

Miniature shoulder milling cutter with incomparable stability





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**

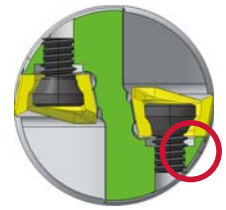
Exceptional reliability and stability

Chatter-free milling

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



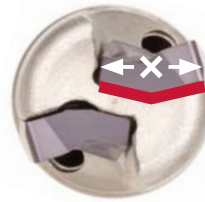
TUNGF^{ORCE}REC



Competitor

Secure insert clamping

- **V** shaped design keeps the inserts securely in place when fixed to the body. This prevents unwanted insert movement during machining, eliminating premature insert failure, 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.



TUNGF^{ORCE}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 ease of handling.



TUNGF^{ORCE}REC
(M2)

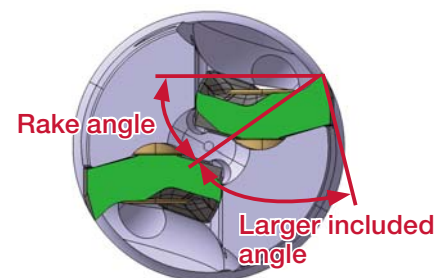


Competitor
(M1.8)

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 a wide variety of material 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, $R = 0.008"$, $0.016"$, & $0.031"$
- 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

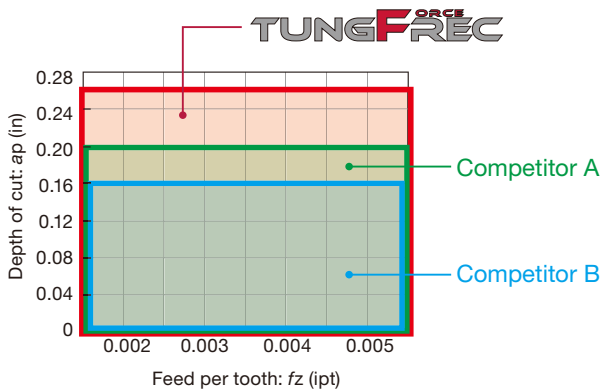
AJ type

- 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, $R = 0.008"$, $0.016"$, & $0.031"$
- Uncoated carbide grade, KS05F with fine grain cemented carbide has high wear resistance for non-ferrous machining.



AVGT-AJ

APPLICATION RANGE

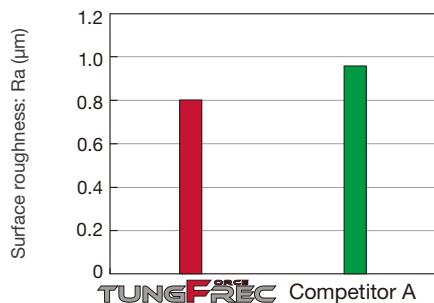


Cutter	: EPAV06U0.37C0.37R01 ($\phi D_c = 0.375"$)
Insert	: AVGT060302PBER-MJ AH3135
Workpiece material	: 1055
Cutting speed	: $V_c = 886$ sfm
Machining	: Slotting
Cutting width	: $0.375"$
Coolant	: Dry
Machine	: Vertical M/C, CAT40 18.5 kW

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

CUTTING PERFORMANCE

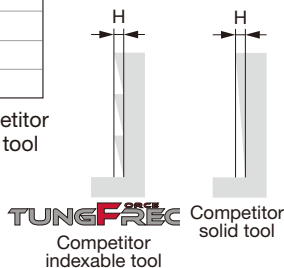
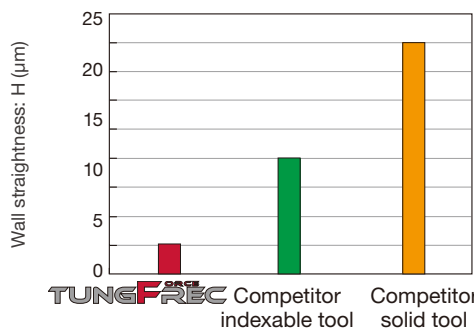
Surface finish: Carbon steel



Cutter : EPAV06U0.50C0.50R02
 (øDc = 0.5", z = 2)
 Insert : AVGT060302PBER-MJ AH3135
 Workpiece material : 1055 (180HB)
 Cutting speed : Vc = 886 sfm
 Feed per tooth : fz = 0.003 ipt
 Depth of cut : ap = 0.079"
 Cutting width : ae = 0.276"
 Coolant : Dry
 Machine : Vertical M/C, CAT40

