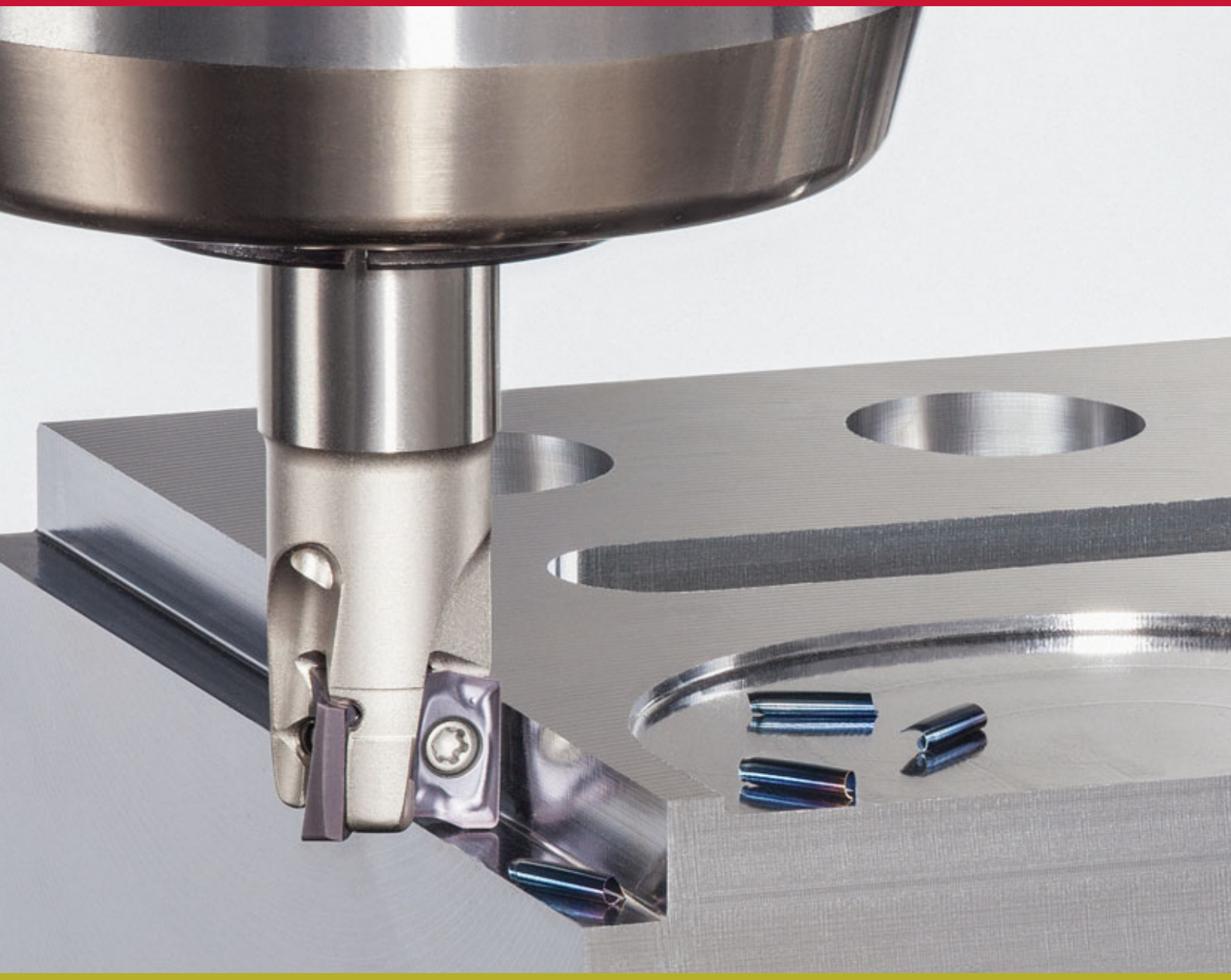
MillLine

TUNGFORCE-REC

www.tungaloy.com

Tungaloy Report No. 506-G

Miniature shoulder milling cutter
with incomparable stability



Member IMC Group Tungaloy


ACCELERATED MACHINING

TUNGFORCE-REC
TUNGALOY

TUNGFORCE MILL
ACCELERATED MACHINING

TungForce-Rec, a **new miniature shoulder milling series**, features a unique clamping system offering **exceptional stability** in machining small pockets and slots.

Square shoulder milling endmills with small diameter **with exceptional stability and productivity**

Exceptional reliability and stability

Chatter-free milling

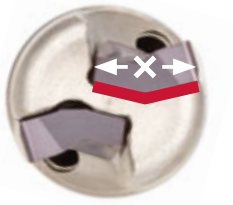
- Unique insert and seat interface allows for a robust body structure and secure insert performance.

TUNGFORCE-REC

Competitor

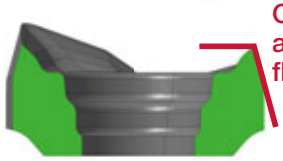
Secure insert clamping

- **V** shaped design keeps the inserts securely in place when fixed to the body. This prevents unwanted insert movements during machining, eliminating premature insert failures, while improving machining accuracy.



