

Square shoulder milling tool

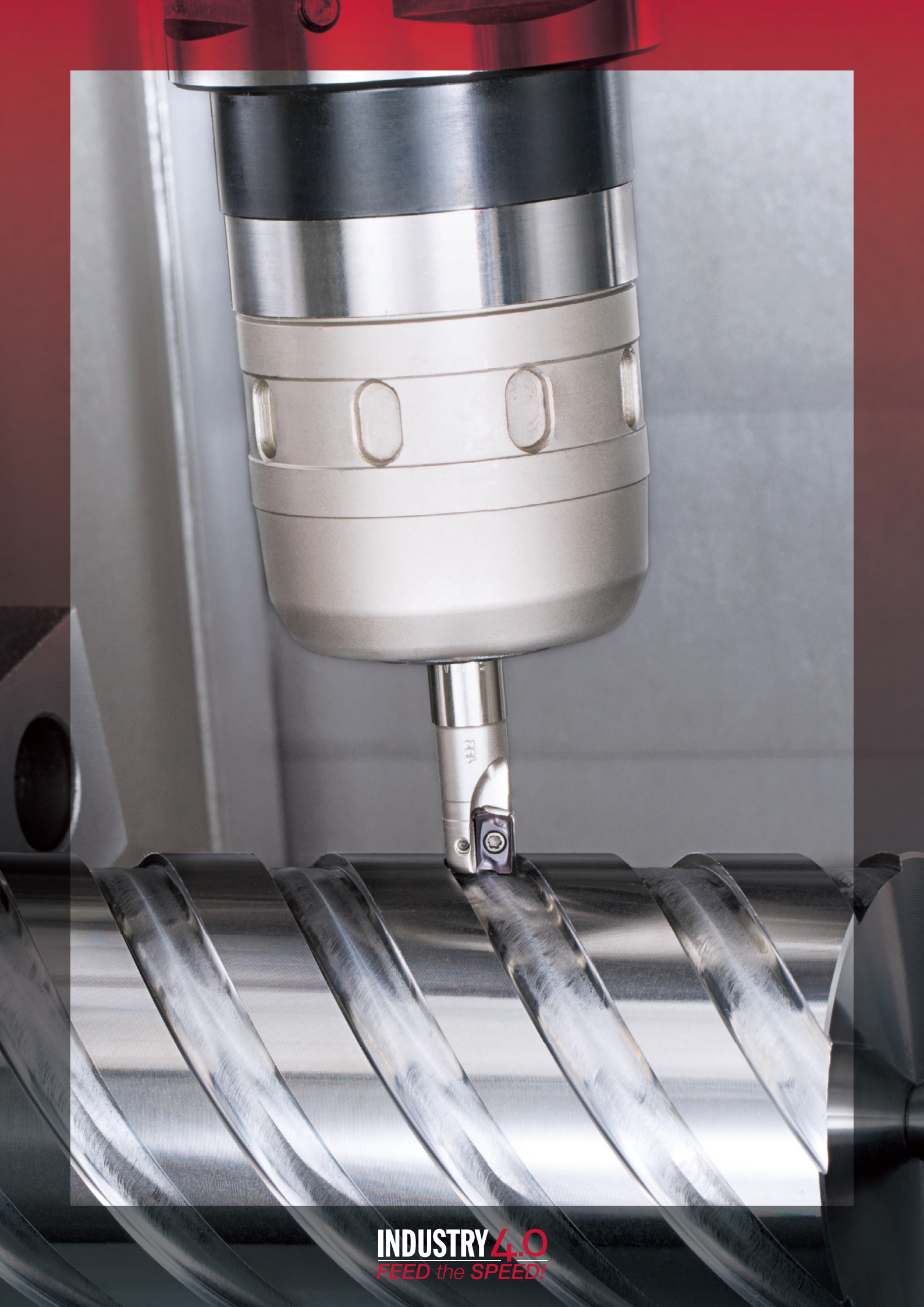
**TUNG**<sup>ORCE</sup>**FREC**

Tungaloy Report No. 506-G

Extremely versatile shoulder milling cutter with unique V shape inserts - **Now offering size 04 inserts for small diameter cutters**

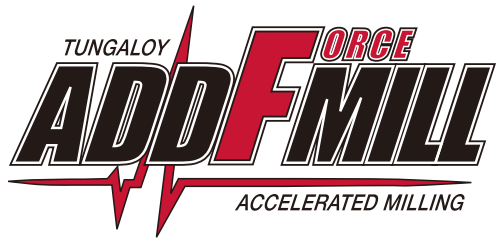






**INDUSTRY 4.0**  
*FEED the SPEED!*





# TUNG FORCE REC

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Unique insert clamping ensures high precision and efficiency machining with stability

## New Size-04 inserts are now available for small-diameter cutters covering **a wider application range with three insert sizes**

**New**

**Size 04**



Max. depth of cut: 4 mm  
Tool diameter: ø6 - 16 mm

- Tool diameters **as small as ø6 mm** available as standard
- Perfect replacement for solid carbide endmills
- **Better cost-per-edge economy** than solid endmills or shoulder mills with larger inserts when used at light depth of cut ≤ 4 mm

**Size 06**



Max. depth of cut: 6 mm  
Tool diameter: ø8 - 40 mm

- **Precision-ground insert** for high part quality
- Creates **virtually step-free wall and bottom surfaces**
- Inserts available in **R0 nose radii**
  - perfect for machining small parts in **Swiss machines**

**Size 12**



Max. depth of cut: 11.5 mm  
Tool diameter: ø12 - 63 mm

- **Robust cutter body design**
- **Close pitch cutter for high productivity**
- **Extensive lineup of insert nose radii and grades** for a wide application coverage

### Lineup of each insert size

| Size          | Max. depth of cut (mm) | Corner radius (mm)              | Workpiece material           | Tool diameter (mm)<br>Number of inserts  |         |             |             |             |  |  |  |  |  |  |
|---------------|------------------------|---------------------------------|------------------------------|--|---------|-------------|-------------|-------------|--|--|--|--|--|--|
| <b>New</b> 04 | 4                      | 0.4 / 0.8                       | <b>P M K</b><br><b>S H</b>   | ø6<br>1  | ø8<br>2 | ø10<br>2, 3 | ø12<br>3, 4 | ø16<br>4, 5 |  |  |  |  |  |  |
| 06            | 6                      | 0 / 0.2<br>0.4 / 0.8            | <b>P M K</b><br><b>S N H</b> | ø8 1    ø10 2    ø12 2, 3    ø14 2, 3    ø16 3, 4    ø18 3, 4    ø20 4, 5    ø22 4, 5    ø25 4, 5, 6    ø32 6, 8    ø40 10 |         |             |             |             |  |  |  |  |  |  |
| 12            | 11.5                   | 0.4 / 0.8<br>1.2 / 1.6<br>2 / 3 | <b>P M K</b><br><b>S N H</b> | ø12 1    ø16 2, 3    ø20 3, 4    ø25 3, 4, 6    ø32 3, 6, 8    ø40 6, 8    ø50 8, 12    ø63 8, 14                          |         |             |             |             |  |  |  |  |  |  |

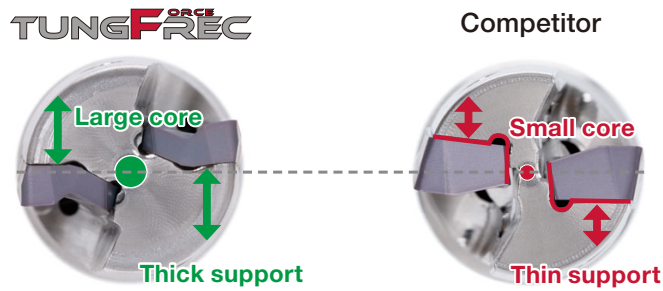
## Unique V shape insert for machining security

### Strong cutter body design

V shape insert design enables the cutter to have a thick core and insert backing.

### Extremely secure insert clamping

V shape design prevents insert movement during machining.



**Ensures high productivity and stability.**

**Eliminates premature insert failure, while providing machining stability.**

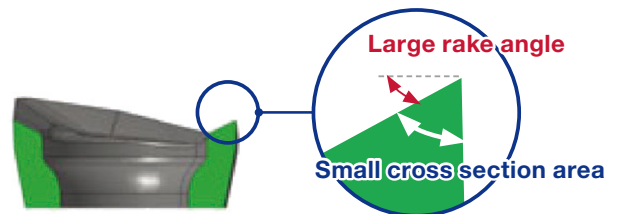
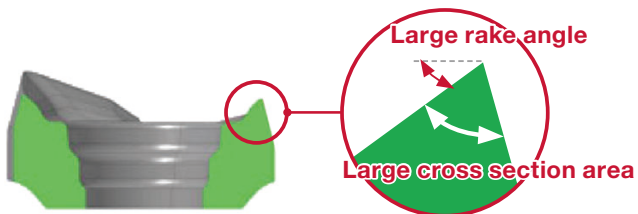
## Sharp and strong cutting edge for increased productivity

**TUNG FALC**

Large rake angle and obtuse flank surface provide low cutting force and anti-chipping performance.

**Competitor**

Large rake angle offers low cutting force but small cross section area leads to chipping on the edge.



**High productivity and stability are achieved with the unique cutting edge design.**

## GRADES

### Addition of AH3225 grade for enhanced insert grade lineup

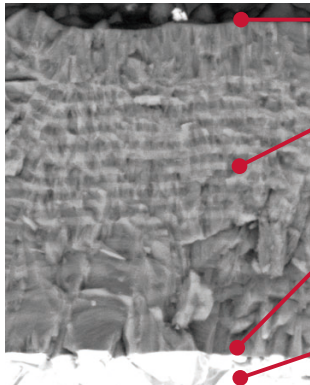
Offering four PVD grades, two CVD grades, and one uncoated carbide grade

New

## AH3225

**P M**

- Nano multi-layer coating technology with three major properties for optimal cutting edge integrity
- Increased resistance to wear, fracture, oxidation, built-up edge, and delamination



#### Resistance to built-up edge

The coating surface prevents built-up edge

#### Resistance to wear, oxidation, and fracture

Multi-layered coating is designed to resist wear and oxidation, while preventing micro-cracks from propagating in the coating layer for improved resistance to edge chipping

#### Strong coating / substrate adhesion

Coating is optimized for strong adhesion property with substrate to maintain strong cutting edge integrity

#### Carbide substrate

High resistance to fracture

## PREMIUMTEC

### AH3135 **P M**

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

### AH120 **P K**

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

### T1215 **K**

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

### T3225 **P M**

- CVD grade with high chipping and fracture resistance

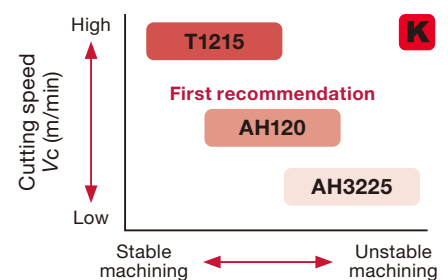
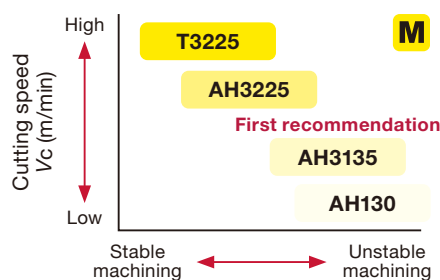
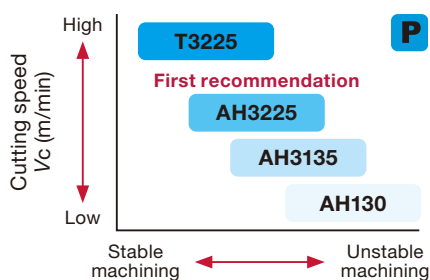
### AH130 **P M S**

- Demonstrates high wear and chipping resistance in the machining of Titanium alloy or heat-resistant alloys
- Remarkable reliability in wet machining

### KS05F **N**

- Fine-grained cemented carbide grade with high wear resistance
- Extremely sharp edge is suitable for non-ferrous materials