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

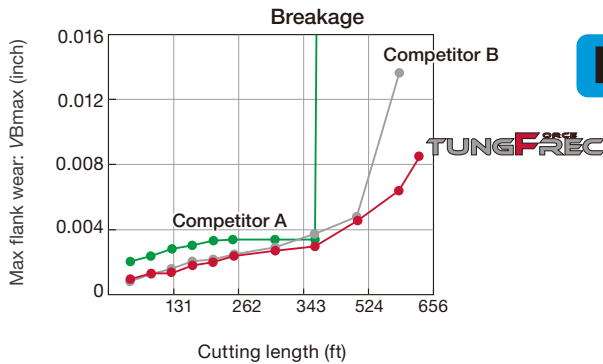
Wall straightness: Carbon steel



Cutter : EPAV06U0.50C0.50R02
 (øDc = 0.5", z = 2)
 Insert : AVGT060304PBER-MJ AH3135
 Workpiece material : 1055 (180HB)
 Cutting speed : Vc = 886 sfm
 (Solid tool: Vc = 197 sfm)
 Feed per tooth : fz = 0.003 ipt
 (Solid tool: fz = 0.0016 ipt)
 Depth of cut : ap = 0.157" × 3pass
 (Solid tool: ap = 0.472")
 Cutting width : ae = 0.02"
 Coolant : Dry
 Machine : Vertical M/C, CAT40

TungForce-Rec has achieved the best wall finish quality.

Tool life: Carbon steel

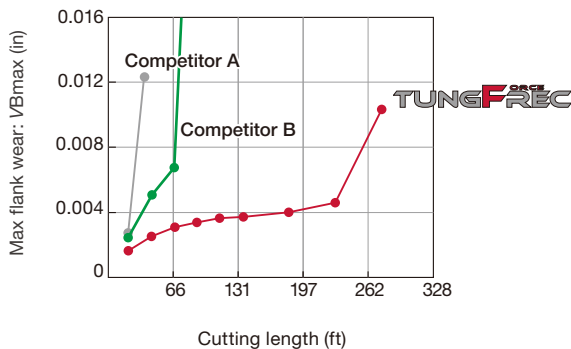


P

Cutter : EPAV06U0.50C0.50R02 ($\phi Dc = 0.5"$, $z = 2$)
 Insert : AVGT060302PBER-MJ AH3135
 Workpiece material : 1055 (180HB)
 Cutting speed : $Vc = 886$ sfm
 Feed per tooth : $fz = 0.003$ ipt
 Depth of cut : $ap = 0.118"$
 Cutting width : $ae = 0.106"$
 Coolant : Dry
 Machine : Vertical M/C, CAT40

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

Tool life: Stainless steel



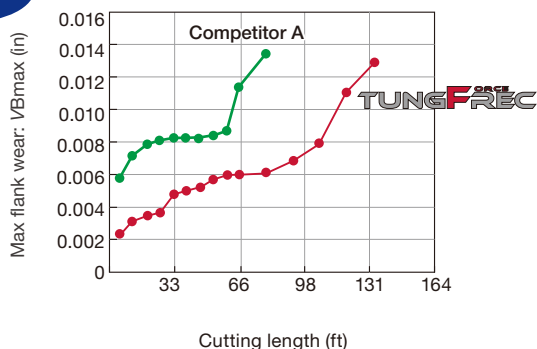
M

Cutter : EPAV06U0.50C0.50R02 ($\phi Dc = 0.5"$, $z = 2$)
 Insert : AVGT060302PBER-MJ AH3135
 Workpiece material : S30400
 Cutting speed : $Vc = 853$ sfm
 Feed per tooth : $fz = 0.003$ ipt
 Depth of cut : $ap = 0.118"$
 Cutting width : $ae = 0.114"$
 Coolant : Dry
 Machine : Vertical M/C, CAT40

Light cutting action, reduced built up edge and thermal cracking, and improved insert life.

