

MillLine

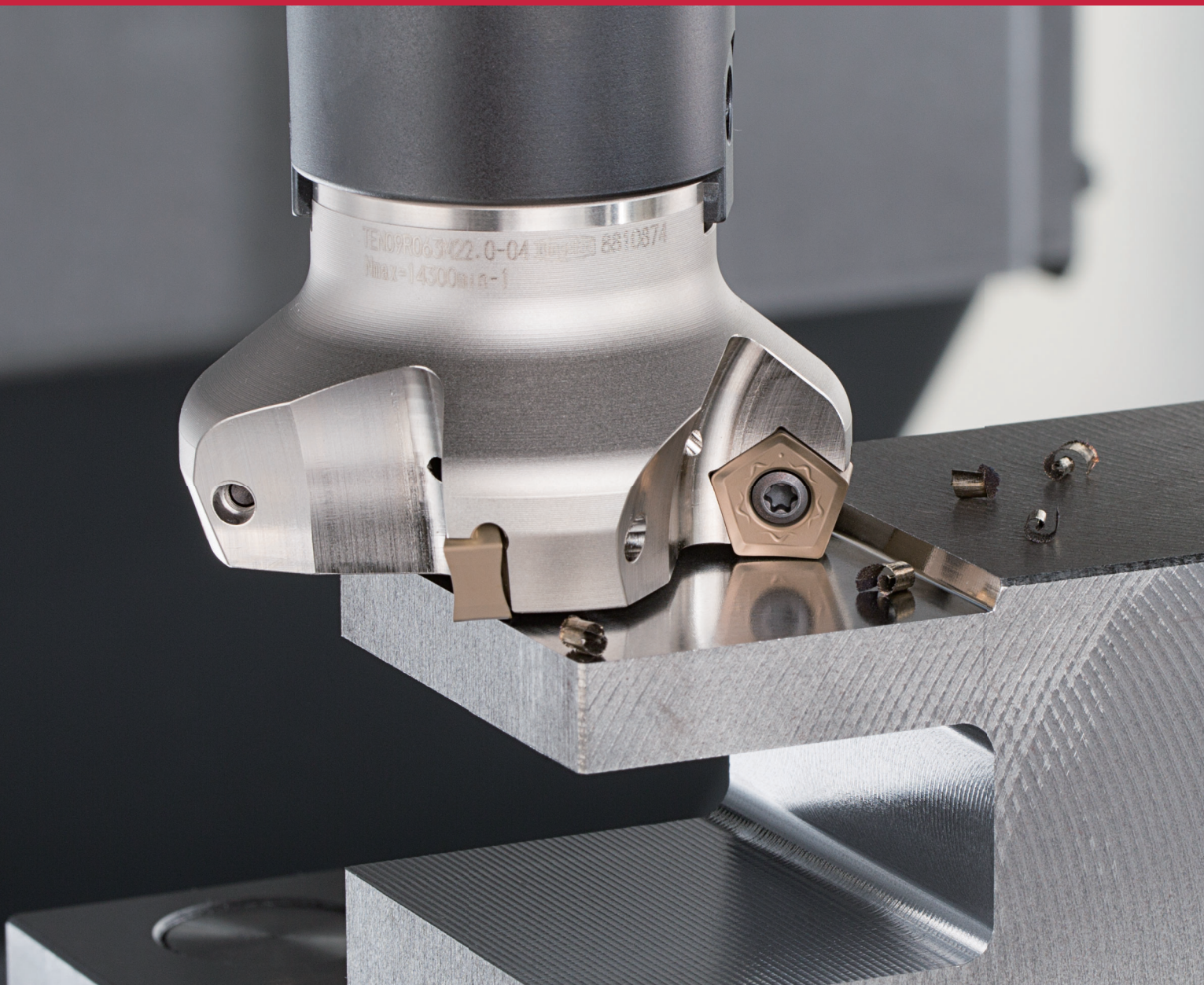


**DOPENT**

www.tungaloy.com

Tungaloy Report No. 372-G

High-speed face milling with superior surface finish - now available in **new CVD grades**



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

BIG-PLUS SPINDLE SYSTEM

NO. BEEU1857 A

Tungaloy

ACCELERATED MACHINING



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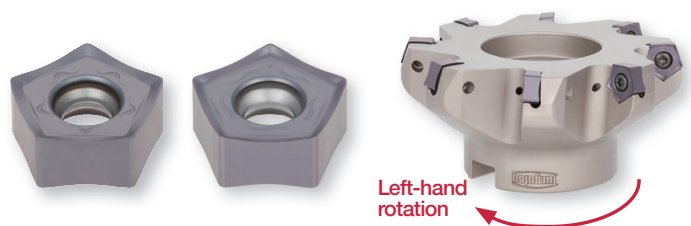
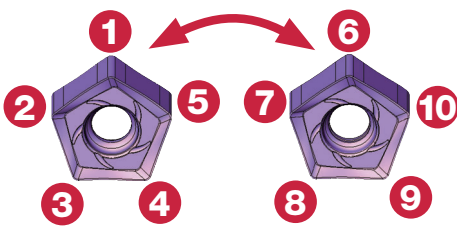
Face milling cutter with low cutting force and low cost per edge

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## Economical face milling cutter with high productivity for all materials!!

