

MillLine

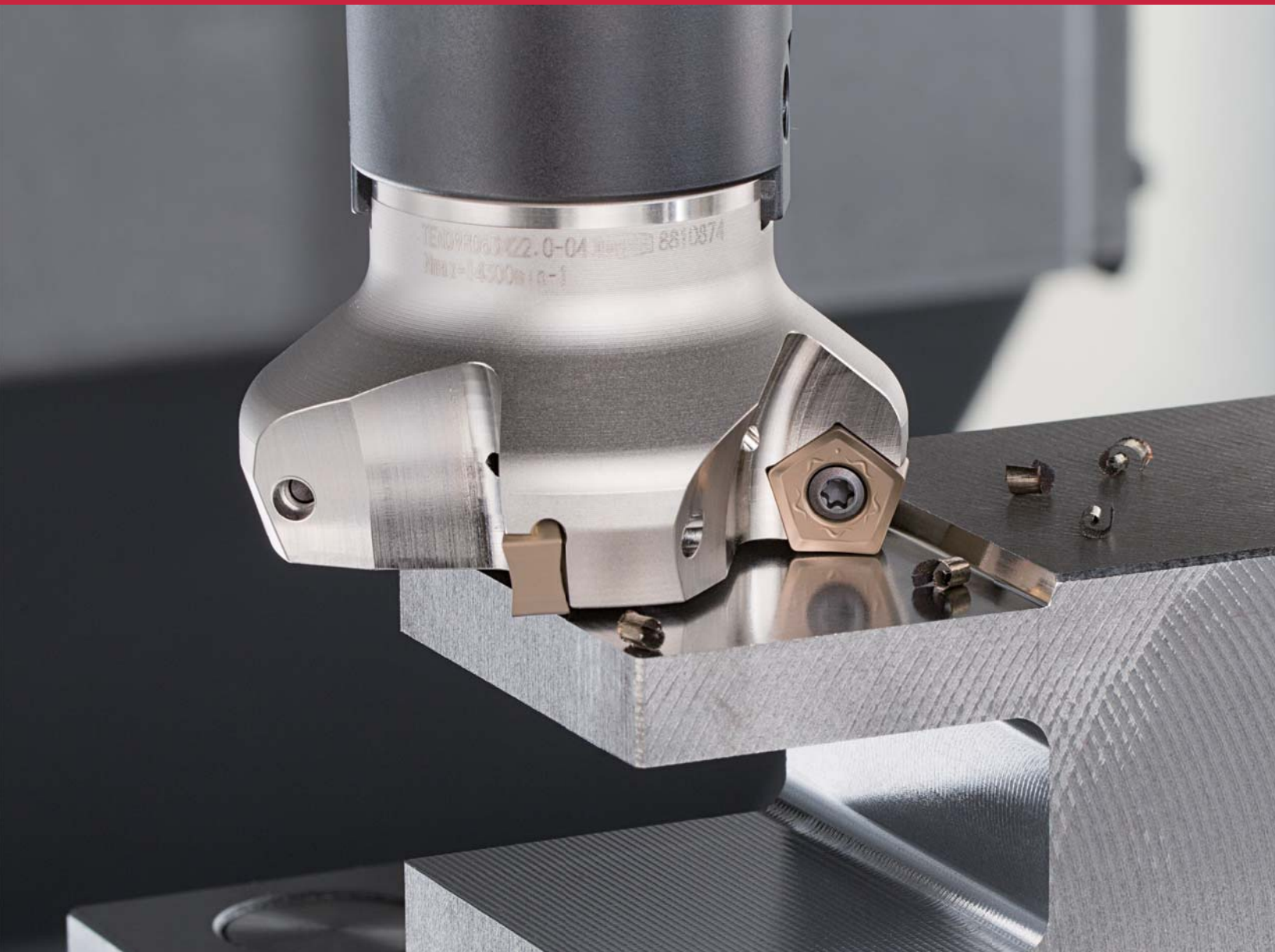
DOPENT

www.tungaloyamerica.com

Tungaloy Report No. 372-US

DOPENT

Face mill with **low cutting force and low cost per edge**





ACCELERATED MACHINING

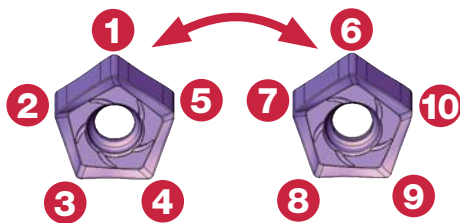


High precision, pentagonal inserts for
superb surface finish

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

Economical pentagonal insert

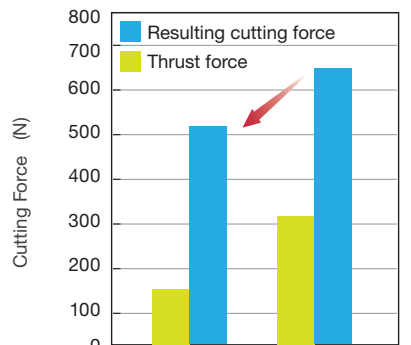
Double-sided insert with 10 cutting edges



Neutral inserts can be mounted on a left hand cutter.

Low cutting force

Free cutting geometry due to the 70° approach angle and large rake angle



DOPENT Competitor
(Negative inserts, 45° approach angle)



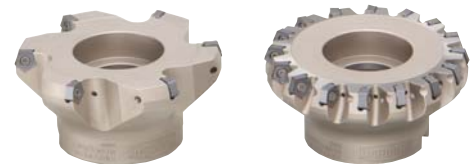
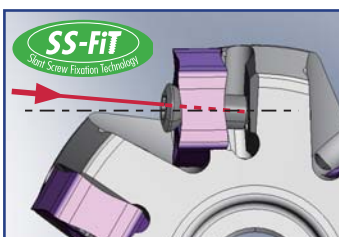
Cutter : TEN09R400U0150A05 ($\phi D_c = 4.000"$, $z = 1$)
 Insert : PNMU0905GNEN-MJ / AH3135
 Workpiece : 1055 (200HB)
 Cutting speed : $V_c = 660$ sfm
 Feed per tooth : $f_z = 0.008$ ipt
 Depth of cut : $a_p = 0.079"$
