	●			6.2	5.6	3.2	1.2
TOMT060308PDER-MJ	0.8	6	●	●	●		6.2	5.6	3.2	0.8
TOMT100404PDER-MJ	0.4	10	●	●			10.5	8.6	4.7	1.5
TOMT100408PDER-MJ	0.8	10	●	●	●		10.5	8.6	4.7	1.1
TOMT100416PDER-MJ	1.6	10	●	●			10.5	8.6	4.7	0.2
New TOGT100404PDFR-AJ	0.4	10				●	10.5	8.6	4.7	1.5
New TOGT100408PDFR-AJ	0.8	10				●	10.5	8.6	4.7	1.1
TOMT150604PDER-MJ	0.4	15	●	●			15.7	12.7	6	2.2
TOMT150608PDER-MJ	0.8	15	●	●	●		15.7	12.7	6	1.9
TOMT150616PDER-MJ	1.6	15	●	●			15.7	12.7	6	1.1
TOMT150620PDER-MJ	2	15	●	●			15.7	12.7	6	0.7
TOMT150608PDER-NMJ	0.8	15	●	●			15.7	12.7	6	1.9

● : Line up

Caution for using NMJ chipbreaker

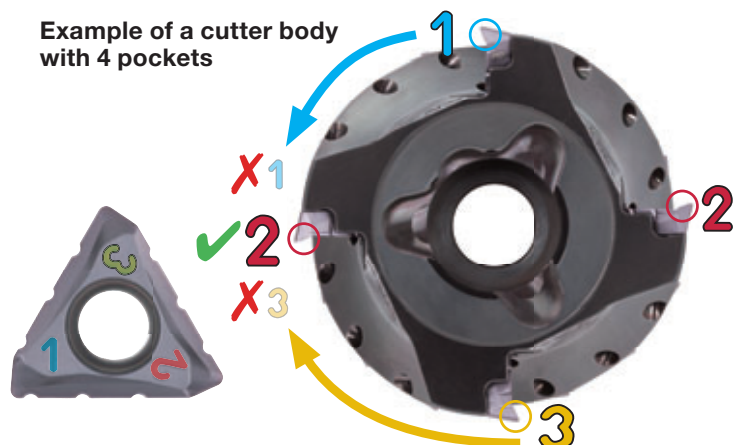


Insert with NMJ chipbreaker has a number marked on each corner. DO NOT place the corners with the same number in adjacent flute as the cutter may be damaged.

For example, if you place the corner #1 in one flute, be sure to use #2 or #3 (and avoid #1) in the next one.

Item: TOMT150608PDER-NMJ

Example of a cutter body with 4 pockets

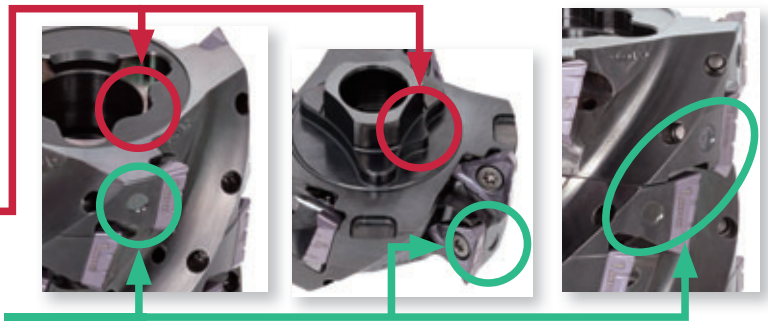


How to set a sub-unit

When setting a sub-unit on the main unit or another sub-unit, be sure to match the markings on the units. Sub-unit has a projection for error-proofing (Poka-yoke) to avoid setting error.