### Economical pentagonal insert

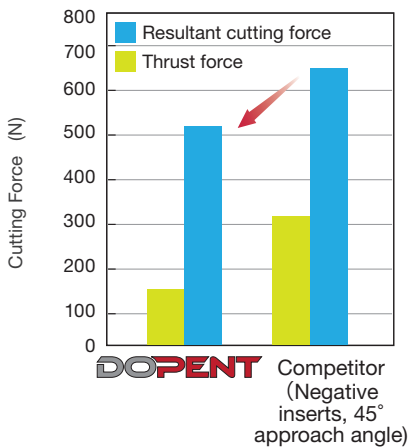
Double-sided insert with 10 cutting edges



The neutral inserts are mountable on the left-hand cutter.

### Low cutting force

Free cutting geometry thanks to its 70° approach angle and large rake angle



**P**

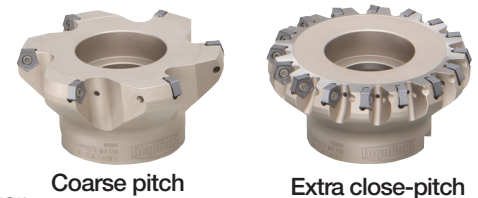
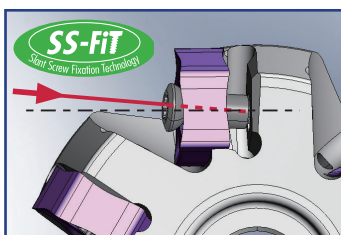
Cutter : TEN09R100M31.7-05( $\phi D_c = 100$  mm,  $z = 1$ )  
 Insert : PNMU0905GNEN-MJ / AH3135  
 Workpiece : S55C / C55, 200HB  
 Cutting speed :  $V_c = 200$  m/min  
 Feed per tooth :  $f_z = 0.2$  mm/t  
 Depth of cut :  $a_p = 2$  mm  
 Width of cut :  $a_e = 60$  mm  
 Coolant : Dry

**Resultant cutting force: down by 30%; Thrust force: down by 50%**

**Perfect for thin-structured, low rigidity workpieces**

### For higher machining efficiency, use the close-pitched cutter.

SS-FIT structure provides exceptional rigidity even with extra close-pitch cutters.



■ Large number of inserts on a cutter

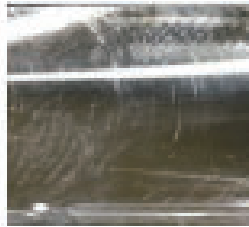
Dimensions $\phi D_c$ (mm)	No. of inserts			
	Close pitch		Extra close-pitch	
	DO PENT	Competitor	DO PENT	Competitor
63	6	5	8	7
80	7	6	10	9
100	8	7	12	11
125	10	9	16	13
160	12	11	20	15

## Superior surface finish quality

Improved surface finish quality thanks to the excellent chip control ability



**DOPENT**



Competitor  
(Negative inserts,  
65° approach angle)

**M**

Cutter : TEN09R063M22.0-06 ( $\phi D_c = 63, z = 6$ )  
 Insert : PNCU0905GNEN-MJ / AH3135  
 Workpiece : SUS304 / X5CrNi18-9, 175HB  
 Cutting speed :  $V_c = 200$  m/min  
 Feed per tooth :  $f_z = 0.2$  mm/t  
 Depth of cut :  $a_p = 0.5$  mm  
 Width of cut :  $a_e = 51$  mm  
 Coolant : Dry

## Improved surface finish by cermet grade

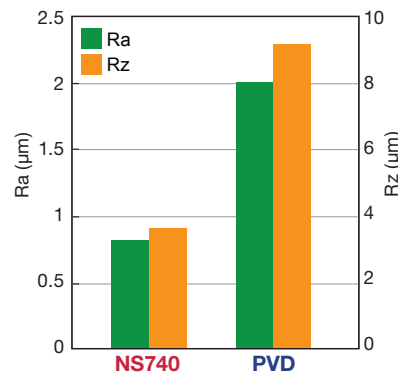
**NS740** performs well in finishing application due to strong welding resistance.



**NS740**



**PVD**



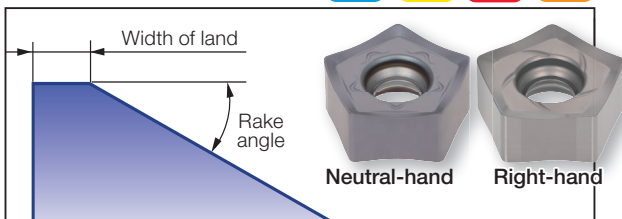
**P**

Cutter : TEN09R100M31.7-05 ( $z = 1$ )  
 Insert : PNCU0905GNER-MJ  
 Workpiece : SS400 / E275A (126HB)  
 Cutting speed :  $V_c = 250$  m/min  
 Feed per tooth :  $f_z = 0.15$  mm/t  
 Depth of cut :  $a_p = 0.3$  mm  
 Width of cut :  $a_e = 75$  mm  
 Coolant : Dry