 Width of cut : $a_e = 2.4"$
 Coolant : Dry

Resulting 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.



Coarse pitch

Extra close-pitch

■ Large number of inserts on a cutter

Dimensions ϕD_c (in)	No. of inserts			
	Close pitch		Extra close-pitch	
	DOPENT	Competitor	DOPENT	Competitor
2.500"	6	5	8	7
3.000"	7	6	10	9
4.000"	8	7	12	11
5.000"	10	9	16	13
6.000"	12	11	20	15

Superior surface finish quality

Improved surface finish quality due to the excellent chip control ability



DOPENT



Competitor
(Negative inserts,
65° approach angle)

M

Cutter : TEN09R250U0075A06 ($\phi D_c = 2.5"$, $z = 6$)
 Insert : PNCU0905GNEN-MJ / AH3135 **New**
 Workpiece : S30400 (175HB)
 Cutting speed : $V_c = 660$ sfm
 Feed per tooth : $f_z = 0.008$ ipt
 Depth of cut : $a_p = 0.020"$
 Width of cut : $a_e = 2.00"$
 Coolant : Dry

Improved surface finish using cermet grade

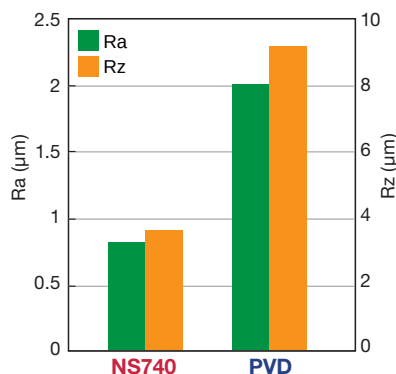
NS740 performs well in finishing application due to strong welding resistance.