High fracture resistance

- Obtuse-angled flank face of the insert strengthens cutting edge and avoids chipping.
- Thicker insert design increases the insert robustness and allows larger screws to be used for added fixture security.



TUNGFORCE-REC

Competitor

Strong and easy-to-handle insert screws

- M2 screws reduce screw neck shears under high cutting forces. Large-sized screws enhances insert fixture and facilitates handlings.

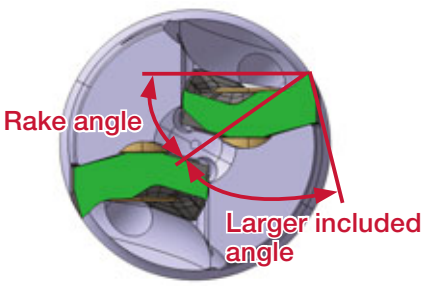
TUNGFORCE-REC
(M2)

Competitor
(M1.8)

High precision shoulder milling - with less tooling cost than solid tools

High accuracy on wall and bottom surfaces

- Secure and rigid insert fixturing enhances the indexing accuracy.
- Sharp cutting edge with large rake angle ensures smooth cutting.
- Ground to high precision, the insert provides highly accurate wall and surface finish.



Inserts

2 types of insert geometries cover wide variety of material machining from steel, stainless, cast iron, aluminum to heat resistant superalloys.

MJ type

- Suitable for tough materials with appropriate cutting edge preparation allows well-balanced sharpness and toughness.
- 3 sizes of corner radii available, R = 0.2, 0.4, & 0.8 mm
- 3 types of grades are available;
  AH3135: Suitable for steel and stainless steel machining with high toughness
  AH120: Ideal for machining of cast iron and heat resistant alloy
  New **AH130: Optimized for titanium alloys and heat resistant alloy. First choice for wet machining**

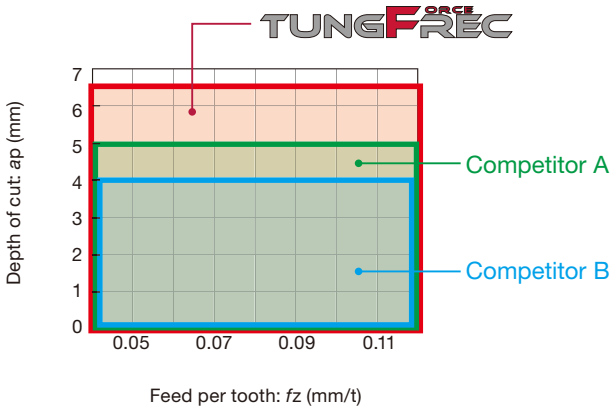
AVGT-MJ

AJ type

- Ideal insert for aluminum or non-ferrous metals machining.
- Precise ground flank face and polished rake surface creates excellent sharpness on the cutting edge.
- 3 sizes of corner radii available, R = 0.2, 0.4, & 0.8 mm
- Uncoated carbide grade, KS05F with fine grain cemented carbide has high wear resistance for non-ferrous machining.

AVGT-AJ

APPLICATION RANGE

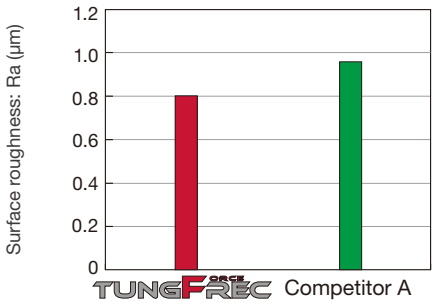


Cutter	: EPAV06M010C10.0R02 (ø*D*c = 10 mm)
Insert	: AVGT060302PBER-MJ AH3135
Workpiece material	: S55C / C55
Cutting speed	: *V*c = 270 m/min
Machining	: Slotting
Cutting width	: *a*e = 10 mm
Coolant	: Dry
Machine	: Vertical M/C, BT40 18.5kW

TungForce-Rec is applicable for a wider range of cutting condition than competitors'.

CUTTING PERFORMANCE

Surface finish: Carbon steel

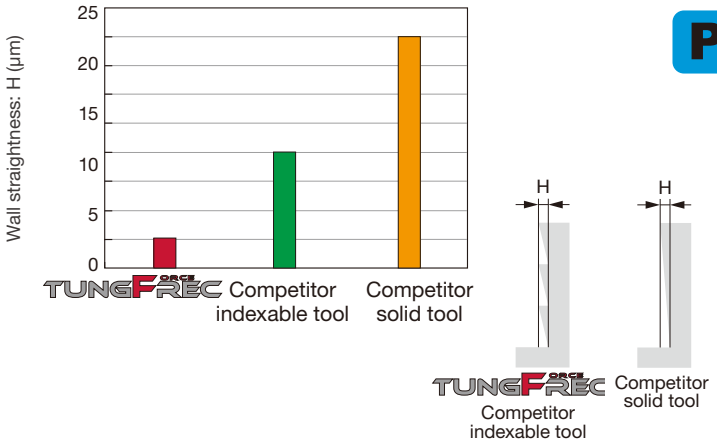


P

Cutter	: EPAV06M010C10.0R02 (ø*D*c = 10 mm, z = 2)
Insert	: AVGT060302PBER-MJ AH3135
Workpiece material	: S55C / C55 (180HB)
Cutting speed	: *V*c = 270 m/min
Feed per tooth	: *f*z = 0.07 mm/t
Depth of cut	: *a*p = 2.0 mm
Cutting width	: *a*e = 7.0 mm
Coolant	: Dry
Machine	: Vertical M/C, BT40

TungForce-Rec provides good surface finish compared with the competitors.