## Wide line-up of inserts for various machining

**MJ** General purpose

**P M K S**

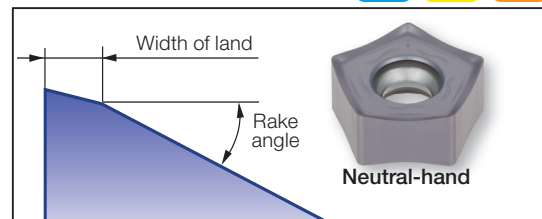


10 cutting edges

Excellent balance between sharpness and toughness of cutting edges

**ML** Light cutting geometry

**P M S**

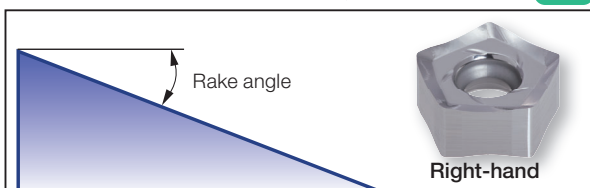


10 cutting edges

Sharp cutting edge for stainless machining

**AJ** For non-ferrous machining

**N**



10 cutting edges

Strong welding resistance due to large rake angle and lapped rake face

**W** With wipers

**P M K S**



2 cutting edges

Provides good surface finish due to wide wiper edge

## Rich grade lineup for every kind of material

### AH3135



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

### AH120



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

### AH725



- Good balance between wear and chipping resistance
- Suitable for machining steel and superalloys

### T1215



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

### New T3225

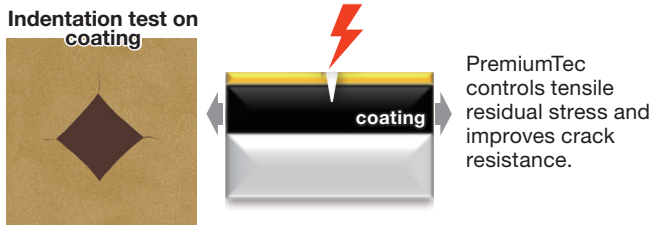
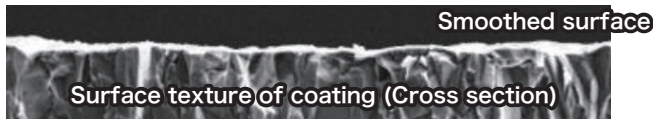


- CVD grade with excellent chipping and fracture resistance
- Most suited for steel and stainless steel at high-speed machining

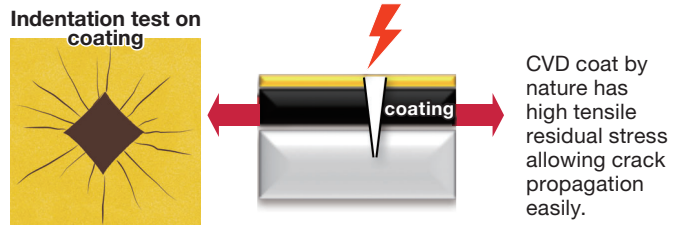
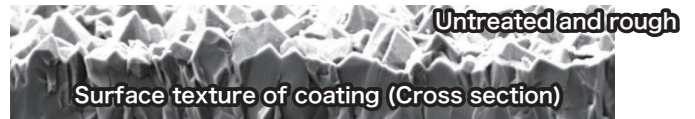
### Special Surface Technology

## PREMIUMTEC

TUNGALOY

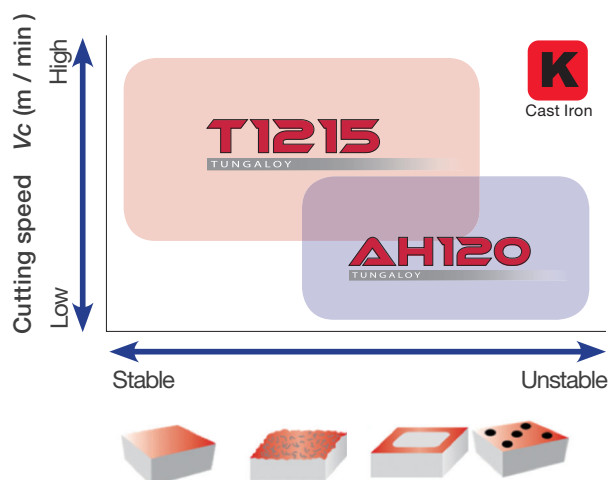
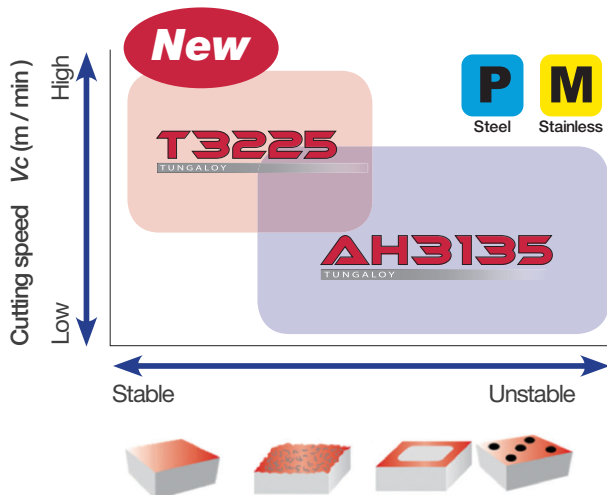


### Conventional item



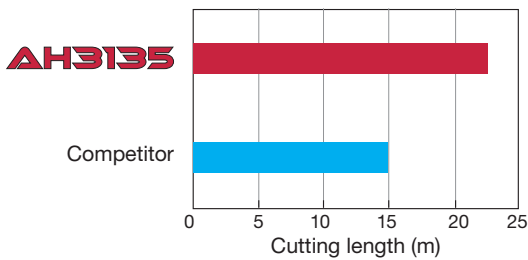
PremiumTec enhances both smoothness and toughness on coating surface, improving resistance to chipping, build-up edge, and fracture.