Projection for error-proofing
(Poka-yoke)

Marking



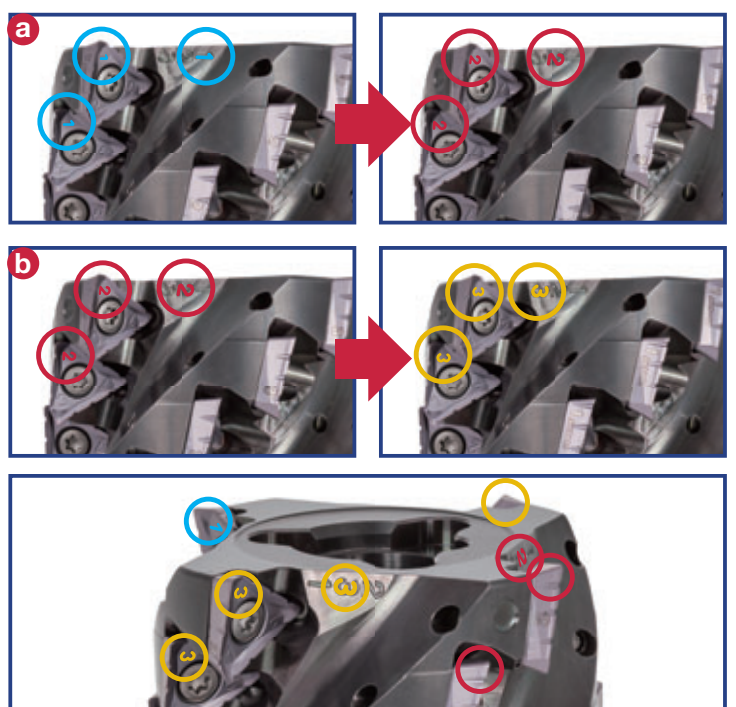
Directions for setting NMJ inserts on roughing type bodies

- 1 Attach the insert on the cutter body so that the number on the working cutting edge matches the first number marked on the cutter body.
(See the image on the right.)
- 2 Attach the remaining inserts on the same flute with the same number marked on the working cutting edge.
- 3 Repeat steps 1 and 2 for the other flutes.
- 4 Make sure the number on the working cutting edge is different from the number used on the adjacent flutes.



Directions for changing corners for inserts on roughing type bodies

- 1 **a** First time to change the corner rotate the insert clock-wise to match the number on the working cutting edge with the second number marked on the cutter body.
(See the image on the right.)
Ex: 1 ➡ 2
2 ➡ 3
3 ➡ 1
- b** Second time to change the corner rotate the insert clock-wise to match the number on the working cutting edge with the last number marked on the cutter body.
(See the image on the right.)
Ex: 2 ➡ 3
3 ➡ 1
1 ➡ 2
- 2 Repeat step 1 for all inserts.
- 3 Make sure the number on the working cutting edge is different from the number used on the adjacent flutes.



STANDARD CUTTING CONDITIONS

TPA/EPA/HPA

ISO	Workpiece materials	Hard- ness HB	Grades	Cutting speed: Vc (m/min)			Feed per tooth: fz (mm/t)				
							MJ		NMJ		AJ
				T/E/HPA06	T/E/HPA10	T/EPA15	T/E/HPA06	T/E/HPA10	T/EPA15	T/EPA15	T/E/HPA10
P	Low carbon steel (SS400 / E275A, S15C / C15E4, etc.)	- 200	AH3135	100 - 220	100 - 250	100 - 250	0.05 - 0.15	0.08 - 0.2	0.08 - 0.25	0.08 - 0.15	-
	High carbon steel (S45C / C45, etc.)	200 - 300	AH3135	100 - 170	100 - 200	100 - 230	0.05 - 0.12	0.08 - 0.15	0.08 - 0.2	0.08 - 0.15	-
	Alloy steel (SCM440, etc. / 42CrMo4, etc.)	150 - 300	AH3135	100 - 170	100 - 200	100 - 230	0.05 - 0.12	0.08 - 0.15	0.08 - 0.2	0.08 - 0.15	-
	Tool steel (SKD61 / X40CrMoV5-1, etc.)	30 - 40 HRC	AH3135	100 - 120	100 - 150	100 - 180	0.05 - 0.12	0.08 - 0.15	0.08 - 0.2	0.08 - 0.15	-
M	Stainless steel (SUS304 / X5CrNi18-9, etc.)	-	AH3135	80 - 150	80 - 200	90 - 200	0.05 - 0.15	0.08 - 0.2	0.08 - 0.2	0.08 - 0.15	-
K	Grey cast iron (FC250 / GG25 / 250, etc.)	150 - 250	AH120	100 - 200	100 - 250	140 - 250	0.05 - 0.15	0.08 - 0.2	0.08 - 0.25	0.08 - 0.15	-
			T1215	150 - 250	150 - 300	200 - 300	0.05 - 0.12	0.08 - 0.15	0.08 - 0.18	-	-
	Ductile cast iron (FCD450 / GGG45 / 450-10S, etc.)	150 - 250	AH120	80 - 150	80 - 200	110 - 200	0.05 - 0.15	0.08 - 0.2	0.08 - 0.25	0.08 - 0.15	-
			T1215	100 - 200	130 - 250	150 - 250	0.05 - 0.12	0.08 - 0.15	0.08 - 0.18	-	-
N	Aluminium (Si < 13%)	-	KS05F	-	300 - 1000	-	-	-	-	-	0.08 - 0.22
	Aluminium (Si ≥ 13%)	-	KS05F	-	100 - 200	-	-	-	-	-	0.08 - 0.22
S	Titanium alloys (Ti-6Al-4V, etc.)	-	AH120	20 - 50	20 - 60	20 - 60	0.05 - 0.1	0.08 - 0.15	0.08 - 0.18	0.08 - 0.15	-
	Heat-resistant alloys (Inconel 718, etc.)	-	AH120	20 - 35	20 - 40	20 - 40	0.03 - 0.08	0.05 - 0.13	0.07 - 0.15	0.07 - 0.15	-