Wall straightness: Carbon steel

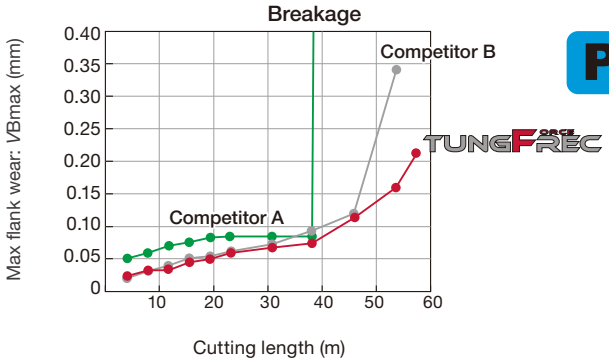


P

Cutter	: EPAV06M012C12.0R03 (ø*D*c = 12 mm, z = 3)
Insert	: AVGT060304PBER-MJ AH3135
Workpiece material	: S50C / C50 (180HB)
Cutting speed	: *V*c = 330 m/min (Solid tool: *V*c = 60 m/min)
Feed per tooth	: *f*z = 0.1 mm/t (Solid tool: *f*z = 0.04 mm/t)
Depth of cut	: *a*p = 4.0 mm x 3 pass (Solid tool: *a*p = 12 mm)
Cutting width	: *a*e = 2.0 mm
Coolant	: Dry
Machine	: Vertical M/C, BT40

TungForce-Rec has achieved the best wall finish quality.

Tool life: Carbon steel

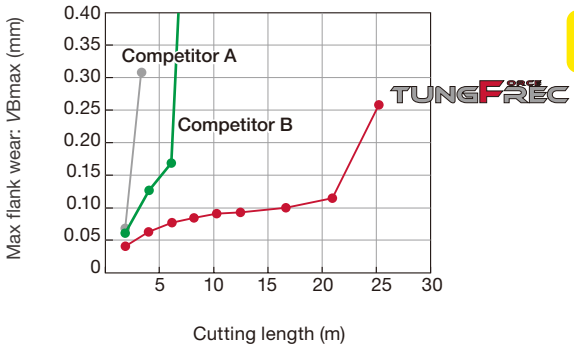


P

Cutter	: EPAV06M010C10.0R02 (ø*D*c = 10 mm, z = 2)
Insert	: AVGT060302PBER-MJ AH3135
Workpiece material	: S55C / C55 (180HB)
Cutting speed	: *V*c = 270 m/min
Feed per tooth	: *f*z = 0.07 mm/t
Depth of cut	: *a*p = 3.0 mm
Cutting width	: *a*e = 2.7 mm
Coolant	: Dry
Machine	: Vertical M/C, BT40

A highly wear resistant, PremiumTec grade, AH3135 has significantly improved insert life over the competitor's grade.

Tool life: Stainless steel



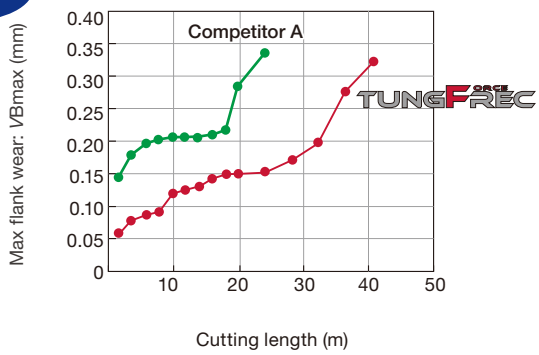
M

Cutter	: EPAV06M010C10.0R02 (ø*D*c = 10 mm, z = 2)
Insert	: AVGT060302PBER-MJ AH3135
Workpiece material	: SUS304 / X5CrNi18-9
Cutting speed	: *V*c = 260 m/min
Feed per tooth	: *f*z = 0.07 mm/t
Depth of cut	: *a*p = 3.0 mm
Cutting width	: *a*e = 2.9 mm
Coolant	: Dry
Machine	: Vertical M/C, BT40

Light cutting action, reduced buildup-edge and thermal cracking, and improved insert life.

Tool life: Superalloys

New



S

Cutter	: EPAV06M016C16.0R04 (ø*D*c = 16 mm, z = 4)
Insert	: AVGT060304PBER-MJ AH130
Workpiece material	: Ti6Al4V
Cutting speed	: *V*c = 80 m/min
Feed per tooth	: *f*z = 0.08 mm/t
Depth of cut	: *a*p = 5.0 mm
Cutting width	: *a*e = 5.0 mm
Coolant	: Emulsion
Machine	: Vertical M/C, BT40, 18.5 kW

Highly wear resistant in a wet cutting, AH130 has dramatically improved the tool life.