NS740



PVD



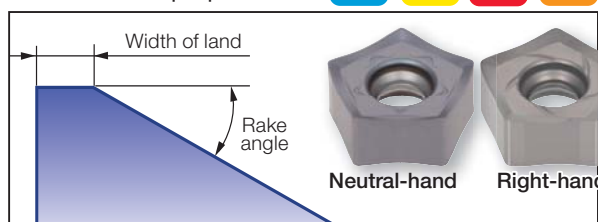
P

Cutter : TEN09R400U0150A05 ($z = 5$)
 Insert : PNCU0905GNER-MJ / NS740
 Workpiece : Low carbon steel (126HB)
 Cutting speed : $V_c = 820$ sfm
 Feed per tooth : $f_z = 0.006$ ipt
 Depth of cut : $a_p = 0.012"$
 Width of cut : $a_e = 3.000"$
 Coolant : Dry

Vast line-up of inserts for various machining

MJ General purpose

P M K S

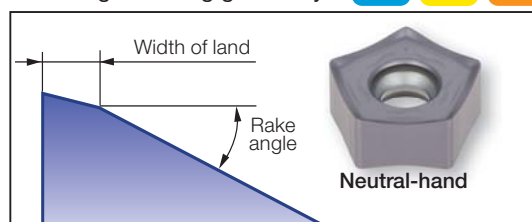


10 cutting edges

Excellent balance between sharpness and toughness of cutting edges

ML Light cutting geometry

P M S

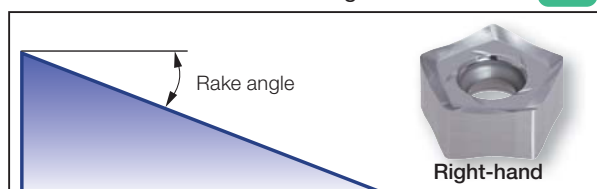


10 cutting edges

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 wiper

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 cast iron

AH725



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

New

T1215

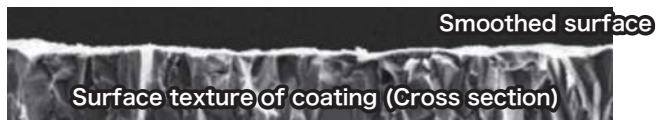


- CVD grade with outstanding wear and chipping resistance
- Best for cast iron at high-speed machining

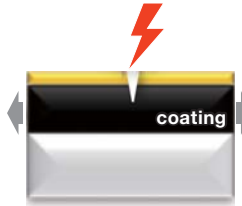
Special Surface Technology

PREMIUMTEC

TUNGALOY



Indentation test on coating

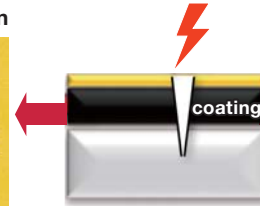


PremiumTec controls tensile residual stress and improves crack resistance.

Conventional item



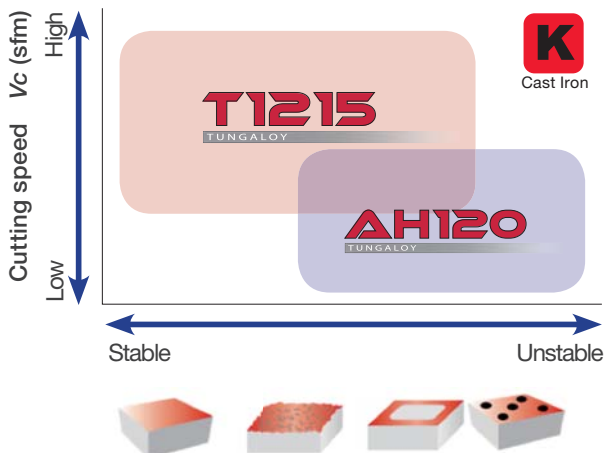
Indentation test on coating



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

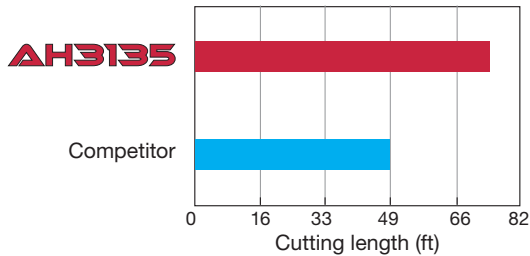
PremiumTec enhances both smoothness and toughness on coating surface, improving resistance to chipping, built-up edge, and fracture.