## Application area



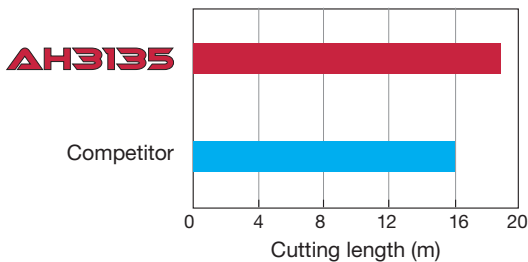
## Stable tool life

- Tool life comparison in machining steel (DC = 100 mm)



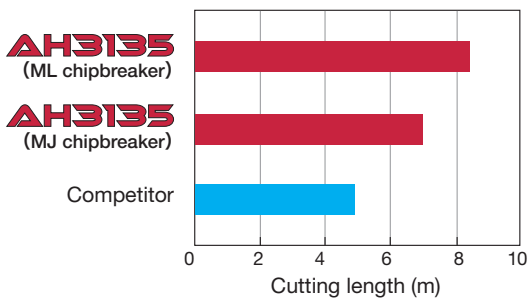
Cutter : TEN09R100M31.7-05 (ø100 mm, z = 1)  
 Insert : PNMU0905GNEN-MJ / AH3135  
 Workpiece : S55C / C55 (200HB)  
 Cutting speed :  $V_c = 200$  m/min  
 Feed per tooth :  $f_z = 0.3$  mm/t  
 Depth of cut :  $a_p = 2$  mm  
 Width of cut :  $a_e = 70$  mm  
 Coolant : Dry

- Tool life comparison in machining steel (DC = 63 mm)



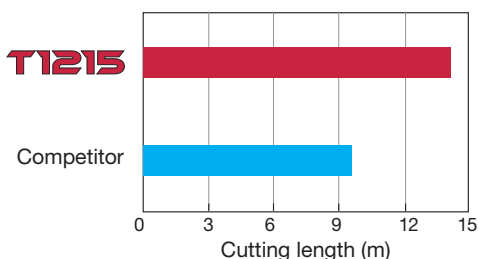
Cutter : TEN09R063M22.0-06 (ø63 mm, z = 1)  
 Insert : PNCU0905GNEN-MJ / AH3135  
 Workpiece : S55C / C55 (210HB)  
 Cutting speed :  $V_c = 200$  m/min  
 Feed per tooth :  $f_z = 0.3$  mm/t  
 Depth of cut :  $a_p = 2$  mm  
 Width of cut :  $a_e = 50$  mm  
 Coolant : Dry

- Tool life comparison in machining stainless (DC = 63 mm)



Cutter : TEN09R063M22.0-06 (ø63 mm, z = 1)  
 Insert : PNCU0905GNEN-MJ / AH3135  
 Workpiece : PNCU0905GNEN-ML / AH3135  
 Workpiece : SUS304 / X5CrNi18-9 (175HB)  
 Cutting speed :  $V_c = 150$  m/min  
 Feed per tooth :  $f_z = 0.2$  mm/t  
 Depth of cut :  $a_p = 2$  mm  
 Width of cut :  $a_e = 50$  mm  
 Coolant : Dry

- Tool life comparison in machining cast iron (DC = 63 mm)



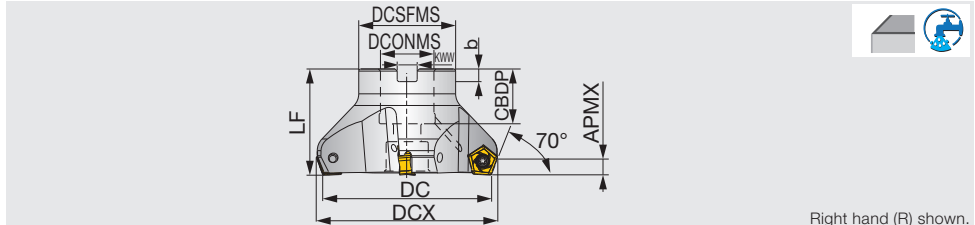
Cutter : TEN09R063M22.0-06 (ø63 mm, z = 1)  
 Insert : PNCU0905GNEN-MJ / T1215  
 Workpiece : FCD600 / 600-3 (160HB)  
 Cutting speed :  $V_c = 250$  m/min  
 Feed per tooth :  $f_z = 0.3$  mm/t  
 Depth of cut :  $a_p = 3$  mm  
 Width of cut :  $a_e = 50$  mm  
 Coolant : Dry

70° face mills with double sided pentagonal inserts.

## CUTTER - BORE TYPE

TEN09R/L

A.R.=-6°,R.R.=-10°~-2°



Right hand (R) shown.