- When you use the NMJ chipbreaker, please set up the feed less than 0.15 mm/t.
- Remove excessive chip accumulation with an air blast.
- For the operation with depth of cut which varies (ex. casting skin) and machining of workpiece materials with interrupted surface, the feed per tooth (fz) should be set to the lower recommended value shown in the above table.

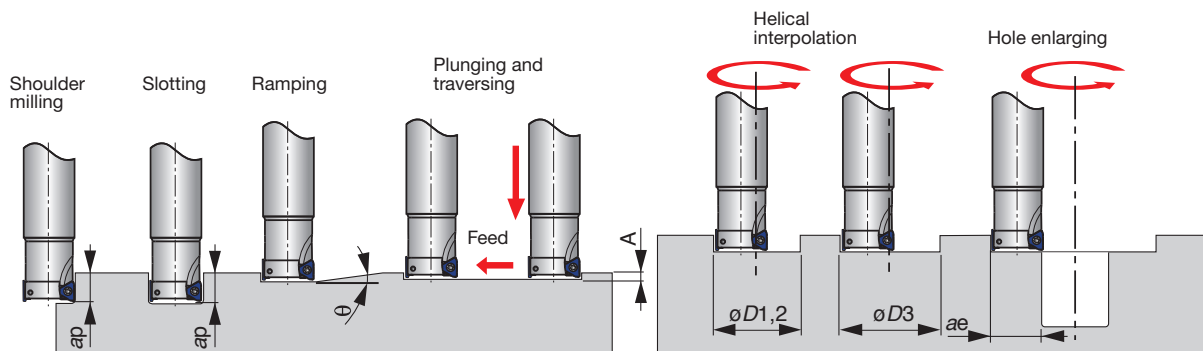
- Cutting conditions maybe limited depending on machine power, workpiece rigidity, and spindle output. When the cutting width, depth, or overhang length is large, set Vc and fz to the lower recommended values and check the machine power and vibration.

TLA (Roughing type)