Tool life: Superalloys

New



S

Cutter : EPAV06U0.62C0.62R04 ($\phi Dc = 0.625"$, $z = 4$)
 Insert : AVGT060304PBER-MJ AH130
 Workpiece material : Ti6Al4V
 Cutting speed : $Vc = 262$ sfm
 Feed per tooth : $fz = 0.003$ ipt
 Depth of cut : $ap = 0.197"$
 Cutting width : $ae = 0.197"$
 Coolant : Emulsion
 Machine : Vertical M/C, CAT40, 18.5 kW

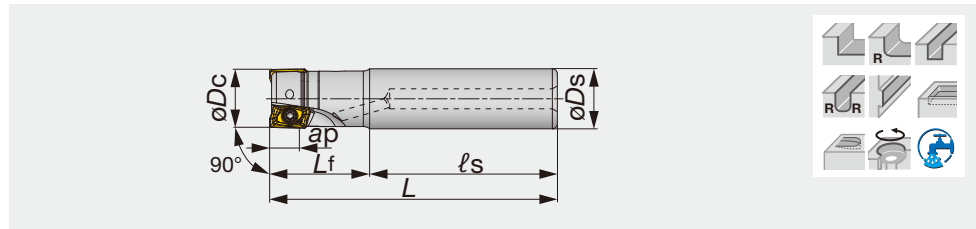
Highly wear resistant in wet cutting, AH130 has dramatically improved tool life.

Mini square shoulder milling cutter

CUTTER - SHANK TYPE

TungForce-Rec EPAV

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



Inch	Max. ap	ϕD_c	z	ϕD_s	l_s	L_f	L	lb	Insert
EPAV06U0.31C0.37R01	0.236	0.313	1	0.375	2.463	0.787	3.250	0.09	AVGT06...
EPAV06U0.37C0.37R01	0.236	0.375	1	0.375	2.463	0.787	3.250	0.09	AVGT06...
EPAV06U0.37C0.37R01L	0.236	0.375	1	0.375	2.622	1.378	4.000	0.11	AVGT06...
EPAV06U0.50C0.50R02	0.236	0.500	2	0.500	2.463	0.787	3.250	0.15	AVGT06...
EPAV06U0.50C0.50R03	0.236	0.500	3	0.500	2.463	0.787	3.250	0.15	AVGT06...
EPAV06U0.50C0.50R02L	0.236	0.500	2	0.500	3.388	1.362	4.750	0.22	AVGT06...
EPAV06U0.62C0.62R03	0.236	0.625	3	0.625	2.713	0.787	3.500	0.26	AVGT06...
EPAV06U0.62C0.62R04	0.236	0.625	4	0.625	2.713	0.787	3.500	0.26	AVGT06...
EPAV06U0.62C0.62R03L	0.236	0.625	3	0.625	4.122	1.378	5.500	0.42	AVGT06...
New EPAV06U0.75C0.62R04	0.236	0.750	4	0.625	2.815	1.185	4.000	0.33	AVGT06...
New EPAV06U0.75C0.75R04	0.236	0.750	4	0.750	2.815	1.185	4.000	0.44	AVGT06...
New EPAV06U0.75C0.75R05	0.236	0.750	5	0.750	2.815	1.185	4.000	0.44	AVGT06...
New EPAV06U0.75C0.75R04L	0.236	0.750	4	0.750	6.500	1.375	7.875	0.90	AVGT06...
New EPAV06U1.00C0.75R06	0.236	1.000	6	0.750	3.125	1.375	4.500	0.55	AVGT06...
New EPAV06U1.00C1.00R05	0.236	1.000	5	1.000	3.125	1.375	4.500	0.93	AVGT06...
New EPAV06U1.00C1.00R06	0.236	1.000	6	1.000	3.125	1.375	4.500	0.93	AVGT06...
New EPAV06U1.00C1.00R04L	0.236	1.000	4	1.000	6.425	1.575	8.000	1.68	AVGT06...

SPARE PARTS

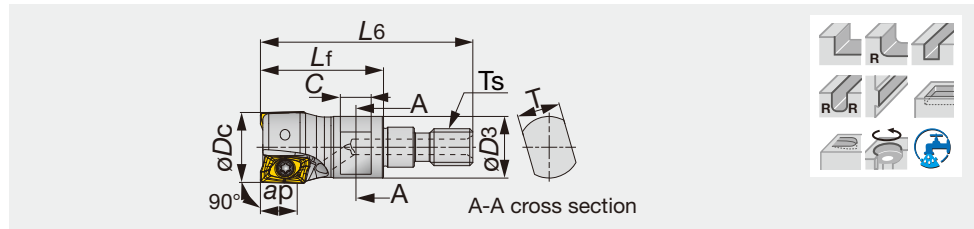
Designation	Clamping screw	Lubricant	Wrench
EPAV06M...	CSPB-2H	M-1000	IP-6DB