Designation	APMX	DC	CICT	DCX	DCSFMS	LF	DCONMS	CBDF	KWW	b	WT(kg)	Air hole	Insert
TEN09R050M22.0-03	6.4	50	3	56	41	40	22	20	10	6	0.3	with	PN*U0905...
TEN09R050M22.0-04	6.4	50	4	56	41	40	22	20	10	6	0.3	with	PN*U0905...
TEN09R050M22.0-06	6.4	50	6	56	41	40	22	20	10	6	0.3	with	PN*U0905...
TEN09R050M22.0E04	6.4	50	4	56	41	40	22	20	10.4	6.3	0.3	with	PN*U0905...
TEN09R050M22.0E06	6.4	50	6	56	41	40	22	20	10.4	6.3	0.3	with	PN*U0905...
TEN09R063M22.0-04	6.4	63	4	69	41	40	22	20	10	6	0.5	with	PN*U0905...
TEN09R063M22.0-06	6.4	63	6	69	41	40	22	20	10	6	0.5	with	PN*U0905...
TEN09R063M22.0-08	6.4	63	8	69	41	40	22	20	10	6	0.5	with	PN*U0905...
TEN09R063M22.0E06	6.4	63	6	69	41	40	22	20	10.4	6.3	0.5	with	PN*U0905...
TEN09R063M22.0E08	6.4	63	8	69	41	40	22	20	10.4	6.3	0.5	with	PN*U0905...
TEN09R080M25.4-04	6.4	80	4	86	46	50	25.4	26	9.5	6	0.9	with	PN*U0905...
TEN09R080M25.4-07	6.4	80	7	86	46	50	25.4	26	9.5	6	0.9	with	PN*U0905...
TEN09R080M25.4-10	6.4	80	10	86	46	50	25.4	26	9.5	6	0.9	with	PN*U0905...
TEN09R100M31.7-05	6.4	100	5	106	60	50	31.75	32	12.7	8	1.3	with	PN*U0905...
TEN09R/L100M31.7-08*	6.4	100	8	106	60	50	31.75	32	12.7	8	1.3	with	PN*U0905...
TEN09R100M31.7-12	6.4	100	12	106	60	50	31.75	32	12.7	8	1.4	with	PN*U0905...
TEN09R125M38.1-06	6.4	125	6	131	80	63	38.1	38	15.9	10	2.6	with	PN*U0905...
TEN09R/L125M38.1-10*	6.4	125	10	131	80	63	38.1	38	15.9	10	2.7	with	PN*U0905...
TEN09R125M38.1-16	6.4	125	16	131	80	63	38.1	43	15.9	10	2.9	with	PN*U0905...
TEN09R160M50.8-07	6.4	160	7	166	100	63	50.8	46	19	11	4.4	without	PN*U0905...
TEN09R/L160M50.8-12*	6.4	160	12	166	100	63	50.8	46	19	11	4.6	without	PN*U0905...
TEN09R160M50.8-20	6.4	160	20	166	100	63	50.8	46	19	11	4.9	without	PN*U0905...

\* For TEN09L (left-hand cutter), use the neutral-hand inserts.

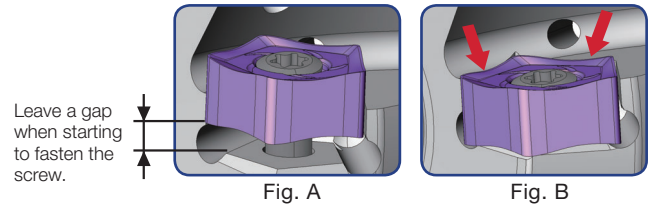
### SPARE PARTS

Designation	Clamping screw	Grip	Lubricant	Shell locking bolt	Shell locking bolt 1	Torx bit
TEN09R050 - 063...	CSTR-4L100	H-TBS	M-1000	-	CM10X30H	BT15S
TEN09R080...	CSTR-4L100	H-TBS	M-1000	-	CM12X30H	BT15S
TEN09R/L100...	CSTR-4L100	H-TBS	M-1000	TMBA-M16H	-	BT15S
TEN09R125...06	CSTR-4L100	H-TBS	M-1000	TMBA-M20H	-	BT15M
TEN09R/L125M...10	CSTR-4L100	H-TBS	M-1000	TMBA-M20H	-	BT15M
TEN09R125M...16	CSTR-4L100	H-TBS	M-1000	TMBA-M20H	-	BT15S
TEN09R160M...07	CSTR-4L100	H-TBS	M-1000	-	-	BT15M
TEN09R160M...12	CSTR-4L100	H-TBS	M-1000	-	-	BT15M
TEN09R160M...20	CSTR-4L100	H-TBS	M-1000	-	-	BT15S



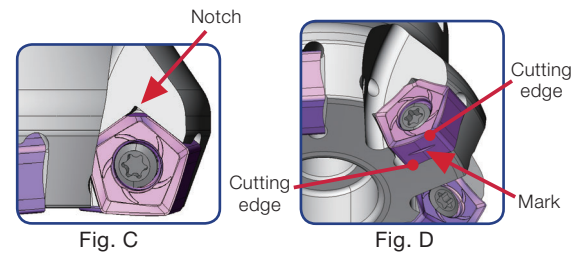
## Installation of inserts on an extra close-pitch cutter

- On an extra close-pitch cutter, the screw hole of an insert pocket is placed at an angle.
- Leave a gap between the insert and pocket when starting to fasten the screw on the cutter body as shown in Fig. A.
- After fastening the screw, please ensure that there is no gap between the cutter body and insert. (Fig. B)



## Notes for using wiper inserts

- When fine surface finish is required, wiper insert PNCU0905GNER-W is recommended.
- Attach the insert with its notch on the top, as shown in Fig. C.
- Also, make sure that the mark of the insert is located at the bottom of the cutter body, as shown in Fig. D.
- The wiper insert has two corners available (Fig. D). Do not use the other corners as the cutter body may be broken.