## APPLICATION AREAS



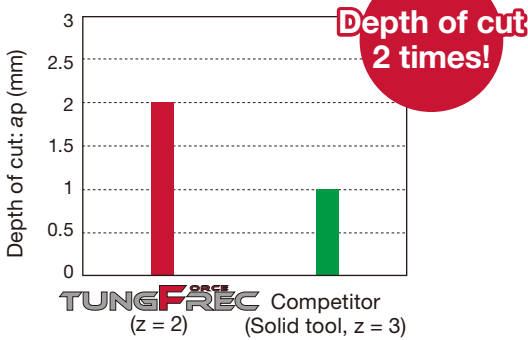
## CUTTING PERFORMANCE

### Size 04 - First choice for cutter diameters $\phi 6 - 10$ mm

#### ■ TungForce-Rec performance in slot milling vs solid carbide endmill $\phi 8$ mm



Slotting



**P**

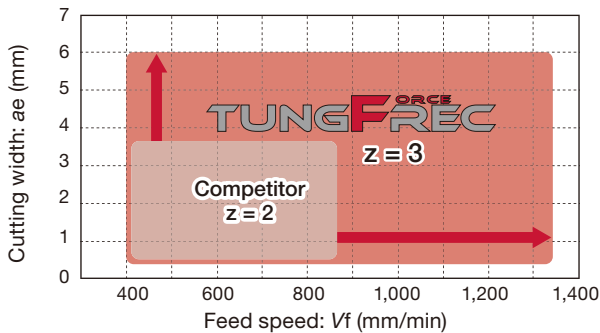
Cutter : EPAV04M008C08.0R02 ( $\phi 8$  mm, z = 2)  
 Insert : AVMT040204PPER-MM AH3225  
 Workpiece material : S55C / C55  
 Cutting speed :  $V_c = 100$  m/min  
 Feed speed :  $V_f = 448$  mm/min  
 Overhang length : 20 mm  
 Coolant : Air blast  
 Machine : Vertical M/C, BT30  
 Tool life criteria : Chatter generation

#### Boosts productivity for shoulder milling thanks to increased tooth density and tool rigidity

#### ■ Comparison with the competitor's tool ( $\phi 10$ mm)



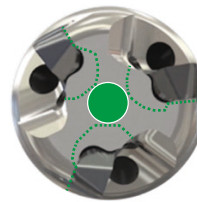
Shoulder milling



#### ■ Comparison of web thickness

TUNGFORCE

Competitor



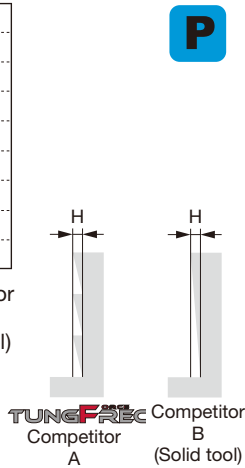
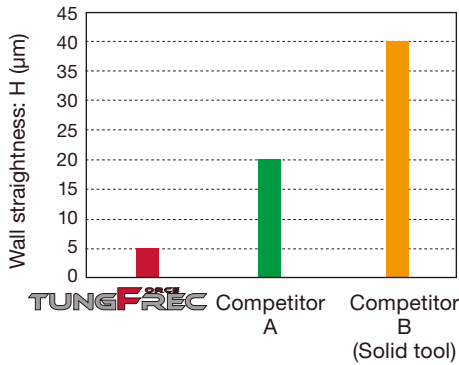
**P**

Cutter : EPAV04M010C10.0R03 ( $\phi 10$  mm, z = 3)  
 Insert : AVMT040204PPER-MM AH3225  
 Workpiece material : S55C / C55  
 Cutting speed :  $V_c = 200$  m/min  
 Feed per tooth :  $f_z = 0.07$  mm/t  
 Depth of cut :  $a_p = 4$  mm  
 Overhang length : 20 mm  
 Coolant : Air blast  
 Machine : Vertical M/C, HSK63A  
 Tool life criteria : Chatter generation

## CUTTING PERFORMANCE

### Size 06 - For outstanding part quality

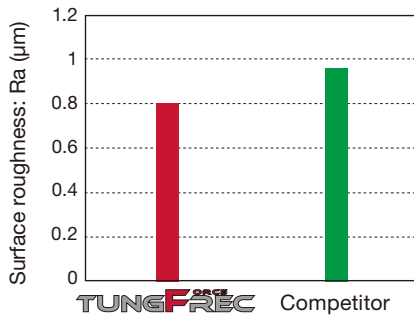
#### Wall straightness: Carbon steel



**P** Cutter : EPAV06M012C12.0R03 (ø12 mm, z = 3)  
 Insert : AVGT060304PBER-MJ AH3135  
 Workpiece material : S55C / C55 (180HB)  
 Cutting speed :  $V_c = 330$  m/min (Competitor B: 60 m/min)  
 Feed per tooth :  $f_z = 0.1$  mm/t (Competitor B: 0.04 mm/t)  
 Depth of cut :  $a_p = 4$  mm x 3 pass (Competitor B: 12 mm)  
 Cutting width :  $a_e = 2$  mm  
 Coolant : Dry  
 Machine : Vertical M/C, BT40

**TungForce-Rec has achieved the best wall finish quality.**

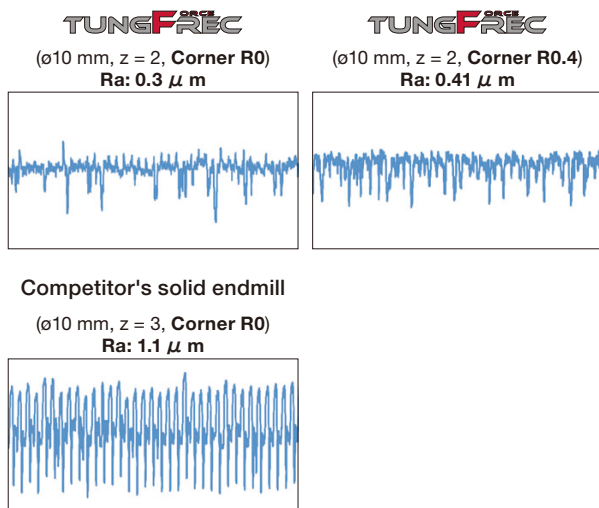
#### Surface finish: Carbon steel



**P** Cutter : EPAV06M010C10.0R02 (ø10 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 :  $a_p = 2$  mm  
 Cutting width :  $a_e = 7$  mm  
 Coolant : Dry  
 Machine : Vertical M/C, BT40

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

#### Surface roughness comparison (in machining steel)



**P** Cutter : HPAV06M010S06R02 (ø10 mm, z = 2)  
 Insert : AVGT060300PBER-MJ AH3135  
 AVGT060304PBER-MJ AH3135  
 Shank : VER16CLO10S06-S  
 Workpiece material : S45C / C45  
 Cutting speed :  $V_c = 60$  m/min  
 Feed :  $f = 0.1$  mm/rev  
 Feed speed :  $V_f = 191$  mm/min  
 Depth of cut :  $a_p = 1$  mm  
 Width of cut :  $a_e = 4$  mm  
 Machine : Swiss lathe

**R0 insert achieved better surface quality than solid endmill.**



## Size 12 - For extreme productivity and part quality

### Close pitch cutter body design

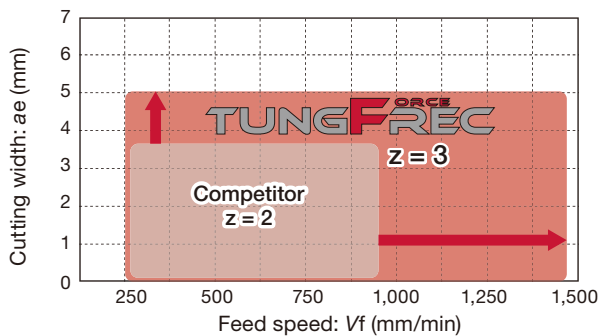
The use of V shape inserts enables TungForce-Rec to have higher tooth density than competitors' shoulder mills.

| Tool dia. (mm) | No. of inserts |             | Competitor | Productivity improvement compared to competitor |
|----------------|----------------|-------------|------------|---|
|                | TUNGFORCE-REC  |             |            |   |
|                | Coarse pitch   | Close pitch |            |   |
| ø16            | 2              | 3           | 2          | 1.5 times                                       |
| ø20            | 3              | 4           | 3          | 1.33 times                                      |
| ø25            | 4              | 6           | 4          | 1.5 times                                       |
| ø32            | 6              | 8           | 6          | 1.33 times                                      |
| ø40            | 6              | 8           | 6          | 1.33 times                                      |
| ø50            | 8              | 12          | 8          | 1.5 times                                       |
| ø63            | 8              | 14          | 8          | 1.75 times                                      |

### Performance comparison - Cutting width vs Table feed (ø16 mm)



Shoulder milling

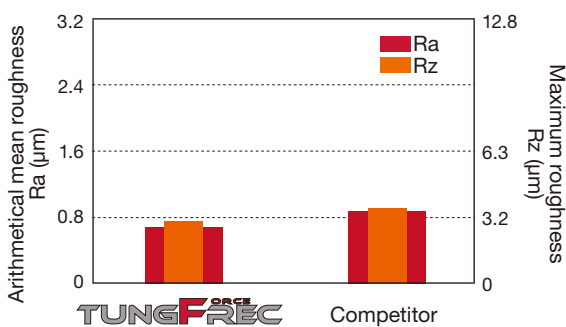


|          |                    |                                      |
|----------|--------------------|--------------------------------------|
| <b>P</b> | Cutter             | : EPAV12M016C16.0R03 (ø16 mm, z = 3) |
|          | Insert             | : AVMT120408PBER-MM AH3225           |
|          | Workpiece material | : S55C / C55                         |
|          | Cutting speed      | : Vc = 16 m/min                      |
|          | Feed per tooth     | : fz = 0.12 mm/t                     |
|          | Depth of cut       | : ap = 9 mm                          |
|          | Overhang length    | : 35 mm                              |
|          | Coolant            | : Dry                                |

**TungForce-Rec enables high efficiency machining of up to 1.4x greater cutting width at a maximum of 1.5x faster table feed.**

### Performance comparison - Precise machining

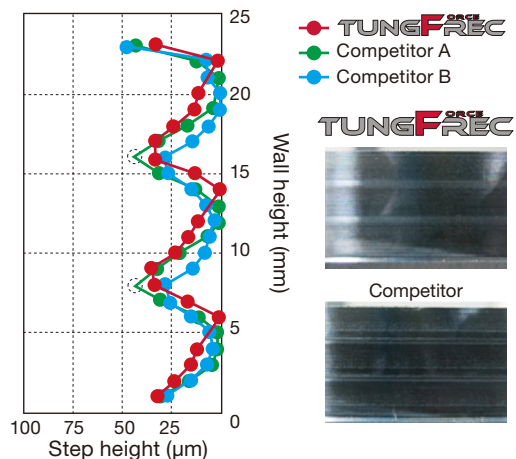
#### Surface finishing



|                    |                                      |
|--------------------|--------------------------------------|
| Cutter             | : EPAV12M020C20.0R03 (ø20 mm, z = 3) |
| Insert             | : AVMT120408PBER-MM AH3225           |
| Workpiece material | : S55C / C55                         |
| Cutting speed      | : Vc = 180 m/min                     |
| Feed per tooth     | : fz = 0.1 mm/t                      |
| Depth of cut       | : ap = 1 mm                          |
| Cutting width      | : ae = 16 mm                         |
| Coolant            | : Dry                                |

**Better surface quality vs the competitor.**

#### Wall finishing



|                    |                                      |
|--------------------|--------------------------------------|
| Cutter             | : EPAV12M020C20.0R03 (ø20 mm, z = 3) |
| Insert             | : AVMT120408PBER-MM AH3225           |
| Workpiece material | : S55C / C55                         |
| Cutting speed      | : Vc = 180 m/min                     |
| Feed per tooth     | : fz = 0.1 mm/t                      |
| Depth of cut       | : ap = 8 mm                          |
| Cutting width      | : ae = 3 mm                          |
| Coolant            | : Dry                                |

**Equal or better wall step than competitors.**

## CUTTING PERFORMANCE

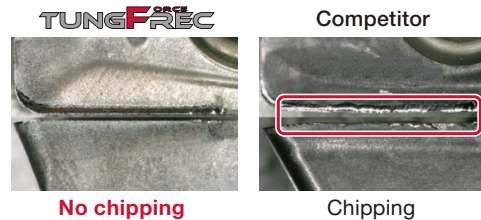
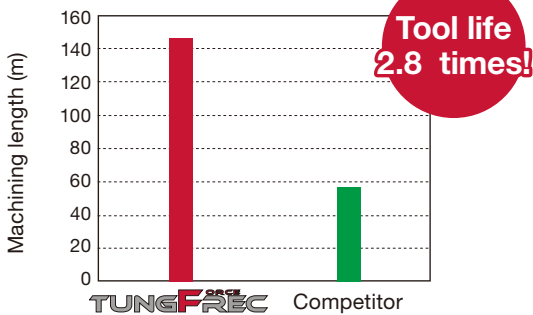
### Tool life



Shoulder milling

**P** S55C / C55

Size 04



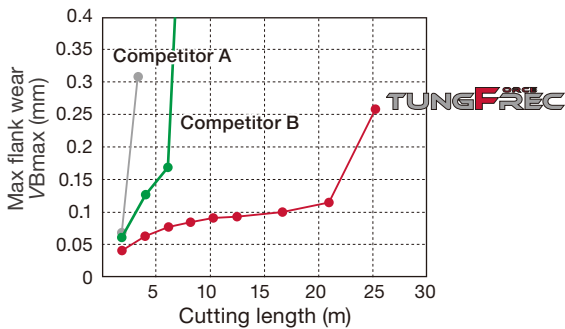
Damage on cutting edges at the same machining time

Cutter : EPAV04M008C08.0R02 ( $\phi 8$  mm,  $z = 2$ )  
 Insert : AVMT040204PPER-MM AH3225  
 Cutting speed :  $V_c = 200$  m/min  
 Feed per tooth :  $f_z = 0.07$  mm/t  
 Depth of cut :  $a_p = 3$  mm  
 Cutting width :  $a_e = 2.7$  mm  
 Coolant : Air blast

Soft cutting geometry with strong cutting edge design provide long and predictable tool life.