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°



Metric	Max. ap	øDc	z	L6	Lf	C	T	øD3	Ts	Kg	Insert
HPAV06M010M06R02	6 (0.236)	10 (0.394)	2	34.5 (1.358)	20.0 (0.787)	5.0 (0.197)	7.0 (0.276)	9.5 (0.374)	M6	0.01	AVGT06...
HPAV06M012M06R02	6 (0.236)	12 (0.472)	2	34.5 (1.358)	20.0 (0.787)	5.0 (0.197)	7.0 (0.276)	10.0 (0.394)	M6	0.01	AVGT06...
HPAV06M012M06R03	6 (0.236)	12 (0.472)	3	34.5 (1.358)	20.0 (0.787)	5.0 (0.197)	7.0 (0.276)	10.0 (0.394)	M6	0.01	AVGT06...
HPAV06M016M08R03	6 (0.236)	16 (0.630)	3	42.0 (1.654)	25.0 (0.315)	8.0 (0.984)	10.0 (0.394)	13.0 (0.512)	M8	0.03	AVGT06...
HPAV06M016M08R04	6 (0.236)	16 (0.630)	4	42.0 (1.654)	25.0 (0.315)	8.0 (0.984)	10.0 (0.394)	13.0 (0.512)	M8	0.03	AVGT06...

For metric shank details, please refer to TungFlex series in the TungFlex technical report (TR419).

Unit: mm (inch)

SPARE PARTS

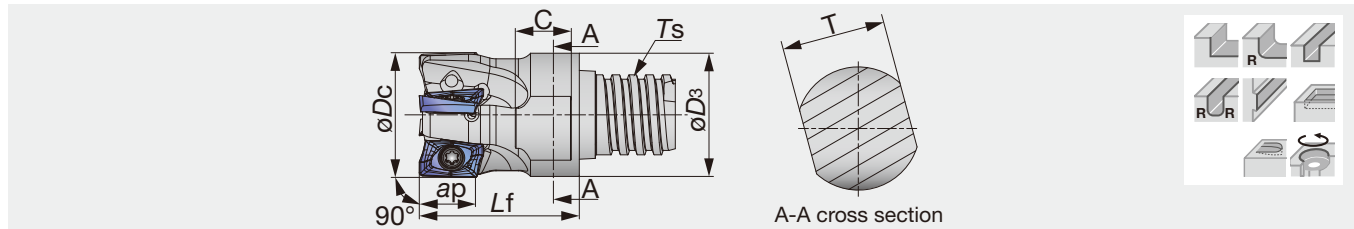


Designation	Clamping screw	Lubricant	Wrench
HPAV06M...	CSPB-2H	M-1000	IP-6DB

Mini square shoulder milling cutter

CUTTER - MODULAR HEAD - TUNGMEISTER THREAD

TungForce-Rec HPAV06-S



Metric	Max. ap	ϕD_c	z	L_f	C	T	ϕD_3	Ts	Kg	Insert
HPAV06M010S06R02	6 (0.236)	10 (0.394)	2	16 (0.630)	5 (0.197)	8	9.8 (0.386)	S06	0.01	AVGT06...
HPAV06M012S08R02	6 (0.236)	12 (0.472)	2	18 (0.709)	5 (0.197)	10	11.7 (0.461)	S08	0.02	AVGT06...
HPAV06M012S08R03	6 (0.236)	12 (0.472)	3	18 (0.709)	5 (0.197)	10	11.7 (0.461)	S08	0.02	AVGT06...
HPAV06M016S10R03	6 (0.236)	16 (0.630)	3	20 (0.787)	7 (0.276)	13	15.4 (0.606)	S10	0.03	AVGT06...
HPAV06M016S10R04	6 (0.236)	16 (0.630)	4	20 (0.787)	7 (0.276)	13	15.4 (0.606)	S10	0.03	AVGT06...

- For shank details, please refer to the TungMeister technical report (TR381).

Shank types: VSSD, VTSD, VSC, VSTD

- For connections between metric shank and TungMeister thread, please use VAD-M type connector

Unit: mm (inch)

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

Optional- to be ordered separately.