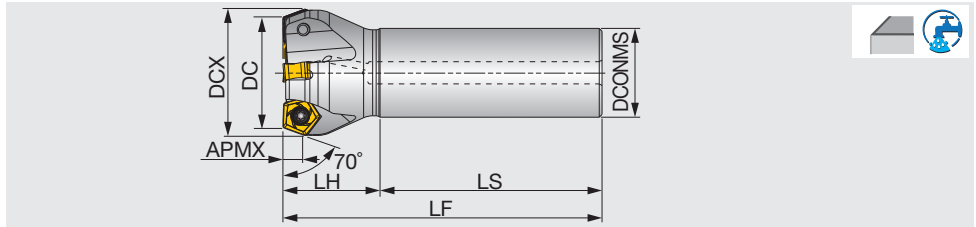


70° endmills with double sided pentagonal inserts.

## CUTTER - SHANK TYPE

EEN09

A.R.=-6°,R.R.=-2°~10°

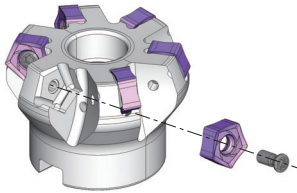


Designation	APMX	DC	CICT	DCX	DCONMS	LS	LH	LF	WT(kg)	Air hole	Insert
EEN09R032M32.0-03	6.4	32	3	38	32	80	35	115	0.7	with	PN*U0905...
EEN09R040M32.0-04	6.4	40	4	46	32	80	35	115	0.7	with	PN*U0905...
EEN09R050M32.0-04	6.4	50	4	56	32	80	40	120	0.9	with	PN*U0905...
EEN09R063M32.0-06	6.4	63	6	69	32	80	40	120	1	with	PN*U0905...
EEN09R080M32.0-07	6.4	80	7	86	32	80	40	120	1.3	with	PN*U0905...

### SPARE PARTS

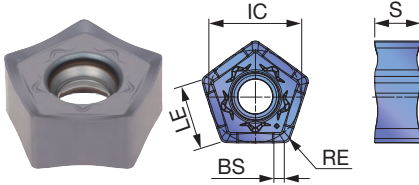


Designation	Clamping screw	Lubricant	Wrench
EEN09	CSTR-4L100	M-1000	T-15D

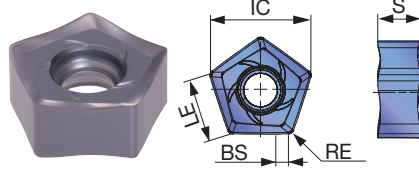


## INSERTS

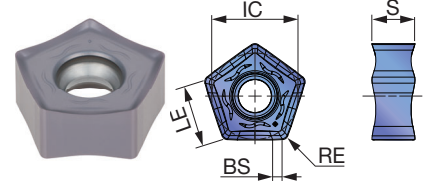
PN\*U0905GNEN-MJ (Neutral-hand)



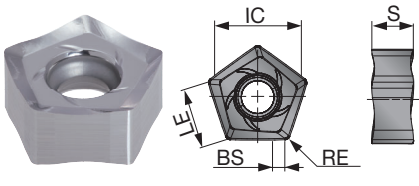
PNCU0905GNER-MJ (Right-hand)



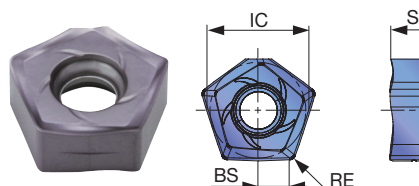
PNCU0905-ML (Neutral-hand)



PNCU0905-AJ (Right-hand)



PNCU0905-W (Right-hand)



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

★ : First choice  
☆ : Second choice

Designation	RE	APMX	Coated							Cermet	Un-coated	LE	S	IC	BS		
			AH120	AH140	AH725	AH3135	T1115	T1215	T3130							T3225	NS740
PNMU0905GNEN-MJ	0.8	6.4	●											8.9	6	12.2	1.4
PNCU0905GNEN-MJ	0.8	6.4	●											8.9	6	12.2	1.4
PNCU0905GNER-MJ	0.8	6.4	●	●	●		●		●					8.9	5.93	12.2	1.4
PNCU0905GNEN-ML	0.8	6.4				●								8.9	5.96	12.2	1.4
PNCU0905GNFR-AJ	0.8	6.4									●			8.9	6.25	12.2	1.4
PNCU0905GNER-W	0.8	2			●									-	5.93	12.2	3.8