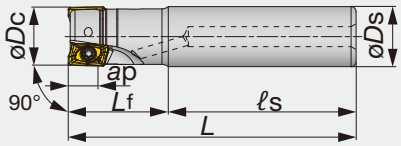
TUNGFORCE-REC
TUNGALOY

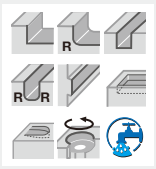
Mini square shoulder milling cutter

CUTTER - SHANK TYPE

TungForce-Rec EPAV

A.R. = +6.0°~ +7.6°, R.R. = -37.1°~ -32.4°





	Designation	Max. *ap*	ø*D*c	z	ø*D*s	*l*s	*L*f	*L*	Kg	Insert
	EPAV06M008C10.0R01	6	8	1	10	60	20	80	0.04	AVGT06...
	EPAV06M010C10.0R02	6	10	2	10	60	20	80	0.04	AVGT06...
	EPAV06M010C10.0R02L	6	10	2	10	65	35	100	0.06	AVGT06...
New	EPAV06M010C08.0R02L	6	10	2	8	80	20	100	0.04	AVGT06...
	EPAV06M012C12.0R02	6	12	2	12	60	20	80	0.06	AVGT06...
	EPAV06M012C12.0R03	6	12	3	12	60	20	80	0.06	AVGT06...
	EPAV06M012C12.0R02L	6	12	2	12	85	35	120	0.09	AVGT06...
New	EPAV06M012C10.0R02L	6	12	2	10	100	20	120	0.07	AVGT06...
New	EPAV06M012C10.0R03	6	12	3	10	60	20	80	0.04	AVGT06...
New	EPAV06M014C12.0R03	6	14	3	12	60	20	80	0.07	AVGT06...
New	EPAV06M014C12.0R03L	6	14	3	12	120	20	140	0.11	AVGT06...
	EPAV06M016C16.0R03	6	16	3	16	70	20	90	0.12	AVGT06...
	EPAV06M016C16.0R04	6	16	4	16	70	20	90	0.12	AVGT06...
	EPAV06M016C16.0R03L	6	16	3	16	105	35	140	0.20	AVGT06...
New	EPAV06M018C16.0R04	6	18	4	16	70	20	90	0.13	AVGT06...
New	EPAV06M018C16.0R03	6	18	3	16	70	20	90	0.13	AVGT06...
New	EPAV06M018C16.0R03L	6	18	3	16	160	20	180	0.26	AVGT06...
New	EPAV06M020C20.0R05	6	20	5	20	70	30	100	0.21	AVGT06...
New	EPAV06M020C20.0R04	6	20	4	20	70	30	100	0.23	AVGT06...
New	EPAV06M020C20.0R04L	6	20	4	20	165	35	200	0.45	AVGT06...
New	EPAV06M020C16.0R04	6	20	4	16	80	30	110	0.17	AVGT06...
New	EPAV06M025C25.0R06	6	25	6	25	80	35	115	0.4	AVGT06...
New	EPAV06M025C25.0R05	6	25	5	25	80	35	115	0.4	AVGT06...
New	EPAV06M025C25.0R04L	6	25	4	25	160	40	200	0.72	AVGT06...
New	EPAV06M025C20.0R06	6	25	6	20	80	35	115	0.27	AVGT06...
New	EPAV06M032C32.0R08	6	32	8	32	80	40	120	0.7	AVGT06...
New	EPAV06M032C32.0R06L	6	32	6	32	155	45	200	1.2	AVGT06...

SPARE PARTS

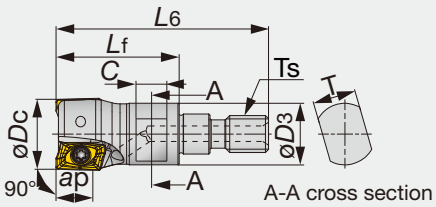
Designation	Clamping screw	Lubricant	Wrench
EPAV06M...	CSPB-2H	M-1000	IP-6DB

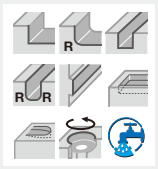
Mini square shoulder milling cutter

CUTTER - MODULAR TYPE - METRIC THREAD

TungForce-Rec HPAV-M

A.R. = +6.0°~ +7.6°, R.R. = -37.1°~ -32.4°





Designation	Max. *ap*	*øDc*	z	*L6*	*Lf*	*C*	T	*øD3*	Ts	Kg	Insert
HPAV06M010M06R02	6	10	2	34.5	20	5	7	9.5	M6	0.01	AVGT06...
HPAV06M012M06R02	6	12	2	34.5	20	5	7	10	M6	0.01	AVGT06...
HPAV06M012M06R03	6	12	3	34.5	20	5	7	10	M6	0.01	AVGT06...
HPAV06M016M08R03	6	16	3	42	25	8	10	13	M8	0.03	AVGT06...
HPAV06M016M08R04	6	16	4	42	25	8	10	13	M8	0.03	AVGT06...