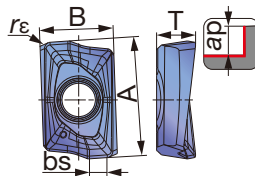
SPARE PARTS

Designation	Clamping screw	Lubricant	Wrench
HPAV06M...	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

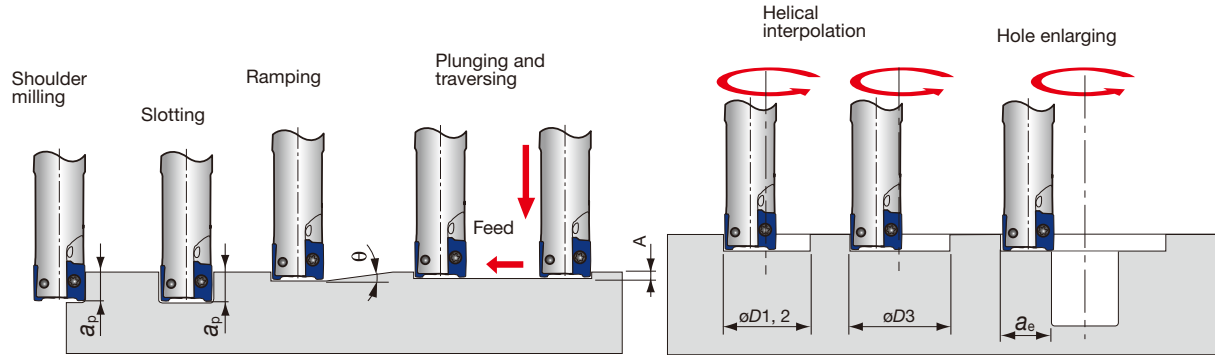
Designation	rε	Max. ap	Coated			Carbide				A	B	T	bs
			AH120	AH130	AH3135	KS05F							
AVGT060302PBER-MJ	0.008	0.236	●	●	●					0.315	0.197	0.106	0.059
AVGT060304PBER-MJ	0.016	0.236	●	●	●					0.315	0.197	0.106	0.051
AVGT060308PBER-MJ	0.031	0.236	●	●	●					0.315	0.197	0.102	0.035
AVGT060302PBFR-AJ	0.008	0.236				●				0.315	0.197	0.106	0.059
AVGT060304PBFR-AJ	0.016	0.236				●				0.315	0.197	0.106	0.051
AVGT060308PBFR-AJ	0.031	0.236				●				0.315	0.197	0.102	0.035

● : New product
● : Line up

STANDARD CUTTING CONDITIONS

ISO	Workpiece materials	Hardness	Priority	Grades	Cutting speed Vc (sfm)	Feed per tooth fz (ipt)	
P	Low carbon steels (1018, 1026, etc.)	- 200 HB	First choice	AH3135	755 - 1410	0.003 - 0.005	
	Carbon steel and alloy steel (1055, 4140, etc.)	- 300 HB	First choice	AH3135	490 - 1150	0.003 - 0.005	
	Prehardened steel (H-13, P-20, etc.)	30 - 40 HRC	First choice	AH3135	325 - 750	0.003 - 0.005	
M	Stainless steel (304, 316, etc.)	-	First choice	AH3135	490 - 720	0.003 - 0.004	
K	Gray cast iron (Class 25, Class 30, etc.)	150 - 250 HB	First choice	AH120	655 - 1080	0.003 - 0.005	
	Ductile cast iron (60-40-12, 80-55-06, etc.)	150 - 250 HB	First choice	AH120	490 - 785	0.003 - 0.005	
N	Aluminum alloys (Si < 13%)	-	First choice	KS05F	2130 - 3280	0.003 - 0.005	
	Aluminum alloys (Si ≥ 13%)	-	First choice	KS05F	325 - 750	0.003 - 0.005	
S	Titanium alloys (Ti-6Al-4V, etc.)	-	First choice	AH130	130 - 295	0.0016 - 0.004	
	Superalloys (Inconel718, etc.)	-	First choice	AH130	145 - 210	0.0016 - 0.004	
H	Hardened steel	(H13, etc.)	40 - 50 HRC	First choice	AH120	145 - 225	0.002 - 0.004
		(H13, etc.)	50 - 60 HRC	First choice	AH120	130 - 210	0.0016 - 0.003