ISO	Workpiece materials	Hardness HB	Grades	Cutting speed: Vc (m/min)		Feed per tooth: fz (mm/t)			
						MJ		NMJ	AJ
				TLA10	TLA15	TLA10	TLA15	TLA15	TLA10
P	Low carbon steel (SS400 / E275A, S15C / C15E4, etc.)	- 200	AH3135	100 - 250	100 - 250	0.08 - 0.18	0.08 - 0.22	0.08 - 0.15	-
	High carbon steel (S45C / C45, etc.)	200 - 300	AH3135	100 - 200	100 - 270	0.08 - 0.14	0.08 - 0.18	0.08 - 0.15	-
	Alloy steel (SCM440, etc. / 42CrMo4, etc.)	30 - 40 HRC	AH3135	100 - 150	100 - 180	0.08 - 0.14	0.08 - 0.18	0.08 - 0.15	-
M	Stainless steel (SUS304 / X5CrNi18-9, etc.)	-	AH3135	80 - 200	90 - 200	0.08 - 0.15	0.08 - 0.18	0.08 - 0.15	-
K	Grey cast iron (FC250 / GG25 / 250, etc.)	150 - 250	AH120	100 - 250	140 - 250	0.08 - 0.18	0.08 - 0.25	0.08 - 0.15	-
			T1215	150 - 250	150 - 250	0.08 - 0.15	0.08 - 0.18	-	-
	Ductile cast iron (FCD450 / GGG45 / 450-10S, etc.)	150 - 250	AH120	80 - 200	110 - 200	0.08 - 0.18	0.08 - 0.25	0.08 - 0.15	-
N			T1215	150 - 250	150 - 250	0.08 - 0.15	0.08 - 0.18	-	-
	Aluminium (Si < 13%)	-	KS05F	300 - 1000	-	-	-	-	0.08 - 0.22
	Aluminium (Si ≥ 13%)	-	KS05F	100 - 200	-	-	-	-	0.08 - 0.22
S	Titanium alloys (Ti-6Al-4V, etc.)	-	AH120	20 - 60	20 - 60	0.08 - 0.15	0.08 - 0.18	0.08 - 0.15	-
	Heat-resistant alloys (Inconel 718, etc.)	-	AH120	20 - 40	20 - 40	0.05 - 0.13	0.07 - 0.15	0.07 - 0.15	-

· When you use the NMJ chipbreaker, please set up the feed less than 0.15 mm/t.

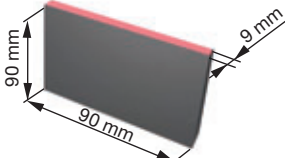
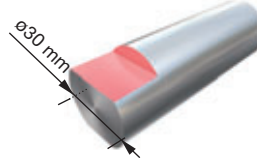
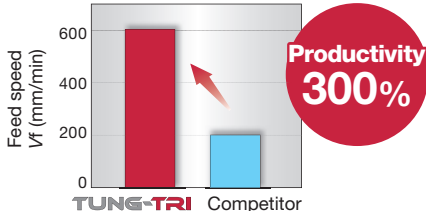
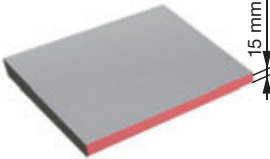
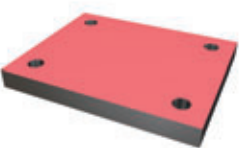
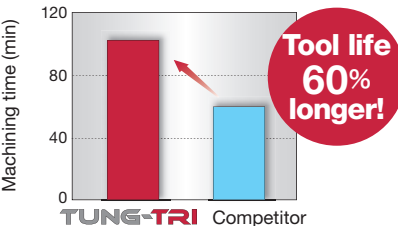
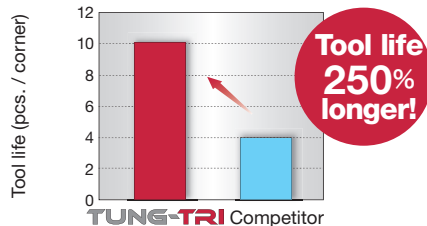
MACHINING APPLICATIONS