For details of metric shank, please refer to TungFlex series in TR419 TungFlex

SPARE PARTS

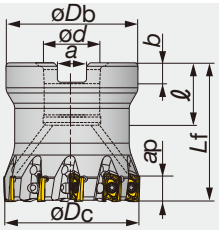


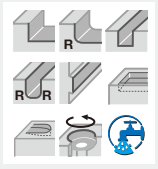
Designation	Clamping screw	Lubricant	Wrench
EPAV06M...	CSPB-2H	M-1000	IP-6DB

New

CUTTER - BORE TYPE

TungForce-Rec TPAV





Designation	Max. *ap*	*øDc*	z	*øDb*	*ød*	*ℓ*	*Lf*	*a*	*b*	Kg	Insert
TPAV06M040B16.0R10	6	40	10	38	16	18	40	8.4	5.6	0.24	AVGT06...

SPARE PARTS

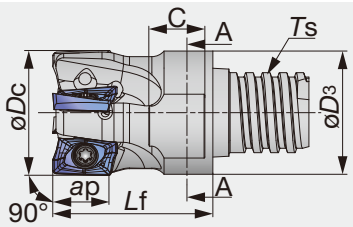


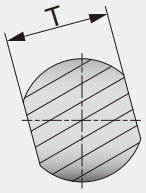

Designation	Clamping screw	Lubricant	Wrench	Center bolt
TPAV06M040B16.0R10	CSPB-2H	M-1000	IP-6DB	CM8X30H

Mini square shoulder milling cutter

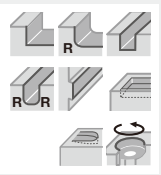
CUTTER - MODULAR HEAD - TUNGMEISTER THREAD

TungForce-Rec HPAV06-S





A-A cross section



Designation	Max. *ap*	ø*Dc*	z	*Lf*	*C*	T	ø*D3*	Ts	Kg	Insert
HPAV06M010S06R02	6	10	2	16	5	8	9.8	S06	0.01	AVGT06...
HPAV06M012S08R02	6	12	2	18	5	10	11.7	S08	0.02	AVGT06...
HPAV06M012S08R03	6	12	3	18	5	10	11.7	S08	0.02	AVGT06...
HPAV06M016S10R03	6	16	3	20	7	13	15.4	S10	0.03	AVGT06...
HPAV06M016S10R04	6	16	4	20	7	13	15.4	S10	0.03	AVGT06...

- For details of shanks, please refer to TR381 TungMeister
Shank types: VSSD, VTSD, VSC, VSTD
- For connections between metric shank and TungMeister thread, please use VAD-M type connector

Spanner for clamping	Cat. No.	Connection screw size
	KEYV-S06	S06
	KEYV-S08	S08
	KEYV-S10	S10

Optional- to be ordered separately.

SPARE PARTS

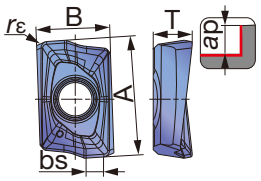


Designation	Clamping screw	Lubricant	Wrench
EPAV06M...	CSPB-2H	M-1000	IP-6DB

INSERTS

AVGT-MJ

AVGT-AJ



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

★ : First choice
☆ : Second choice

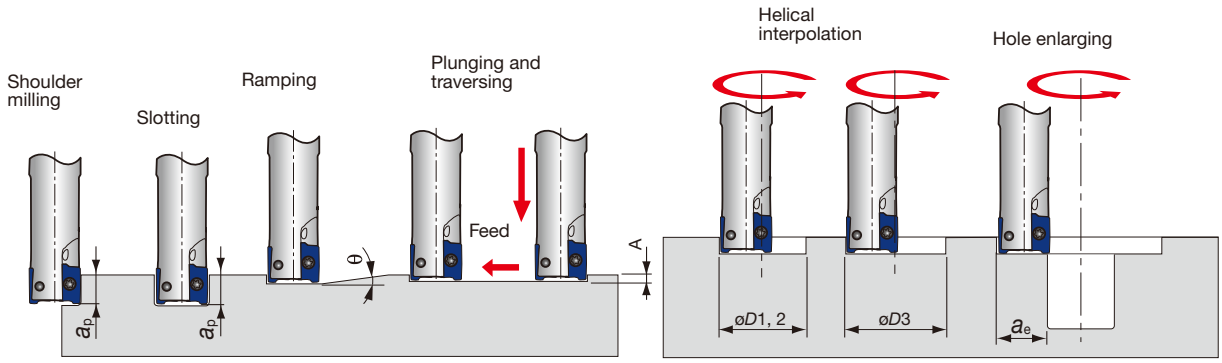
Designation	rε	Max. ap	Coated			Carbide	A	B	T	bs
			AH120	AH130	AH3135	KS05F				
AVGT060302PBER-MJ	0.2	6	●	●	●		8	5	2.7	1.5
AVGT060304PBER-MJ	0.4	6	●	●	●		8	5	2.7	1.3
AVGT060308PBER-MJ	0.8	6	●	●	●		8	5	2.6	0.9
AVGT060302PBFR-AJ	0.2	6				●	8	5	2.7	1.5
AVGT060304PBFR-AJ	0.4	6				●	8	5	2.7	1.3
AVGT060308PBFR-AJ	0.8	6				●	8	5	2.6	0.9