**M** SUS304 / X5CrNi18-9

Size 06

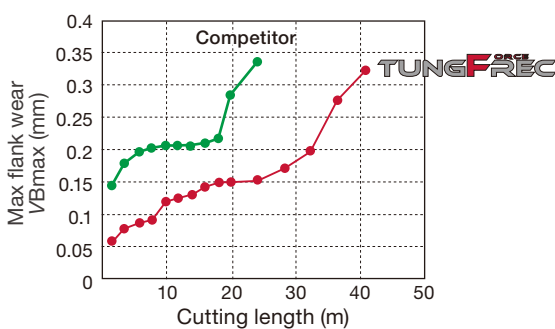


Cutter : EPAV06M010C10.0R02 ( $\phi 10$  mm,  $z = 2$ )  
 Insert : AVGT060302PBER-MJ AH3135  
 Cutting speed :  $V_c = 260$  m/min  
 Feed per tooth :  $f_z = 0.07$  mm/t  
 Depth of cut :  $a_p = 3$  mm  
 Cutting width :  $a_e = 2.9$  mm  
 Coolant : Dry  
 Machine : Vertical M/C, BT40

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

**S** Ti6Al4V

Size 06



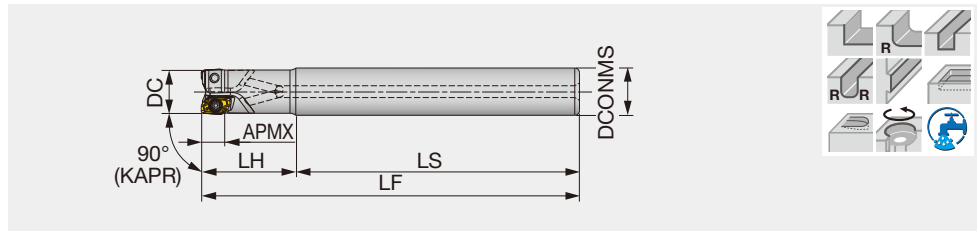
Cutter : EPAV06M016C16.0R04 ( $\phi 16$  mm,  $z = 4$ )  
 Insert : AVGT060304PBER-MJ AH130  
 Cutting speed :  $V_c = 80$  m/min  
 Feed per tooth :  $f_z = 0.08$  mm/t  
 Depth of cut :  $a_p = 5$  mm  
 Cutting width :  $a_e = 5$  mm  
 Coolant : Wet  
 Machine : Vertical M/C, BT40, 18.5 kW

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

## EPAV04

Square shoulder endmill, shank type, with screw clamp system

GAMP = +6°~ +7.6°, GAMF = -37.1°~ -32.4°



| Designation         | APMX | DC | CICT | DCONMS | LS  | LH | LF  | WT(kg) | Air hole | Insert    |
|---------------------|------|----|------|--------|-----|----|-----|--------|----------|-----------|
| EPAV04M006C06.0R01  | 4    | 6  | 1    | 6      | 48  | 12 | 60  | 0.01   | With     | AVMT04... |
| EPAV04M008C08.0R02  | 4    | 8  | 2    | 8      | 48  | 12 | 60  | 0.02   | With     | AVMT04... |
| EPAV04M008C08.0R02L | 4    | 8  | 2    | 8      | 60  | 20 | 80  | 0.03   | With     | AVMT04... |
| EPAV04M010C10.0R02  | 4    | 10 | 2    | 10     | 60  | 20 | 80  | 0.04   | With     | AVMT04... |
| EPAV04M010C10.0R03  | 4    | 10 | 3    | 10     | 60  | 20 | 80  | 0.04   | With     | AVMT04... |
| EPAV04M010C10.0R02L | 4    | 10 | 2    | 10     | 65  | 35 | 100 | 0.05   | With     | AVMT04... |
| EPAV04M012C12.0R03  | 4    | 12 | 3    | 12     | 60  | 20 | 80  | 0.06   | With     | AVMT04... |
| EPAV04M012C12.0R04  | 4    | 12 | 4    | 12     | 60  | 20 | 80  | 0.06   | With     | AVMT04... |
| EPAV04M012C12.0R03L | 4    | 12 | 3    | 12     | 85  | 35 | 120 | 0.09   | With     | AVMT04... |
| EPAV04M016C16.0R04  | 4    | 16 | 4    | 16     | 70  | 20 | 90  | 0.12   | With     | AVMT04... |
| EPAV04M016C16.0R05  | 4    | 16 | 5    | 16     | 70  | 20 | 90  | 0.12   | With     | AVMT04... |
| EPAV04M016C16.0R04L | 4    | 16 | 4    | 16     | 105 | 35 | 140 | 0.19   | With     | AVMT04... |

### SPARE PARTS



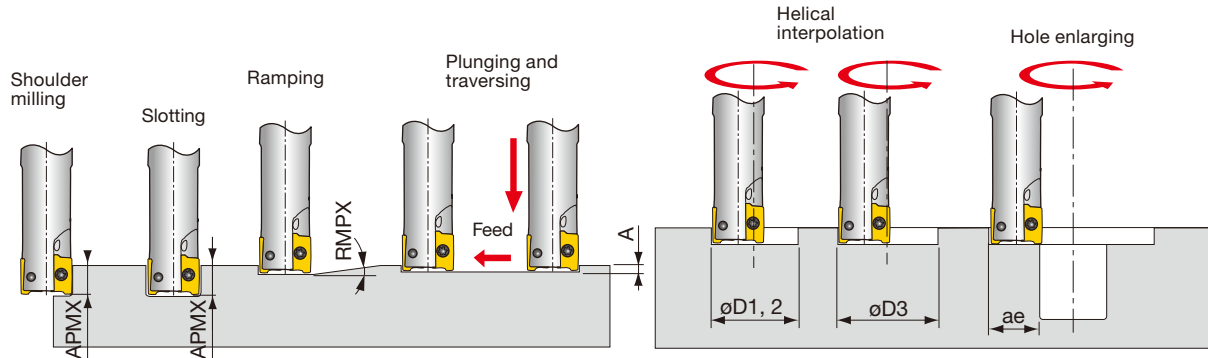
| Designation            | Clamping screw | Wrench |
|------------------------|----------------|--------|
| EPAV04M006C06.0R01     | CSPB-1.8L3.3   | IP-6DB |
| EPAV04M008... - 016... | CSPB-1.8L3.6   | IP-6DB |

\*Recommended clamping torque (N·m): CSPB-1.8L3.3, CSPB-1.8L3.6 = 0.5





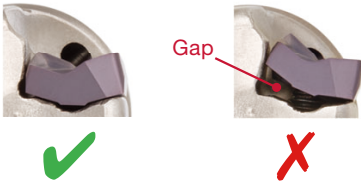
## MACHINING APPLICATIONS



| Designation         | DC | Max. depth of cut |      | Max. ramping angle | Max. plunging | Min. machining |           | Max. machining |      | Max. cutting width in enlarging |
|---------------------|----|-------------------|------|--------------------|---------------|----------------|-----------|----------------|------|---------------------------------|
|                     |    | APMX              | RMPX |                    |               | $\phi D1$      | $\phi D2$ | $\phi D3^*$    | $ae$ |                                 |
| EPAV04M006C06.0R01  | 6  | 4                 | 0.4° | 0.03               | 9.3           | 11.6           | 9.9       | 5.5            |      |                                 |
| EPAV04M008C08.0R02  | 8  | 4                 | 0.5° | 0.04               | 12.7          | 15.6           | 13.6      | 7.5            |      |                                 |
| EPAV04M008C08.0R02L | 8  | 4                 | 0.5° | 0.04               | 12.7          | 15.6           | 13.6      | 7.5            |      |                                 |
| EPAV04M010C10.0R02  | 10 | 4                 | 4.1° | 0.4                | 15.3          | 19.6           | 17.5      | 9.5            |      |                                 |
| EPAV04M010C10.0R03  | 10 | 4                 | 1.7° | 0.2                | 16.1          | 19.6           | 17.5      | 9.5            |      |                                 |
| EPAV04M010C10.0R02L | 10 | 4                 | 4.1° | 0.4                | 16.1          | 19.6           | 17.5      | 9.5            |      |                                 |
| EPAV04M012C12.0R03  | 12 | 4                 | 2.7° | 0.4                | 19.3          | 23.6           | 21.5      | 11.5           |      |                                 |
| EPAV04M012C12.0R04  | 12 | 4                 | 1.3° | 0.2                | 20.1          | 23.6           | 21.5      | 11.5           |      |                                 |
| EPAV04M012C12.0R03L | 12 | 4                 | 2.7° | 0.4                | 19.3          | 23.6           | 21.5      | 11.5           |      |                                 |
| EPAV04M016C16.0R04  | 16 | 4                 | 2°   | 0.4                | 27.2          | 31.6           | 29.5      | 15.5           |      |                                 |
| EPAV04M016C16.0R05  | 16 | 4                 | 2°   | 0.4                | 27.2          | 31.6           | 29.5      | 15.5           |      |                                 |
| EPAV04M016C16.0R04L | 16 | 4                 | 2°   | 0.4                | 27.2          | 31.6           | 29.5      | 15.5           |      |                                 |

\*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.



### Estimation of chip thickness - calculated from feed per tooth ( $fz$ ) and cutting width ( $ae$ ) data

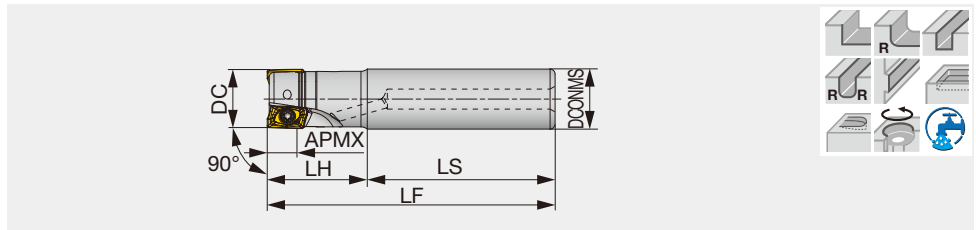
Recommended chip thickness

| Feed per tooth $fz$ (mm/t) | Cutting width (%): $ae$ (mm) / Tool dia.: DC (mm) |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|----------------------------|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                            | 1%  | 2%    | 2.5%  | 3%    | 4%    | 5%    | 10%   | 15%   | 20%   | 25%   | 30%   | 35%   | 40%   | 45%   | 50% - |
| 0.03                       | 0.006   | 0.008 | 0.009 | 0.01  | 0.012 | 0.013 | 0.018 | 0.021 | 0.024 | 0.026 | 0.027 | 0.029 | 0.029 | 0.03  | 0.03  |
| 0.05                       | 0.01  | 0.014 | 0.016 | 0.017 | 0.02  | 0.022 | 0.03  | 0.036 | 0.04  | 0.043 | 0.046 | 0.048 | 0.049 | 0.05  | 0.05  |
| 0.08                       | 0.016   | 0.022 | 0.025 | 0.027 | 0.031 | 0.035 | 0.048 | 0.057 | 0.064 | 0.069 | 0.073 | 0.076 | 0.078 | 0.08  | 0.08  |
| 0.1                        | 0.02  | 0.028 | 0.031 | 0.034 | 0.039 | 0.044 | 0.06  | 0.071 | 0.08  | 0.087 | 0.092 | 0.095 | 0.098 | 0.099 | 0.1   |
| 0.12                       | 0.024   | 0.034 | 0.037 | 0.041 | 0.047 | 0.052 | 0.072 | 0.086 | 0.096 | 0.104 | 0.11  | 0.114 | 0.118 | 0.119 | 0.12  |
| 0.15                       | 0.03  | 0.042 | 0.047 | 0.051 | 0.059 | 0.065 | 0.09  | 0.107 | 0.12  | 0.13  | 0.137 | 0.143 | 0.147 | 0.149 | 0.15  |
| 0.18                       | 0.036   | 0.05  | 0.056 | 0.061 | 0.071 | 0.078 | 0.108 | 0.129 | 0.144 | 0.156 | 0.165 | 0.172 | 0.176 | 0.179 | 0.18  |
| 0.2                        | 0.04  | 0.056 | 0.062 | 0.068 | 0.078 | 0.087 | 0.12  | 0.143 | 0.16  | 0.173 | 0.183 | 0.191 | 0.196 | 0.199 | 0.2   |
| 0.22                       | 0.044   | 0.062 | 0.069 | 0.075 | 0.086 | 0.096 | 0.132 | 0.157 | 0.176 | 0.191 | 0.202 | 0.21  | 0.216 | 0.219 | 0.22  |
| 0.25                       | 0.05  | 0.07  | 0.078 | 0.085 | 0.098 | 0.109 | 0.15  | 0.179 | 0.2   | 0.217 | 0.229 | 0.238 | 0.245 | 0.249 | 0.25  |
| 0.28                       | 0.056   | 0.078 | 0.087 | 0.096 | 0.11  | 0.122 | 0.168 | 0.2   | 0.224 | 0.242 | 0.257 | 0.267 | 0.274 | 0.279 | 0.28  |
| 0.3                        | 0.06  | 0.084 | 0.094 | 0.102 | 0.118 | 0.131 | 0.18  | 0.214 | 0.24  | 0.26  | 0.275 | 0.286 | 0.294 | 0.298 | 0.3   |
| 0.4                        | 0.08  | 0.112 | 0.125 | 0.136 | 0.157 | 0.174 | 0.24  | 0.286 | 0.32  | 0.346 | 0.367 | 0.382 | 0.392 | 0.398 | 0.4   |