Application area



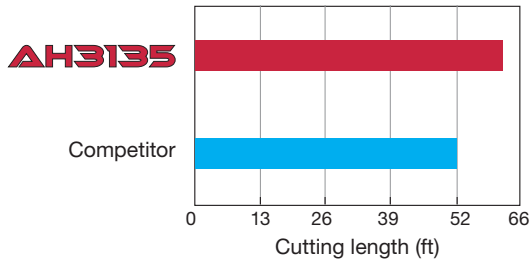
Stable tool life

- Tool life comparison in machining steel ($\phi D_c = 3.937"$)



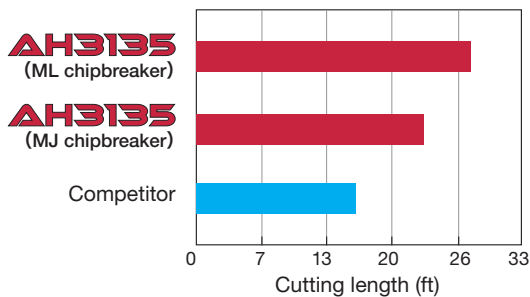
Cutter : TEN09R400U0150A05 ($\phi D_c = 4.0"$, $z = 1$)
 Insert : PNMU0905GNEN-MJ / AH3135
 Workpiece : 1055 (200HB)
 Cutting speed : $V_c = 656$ sfm
 Feed per tooth : $f_z = 0.012$ ipt
 Depth of cut : $a_p = 0.079"$
 Width of cut : $a_e = 2.756"$
 Coolant : Dry

- Tool life comparison in machining steel ($\phi D_c = 2.480"$)



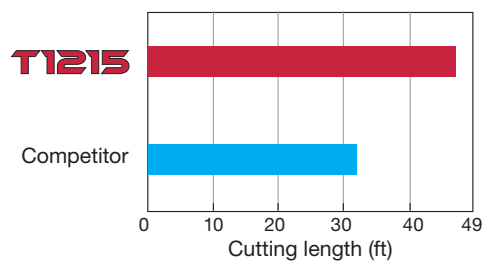
Cutter : TEN09R250U0075A06 ($\phi D_c = 2.5"$, $z = 1$)
 Insert : PNCU0905GNEN-MJ / AH3135 **New**
 Workpiece : 1055 (210HB)
 Cutting speed : $V_c = 656$ sfm
 Feed per tooth : $f_z = 0.012$ ipt
 Depth of cut : $a_p = 0.079"$
 Width of cut : $a_e = 1.969"$
 Coolant : Dry

- Tool life comparison in machining stainless ($\phi D_c = 2.480"$)



Cutter : TEN09R250U0075A06 ($\phi D_c = 2.5"$, $z = 1$)
 Insert : PNCU0905GNEN-MJ / AH3135 **New**
 : PNCU0905GNEN-ML / AH3135
 Workpiece : S30400 (175HB)
 Cutting speed : $V_c = 492$ sfm
 Feed per tooth : $f_z = 0.008$ ipt
 Depth of cut : $a_p = 0.079"$
 Width of cut : $a_e = 1.696"$
 Coolant : Dry

- Tool life comparison in machining cast iron ($\phi D_c = 2.480"$)



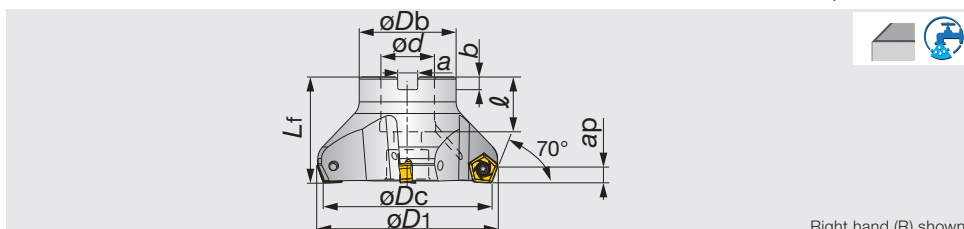
Cutter : TEN09R250U0075A06 ($\phi D_c = 2.5"$, $z = 1$)
 Insert : PNCU0905GNEN-MJ / T1215 **New**
 Workpiece : 80-55-06 (160HB)
 Cutting speed : $V_c = 820$ sfm
 Feed per tooth : $f_z = 0.012$ ipt
 Depth of cut : $a_p = 0.118"$
 Width of cut : $a_e = 1.696"$
 Coolant : Dry

70° face mills with double sided pentagonal inserts.