● : New product  
● : Line up

## STANDARD CUTTING CONDITIONS




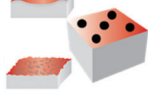
ISO	Workpiece materials	Hardness HB	Selection criteria	Recommended grade	Chip-breaker	Cutting speed Vc (m/min)	Feed per tooth fz (mm/t)
<b>P</b>	Low carbon steels (S15C, etc.)	200 - 300 HB	First choice	AH3135	MJ	100 - 250	0.1 - 0.4
		200 - 300 HB	Low cutting force	AH3135	ML	100 - 250	0.1 - 0.3
		200 - 300 HB	Priority on wear resistance	T3225	MJ	200 - 350	0.1 - 0.3
		200 - 300 HB	Priority on surface quality	NS740	MJ	100 - 250	0.1 - 0.3
	High carbon steels, alloyed steels (S55C, SCM440, etc.)	150 - 300 HB	First choice	AH3135	MJ	100 - 250	0.1 - 0.35
		150 - 300 HB	Low cutting force	AH3135	ML	100 - 250	0.1 - 0.3
		150 - 300 HB	Priority on wear resistance	T3225	MJ	180 - 300	0.1 - 0.3
		150 - 300 HB	Priority on surface quality	NS740	MJ	100 - 250	0.1 - 0.3
	Prehardened steel (NAK80, PX5, etc.)	30 - 40 HRC	First choice	AH3135	MJ	100 - 200	0.1 - 0.3
		30 - 40 HRC	Low cutting force	AH3135	ML	100 - 200	0.1 - 0.25
30 - 40 HRC		Priority on wear resistance	T3225	MJ	150 - 250	0.1 - 0.25	
<b>M</b>	Stainless steel (SUS304 / X5CrNi18-9, etc.)	- 200 HB	First choice	AH3135	ML	100 - 200	0.1 - 0.3
		- 200 HB	Priority on fracture resistance	AH3135	MJ	100 - 200	0.1 - 0.35
		- 200 HB	Priority on wear resistance	T3225	MJ	100 - 250	0.1 - 0.3
<b>K</b>	Ductile cast iron (FCD400 / GGG40, etc.)	150 - 250 HB	First choice	T1215	MJ	100 - 300	0.1 - 0.35
		150 - 250 HB	Priority on fracture resistance	AH120	MJ	100 - 250	0.1 - 0.4
	Ductile cast iron (FCD400 / GGG40, etc.)	150 - 250 HB	First choice	T1215	MJ	100 - 300	0.1 - 0.35
		150 - 250 HB	Priority on fracture resistance	AH120	MJ	80 - 200	0.1 - 0.4
<b>N</b>	Aluminium alloys (Si < 13%)	-	First choice	TH10	AJ	500 - 1500	0.1 - 0.5
	Aluminium alloys (Si ≥ 13%)	-	First choice	TH10	AJ	150 - 500	0.1 - 0.5
<b>S</b>	Titanium alloys Ti-6Al-4V, etc.	- 40 HRC	First choice	AH3135	ML	30 - 60	0.1 - 0.3
		- 40 HRC	Priority on fracture resistance	AH3135	MJ	30 - 60	0.1 - 0.3
	Heat-resistance alloys Inconel 718, etc.	- 40 HRC	First choice	AH725	MJ	10 - 40	0.04 - 0.1

- Remove excessive chip with an air blast to prevent chip jamming.
- Use water-soluble coolant to avoid built-up edge in case extreme welding occurs on cutting edges. (ex. aluminium machining).
- For the operation with depth of cut which varies (ex. casting skin) and machining of workpiece materials with interrupted surface, the feed (fz) should be set to the lower recommended value shown in the above table.


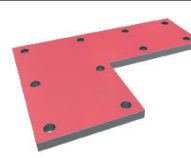
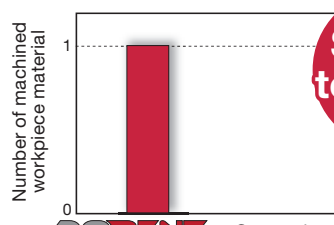
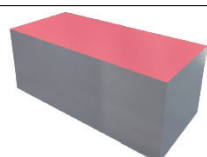

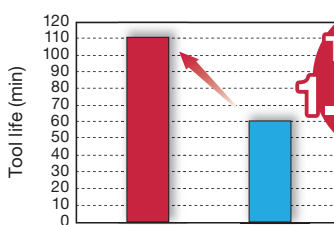
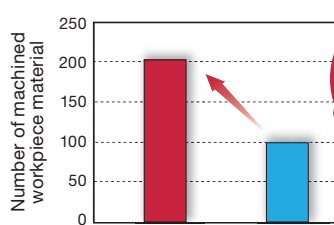
- Cutting conditions may be limited depending on machine power, workpiece rigidity, and spindle output. When the cutting width, depth or overhang length is large, set Vc and fz to the lower recommended values and check the machine power and vibration.


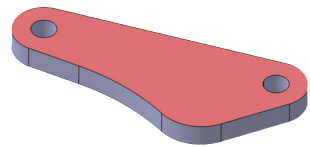
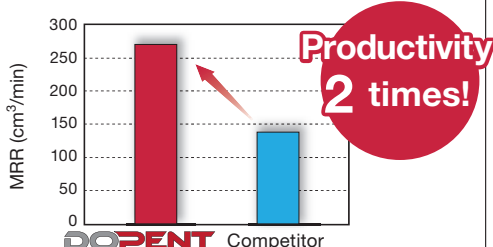
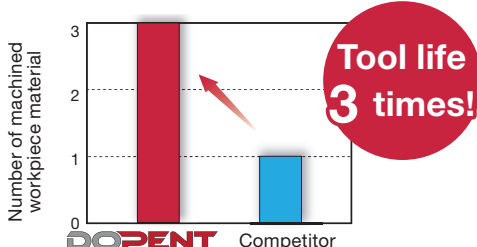
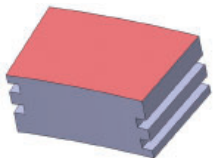
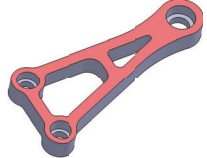
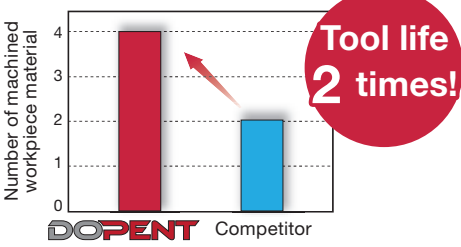
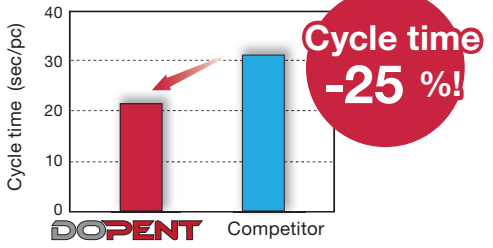
## Selection guide for face milling cutters