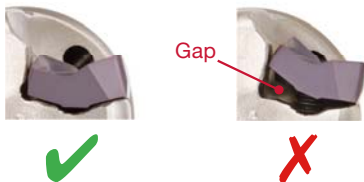
MACHINING APPLICATIONS



Designation	ϕDc	Max. depth of cut ap	Max. ramping angle θ	Max. plunging A	Min. machining $\phi D1$	Max. machining		Max. cutting width in enlarging ae
						$\phi D2$	$\phi D3^*$	
EPAV06U0.31...	0.313	0.236	-	-	-	-	-	-
EPAV06U0.37...	0.375	0.236	3°	0.012	0.591	0.748	0.709	0.374
EPAV06U0.50...	0.500	0.236	3°	0.012	0.709	0.906	0.866	0.453
EPAV06U0.62...	0.625	0.236	2°	0.012	1.026	1.220	1.181	0.610
New EPAV06U0.75...	0.750	0.236	1.5°	0.012	1.276	1.460	1.421	0.730
New EPAV06U1.00...	1.000	0.236	1°	0.012	1.775	1.960	1.921	0.980

*Flat bottom hole

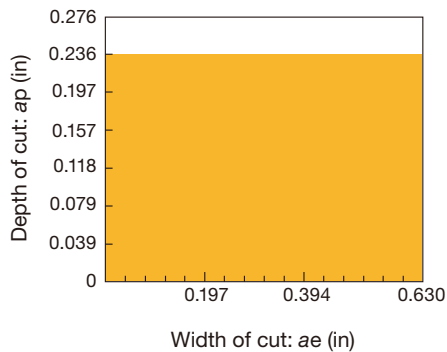
When clamping the insert, please confirm that there is no gap between the cutter body and the insert as shown in the picture.



Caution for using a large diameter cutter (over $\phi 0.709"$)

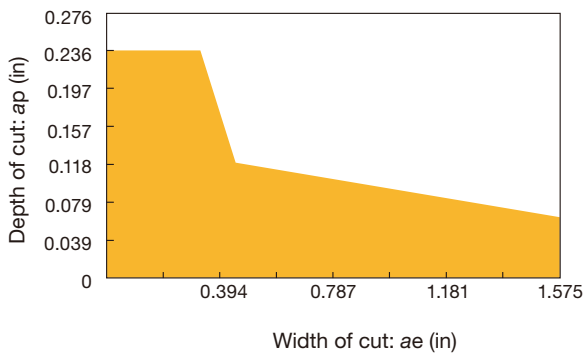
When using a cutter diameter over 0.709", please note that the applicable range of cutting depth significantly drops as the cutting width applied increases, thus an additional finishing process may be required.

Cutting depth in relation to cutting width (for up to $\phi 0.625"$)



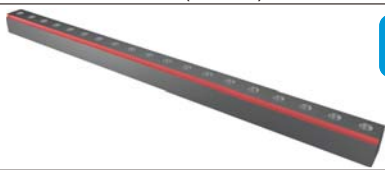
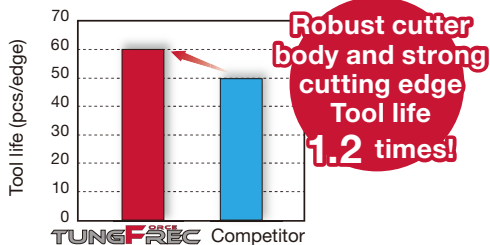
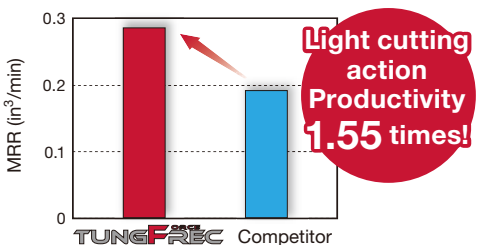
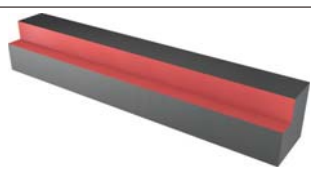