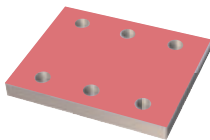
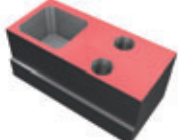
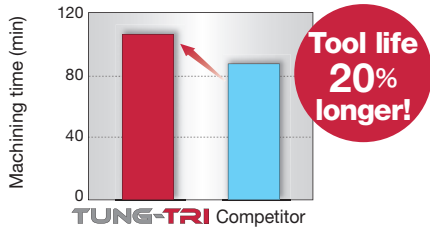
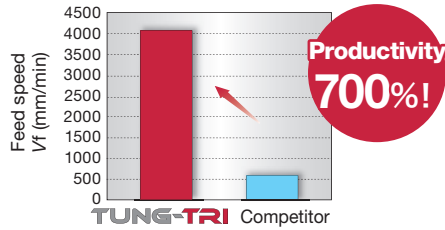
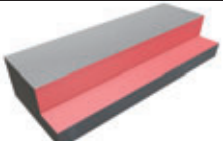
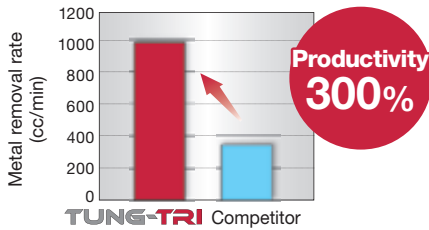
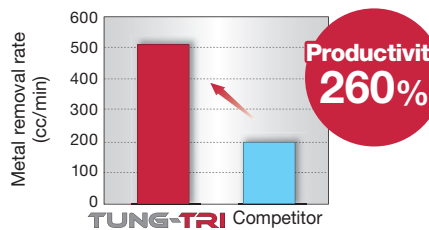
Designation	ϕD_c	Max. depth of cut a_p	Max. ramping angle θ	Max. plunging A	Min. machining $\phi D1$	Max. machining			Max. cutting width in enlarging a_e
					$\phi D2$	$\phi D3^*$	r_ϵ		
EPA06R012...	12	6	5°	0.6	18	23.6	21	0.4	11.5
EPA06R016...	16	6	4.3°	0.6	25	31.6	29	0.4	15.5
EPA06R018...	18	6	3.5°	0.6	29.5	35.6	33	0.4	17.5
EPA06R020...	20	6	2.8°	0.6	33.5	39.6	37	0.4	19.5
EPA06R022...	22	6	2.5°	0.6	37.5	43.6	41	0.4	21.5
EPA06R025...	25	6	2°	0.6	43.5	49.6	47	0.4	24.5
EPA06R028...	28	6	1.8°	0.6	49.5	55.6	53	0.4	27.5
TPA06R032...	32	6	1.5°	0.6	57.5	63.6	61	0.4	31.5
TPA06R040...	40	6	1°	0.6	73.5	79.6	77	0.4	39.5
TPA06R050...	50	6	0.7°	0.6	94	99.6	97	0.4	49.5
EPA10R025...	25	10	2°	0.6	42.1	49.6	47	0.4	24.5
EPA10R028...	28	10	2°	0.6	48.1	55.6	53	0.4	27.5
EPA10R032...	32	10	2°	0.6	56.1	63.6	61	0.4	31.5
EPA10R035...	35	10	1.7°	0.6	62.1	69.6	67	0.4	34.5
E/TPA10R040...	40	10	1.4°	0.6	72.1	79.6	77	0.4	39.5
TPA10R050...	50	10	0.9°	0.6	92.1	99.6	97	0.4	49.5
TPA10R063...	63	10	0.8°	0.6	118.1	125.6	123	0.4	62.5
TPA10R080...	80	10	0.6°	0.6	152.1	159.6	157	0.4	79.5
TPA10R100...	100	10	0.5°	0.6	192.1	199.6	197	0.4	99.5
EPA15R040...	40	15	2.3°	0.8	68.5	79.2	75.5	0.8	39
E/TPA15R050...	50	15	1.7°	0.8	88.5	99.2	95.5	0.8	49
TPA15R063...	63	15	1.4°	0.8	114.5	125.2	121.5	0.8	62
TPA15R080...	80	15	1°	0.8	148.5	159.2	155.5	0.8	79
TPA15R100...	100	15	0.8°	0.8	188.5	199.2	195.5	0.8	99
TPA15R125...	125	15	0.6°	0.8	238.5	249.2	245.5	0.8	124
TPA15R160...	160	15	0.5°	0.8	308.5	319.2	315.5	0.8	159