## EPAV06

Square shoulder endmill, shank type, with screw clamp system

GAMP = +6°~ +7.7°, GAMF = -37.1°~ -30°



| Designation         | APMX | DC | CICT | DCONMS | LS  | LH | LF  | WT(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... |
| 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... |
| EPAV06M012C10.0R02L | 6    | 12 | 2    | 10     | 100 | 20 | 120 | 0.07   | AVGT06... |
| EPAV06M012C10.0R03  | 6    | 12 | 3    | 10     | 60  | 20 | 80  | 0.04   | AVGT06... |
| EPAV06M014C12.0R03  | 6    | 14 | 3    | 12     | 60  | 20 | 80  | 0.07   | AVGT06... |
| 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... |
| EPAV06M018C16.0R03  | 6    | 18 | 3    | 16     | 70  | 20 | 90  | 0.13   | AVGT06... |
| EPAV06M018C16.0R04  | 6    | 18 | 4    | 16     | 70  | 20 | 90  | 0.13   | AVGT06... |
| EPAV06M018C16.0R03L | 6    | 18 | 3    | 16     | 160 | 20 | 180 | 0.26   | AVGT06... |
| EPAV06M020C20.0R04  | 6    | 20 | 4    | 20     | 70  | 30 | 100 | 0.23   | AVGT06... |
| EPAV06M020C20.0R05  | 6    | 20 | 5    | 20     | 70  | 30 | 100 | 0.21   | AVGT06... |
| EPAV06M020C20.0R04L | 6    | 20 | 4    | 20     | 165 | 35 | 200 | 0.45   | AVGT06... |
| EPAV06M020C16.0R04  | 6    | 20 | 4    | 16     | 80  | 30 | 110 | 0.17   | AVGT06... |
| EPAV06M025C25.0R05  | 6    | 25 | 5    | 25     | 80  | 35 | 115 | 0.4    | AVGT06... |
| EPAV06M025C25.0R06  | 6    | 25 | 6    | 25     | 80  | 35 | 115 | 0.4    | AVGT06... |
| EPAV06M025C25.0R04L | 6    | 25 | 4    | 25     | 160 | 40 | 200 | 0.72   | AVGT06... |
| EPAV06M025C20.0R06  | 6    | 25 | 6    | 20     | 80  | 35 | 115 | 0.27   | AVGT06... |
| EPAV06M032C32.0R08  | 6    | 32 | 8    | 32     | 80  | 40 | 120 | 0.7    | AVGT06... |
| 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 |

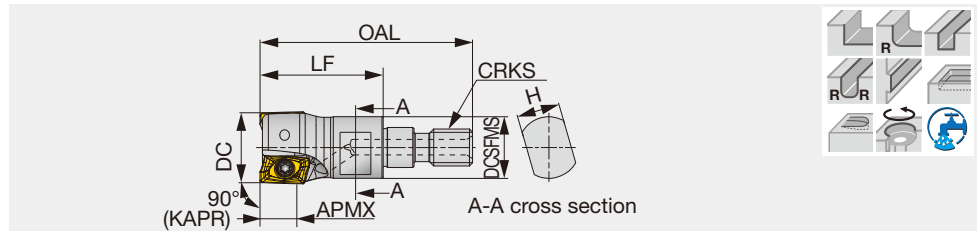
\*Recommended clamping torque (N·m): CSPB-2H = 0.7



## HPAV06-M

Square shoulder endmill, modular type (TungFlex), with screw clamp system

GAMP = +6.9°~ +7.6°, GAMF = -35.2°~ -32.4°



| Designation      | APMX | DC | CICT | OAL  | LF | H  | DCSFMS | CRKS | WT(kg) | Insert    |
|------------------|------|----|------|------|----|----|--------|------|--------|-----------|
| HPAV06M010M06R02 | 6    | 10 | 2    | 34.5 | 20 | 7  | 9.5    | M6   | 0.01   | AVGT06... |
| HPAV06M012M06R02 | 6    | 12 | 2    | 34.5 | 20 | 7  | 10     | M6   | 0.01   | AVGT06... |
| HPAV06M012M06R03 | 6    | 12 | 3    | 34.5 | 20 | 7  | 10     | M6   | 0.01   | AVGT06... |
| HPAV06M016M08R03 | 6    | 16 | 3    | 42   | 25 | 10 | 13     | M8   | 0.03   | AVGT06... |
| HPAV06M016M08R04 | 6    | 16 | 4    | 42   | 25 | 10 | 13     | M8   | 0.03   | AVGT06... |

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

### SPARE PARTS



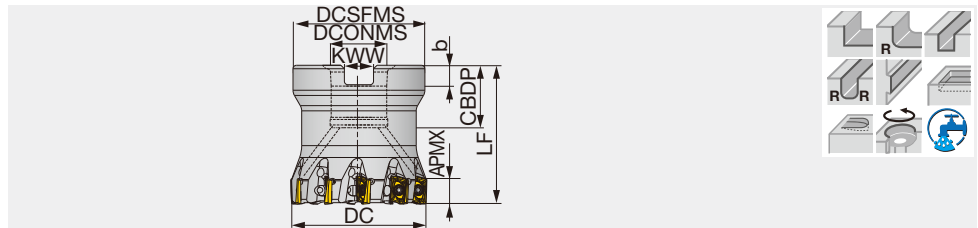
| Designation | Clamping screw | Lubricant | Wrench |
|-------------|----------------|-----------|--------|
| HPAV06M...  | CSPB-2H        | M-1000    | IP-6DB |

\*Recommended clamping torque (N·m): CSPB-2H = 0.7

## TPAV06

Square shoulder mill, bore type, with screw clamp system

GAMP = +7.7°, GAMF = -29.8°



| Designation        | APMX | DC | CICT | DCSFMS | DCONMS | CBDP | LF | KWW | b   | WT(kg) | Insert    |
|--------------------|------|----|------|--------|--------|------|----|-----|-----|--------|-----------|
| TPAV06M040B16.0R10 | 6    | 40 | 10   | 38     | 16     | 18   | 40 | 8.4 | 5.6 | 0.24   | AVGT06... |

### SPARE PARTS



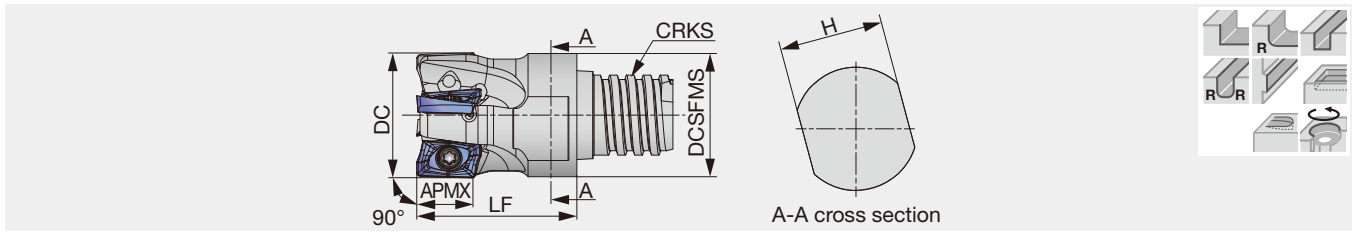
| Designation        | Clamping screw | Lubricant | Wrench | Center bolt |
|--------------------|----------------|-----------|--------|-------------|
| TPAV06M040B16.0R10 | CSPB-2H        | M-1000    | IP-6DB | CM8X30H     |

\*Recommended clamping torque (N·m): CSPB-2H = 0.7

## HPAV06-S

Square shoulder endmill, modular type (TungMeister), with screw clamp system

GAMP = +6.9°~ +7.6°, GAMF = -35.2°~ -32.4°



| Designation      | APMX | DC | CICT | LF | H  | DCSFMS | CRKS | WT(kg) | Insert    |
|------------------|------|----|------|----|----|--------|------|--------|-----------|
| HPAV06M010S05R02 | 6    | 10 | 2    | 10 | 8  | 8      | S05  | 0.01   | AVGT06... |
| HPAV06M010S06R02 | 6    | 10 | 2    | 16 | 8  | 9.8    | S06  | 0.01   | AVGT06... |
| HPAV06M012S08R02 | 6    | 12 | 2    | 18 | 10 | 11.7   | S08  | 0.02   | AVGT06... |
| HPAV06M012S08R03 | 6    | 12 | 3    | 18 | 10 | 11.7   | S08  | 0.02   | AVGT06... |
| HPAV06M016S10R03 | 6    | 16 | 3    | 20 | 13 | 15.4   | S10  | 0.03   | AVGT06... |
| HPAV06M016S10R04 | 6    | 16 | 4    | 20 | 13 | 15.4   | S10  | 0.03   | AVGT06... |

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

| Designation    | Wrench*  |
|----------------|----------|
| HPAV06M010S... | KEYV-S06 |
| HPAV06M012S... | KEYV-S08 |
| HPAV06M016S... | KEYV-S10 |

\*sold separately

### SPARE PARTS

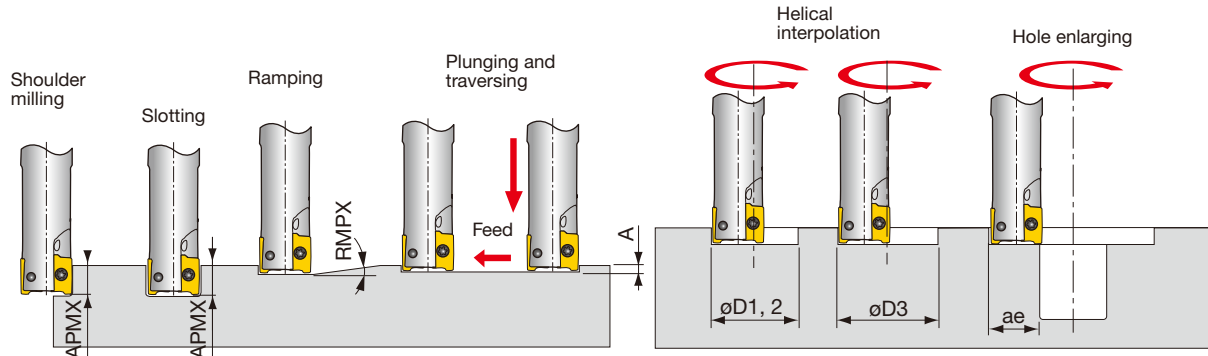
| Designation | Clamping screw | Lubricant | Wrench |
|-------------|----------------|-----------|--------|
| HPAV06M...  | CSPB-2H        | M-1000    | IP-6DB |

\*Recommended clamping torque (N·m): CSPB-2H = 0.7





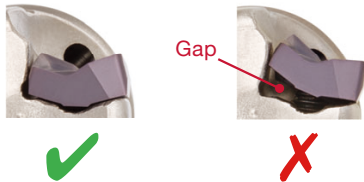
## MACHINING APPLICATIONS



| Designation        | DC | Max. depth of cut |      | Max. plunging | Min. machining | Max. machining |     | Max. cutting width in enlarging |
|--------------------|----|-------------------|------|---------------|----------------|----------------|-----|---------------------------------|
|                    |    | APMX              | RMPX |               |                | øD1            | øD2 |                                 |
| EPAV06M008...      | 8  | 6                 | -    | -             | -              | -              | -   | -                               |
| EPAV/HPAV06M010... | 10 | 6                 | 3°   | 0.3           | 15             | 19             | 18  | 9.5                             |
| EPAV/HPAV06M012... | 12 | 6                 | 3°   | 0.3           | 18             | 23             | 22  | 11.5                            |
| EPAV/HPAV06M014... | 14 | 6                 | 2.3° | 0.3           | 22             | 27             | 26  | 13.5                            |
| EPAV/HPAV06M016... | 16 | 6                 | 2°   | 0.3           | 28             | 31             | 30  | 15.5                            |
| EPAV/HPAV06M018... | 18 | 6                 | 1.6° | 0.3           | 30             | 35             | 34  | 17.5                            |
| EPAV/HPAV06M020... | 20 | 6                 | 1.4° | 0.3           | 34             | 39             | 38  | 19.5                            |
| EPAV/HPAV06M025... | 25 | 6                 | 1.1° | 0.3           | 44             | 49             | 48  | 24.5                            |
| EPAV/HPAV06M032... | 32 | 6                 | 0.8° | 0.3           | 58             | 63             | 62  | 31.5                            |
| TPAV06M040...      | 40 | 6                 | 0.6° | 0.3           | 74             | 79             | 78  | 39.5                            |

\*Flat bottom hole

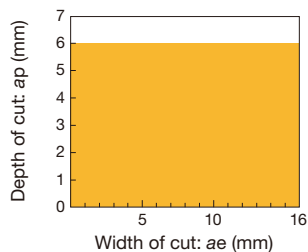
When clamping the insert, please confirm that there is no gap between the cutter body and the insert as shown in the picture.