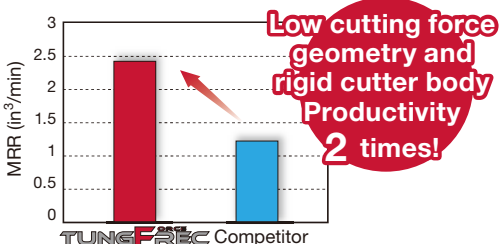
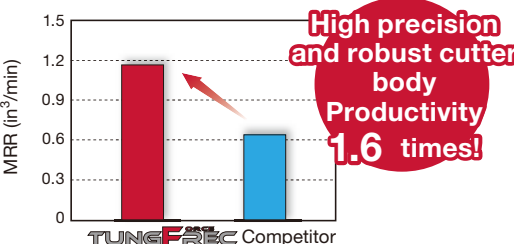
Cutter : EPAV06U0.62C0.62R04 ($\phi D_c = 0.625"$, $z = 4$)
 Insert : AVGT060304PBER-MJ AH3135
 Workpiece material : 1055
 Cutting speed : $V_c = 820$ sfm
 Feed per tooth : $f_z = 0.003$ ipt
 Machining : Slot milling
 Coolant : Dry
 Machine : Vertical M/C, BT40, 18.5 kW



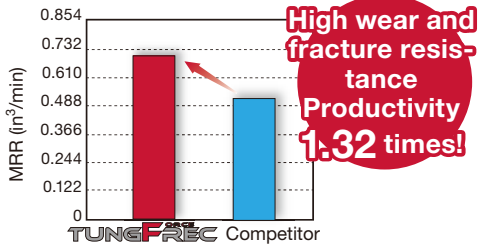
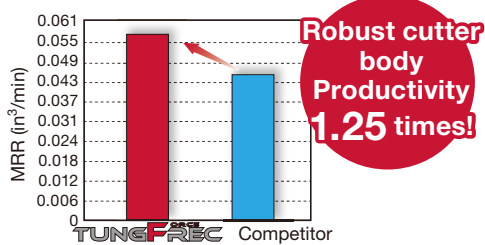


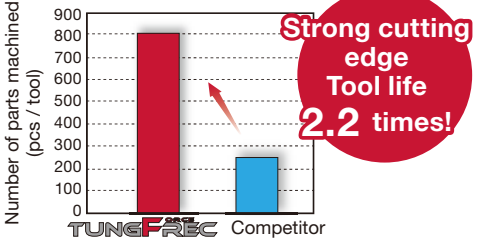
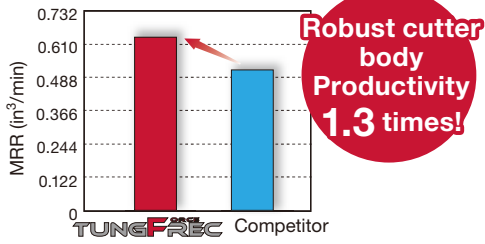
Cutting depth in relation to cutting width (for $\phi 0.750"$ and up)



Cutter : EPAV06U1.00C1.00R06 ($\phi D_c = 1.00"$, $z = 6$)
 Insert : AVGT060304PBER-MJ AH3135
 Workpiece material : 1055
 Cutting speed : $V_c = 820$ sfm
 Feed per tooth : $f_z = 0.003$ ipt
 Coolant : Dry
 Machine : Vertical M/C, BT40, 18.5 kW