CUTTER - BORE TYPE

TEN09R

A.R.=-6°,R.R.=-10°~-2°



Right hand (R) shown.

Inch	Max. ap	ϕD_c	z	ϕD_1	ϕD_b	L_f	ϕd	ℓ	a	b	lb	Air hole	Insert
TEN09R200U0075A03	0.252	2.000	3	2.240	1.690	1.570	0.750	0.750	0.310	0.200	0.300	with	PN*U0905...
TEN09R200U0075A04	0.252	2.000	4	2.240	1.690	1.570	0.750	0.750	0.310	0.200	0.300	with	PN*U0905...
TEN09R200U0075A06	0.252	2.000	6	2.240	1.690	1.570	0.750	0.750	0.310	0.200	0.300	with	PN*U0905...
TEN09R250U0075A04	0.252	2.500	4	2.740	1.690	1.570	0.750	0.750	0.310	0.200	0.500	with	PN*U0905...
TEN09R250U0075A06	0.252	2.500	6	2.740	1.690	1.570	0.750	0.750	0.310	0.200	0.500	with	PN*U0905...
TEN09R250U0075A08	0.252	2.500	8	2.740	1.690	1.570	0.750	0.750	0.310	0.200	0.500	with	PN*U0905...
TEN09R300U0100A04	0.252	3.000	4	3.240	1.970	1.970	1.000	1.020	0.370	0.240	0.900	with	PN*U0905...
TEN09R300U0100A07	0.252	3.000	7	3.240	1.970	1.970	1.000	1.020	0.370	0.240	0.900	with	PN*U0905...
TEN09R300U0100A10	0.252	3.000	10	3.240	1.970	1.970	1.000	1.020	0.370	0.240	0.900	with	PN*U0905...
TEN09R400U0150A05	0.252	4.000	5	4.240	3.150	1.970	1.500	1.380	0.630	0.390	1.300	with	PN*U0905...
TEN09R400U0150A08	0.252	4.000	8	4.240	3.150	1.970	1.500	1.380	0.630	0.390	1.300	with	PN*U0905...
TEN09R400U0150A12	0.252	4.000	12	4.240	3.150	1.970	1.500	1.380	0.630	0.390	1.400	with	PN*U0905...
TEN09R500U0150A06	0.252	5.000	6	5.240	3.150	2.480	1.500	1.460	0.630	0.390	2.600	with	PN*U0905...
TEN09R500U0150A10	0.252	5.000	10	5.240	3.150	2.480	1.500	1.460	0.630	0.390	2.700	with	PN*U0905...
TEN09R500U0150A16	0.252	5.000	16	5.240	3.150	2.480	1.500	1.460	0.630	0.390	2.900	with	PN*U0905...
TEN09R600U0200A07	0.252	6.000	7	6.240	3.940	2.480	2.000	1.500	0.750	0.430	4.400	without	PN*U0905...
TEN09R600U0200A12	0.252	6.000	12	6.240	3.940	2.480	2.000	1.500	0.750	0.430	4.600	without	PN*U0905...
TEN09R600U0200A20	0.252	6.000	20	6.240	3.940	2.480	2.000	1.500	0.750	0.430	4.900	without	PN*U0905...

SPARE PARTS

Designation	Clamping screw	Grip	Lubricant	Center bolt (Optional parts)	Center bolt 1 (Optional parts)	Torx bit
TEN09R200, 250...	CSTR-4L100	H-TBS	M-1000	-	(C0.375X1.125H)	BT15S
TEN09R300...	CSTR-4L100	H-TBS	M-1000	-	(C0.500X1.375H)	BT15S
TEN09R400, 500...	CSTR-4L100	H-TBS	M-1000	(TMBA-0.750H)	-	BT15S
TEN09R600...	CSTR-4L100	H-TBS	M-1000	-	-	BT15M

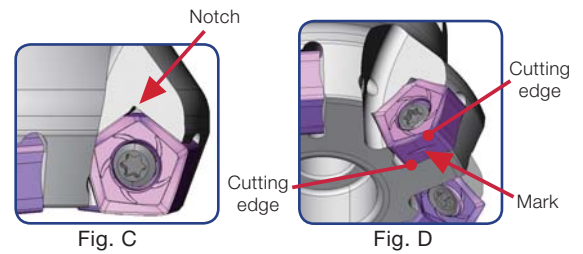
Installation of inserts on an extra close-pitch cutter

- On an extra close-pitch cutter, the screw hole of the 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 on 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 other corners. It may break the tool body.