For workpiece configuration and spindle power

Spindle power			light interrupted cuts	Edging of thin sections	Thin plates / hollow structure	Heavy interrupted cuts / scale or unstable surface
BT40 (≥15kW)	BT50 (≥22kW)	BT50/ BT60 (≥30kW)				
<b>DOPENT</b>			◎	○	◎	○
←→			◎	◎	○	◎
<b>DO<sup>TRIPLE</sup>MILL</b>			◎	◎	○	◎
←→			◎	△	△	◎
<b>DOOCTO DOQUAD</b>			◎	△	△	◎
←→						

## PRACTICAL EXAMPLES

Workpiece type		Pump housing	Machine part
Cutter		TEN09R125M38.1-06 (ø125 mm, z = 6)	EEN09R050M32.0-04 (ø50 mm, z = 4)
Insert		PNCU0905GNEN-ML	PNMU0905GNEN-MJ
Grade		AH3135 SKD11	AH3135 SS400 / E275A
Workpiece material		 <b>P</b>	 <b>P</b>
Cutting conditions	Cutting speed: $V_c$ (m/min)	120	160
	Feed per tooth: $f_z$ (mm/t)	0.25	0.2
	Feed speed: $V_f$ (m/min)	458	815
	Depth of cut: $a_p$ (mm)	3	1
	Width of cut: $a_e$ (mm)	60	40
	Machining	Face milling	Face milling
	Coolant	Dry	Dry
Machine		Horizontal M/C	Vertical M/C
Results		 <p><b>Stable tool life!</b></p> <p>A weak workpiece fixture was causing a tool vibration. DoPent provided stable machining due to its light cutting design.</p>	<p>The competitor's tool was vibrating due to the thin workpiece. DoPent has successfully machined with no tool fractures.</p>
Workpiece type		Rolling die material	EGR valve
Cutter		TEN09R160M50.8-12 (ø160 mm, z = 12)	TEN09R125M38.1-06 (ø125 mm, z = 6)
Insert		PNMU0905GNEN-MJ	PNCU0905GNEN-MJ
Grade		T3225 <b>New</b> Tool steel	AH120 FC250 / 250
Workpiece material		 <b>P</b>	 <b>K</b>
Cutting conditions	Cutting speed: $V_c$ (m/min)	300	390
	Feed per tooth: $f_z$ (mm/t)	0.1	0.15
	Feed speed: $V_f$ (m/min)	716	900
	Depth of cut: $a_p$ (mm)	0.8	0.9
	Width of cut: $a_e$ (mm)	50	75
	Machining	Face milling	Face milling
	Coolant	Dry	External coolant
Machine		Horizontal M/C	Vertical M/C, 6kW
Results		 <p><b>Tool life 1.8 times!</b></p> <p>The new T3225 grade offered superior wear resistance and improved the tool life 1.8x over the competitor's.</p>	 <p><b>Tool life 2 times!</b></p> <p>DoPent has exhibited a smooth cutting action even on the low-power machine.</p>

Workpiece type		Steering knuckle	Airplane parts
Cutter		TEN09R050M22.0-06 (ø50 mm, z = 6)	TEN09R080M25.4-07 (ø80 mm, z = 7)
Insert		PNCU0905GNEN-MJ	PNCU0905GNEN-ML
Grade		AH120	AH3135
Workpiece material		Ductile cast iron  <b>K</b>	SUS630 / X5CrNiCuNb16-4  <b>M</b>
Cutting conditions	Cutting speed: $V_c$ (m/min)	350	85
	Feed per tooth: $f_z$ (mm/t)	0.17	0.11
	Feed speed: $V_f$ (m/min)	2270	260
	Depth of cut: $a_p$ (mm)	3	1.9
	Width of cut: $a_e$ (mm)	40	60
	Machining	Face milling	Face milling
	Coolant	Internal coolant	Dry
Machine		Horizontal M/C	Vertical M/C, BT50
Results		 <p>DoPent's low cutting force has allowed to double the feedrate over the competitor's.</p>	 <p>Too life is increased by 30% due to the combination of ML chipbreaker with sharp cutting edges and tough AH3135 grade.</p>
Workpiece type		Shroud	Motorcycle parts
Cutter		TEN09R063M22.0-06 (ø63 mm, z = 6)	TEN09R125M38.1-10 (ø125 mm, z = 10)
Insert		PNCU0905GNFR-MJ	PNCU0905GNFR-AJ
Grade		AH725 HR120	TH10 A7075S / AlZn5.5MgCu (200HB)
Workpiece material		 <b>S</b>	 <b>N</b>
Cutting conditions	Cutting speed: $V_c$ (m/min)	54	1000
	Feed per tooth: $f_z$ (mm/t)	0.03	Roughing: 0.3, Finishing: 0.1
	Feed speed: $V_f$ (m/min)	50	Roughing: 7640, Finishing: 2550
	Depth of cut: $a_p$ (mm)	2	Roughing: 2, Finishing: 0.5
	Width of cut: $a_e$ (mm)	50	20 - 80
	Machining	Face milling	Face milling
	Coolant	Internal coolant	Wet
Machine		Vertical M/C	Vertical M/C, BT40
Results		 <p>DoPent has doubled the tool life over the competitor thanks to its balanced sharp and tough cutting edges.</p>	 <p>Higher feed increases productivity in roughing by 190% and significantly reduces total cycle time.</p>

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