●: New product
●: Line up

STANDARD CUTTING CONDITIONS

ISO	Workpiece materials		Hardness	Priority	Grades	Cutting speed *Vc* (m/min)	Feed per tooth *fz* (mm/t)
P	Low carbon steel (S15C / C15E4, SS400 / E275A, etc.)		- 200 HB	First choice	AH3135	230 - 430	0.07 - 0.12
	Carbon steel and alloy steel (S55C / C55, SCM440 / 42CrMo4, etc.)		- 300 HB	First choice	AH3135	150 - 350	0.07 - 0.12
	Prehardend steel (NAK80, PX5, etc.)		30 - 40 HRC	First choice	AH3135	100 - 230	0.07 - 0.12
M	Stainless steel (SUS304 / X5CrNi18-9, SUS316 / X5CrNiMo17-12-3, etc.)		-	First choice	AH3135	150 - 220	0.06 - 0.1
K	Grey cast iron (FC250 / 250, FC300 / 300, etc.)		150 - 250 HB	First choice	AH120	200 - 330	0.07 - 0.12
	Ductile cast iron (FCD400, FCD600 / 600-3, etc.)		150 - 250 HB	First choice	AH120	150 - 240	0.07 - 0.12
N	Aluminium alloys (Si < 13%)		-	First choice	KS05F	650 - 1000	0.07 - 0.12
	Aluminium alloys (Si ≥ 13%)		-	First choice	KS05F	100 - 230	0.04 - 0.12
S	Titanium alloys (Ti-6Al-4V, etc.)		-	First choice	AH130	40 - 90	0.04 - 0.1
	Superalloys (Inconel718, etc.)		-	First choice	AH130	45 - 65	0.04 - 0.09
H	Hardened steel	(SKD61 / X40CrMoV5-1, etc.)	40 - 50 HRC	First choice	AH120	45 - 70	0.04 - 0.08
		(SKD11 / X153CrMoV12, etc.)	50 - 60 HRC		AH120	40 - 65	0.04 - 0.06

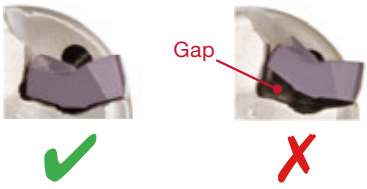
MACHINING APPLICATIONS



Designation	øDc	Max. depth of cut ap	Max. ramping angle θ	Max. plunging A	Min. machining øD1	Max. machining øD2	Max. machining øD3*	Max. cutting width in enlarging ae
EPAV06_008…	8	6	-	-	-	-	-	-
EPAV/HPAV06_010…	10	6	3°	0.3	15	19	18	9.5
EPAV/HPAV06_012…	12	6	3°	0.3	18	23	22	11.5
New EPAV/HPAV06_014…	14	6	2.3°	0.3	22	27	26	13.5
EPAV/HPAV06_016…	16	6	2°	0.3	28	31	30	15.5
New EPAV/HPAV06_018…	18	6	1.6°	0.3	30	35	34	17.5
New EPAV/HPAV06_020…	20	6	1.4°	0.3	34	39	38	19.5
New EPAV/HPAV06_025…	25	6	1.1°	0.3	44	49	48	24.5
New EPAV/HPAV06_032…	32	6	0.8°	0.3	58	63	62	31.5
New TPAV06_040…	40	6	0.6°	0.3	74	79	78	39.5

*Flat bottom hole

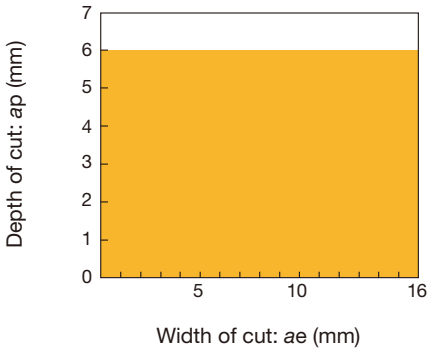
When clamping the insert, please confirm that there is no gap between the cutter body and the insert as shown in the picture.



Caution for using a large diameter cutter (over ø18 mm)

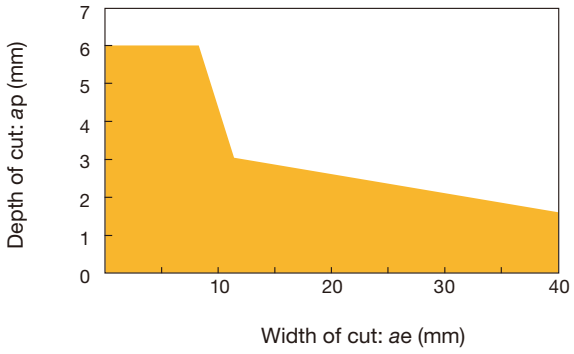
When using a cutter diameter over 18 mm, please note that the applicable range of cutting depth significantly drops as the cutting width applied increases, thus an additional finishing process may be required.