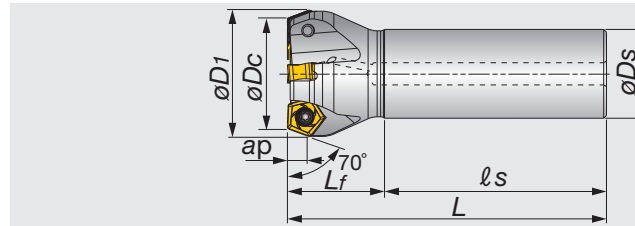


70° endmills with double sided pentagonal inserts.

CUTTER - SHANK TYPE

EEN09

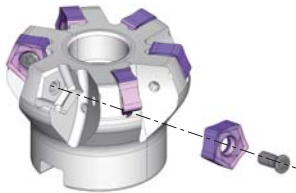
A.R.=-6°,R.R.=-2°~-10°



Inch	Max. ap	ϕD_c	z	ϕD_1	ϕD_s	ℓ_s	L_f	L	lb	Air hole	Insert
EEN09R125U0125W03	0.252	1.250	3	1.250	1.250	2.280	1.500	3.780	0.700	with	PN*U0905...
EEN09R150U0125W04	0.252	1.500	4	1.500	1.250	2.280	2.000	4.280	0.700	with	PN*U0905...

SPARE PARTS

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



STANDARD CUTTING CONDITIONS

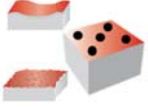
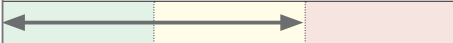
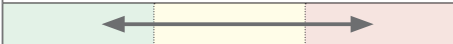
ISO	Workpiece materials	Hardness HB	Selection criteria	Recommended grade	Chip-breaker	Cutting speed Vc (sfm)	Feed per tooth fz (ipt)
P	Low carbon steels (1015 etc.)	200 - 300 HB	First choice	AH3135	MJ	328 - 820	0.004 - 0.016
		200 - 300 HB	Low cutting force	AH3135	ML	328 - 820	0.004 - 0.012
		200 - 300 HB	Priority on wear resistance	T3130	MJ	328 - 820	0.004 - 0.012
		200 - 300 HB	Priority on surface quality	NS740	MJ	328 - 820	0.004 - 0.012
	High carbon steels, alloyed steels (1045, 4140 etc.)	150 - 300 HB	First choice	AH3135	MJ	328 - 820	0.004 - 0.014
		150 - 300 HB	Low cutting force	AH3135	ML	328 - 820	0.004 - 0.012
		150 - 300 HB	Priority on wear resistance	T3130	MJ	328 - 820	0.004 - 0.012
		150 - 300 HB	Priority on surface quality	NS740	MJ	328 - 820	0.004 - 0.012
	Prehardened steel (NAK80, PX5, etc.)	30 - 40 HRC	First choice	AH3135	MJ	328 - 656	0.004 - 0.012
		30 - 40 HRC	Low cutting force	AH3135	ML	328 - 656	0.004 - 0.010
		30 - 40 HRC	Priority on wear resistance	T3130	MJ	328 - 656	0.004 - 0.010
M	Stainless steel (S30400, etc.)	- 200 HB	First choice	AH3135	ML	328 - 656	0.004 - 0.012
		- 200 HB	Priority on fracture resistance	AH3135	MJ	328 - 656	0.004 - 0.012
K	Ductile cast iron No.250B, No.300B, etc.)	150 - 250 HB	First choice	T1215	MJ	328 - 984	0.004 - 0.014
		150 - 250 HB	Priority on fracture resistance	AH120	MJ	328 - 820	0.004 - 0.016
	Ductile cast iron (60-40-18, etc.)	150 - 250 HB	First choice	T1215	MJ	328 - 984	0.004 - 0.014
		150 - 250 HB	Priority on fracture resistance	AH120	MJ	262 - 656	0.004 - 0.016
N	Aluminum alloys (Si < 13%)	-	First choice	TH10	AJ	1640 - 4921	0.004 - 0.020
	Aluminum alloys (Si ≥ 13%)	-	First choice	TH10	AJ	492 - 1640	0.004 - 0.020
S	Titanium alloys Ti-6Al-4V, etc.	- 40 HRC	First choice	AH3135	ML	98 - 197	0.004 - 0.012
		- 40 HRC	Priority on fracture resistance	AH3135	MJ	98 - 197	0.004 - 0.012
	Heat-resistant alloys Inconel 718, etc.	- 40 HRC	First choice	AH725	MJ	33 - 131	0.002 - 0.004