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

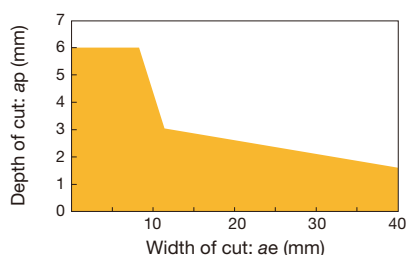
When using a cutter diameter over 18 mm, please note that the applicable range of cutting depth significantly drops as the cutting width applied increases, thus an additional finishing process may be required.

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



Cutter : EPAV06M016C16.0R04 (ø16 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 : Slotting  
 Coolant : Dry  
 Machine : Vertical M/C, BT40, 18.5 kW

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

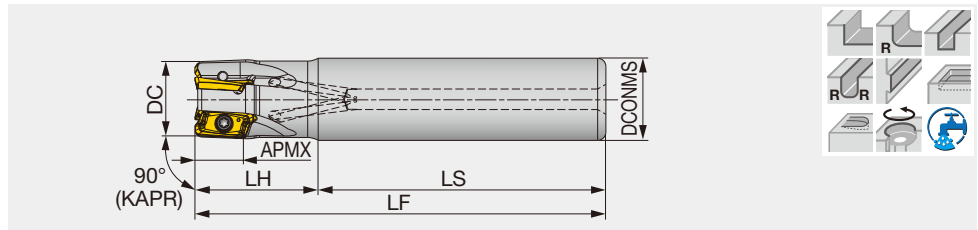


Cutter : EPAV06M032C32.0R08 (ø32 mm, z = 8)  
 Insert : AVGT060304PBER-MJ AH3135  
 Workpiece material : S55C / C55  
 Cutting speed :  $V_c = 250$  m/min  
 Feed per tooth :  $f_z = 0.07$  mm/t  
 Coolant : Dry  
 Machine : Vertical M/C, BT40, 18.5 kW

## EPAV12

Square shoulder endmill, shank type, with screw clamp system

GAMP = +6°~ +7.6°, GAMF = -37.1°~ -32.4°



| Designation         | APMX | DC | CICT | DCONMS | LS  | LH | LF  | WT(kg) | Air hole | Insert      |
|---------------------|------|----|------|--------|-----|----|-----|--------|----------|-------------|
| EPAV12M012C12.0R01  | 11.5 | 12 | 1    | 12     | 60  | 25 | 85  | 0.06   | With     | AVM/GT12... |
| EPAV12M016C16.0R02  | 11.5 | 16 | 2    | 16     | 60  | 25 | 85  | 0.12   | With     | AVM/GT12... |
| EPAV12M016C16.0R03  | 11.5 | 16 | 3    | 16     | 60  | 25 | 85  | 0.12   | With     | AVM/GT12... |
| EPAV12M016C16.0R02L | 11.5 | 16 | 2    | 16     | 105 | 40 | 145 | 0.20   | With     | AVM/GT12... |
| EPAV12M020C20.0R03  | 11.5 | 20 | 3    | 20     | 70  | 30 | 100 | 0.22   | With     | AVM/GT12... |
| EPAV12M020C20.0R04  | 11.5 | 20 | 4    | 20     | 70  | 30 | 100 | 0.21   | With     | AVM/GT12... |
| EPAV12M020C20.0R02L | 11.5 | 20 | 2    | 20     | 135 | 50 | 185 | 0.41   | With     | AVM/GT12... |
| EPAV12M025C25.0R04  | 11.5 | 25 | 4    | 25     | 80  | 35 | 115 | 0.38   | With     | AVM/GT12... |
| EPAV12M025C25.0R06  | 11.5 | 25 | 6    | 25     | 80  | 35 | 115 | 0.39   | With     | AVM/GT12... |
| EPAV12M025C25.0R03L | 11.5 | 25 | 3    | 25     | 150 | 70 | 220 | 0.74   | With     | AVM/GT12... |
| EPAV12M032C32.0R06  | 11.5 | 32 | 6    | 32     | 80  | 40 | 120 | 0.68   | With     | AVM/GT12... |
| EPAV12M032C32.0R08  | 11.5 | 32 | 8    | 32     | 80  | 40 | 120 | 0.68   | With     | AVM/GT12... |
| EPAV12M032C32.0R03L | 11.5 | 32 | 3    | 32     | 175 | 80 | 255 | 1.47   | With     | AVM/GT12... |

### SPARE PARTS



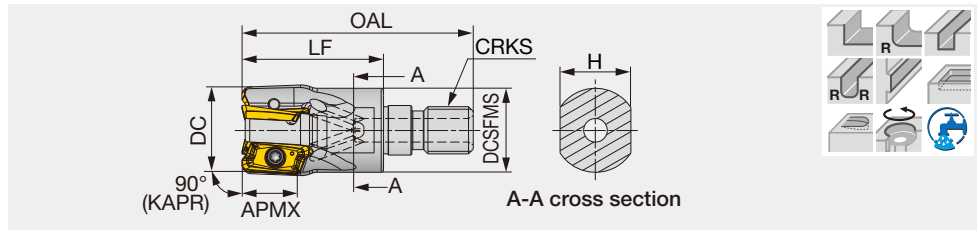
| Designation         | Clamping screw | Wrench |
|---------------------|----------------|--------|
| EPAV12M012C12.0R01  | CPSB-2.5       | IP-8D  |
| EPAV12M016C16.0R02  | CPSB-2.5       | IP-8D  |
| EPAV12M016C16.0R03  | CPSB-2.5S      | IP-8D  |
| EPAV12M016C16.0R02L | CPSB-2.5       | IP-8D  |
| EPAV12M020C20.0R03  | CPSB-2.5       | IP-8D  |
| EPAV12M020C20.0R04  | CPSB-2.5S      | IP-8D  |
| EPAV12M020C20.0R02L | CPSB-2.5       | IP-8D  |
| EPAV12M025C25.0R04  | CPSB-2.5       | IP-8D  |
| EPAV12M025C25.0R06  | CPSB-2.5S      | IP-8D  |
| EPAV12M025C25.0R03L | CPSB-2.5       | IP-8D  |
| EPAV12M032C32.0R06  | CPSB-2.5       | IP-8D  |
| EPAV12M032C32.0R08  | CPSB-2.5S      | IP-8D  |
| EPAV12M032C32.0R03L | CPSB-2.5       | IP-8D  |

\*Recommended clamping torque (N·m): CSPB-2.5, CSPB-2.5S = 1.3

## HPAV12-M

Square shoulder endmill, modular type (TungFlex), with screw clamp system

GAMP = +6°~ +7.6°, GAMF = -37.1°~ -32.4°



| Designation      | APMX | DC | CICT | OAL | LF | H  | DCSFMS | CRKS | WT(kg) | Air hole | Insert      |
|------------------|------|----|------|-----|----|----|--------|------|--------|----------|-------------|
| HPAV12M016M08R02 | 11.5 | 16 | 2    | 42  | 25 | 10 | 14.5   | M8   | 0.03   | With     | AVM/GT12... |
| HPAV12M016M08R03 | 11.5 | 16 | 3    | 42  | 25 | 10 | 14.5   | M8   | 0.03   | With     | AVM/GT12... |
| HPAV12M020M10R03 | 11.5 | 20 | 3    | 49  | 30 | 15 | 17.8   | M10  | 0.06   | With     | AVM/GT12... |
| HPAV12M020M10R04 | 11.5 | 20 | 4    | 49  | 30 | 15 | 17.8   | M10  | 0.05   | With     | AVM/GT12... |
| HPAV12M025M12R04 | 11.5 | 25 | 4    | 57  | 35 | 17 | 23     | M12  | 0.1    | With     | AVM/GT12... |
| HPAV12M025M12R06 | 11.5 | 25 | 6    | 57  | 35 | 17 | 23     | M12  | 0.1    | With     | AVM/GT12... |
| HPAV12M032M16R06 | 11.5 | 32 | 6    | 63  | 40 | 22 | 28.8   | M16  | 0.21   | With     | AVM/GT12... |
| HPAV12M032M16R08 | 11.5 | 32 | 8    | 63  | 40 | 22 | 28.8   | M16  | 0.21   | With     | AVM/GT12... |
| HPAV12M040M16R06 | 11.5 | 40 | 6    | 63  | 40 | 22 | 28.8   | M16  | 0.25   | With     | AVM/GT12... |
| HPAV12M040M16R08 | 11.5 | 40 | 8    | 63  | 40 | 22 | 28.8   | M16  | 0.24   | With     | AVM/GT12... |

### SPARE PARTS



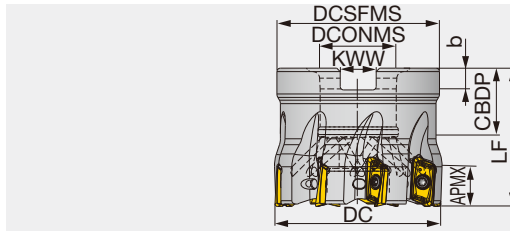
| Designation      | Clamping screw | Wrench |
|------------------|----------------|--------|
| HPAV12M016M08R02 | CSPB-2.5       | IP-8D  |
| HPAV12M016M08R03 | CSPB-2.5S      | IP-8D  |
| HPAV12M020M10R03 | CSPB-2.5       | IP-8D  |
| HPAV12M020M10R04 | CSPB-2.5S      | IP-8D  |
| HPAV12M025M12R04 | CSPB-2.5       | IP-8D  |
| HPAV12M025M12R06 | CSPB-2.5S      | IP-8D  |
| HPAV12M032M16R06 | CSPB-2.5       | IP-8D  |
| HPAV12M032M16R08 | CSPB-2.5S      | IP-8D  |
| HPAV12M040M16R06 | CSPB-2.5       | IP-8D  |
| HPAV12M040M16R08 | CSPB-2.5       | IP-8D  |

\*Recommended clamping torque (N·m): CSPB-2.5, CSPB-2.5S = 1.3

# TPAV12

Square shoulder mill, bore type, with screw clamp system

GAMP = +6°~ +7.6°, GAMF = -37.1°~ -32.4°



| Designation        | APMX | DC | CICT | DCSFMS | DCONMS | CBDP | LF | KWW  | b   | WT(kg) | Air hole | Insert      |
|--------------------|------|----|------|--------|--------|------|----|------|-----|--------|----------|-------------|
| TPAV12M050B22.0R08 | 11.5 | 50 | 8    | 47     | 22     | 20   | 40 | 10.4 | 6.3 | 0.37   | With     | AVM/GT12... |
| TPAV12M050B22.0R12 | 11.5 | 50 | 12   | 47     | 22     | 20   | 40 | 10.4 | 6.3 | 0.37   | With     | AVM/GT12... |
| TPAV12M063B22.0R08 | 11.5 | 63 | 8    | 47     | 22     | 20   | 40 | 10.4 | 6.3 | 0.52   | With     | AVM/GT12... |
| TPAV12M063B22.0R14 | 11.5 | 63 | 14   | 47     | 22     | 20   | 40 | 10.4 | 6.3 | 0.54   | With     | AVM/GT12... |

## SPARE PARTS



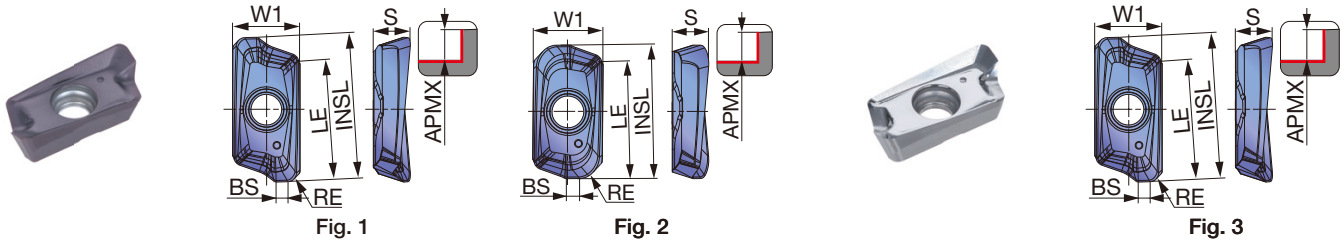
| Designation | Clamping screw | Wrench | Shell locking bolt |
|-------------|----------------|--------|--------------------|
| TPAV12M...  | CSPB-2.5       | IP-8D  | CM10x30H           |