*Flat bottom hole

PRACTICAL EXAMPLES

Workpiece type		Plate	Machine part									
Cutter		EPA06R020M20.0-03N (ø20, z = 3)	EPA10R032M32.0-03N (ø32, z = 3)									
Insert		TOMT060304PDER-MJ	TOMT100404PDER-MJ									
Grade		AH3135	AH3135									
Workpiece material		SUS304 / X5CrNi18-9	S45C / C45									
		 M	 P									
Cutting conditions	Cutting speed: V_c (m/min)	125	150									
	Feed per tooth: f_z (mm/t)	0.083	0.19									
	Feed speed: V_f (mm/min)	600	836									
	Depth of cut : a_p (mm)	1.5	1									
	Width of cut : a_e (mm)	9	5									
	Machining	Face milling	Shoulder milling									
	Coolant	Dry	Wet (External coolant)									
	Machine	BT40	Turn-Mill center									
Results		 Uniquely designed cutting edge geometry delivers low cutting force and prevents chattering, resulting in highly efficient machining of steel sheet.	<table><tr><th>Conditions</th><th>Burr</th><th>Wall surface finish</th></tr><tr><td>TUNG-TRI</td><td>Small</td><td>Better</td></tr><tr><td>Competitor</td><td>Big</td><td>Worse</td></tr></table> Due to low cutting force, Tung-Tri leaves a smaller burr and better wall surface finish compared to the competitor.	Conditions	Burr	Wall surface finish	TUNG-TRI	Small	Better	Competitor	Big	Worse
Conditions	Burr	Wall surface finish										
TUNG-TRI	Small	Better										
Competitor	Big	Worse										
Workpiece type		Base	Block									
Cutter		EPA10R032M32.0-03N (ø32, z = 3)	TPA10R063M22.0E06 (ø63, z = 6)									
Insert		TOMT100404PDER-MJ	TOMT100408PDER-MJ									
Grade		AH3135	T1215									
Workpiece material		S50C / C50	FCD700									
		 P	 K									
Cutting conditions	Cutting speed: V_c (m/min)	130	196									
	Feed per tooth: f_z (mm/t)	0.1	0.15									
	Feed speed: V_f (mm/min)	390	900									
	Depth of cut : a_p (mm)	1.5	2.5									
	Width of cut : a_e (mm)	25	54.5									
	Machining	Shoulder milling	Face milling									
	Coolant	External air	Dry									
	Machine	Vertical M/C	BT40									
Results		 Due to strong wear resistance of AH3135 grade, tool life is increased by 60%.	 T1215 exhibited a superior wear resistance, extending the tool life well over to 250%.									

PRACTICAL EXAMPLES

Workpiece type		Blank	General machine part
Cutter		EPA10R040M32.0-04N (ø40, z = 4)	EPA10R025M25.0-02N (ø25, z = 2)
Insert		TOMT100408PDER-MJ	TOGT100408PDFR-AJ
Grade		AH3135	KS05F
Workpiece material		Titanium	AC4B
		 S	 N
Cutting conditions	Cutting speed: V_c (m/min)	55	457
	Feed per tooth: f_z (mm/t)	0.1	0.3
	Feed speed: V_f (mm/min)	175	4072
	Depth of cut : a_p (mm)	2.5	1.27
	Width of cut : a_e (mm)	25	-
	Machining	Face milling	Face milling
	Coolant	Wet (External coolant)	Wet (External coolant)
Machine		Vertical M/C, BT50	Vertical M/C, BT40
Results		 Tool life 20% longer! Sharp cutting edges prevent welding, which extends tool life.	 Productivity 700%! The AJ chipbreaker exhibited its high fracture resistance even in a demanding cutting condition.
Workpiece type		Molding machine part	Generator
Cutter		TLA15R080L070M31.7-04M (ø80) TLA15R080L028-04S	TLA15R100L083M38.1-05M (ø100, z = 5)
Insert		TOMT150608PDER-MJ	TOMT150608PDER-NMJ
Grade		AH120	AH3135
Workpiece material		FCD400 / 400-15S	S45C / C45
		 K	 P
Cutting conditions	Cutting speed: V_c (m/min)	180	160
	Feed per tooth: f_z (mm/t)	0.2	0.16
	Feed speed: V_f (mm/min)	573.0	407
	Depth of cut : a_p (mm)	74	50
	Width of cut : a_e (mm)	24	25
	Machining	Contouring	Shoulder milling (Roughing)
	Coolant	Dry	Wet (External coolant)
Machine		Vertical M/C, BT50	Vertical M/C, BT50
Results		 Productivity 300% NMJ insert reduces cutting force, and dramatically improves efficiency.	 Productivity 260% The serrated cutting edges of the NMJ chip-breaker significantly reduced vibration, while outputting a high MMR.

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