Cutting depth in relation to cutting width (for up to ø16 mm)



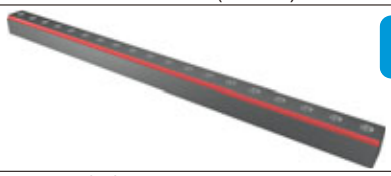
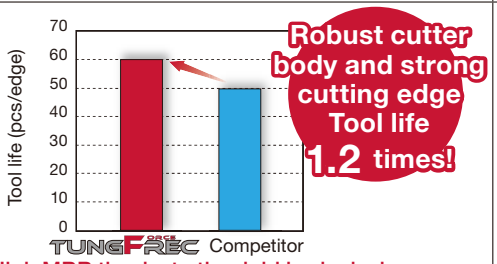
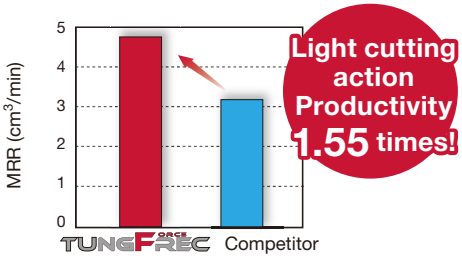
Cutter	: EPAV06M016C16.0R04 (ø*D*c = 16 mm, z = 4)
Insert	: AVGT060304PBER-MJ AH3135
Workpiece material	: S55C / C55
Cutting speed	: *V*c = 250 m/min
Feed per tooth	: *f*z = 0.07 mm/t
Machining	: Slot milling
Coolant	: Dry
Machine	: Vertical M/C, BT40, 18.5 kW

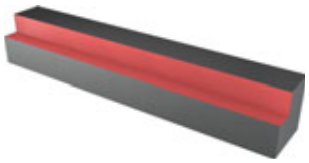
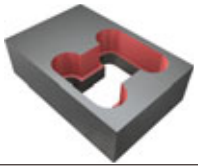
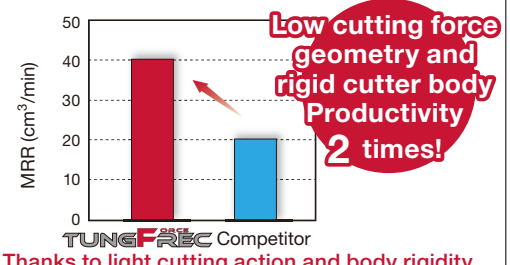
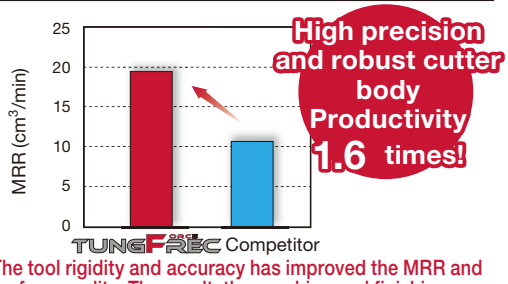
Cutting depth in relation to cutting width (for ø18 mm and up)

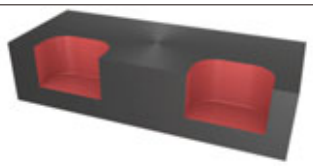
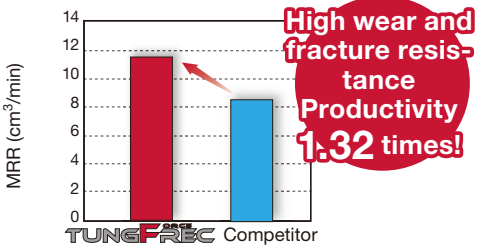
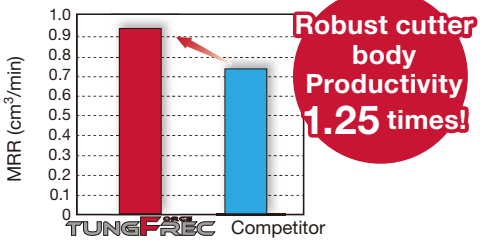
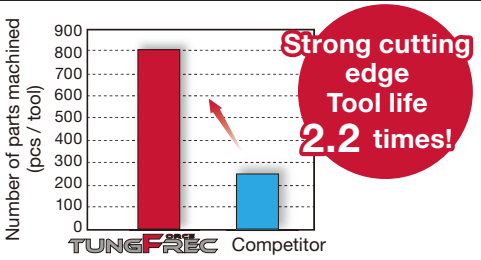
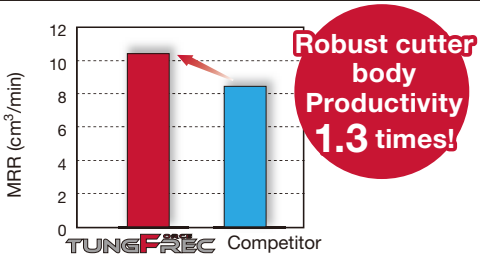


Cutter	: EPAV06M032C32.0R08 (ø*D*c = 32 mm, z = 8)
Insert	: AVGT060304PBER-MJ AH3135
Workpiece material	: S55C / C55
Cutting speed	: *V*c = 250 m/min
Feed per tooth	: *f*z = 0.07 mm/t
Coolant	: Dry
Machine	: Vertical M/C, BT40, 18.5 kW