\*Recommended clamping torque (N·m): CSPB-2.5, CSPB-2.5S = 1.3

## INSERT

### AVMT-MM

### AVGT-AM



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

★ : First choice  
☆ : Second choice

| Designation       | RE  | APMX | Coated |        |       |       |       | Carbide |  |  |  |     | W1   | INSL | S   | BS   | LE | Fig. |
|-------------------|-----|------|--------|--------|-------|-------|-------|---------|--|--|--|-----|------|------|-----|------|----|------|
|                   |     |      | AH120  | AH3225 | T1215 | T3225 | KS05F |         |  |  |  |     |      |      |     |      |    |      |
| AVMT120404PDER-MM | 0.4 | 11.5 | ●      | ●      | ●     | ●     |       |         |  |  |  | 6.6 | 14.2 | 3.6  | 1.5 | 11.8 | 1  |      |
| AVMT120408PDER-MM | 0.8 | 11.5 | ●      | ●      | ●     | ●     |       |         |  |  |  | 6.6 | 14.2 | 3.6  | 1.1 | 11.8 | 1  |      |
| AVMT120412PDER-MM | 1.2 | 11.5 | ●      | ●      | ●     | ●     |       |         |  |  |  | 6.6 | 14.2 | 3.6  | 0.7 | 11.8 | 1  |      |
| AVMT120416PDER-MM | 1.6 | 11.5 | ●      | ●      | ●     | ●     |       |         |  |  |  | 6.6 | 14.2 | 3.6  | 0.3 | 11.8 | 1  |      |
| AVMT120420PDER-MM | 2   | 10.5 | ●      | ●      | ●     | ●     |       |         |  |  |  | 6.6 | 12.7 | 3.4  | 1.2 | 11.1 | 2  |      |
| AVMT120430PDER-MM | 3   | 10.5 | ●      | ●      | ●     | ●     |       |         |  |  |  | 6.6 | 12.7 | 3.4  | 0.2 | 11.1 | 2  |      |
| AVGT120404PDFR-AM | 0.4 | 11.5 |        |        |       |       | ●     |         |  |  |  | 6.6 | 14.2 | 3.6  | 1.5 | 11.8 | 3  |      |
| AVGT120408PDFR-AM | 0.8 | 11.5 |        |        |       |       | ●     |         |  |  |  | 6.6 | 14.2 | 3.6  | 1.1 | 11.8 | 3  |      |

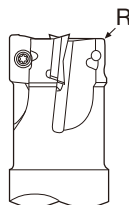
● : Line up

## STANDARD CUTTING CONDITIONS

| ISO | Workpiece materials  | Hardness                    | Priority        | Grades       | Cutting speed<br>Vc (m/min) | Feed per tooth<br>fz (mm/t) |             |
|-----|--|-----------------------------|-----------------|--------------|-----------------------------|-----------------------------|-------------|
| P   | Low carbon steel<br>S15C, SS400, etc.<br>C15E, C15E4, E275A, etc.            | - 200 HB                    | First choice    | AH3225       | 100 - 300                   | 0.06 - 0.22                 |             |
|     |  | - 200 HB                    | Wear resistance | T3225        | 200 - 400                   | 0.06 - 0.18                 |             |
|     | Carbon steel and alloy steel<br>S55C, SCM440, etc.<br>C55, 42CrMo4, etc.     | - 300 HB                    | First choice    | AH3225       | 100 - 250                   | 0.06 - 0.22                 |             |
|     |  | - 300 HB                    | Wear resistance | T3225        | 200 - 400                   | 0.06 - 0.18                 |             |
|     | Prehardened steel<br>NAK80, PX5, etc.  | 30 - 40 HRC                 | First choice    | AH3225       | 100 - 200                   | 0.06 - 0.22                 |             |
|     |  | 30 - 40 HRC                 | Wear resistance | T3225        | 200 - 400                   | 0.06 - 0.15                 |             |
| M   | Stainless steel<br>SUS304, SUS316, etc.<br>X5CrNi18-9, X5CrNiMo17-12-3, etc. | -                           | First choice    | AH3225       | 80 - 180                    | 0.07 - 0.2                  |             |
| K   | Grey cast iron<br>FC250, FC300, etc.<br>GG25, GG30, etc.<br>250, 300, etc.   | 150 - 250 HB                | First choice    | AH120        | 100 - 300                   | 0.05 - 0.12                 |             |
|     |  | 150 - 250 HB                | Wear resistance | T1215        | 200 - 400                   | 0.05 - 0.18                 |             |
|     | Ductile cast iron<br>FCD400, FCD600, etc.<br>GGG60, 600-3, etc.              | 150 - 250 HB                | First choice    | AH120        | 100 - 250                   | 0.05 - 0.12                 |             |
|     |  | 150 - 250 HB                | Wear resistance | T1215        | 150 - 300                   | 0.05 - 0.18                 |             |
| N   | Aluminum alloys<br>Si < 13%  | -                           | First choice    | KS05F        | 300 - 1500                  | 0.05 - 0.32                 |             |
|     | Aluminum alloys<br>Si ≥ 13%  | -                           | First choice    | KS05F        | 100 - 200                   | 0.05 - 0.32                 |             |
| S   | Titanium alloys<br>Ti-6Al-4V, etc.   | - 40 HRC                    | First choice    | AH3225       | 20 - 60                     | 0.04 - 0.15                 |             |
|     | Superalloys<br>Inconel 718, etc.   | - 40 HRC                    | First choice    | AH120        | 20 - 40                     | 0.04 - 0.15                 |             |
| H   | Hardened steel   | SKD61,<br>X40CrMoV5-1, etc. | 40 - 50 HRC     | First choice | AH120                       | 50 - 150                    | 0.04 - 0.07 |
|     |  | SKD11,<br>X153CrMoV12, etc. | 50 - 60 HRC     | First choice | AH120                       | 40 - 70                     | 0.04 - 0.07 |

### Cautionary point in modifying cutter bodies

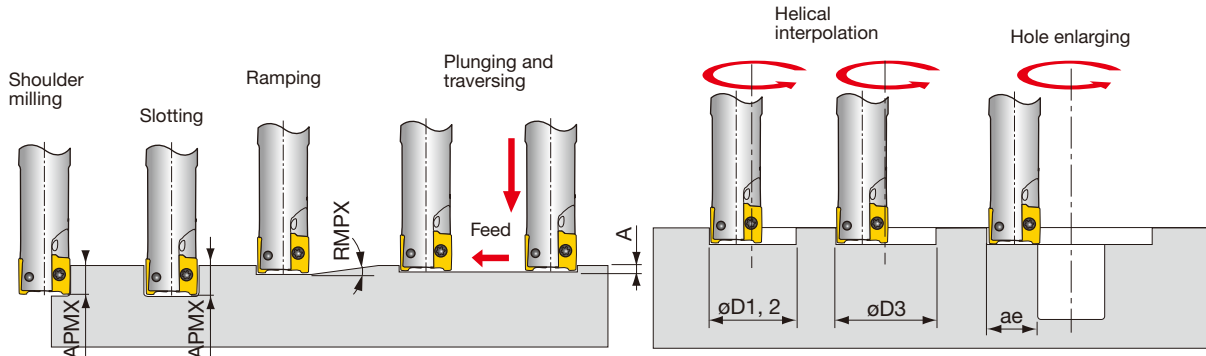
When using inserts with corner radius  
RE ≥ 2 mm, standard cutter bodies have to be  
modified "R". (EPAV12, TPAV12, HPAV12)



| Corner radius RE (mm) | The dimension of modifying (mm) |
|-----------------------|---------------------------------|
| 0.4 - 1.6             | Unnecessary                     |
| 2 - 3                 | 2                               |



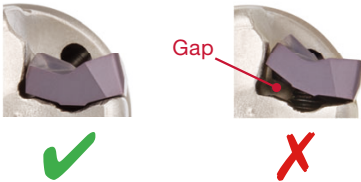
# MACHINING APPLICATIONS



| Designation     | DC | Max. depth of cut |      | Max. plunging | Min. machining | Max. machining |             | Max. cutting width in enlarging |
|-----------------|----|-------------------|------|---------------|----------------|----------------|-------------|---------------------------------|
|                 |    | APMX              | RMPX |               |                | $\phi D1, 2$   | $\phi D3^*$ |                                 |
| EPAV12M012...   | 12 | 11.5              | 4.5° | 0.5           | 17.8           | 23             | 22          | 11                              |
| E/HPAV12M016... | 16 | 11.5              | 3.5° | 0.5           | 25.3           | 31             | 30          | 15                              |
| E/HPAV12M020... | 20 | 11.5              | 3°   | 0.5           | 33             | 39             | 38          | 19                              |
| E/HPAV12M025... | 25 | 11.5              | 2.5° | 0.5           | 42.6           | 49             | 48          | 24                              |
| E/HPAV12M032... | 32 | 11.5              | 2°   | 0.5           | 56.4           | 63             | 62          | 31                              |
| HPAV12M040...   | 40 | 11.5              | 2°   | 0.5           | 71.5           | 78             | 77          | 39                              |
| TPAV12M050...   | 50 | 11.5              | 2°   | 0.5           | 90.4           | 99             | 98          | 49                              |
| TPAV12M063...   | 63 | 11.5              | 1.8° | 0.5           | 115.6          | 125            | 124         | 62                              |

\*Flat bottom hole

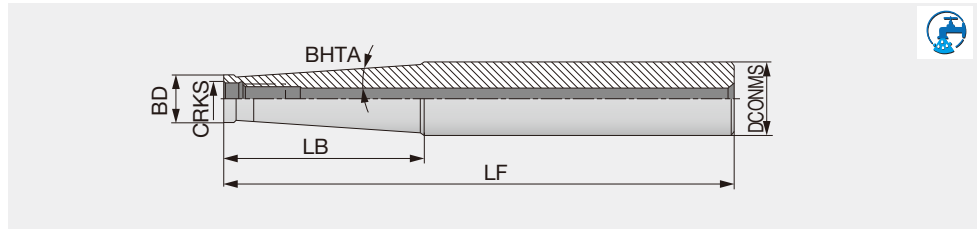
When clamping the insert, please confirm that there is no gap between the cutter body and the insert as shown in the picture.



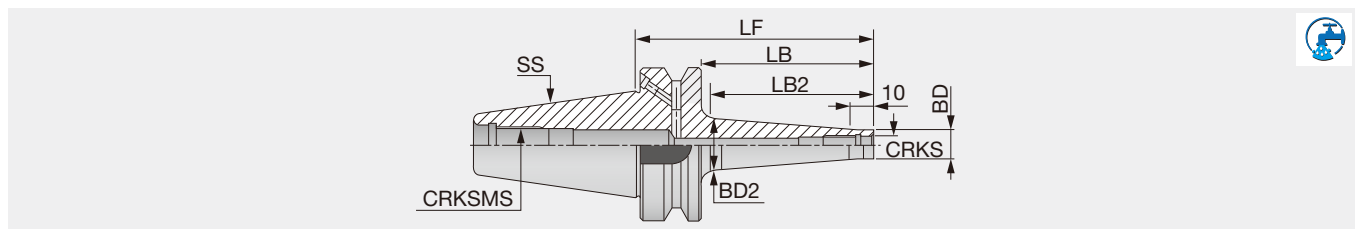
## Estimation of chip thickness - calculated from feed per tooth ( $f_z$ ) and cutting width ( $ae$ ) data