PRACTICAL EXAMPLES

Workpiece type	Guide shift	Spindle	
Cutter	EPAV06U0.50R02 ($\phi 0.5"$, $z = 2$)	EPAU06U0.50C0.50R03 ($\phi 0.5"$, $z = 3$)	
Insert	AVGT060304PBER-MJ	AVGT060304PBER-MJ	
Grade	AH3135	AH3135	
Workpiece material	1045 (25HRC)  P	Alloy steel (low carbon, 30HRC)  P	
Cutting conditions	Cutting speed: Vc (sfm)	495 (Competitor: Vc = 197)	469 (Competitor: Vc = 236)
	Feed per tooth: fz (ipt)	0.002	0.002
	Feed speed: Vf (ipm)	15 (Competitor: Vf = 6)	21 (Competitor: Vf = 15)
	Depth of cut: ap (inch)	0.040	0.040
	Width of cut: ae (inch)	0.098	0.063
	Machining	Shoulder milling	Shoulder milling
	Coolant	Wet	Dry
	Machine	Vertical M/C, BT40	Vertical M/C, CAT30
Results	 <p>Robust cutter body and strong cutting edge Tool life 1.2 times!</p>	 <p>Light cutting action Productivity 1.55 times!</p>	
	<p>High MRR thanks to the rigid body design. Optimized geometry allows high speed milling.</p>		<p>The sharp cutting edge geometry has enabled smoother, vibration-free cutting at higher parameters even on a low power machine.</p>
Workpiece type	Machine parts	Bracket	
Cutter	EPAV06U0.62C0.62R04 ($\phi 0.625"$, $z = 4$)	EPAV06U0.62C00.62R03 ($\phi 0.625"$, $z = 3$)	
Insert	AVGT060408PBER-AJ	AVGT060304PBER-MJ	
Grade	KS05F	AH120	
Workpiece material	5052  N	Class 25  K	
Cutting conditions	Cutting speed: Vc (sfm)	823	656 (Competitor: Vc = 476)
	Feed per tooth: fz (ipt)	0.004	0.003 (Competitor: fz = 0.02)
	Feed speed: Vf (ipm)	80 (Competitor: Vf = 39)	36 (Competitor: Vf = 22)
	Depth of cut: ap (inch)	0.080	0.197
	Width of cut: ae (inch)	0.312	0.157
	Machining	Shoulder milling	Shoulder milling
	Coolant	Wet	Dry
	Machine	Vertical M/C, BT40	Horizontal M/C, BT40
Results	 <p>Low cutting force geometry and rigid cutter body Productivity 2 times!</p>	 <p>High precision and robust cutter body Productivity 1.6 times!</p>	
	<p>Thanks to light cutting action and body rigidity, stable, chatter-free milling was possible with a high MRR.</p>		<p>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.</p>

Workpiece type	Blocks	Machine parts	
Cutter	EPAV06U0.62C0.62R04 ($\phi 0.625"$, $z = 4$)	EPAV06U0.50C0.50R02 ($\phi 0.5"$, $z = 2$)	
Insert	AVGT060308PBER-M	AVGT060302PBER-MJ	
Grade	AH130 Ti6Al4V	AH3135 S30400	
Workpiece material	 S	 M	
Cutting conditions	Cutting speed: V_c (sfm)	164 (Competitor: $V_c = 131$)	308 (Competitor: $V_c = 164$)
	Feed per tooth: f_z (ipt)	0.005	0.002 (Competitor: $f_z = 0.001$)
	Feed speed: V_f (ipm)	20 (Competitor: $V_f = 16$)	9 (Competitor: $V_f = 2.5$)
	Depth of cut: a_p (inch)	0.059 (Competitor: $a_p = 0.020$)	0.020
	Width of cut: a_e (inch)	0.630	0.248
	Machining	Shoulder milling	Face milling
	Coolant	Internal	External
	Machine	With angle head, BT50	Lathe (Swiss type)
Results	 <p>High wear and fracture resistance Productivity 1.32 times!</p>	 <p>Robust cutter body Productivity 1.25 times!</p>	
	<p>High wear and fracture resistant, AH130 has enabled a high M.R.R. with stability, eliminating premature insert failures.</p>	<p>Enhanced machining stability has improved the MRR at high cutting parameters.</p>	
Workpiece type	Screw	Machine parts	
Cutter	EPAV06U0.50C0.50R02 ($\phi 0.5"$, $z = 2$)	EPAV06U0.50C0.50R02 ($\phi 0.5"$, $z = 2$)	
Insert	AVGT060302PBER-MJ	AVGT060304PBER	
Grade	AH3135 1045	AH3135 Alloy steel (Nickel-Chromium-Molybdenum)	
Workpiece material	 P	 S	
Cutting conditions	Cutting speed: V_c (sfm)	331	459 (Competitor: $V_c = 361$)
	Feed per tooth: f_z (ipt)	0.002 (Competitor: $f_z = 0.002$)	0.003 (Competitor: $f_z = 0.002$)
	Feed speed: V_f (ipm)	10	21 (Competitor: $V_f = 19$)
	Depth of cut: a_p (inch)	0.079	0.059
	Width of cut: a_e (inch)	0.394	0.394
	Machining	Face milling	Grooving
	Coolant	External	External
	Machine	Lathe (Swiss type)	Lathe
Results	 <p>Strong cutting edge Tool life 2.2 times!</p>	 <p>Robust cutter body Productivity 1.3 times!</p>	
	<p>The robust edge geometry has improved the tool life stability, eliminating premature failures.</p>	<p>The high tool rigidity has allowed for stable, chatter-free machining at high cutting parameters.</p>	

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