- 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. aluminum machining).
- For the operations where depth of cut 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

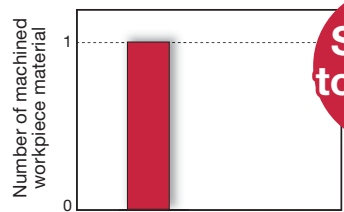
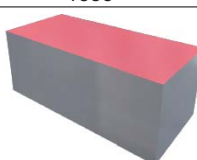
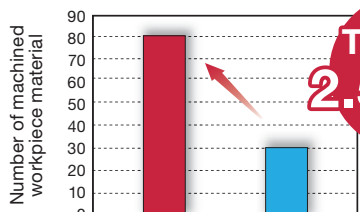
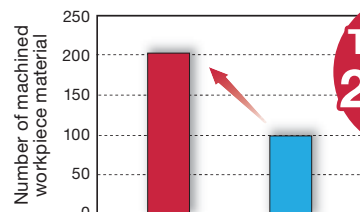
Spindle power			light interrupted cuts	Edging of thin sections	Thin plates / hollow structure	Heavy interrupted cuts / scale or unstable surface
CAT40 (≥15kW)	CAT50 (≥22kW)	CAT50/ CAT60 (≥30kW)				
DOPENT 						
DO TRIPLE MILL 						
DO OCTO DO QUAD 						

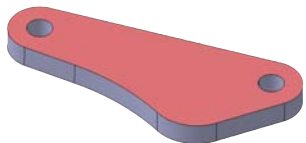
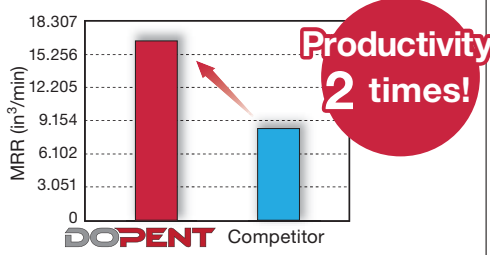
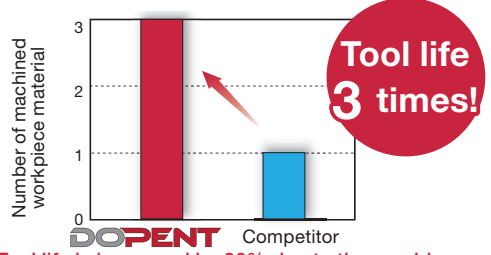
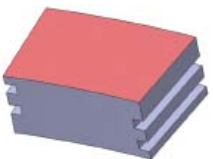
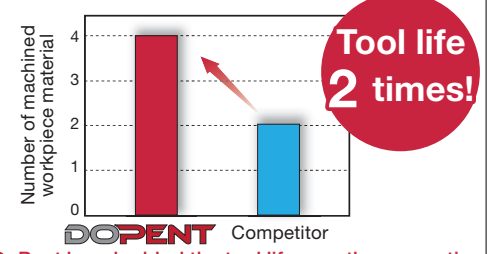
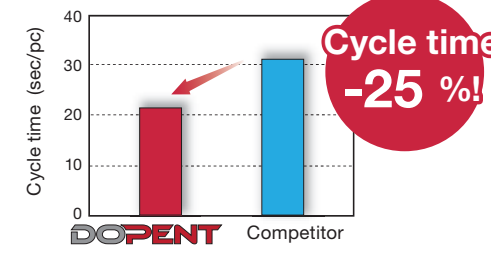
 : First choice