Recommended chip thickness

| Feed per tooth $f_z$ (mm/t) | Cutting width (%): $ae$ (mm) / Tool dia.: DC (mm) |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|-----------------------------|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                             | 1%  | 2%    | 2.5%  | 3%    | 4%    | 5%    | 10%   | 15%   | 20%   | 25%   | 30%   | 35%   | 40%   | 45%   | 50% - |
| 0.03                        | 0.006   | 0.008 | 0.009 | 0.01  | 0.012 | 0.013 | 0.018 | 0.021 | 0.024 | 0.026 | 0.027 | 0.029 | 0.029 | 0.03  | 0.03  |
| 0.05                        | 0.01  | 0.014 | 0.016 | 0.017 | 0.02  | 0.022 | 0.03  | 0.036 | 0.04  | 0.043 | 0.046 | 0.048 | 0.049 | 0.05  | 0.05  |
| 0.08                        | 0.016   | 0.022 | 0.025 | 0.027 | 0.031 | 0.035 | 0.048 | 0.057 | 0.064 | 0.069 | 0.073 | 0.076 | 0.078 | 0.08  | 0.08  |
| 0.10                        | 0.02  | 0.028 | 0.031 | 0.034 | 0.039 | 0.044 | 0.06  | 0.071 | 0.08  | 0.087 | 0.092 | 0.095 | 0.098 | 0.099 | 0.1   |
| 0.12                        | 0.024   | 0.034 | 0.037 | 0.041 | 0.047 | 0.052 | 0.072 | 0.086 | 0.096 | 0.104 | 0.11  | 0.114 | 0.118 | 0.119 | 0.12  |
| 0.15                        | 0.03  | 0.042 | 0.047 | 0.051 | 0.059 | 0.065 | 0.09  | 0.107 | 0.12  | 0.13  | 0.137 | 0.143 | 0.147 | 0.149 | 0.15  |
| 0.18                        | 0.036   | 0.05  | 0.056 | 0.061 | 0.071 | 0.078 | 0.108 | 0.129 | 0.144 | 0.156 | 0.165 | 0.172 | 0.176 | 0.179 | 0.18  |
| 0.20                        | 0.04  | 0.056 | 0.062 | 0.068 | 0.078 | 0.087 | 0.12  | 0.143 | 0.16  | 0.173 | 0.183 | 0.191 | 0.196 | 0.199 | 0.2   |
| 0.22                        | 0.044   | 0.062 | 0.069 | 0.075 | 0.086 | 0.096 | 0.132 | 0.157 | 0.176 | 0.191 | 0.202 | 0.21  | 0.216 | 0.219 | 0.22  |
| 0.25                        | 0.05  | 0.07  | 0.078 | 0.085 | 0.098 | 0.109 | 0.15  | 0.179 | 0.2   | 0.217 | 0.229 | 0.238 | 0.245 | 0.249 | 0.25  |
| 0.28                        | 0.056   | 0.078 | 0.087 | 0.096 | 0.11  | 0.122 | 0.168 | 0.2   | 0.224 | 0.242 | 0.257 | 0.267 | 0.274 | 0.279 | 0.28  |
| 0.30                        | 0.06  | 0.084 | 0.094 | 0.102 | 0.118 | 0.131 | 0.18  | 0.214 | 0.24  | 0.26  | 0.275 | 0.286 | 0.294 | 0.298 | 0.3   |
| 0.40                        | 0.08  | 0.112 | 0.125 | 0.136 | 0.157 | 0.174 | 0.24  | 0.286 | 0.32  | 0.346 | 0.367 | 0.382 | 0.392 | 0.398 | 0.4   |



| Designation   | DCONMS | BD  | LF  | LB   | BHTA | CRKS |
|---------------|--------|-----|-----|------|------|------|
| SM06-L60C10   | 10     | 9.7 | 60  | 20   | 0°   | M6   |
| SM06-L105-C12 | 12     | 9.7 | 105 | 60   | 1.2° | M6   |
| SM06-L125-C16 | 16     | 9.7 | 125 | 60   | 3.3° | M6   |
| SM08-L73C16   | 16     | 13  | 73  | 25   | 0°   | M8   |
| SM08-L128-C16 | 16     | 13  | 128 | 80   | 0.9° | M8   |
| SM08-L170-C20 | 20     | 13  | 170 | 66.8 | 3.3° | M8   |
| SM10-L80-C20  | 20     | 18  | 80  | 30   | 0°   | M10  |
| SM10-L130-C20 | 20     | 18  | 130 | 80   | 0.6° | M10  |
| SM10-L200-C25 | 25     | 19  | 200 | 57.2 | 3.3° | M10  |
| SM12-L86-C25  | 25     | 21  | 86  | 30   | 5.1° | M12  |
| SM12-L200-C32 | 32     | 21  | 200 | 78   | 4.4° | M12  |
| SM16-L95-C32  | 32     | 29  | 95  | 35   | 1.7° | M16  |
| SM16-L230-C32 | 32     | 29  | 230 | 50   | 1.8° | M16  |

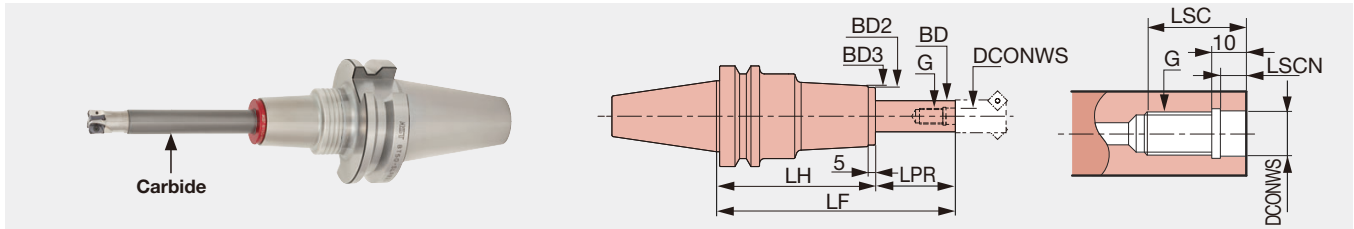


| Designation                  | SS | CRKS | BD  | BD2  | LF  | LB  | LB2 | CRKSMS |
|------------------------------|----|------|-----|------|-----|-----|-----|--------|
| BT40ODP6X66                  | 40 | M6   | 9.8 | 13   | 66  | 39  | 30  | M16    |
| BT40ODP6X106                 | 40 | M6   | 9.8 | 23   | 106 | 79  | 70  | M16    |
| BT40ODP8X66                  | 40 | M8   | 13  | 15   | 66  | 39  | 30  | M16    |
| BT40ODP8X106                 | 40 | M8   | 13  | 23   | 106 | 79  | 70  | M16    |
| BT40ODP10X66                 | 40 | M10  | 18  | 20   | 66  | 39  | 30  | M16    |
| BT40ODP10X106                | 40 | M10  | 18  | 28   | 106 | 79  | 70  | M16    |
| BT40ODP12X66                 | 40 | M12  | 21  | 24   | 66  | 39  | 30  | M16    |
| BT40ODP12X106                | 40 | M12  | 21  | 31   | 106 | 79  | 70  | M16    |
| BT40ODP16X66                 | 40 | M16  | 29  | 28.6 | 66  | 39  | -   | M16    |
| BT40ODP16X106                | 40 | M16  | 29  | 34   | 106 | 79  | 70  | M16    |
| BT50ODP12X94                 | 50 | M12  | 23  | 30   | 94  | 56  | 50  | M24    |
| BT50ODP12X144 <sup>(1)</sup> | 50 | M12  | 23  | 40   | 144 | 106 | 100 | M24    |
| BT50ODP12X194 <sup>(1)</sup> | 50 | M12  | 23  | 40   | 194 | 156 | 150 | M24    |
| BT50ODP12X244 <sup>(1)</sup> | 50 | M12  | 23  | 46   | 244 | 206 | 200 | M24    |
| BT50ODP16X94 <sup>(1)</sup>  | 50 | M16  | 29  | 34   | 94  | 56  | 50  | M24    |
| BT50ODP16X144 <sup>(1)</sup> | 50 | M16  | 29  | 40   | 144 | 106 | 100 | M24    |
| BT50ODP16X194 <sup>(1)</sup> | 50 | M16  | 29  | 55   | 194 | 156 | 150 | M24    |
| BT50ODP16X244 <sup>(1)</sup> | 50 | M16  | 29  | 60   | 244 | 206 | 200 | M24    |

Applicable for 10 MPa pressure coolant  
 (1) Balanced to G6.3 at 12,000 min<sup>-1</sup>

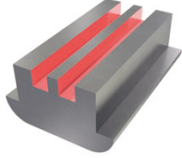
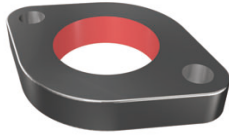
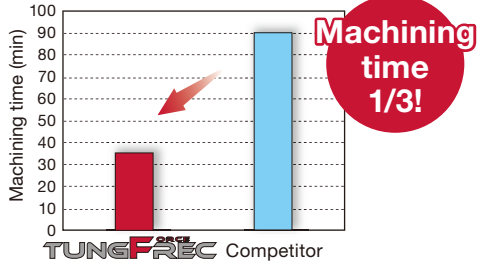
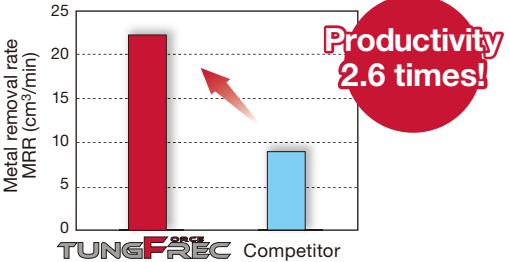
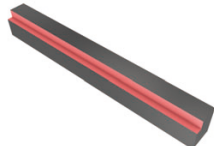

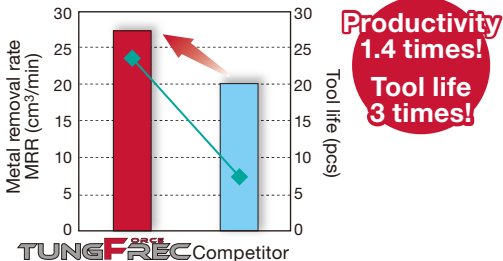
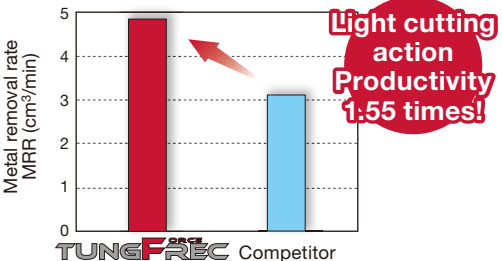
## BT-RSG (Screw clamping head holder)

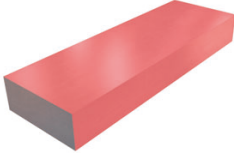

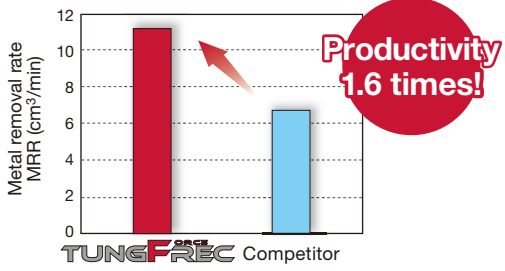
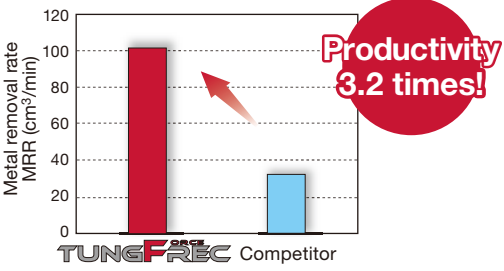
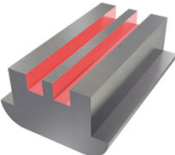
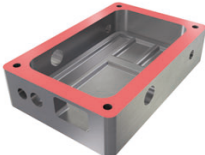
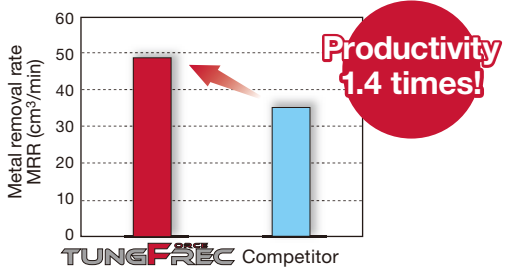
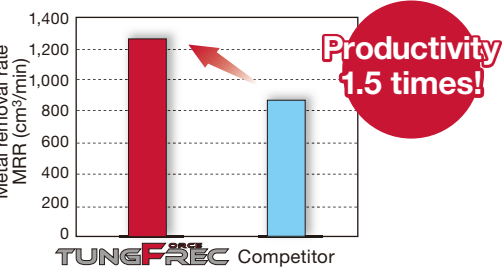
TungFlex modular tooling system with BT shank