PRACTICAL EXAMPLES

	Workpiece type	Guide shift	Spindle
	Cutter	EPAV06M010C10.0R02 (ø10, z = 2)	EPAV06M012C12.0R03 (ø12, z = 3)
	Insert	AVGT060304PBER-MJ	AVGT060304PBER-MJ
	Grade	AH3135	AH3135
	Workpiece material	S45C / C45 (25HRC)	Alloy steel (low carbon, 30HRC)
		 P	 P
Cutting conditions	Cutting speed: *Vc* (m/min)	151 (Competitor: *Vc* = 60)	143 (Competitor: *Vc* = 72)
	Feed per tooth: *fz* (mm/t)	0.05	0.04
	Feed speed: *Vf* (m/min)	481 (Competitor: *Vf* = 382)	601 (Competitor: *Vf* = 382)
	Depth of cut: *ap* (mm)	0.1	1
	Width of cut: *ae* (mm)	2.5	1.6
	Machining	Shoulder milling	Shoulder milling
	Coolant	Wet	Dry
	Machine	Vertical M/C, BT40	Vertical M/C, BT30
	Results	 High MRR thanks to the rigid body design. Optimized geometry has allowed for high speed milling.	 The sharp cutting edge geometry has enabled a smoother, vibration-free cutting at higher parameters even on a low power machine.

	Workpiece type	Machine parts	Bracket
	Cutter	EPAV06M016C16.0R04 (ø16, z = 4)	EPAV06M016C16.0R03L (ø16, z = 3)
	Insert	AVGT060403PBER-AJ	AVGT060304PBER-MJ
	Grade	KS05F	AH120
	Workpiece material	A5025 / AlMg2.5	FC250 / 250 /GG25
		 N	 K
Cutting conditions	Cutting speed: *Vc* (m/min)	251	200 (Competitor: *Vc* = 145)
	Feed per tooth: *fz* (mm/t)	0.1	0.08 (Competitor: *fz* = 0.06)
	Feed speed: *Vf* (m/min)	1998 (Competitor: *Vf* = 999)	955 (Competitor: *Vf* = 554)
	Depth of cut: *ap* (mm)	2	5.0
	Width of cut: *ae* (mm)	10	4
	Machining	Shoulder milling	Shoulder milling
	Coolant	Wet	Dry
	Machine	Vertical M/C, BT40	Horizontal M/C, BT40
	Results	 Thanks to light cutting action and body rigidity, stable, chatter-free milling was possible with a high MRR.	 The tool rigidity and accuracy has improved the MRR and surface quality. The result: the roughing and finishing processes are now integrated into a single operation.

	Workpiece type	Blocks	Machine parts
	Cutter	EPAV06M016C16.0R04 (ø16, z = 4)	EPAV06M010C10.0R02 (ø10, z = 2)
	Insert	AVGT060308PBER-M	AVGT060302PBER-MJ
	Grade	AH130	AH3135
	Workpiece material	Ti6Al4V	SUS304 / X5CrNi18-9
		 S	 M
Cutting conditions	Cutting speed: *Vc* (m/min)	50 (Competitor: *Vc* = 40)	94 (Competitor: *Vc* = 50)
	Feed per tooth: *fz* (mm/t)	0.12	0.05 (Competitor: *fz* = 0.03)
	Feed speed: *Vf* (m/min)	478	299 (Competitor: *Vf* = 239)
	Depth of cut: *ap* (mm)	1.5 (Competitor: *ap* = 0.5)	0.5
	Width of cut: *ae* (mm)	16	6.3
	Machining	Shoulder milling	Face milling
	Coolant	Internal	External
	Machine	With angle head, BT50	Lathe (Swiss type)
	Results	 High wear and fracture resistant, AH130 has enabled a high M.R.R. with stability, eliminating premature insert failures.	 Enhanced machining stability has improved the MRR at high cutting parameters.
	Workpiece type	Screw	Machine parts
	Cutter	EPAV06M010C10.0R02 (ø10, z = 2)	HPAV06M010M06R02 (ø10, z = 2)
	Insert	AVGT060302PBER-MJ	AVGT060304PBER
	Grade	AH3135	AH3135
	Workpiece material	S45C / C45	Alloy steel (Nickel-Chromium-Molybdenum)
		 P	 S
Cutting conditions	Cutting speed: *Vc* (m/min)	101	140 (Competitor: *Vc* = 110)
	Feed per tooth: *fz* (mm/t)	0.06 (Competitor: *fz* = 0.04)	0.08 (Competitor: *fz* = 0.04)
	Feed speed: *Vf* (m/min)	386	713 (Competitor: *Vf* = 560)
	Depth of cut: *ap* (mm)	2	1.5
	Width of cut: *ae* (mm)	10	10
	Machining	Face milling	Grooving
	Coolant	External	External
	Machine	Lathe (Swiss type)	Lathe
	Results	 The robust edge geometry has improved the tool life stability, eliminating premature failures.	 The high tool rigidity has allowed for a stable, chatter-free machining at high cutting parameters.

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