 : Second choice

 : Third choice

PRACTICAL EXAMPLES

Workpiece type		Pump housing	Machine part
Cutter		TEN09R500U0150A06 ($\phi 5.0"$, $z = 6$)	EEN09R150U0125W04 ($\phi 50$ mm, $z = 4$)
Insert		PNCU0905GNEN-ML	PNMU0905GNEN-MJ
Grade		AH3135	AH3135
Workpiece material		D2	Low carbon steel
		 P	 P
Cutting conditions	Cutting speed: V_c (sfm)	394	525
	Feed per tooth: f_z (ipt)	0.010	0.008
	Feed speed: V_f (ipm)	18.03	32.08
	Depth of cut: a_p (in)	0.118	0.039
	Width of cut: a_e (in)	2.362	1.181
	Machining	Face milling	Face milling
	Coolant	Dry	Dry
Machine		Horizontal M/C	Vertical M/C
Results		 Stable tool life! The competitor's tool was vibrating due to the thin workpiece. DoPent has successfully machined with no tool fractures. A weak workpiece fixture was causing a tool vibration. DoPent provided stable machining due to its light cutting design.	
Workpiece type		Block	EGR valve
Cutter		TEN09R300U0100A04 ($\phi 3.0"$, $z = 4$)	TEN09R500U0150A06 ($\phi 5.0"$, $z = 6$)
Insert		PNCU0905GNEN-MJ	PNCU0905GNEN-MJ
Grade		T3130	AH120
Workpiece material		1050	No.250B
		 P	 K
Cutting conditions	Cutting speed: V_c (sfm)	492	1280
	Feed per tooth: f_z (ipt)	0.010	0.006
	Feed speed: V_f (ipm)	25	35.433
	Depth of cut: a_p (in)	0.079	0.035
	Width of cut: a_e (in)	1.969	2.953
	Machining	Face milling	Face milling
	Coolant	Dry	External coolant
Machine		Vertical M/C, CAT40	Vertical M/C, 6kW
Results		 Tool life 2.5 times! Due to its light cutting geometry, DoPent provided machining stability on a low-rigidity machine.	 Tool life 2 times! DoPent has exhibited a smooth cutting action even on the low-power machine.

Workpiece type		Steering knuckle	Airplane parts
Cutter		TEN09R200U0075A06 ($\phi 2.0"$, $z = 6$)	TEN09R300U0100A07 ($\phi 3.0"$, $z = 7$)
Insert		PNCU0905GNEN-MJ	PNCU0905GNEN-ML
Grade		AH120	AH3135
Workpiece material		Ductile cast iron	S17400
		 K	 M
Cutting conditions	Cutting speed: V_c (sfm)	1148	279
	Feed per tooth: f_z (ipt)	0.007	0.004
	Feed speed: V_f (ipm)	89.370	10.3
	Depth of cut: a_p (in)	0.118	0.075
	Width of cut: a_e (in)	1.575	2.400
	Machining	Face milling	Face milling
	Coolant	Internal coolant	Dry
Machine		Horizontal M/C	Vertical M/C, CAT50
Results		 DoPent's low cutting force allowed double the feedrate over the competitor's.	 Tool life is increased by 30% due to the combination of ML chipbreaker with sharp cutting edges and tough AH3135 grade.
Workpiece type		Shroud	Motorcycle parts
Cutter		TEN09R250U0075A06 ($\phi 2.5"$, $z = 6$)	TEN09R500U0150A10 ($\phi 5.0"$, $z = 10$)
Insert		PNCU0905GNFR-MJ	PNCU0905GNFR-AJ
Grade		AH725	TH10
Workpiece material		HR120	Extra super duralumin (200HB)
		 S	 N
Cutting conditions	Cutting speed: V_c (sfm)	177	3300
	Feed per tooth: f_z (ipt)	0.001	Roughing: 0.012, Finishing: 0.004
	Feed speed: V_f (ipm)	1.969	Roughing: 330, Finishing: 100
	Depth of cut: a_p (in)	0.079	Roughing: 0.012, Finishing: 0.004
	Width of cut: a_e (in)	1.969	1.000 - 3.000
	Machining	Face milling	Face milling
	Coolant	Internal coolant	Wet
Machine		Vertical M/C	Vertical M/C, CAT40
Results		 DoPent has doubled the tool life over the competitor thanks to its balanced sharp and tough cutting edges.	 Higher feed increases productivity in roughing by 190% and significantly reduces total cycle time.

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