| Designation          | DCONWS | LSC | LSCN | BD | LF  | LPR | LH  | BD2 | BD3 | WT (kg) | G   |
|----------------------|--------|-----|------|----|-----|-----|-----|-----|-----|---------|-----|
| BT40-RSG 8-105-M 25  | 8.5    | 18  | 6.5  | 15 | 105 | 25  | 80  | 30  | 32  | 1.4     | M8  |
| BT40-RSG 8-135-M 25  | 8.5    | 18  | 6.5  | 15 | 135 | 25  | 110 | 30  | 32  | 1.8     | M8  |
| BT40-RSG 8-130-M 50  | 8.5    | 18  | 6.5  | 15 | 130 | 50  | 80  | 30  | 32  | 1.4     | M8  |
| BT40-RSG 8-160-M 50  | 8.5    | 18  | 6.5  | 15 | 160 | 50  | 110 | 30  | 32  | 1.8     | M8  |
| BT40-RSG 8-155-M 75  | 8.5    | 18  | 6.5  | 15 | 155 | 75  | 80  | 30  | 32  | 1.5     | M8  |
| BT40-RSG 8-185-M 75  | 8.5    | 18  | 6.5  | 15 | 185 | 75  | 110 | 30  | 32  | 1.9     | M8  |
| BT40-RSG 10-125-M 25 | 10.5   | 22  | 6.5  | 19 | 125 | 25  | 100 | 36  | 38  | 1.8     | M10 |
| BT40-RSG 10-155-M 25 | 10.5   | 22  | 6.5  | 19 | 155 | 25  | 130 | 36  | 38  | 2.2     | M10 |
| BT40-RSG 10-150-M 50 | 10.5   | 22  | 6.5  | 19 | 150 | 50  | 100 | 36  | 38  | 1.9     | M10 |
| BT40-RSG 10-180-M 50 | 10.5   | 22  | 6.5  | 19 | 180 | 50  | 130 | 36  | 38  | 2.3     | M10 |
| BT40-RSG 10-175-M 75 | 10.5   | 22  | 6.5  | 19 | 175 | 75  | 100 | 36  | 38  | 2       | M10 |
| BT40-RSG 10-205-M 75 | 10.5   | 22  | 6.5  | 19 | 205 | 75  | 130 | 36  | 38  | 2.4     | M10 |
| BT40-RSG 10-200-M100 | 10.5   | 22  | 6.5  | 19 | 200 | 100 | 100 | 36  | 38  | 2       | M10 |
| BT40-RSG 10-230-M100 | 10.5   | 22  | 6.5  | 19 | 230 | 100 | 130 | 36  | 38  | 2.4     | M10 |
| BT40-RSG 12-125-M 25 | 12.5   | 22  | 6    | 24 | 125 | 25  | 100 | 43  | 45  | 2       | M12 |
| BT40-RSG 12-155-M 25 | 12.5   | 22  | 6    | 24 | 155 | 25  | 130 | 43  | 45  | 2.4     | M12 |
| BT40-RSG 12-150-M 50 | 12.5   | 22  | 6    | 24 | 150 | 50  | 100 | 43  | 45  | 2.1     | M12 |
| BT40-RSG 12-180-M 50 | 12.5   | 22  | 6    | 24 | 180 | 50  | 130 | 43  | 45  | 2.5     | M12 |
| BT40-RSG 12-175-M 75 | 12.5   | 22  | 6    | 24 | 175 | 75  | 100 | 43  | 45  | 2.3     | M12 |
| BT40-RSG 12-205-M 75 | 12.5   | 22  | 6    | 24 | 205 | 75  | 130 | 43  | 45  | 2.7     | M12 |
| BT40-RSG 12-200-M100 | 12.5   | 22  | 6    | 24 | 200 | 100 | 100 | 43  | 45  | 2.4     | M12 |
| BT40-RSG 12-230-M100 | 12.5   | 22  | 6    | 24 | 230 | 100 | 130 | 43  | 45  | 2.8     | M12 |
| BT50-RSG 8-120-M 25  | 8.5    | 18  | 6.5  | 15 | 120 | 25  | 95  | 30  | 32  | 4       | M8  |
| BT50-RSG 8-150-M 25  | 8.5    | 18  | 6.5  | 15 | 150 | 25  | 125 | 30  | 32  | 4.3     | M8  |
| BT50-RSG 8-145-M 50  | 8.5    | 18  | 6.5  | 15 | 145 | 50  | 95  | 30  | 32  | 4       | M8  |
| BT50-RSG 8-175-M 50  | 8.5    | 18  | 6.5  | 15 | 175 | 50  | 125 | 30  | 32  | 4.3     | M8  |
| BT50-RSG 8-170-M 75  | 8.5    | 18  | 6.5  | 15 | 170 | 75  | 95  | 30  | 32  | 4.1     | M8  |
| BT50-RSG 8-200-M 75  | 8.5    | 18  | 6.5  | 15 | 200 | 75  | 125 | 30  | 32  | 4.4     | M8  |
| BT50-RSG 10-140-M 25 | 10.5   | 22  | 6.5  | 19 | 140 | 25  | 115 | 36  | 38  | 4.3     | M10 |
| BT50-RSG 10-170-M 25 | 10.5   | 22  | 6.5  | 19 | 170 | 25  | 145 | 36  | 38  | 4.6     | M10 |
| BT50-RSG 10-165-M 50 | 10.5   | 22  | 6.5  | 19 | 165 | 50  | 115 | 36  | 38  | 4.4     | M10 |
| BT50-RSG 10-195-M 50 | 10.5   | 22  | 6.5  | 19 | 195 | 50  | 145 | 36  | 38  | 4.7     | M10 |
| BT50-RSG 10-190-M 75 | 10.5   | 22  | 6.5  | 19 | 190 | 75  | 115 | 36  | 38  | 4.5     | M10 |
| BT50-RSG 10-220-M 75 | 10.5   | 22  | 6.5  | 19 | 220 | 75  | 145 | 36  | 38  | 4.8     | M10 |
| BT50-RSG 10-215-M100 | 10.5   | 22  | 6.5  | 19 | 215 | 100 | 115 | 36  | 38  | 4.5     | M10 |
| BT50-RSG 10-245-M100 | 10.5   | 22  | 6.5  | 19 | 245 | 100 | 145 | 36  | 38  | 4.8     | M10 |
| BT50-RSG 12-140-M 25 | 12.5   | 22  | 6    | 24 | 140 | 25  | 115 | 43  | 45  | 4.6     | M12 |
| BT50-RSG 12-170-M 25 | 12.5   | 22  | 6    | 24 | 170 | 25  | 145 | 43  | 45  | 5       | M12 |
| BT50-RSG 12-165-M 50 | 12.5   | 22  | 6    | 24 | 165 | 50  | 115 | 43  | 45  | 4.7     | M12 |
| BT50-RSG 12-195-M 50 | 12.5   | 22  | 6    | 24 | 195 | 50  | 145 | 43  | 45  | 5.1     | M12 |
| BT50-RSG 12-190-M 75 | 12.5   | 22  | 6    | 24 | 190 | 75  | 115 | 43  | 45  | 4.9     | M12 |
| BT50-RSG 12-220-M 75 | 12.5   | 22  | 6    | 24 | 220 | 75  | 145 | 43  | 45  | 5.3     | M12 |
| BT50-RSG 12-215-M100 | 12.5   | 22  | 6    | 24 | 215 | 100 | 115 | 43  | 45  | 5       | M12 |
| BT50-RSG 12-245-M100 | 12.5   | 22  | 6    | 24 | 245 | 100 | 145 | 43  | 45  | 5.4     | M12 |
| BT50-RSG 12-240-M125 | 12.5   | 22  | 6    | 24 | 240 | 125 | 115 | 43  | 45  | 5.2     | M12 |
| BT50-RSG 16-140-M 25 | 17     | 25  | 6    | 29 | 140 | 25  | 115 | 52  | 54  | 5.4     | M16 |
| BT50-RSG 16-165-M 50 | 17     | 25  | 6    | 29 | 165 | 50  | 115 | 52  | 54  | 5.6     | M16 |
| BT50-RSG 16-190-M 75 | 17     | 25  | 6    | 29 | 190 | 75  | 115 | 52  | 54  | 5.8     | M16 |
| BT50-RSG 16-215-M100 | 17     | 25  | 6    | 29 | 215 | 100 | 115 | 52  | 54  | 6       | M16 |
| BT50-RSG 16-240-M125 | 17     | 25  | 6    | 29 | 240 | 125 | 115 | 52  | 54  | 6.2     | M16 |

## ■ PRACTICAL EXAMPLES

| Workpiece type     |   | Machine parts  | Machine parts   |  |
|--------------------|---|--|---|--|
| Cutter             |   | EPAV04M008C08.0R02 (ø8 mm, z=2)  | EPAV04M008C08.0R02L (ø8 mm, z=2)  |  |
| Insert             |   | AVMT040204PPER-MM  | AVMT040204PPER-MM   |  |
| Grade              |   | AH3225   | AH3225  |  |
| Workpiece material |   | SUS304 / X5CrNiMo18-9  | S50C  |  |
|                    |   |  <b>M</b>   |  <b>P</b>  |  |
| Cutting conditions | Cutting speed : Vc (m/min)  | 150  | 251   |  |
|                    | Feed per tooth : fz (mm/t)  | 0.08   | 0.07  |  |
|                    | Feed speed : Vf (m/min)   | 895  | 1,400   |  |
|                    | Depth of cut : ap (mm)  | 1.429  | 2   |  |
|                    | Width of cut : ae (mm)  | 8  | 8   |  |
|                    | Machining   | Slotting   | Slotting  |  |
|                    | Coolant   | Air blast  | Air blast   |  |
|                    | Machine   | Vertical M/C, BT50   | Vertical M/C, BT50  |  |
| Results            |  <p><b>Machining time 1/3!</b></p>  |  |  <p><b>Productivity 2.6 times!</b></p>                                   |  |
|                    | <p>TungForce-Rec endmill with high rigidity shortened the machining time to 1/3 compared to the solid endmill.</p>  |  | <p>TungForce-Rec endmill machines with 2.6 times higher productivity due to the incredible rigidity.</p>  |  |
| Workpiece type     |   | Machine parts  | Spindle   |  |
| Cutter             |   | EPAV06M014C12.0R03 (ø14 mm, z=3)   | EPAV06M012C12.0R03 (ø12 mm, z = 3)  |  |
| Insert             |   | AVGT060302PBER-MJ  | AVGT060304PBER-MJ   |  |
| Grade              |   | AH3225   | AH3135  |  |
| Workpiece material |   | SS400 / E275A  | Alloy steel (Low carbon, 30HRC)   |  |
|                    |   |  <b>P</b> |  <b>P</b>  |  |
| Cutting conditions | Cutting speed : Vc (m/min)  | 264  | 143   |  |
|                    | Feed per tooth : fz (mm/t)  | 0.125  | 0.04  |  |
|                    | Feed speed : Vf (m/min)   | 1,500  | 601   |  |
|                    | Depth of cut : ap (mm)  | 6  | 1   |  |
|                    | Width of cut : ae (mm)  | 3  | 1.6   |  |
|                    | Machining   | Shoulder milling   | Shoulder milling  |  |
|                    | Coolant   | Wet (External)   | Dry   |  |
|                    | Machine   | Vertical M/C, BT40   | Vertical M/C, BT30  |  |
| Results            |  <p><b>Productivity 1.4 times!</b><br/><b>Tool life 3 times!</b></p>                       |  |  <p><b>Light cutting action</b><br/><b>Productivity 1.55 times!</b></p> |  |
|                    | <p>TungForce-Rec endmill achieves 3 times longer tool life and 140 % productivity compared to the solid endmill, thanks to the latest AH3225 grade with high performance.</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     |                            | Plate for mold   | Machine parts  |
|--------------------|----------------------------|--|--|
| Cutter             |                            | EPAV12M20C20.0R04 (ø20 mm, z = 4)  | TPAV12M050B22.0R12 (ø50 mm, z = 12)  |
| Insert             |                            | AVMT120408PDER-MM  | AVMT120408PDER-MM  |
| Grade              |                            | AH3225   | AH3225   |
| Workpiece material |                            | Prehardened steel  | SS400 / E275A  |
|                    |                            |  <b>P</b>   |  <b>P</b>   |
| Cutting conditions | Cutting speed : Vc (m/min) | 72   | 157  |
|                    | Feed per tooth : fz (mm/t) | 0.1  | 0.12   |
|                    | Feed speed : Vf (m/min)    | 458  | 1,440  |
|                    | Depth of cut : ap (mm)     | 4  | 2  |
|                    | Width of cut : ae (mm)     | 6  | 35   |
|                    | Machining                  | Face milling   | Face milling   |
|                    | Coolant                    | Air blast  | Air blast  |
| Machine            |                            | Vertical M/C, BT50   | Vertical M/C, BT40   |
| Results            |                            |  <p>Thanks to dense number of teeth and robust cutting edge, TungForce-Rec offered high productivity without chipping.</p>   |  <p>Dense number of teeth and large rake angle allowed TungForce-Rec to offer high productivity without chattering.</p>           |
|                    |                            | <p><b>Workpiece type</b></p> <p><b>Cutter</b></p> <p><b>Insert</b></p> <p><b>Grade</b></p>   |  |
| Machine parts      |                            | Machine parts  | Machine parts  |
| Cutter             |                            | EPAV12M20C20.0R04 (ø20 mm, z = 4)  | TPAV12M050B22.0R12 (ø50 mm, z = 12)  |
| Insert             |                            | AVMT120408PDER-MM  | AVGT120408PDFR-AM  |
| Grade              |                            | AH3225   | KS05F  |
| Workpiece material |                            | SNCM431 / 30CrNiMo8  | Cast aluminum  |
|                    |                            |  <b>P</b>   |  <b>N</b>   |
| Cutting conditions | Cutting speed : Vc (m/min) | 157  | 950  |
|                    | Feed per tooth : fz (mm/t) | 0.12   | 0.15   |
|                    | Feed speed : Vf (m/min)    | 1,200  | 11,000   |
|                    | Depth of cut : ap (mm)     | 2  | 6  |
|                    | Width of cut : ae (mm)     | 20   | 35   |
|                    | Machining                  | Slotting   | Face milling   |
|                    | Coolant                    | Air blast  | Wet (External)   |
| Machine            |                            | Vertical M/C, BT40   | Vertical M/C, BT50   |
| Results            |                            |  <p>Dense number of teeth and rigid tool design allowed TungForce-Rec to offer high productivity in slotting operation.</p> |  <p>Dense number of teeth and rigid tool design allowed TungForce-Rec to offer high productivity in cast aluminum machining.</p> |



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