**Mill**Line

# TUNGSMILL

www.tungaloy.com/us
**Tungaloy Report No. 524-US**

Member IMC Group
**Tungaloy**

# High Speed Face Milling Cutter
## for finishing aluminum



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

TPYD06J100B31.7R22 Tungaloy 895?355
Nmax=15000min-1

ACCELERATED MACHINING

# TUNGSMILL
PEED

TUNGALOY

# tunGMILL
FORCE

ACCELERATED MACHINING

# Super high density PCD cutter

with innovative insert clamp design for quick and
easy insert setting

# TUNGSPEED MILL

TUNGALOY

# Super high density cutter
## for efficient aluminum finishing

## Significantly higher number of PCD cutting edges

### Ensures machining efficiency
22 inserts per ø4" cutter diameter.
Allows for higher cutting feeds over the competition.

**Unique axial adjusting mechanism - CamAdjust**
A single key wrench is all it takes for mounting the inserts and fine-adjusting for precision, reducing time spent on presetting work.
Setting range: 0.039" (1mm)

**Internal coolant in each pocket**
Coolant is directed to the cutting edge, facilitating smooth chip evacuation

**Steel body**
the cutter body is made of durable steel

**Exceptionally high balancing quality for high speed milling**
Balance level = G6.3 (ISO1940/1)

## Safety measures for high speed milling

### The insert is safely locked against centrifugal forces
Inserts are securely retained in place, preventing them from being dislocated by centrifugal force during high speed milling

Clamp force

Retention
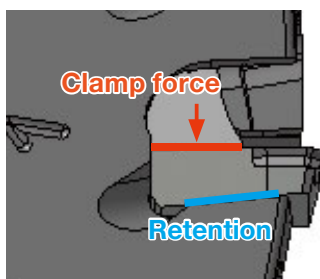
Wedge shape design prevents the insert from breaking off the seat induced by centrifugal inertia force.
Note: Do not exceed the maximum rotation (n max) inscribed on the cutter body.

| Cutter diameter (Inch) | Max num. of teeth | Max. rotation number (rpm) | Cutter weight (lb) |
|---|---|---|---|
| 2 | 8 | 20,000 | 1.92 |
| 2.5 | 10 | 19,000 | 1.34 |
| 3 | 16 | 17,000 | 2.56 |
| 4 | 22 | 15,000 | 4.30 |
| 5 | 26 | 14,000 | 8.03 |
| 6 | 34 | 12,000 | 10.76 |

# CamAdjust system - innovative insert axial adjusting mechanism

- The same key is used for mounting and adjusting the inserts
- The key wrench is operated in a single direction making insert adjustment easy on the pre-setter
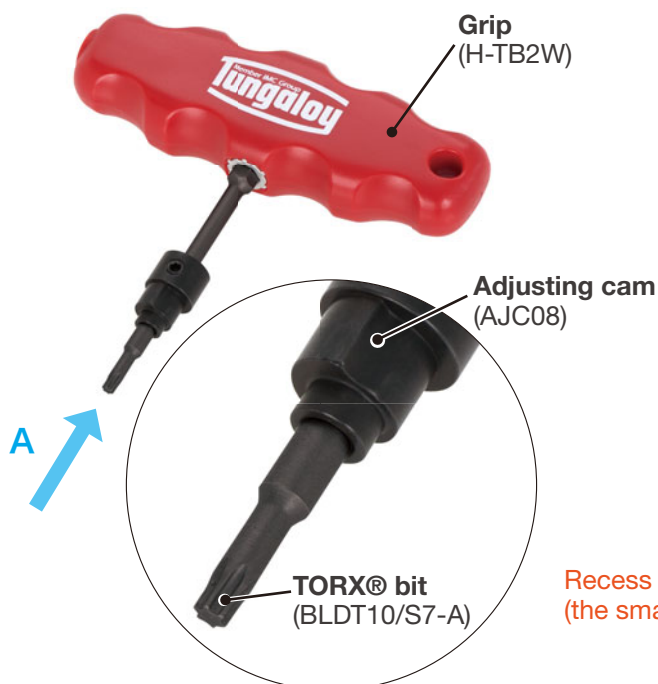- Significantly reduced insert setting time

**TORX bit**
for clamping insert



**Eccentric cam**
for adjusting axial runout
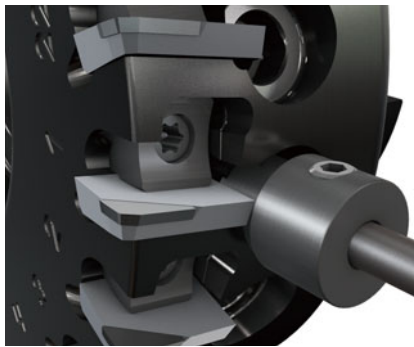


## Special key wrench with adjusting cam



**Grip**
(H-TB2W)

**Adjusting cam**
(AJC08)

A

**TORX® bit**
(BLDT10/S7-A)

Insert's axial runout is adjusted with the eccentric cam profile. Insert the key with the smallest cam diameter in contact with the insert bottom and rotate for larger cam diameter to obtain the required height.

※ **View from A**



Key rotation

Cam

Recess
(the smallest diameter)

TORX® head
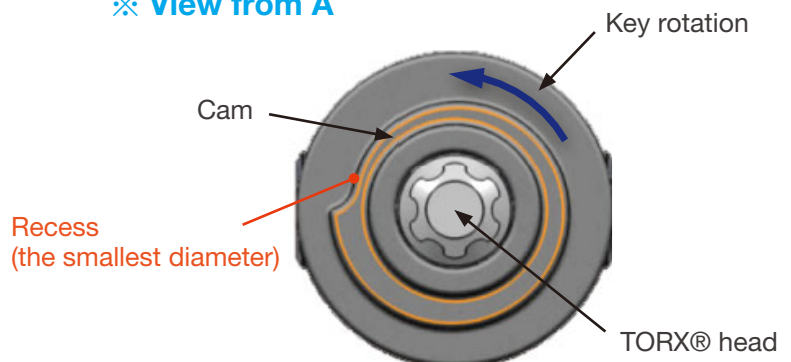
# Insert variations

## Standard insert with built-in deburrer
(YDEN0603PDFR-D, YDEN0603PDSR-D)

- Double-angled cutting edge for effective chip splitting
- Burr formation is significantly minimized by the cutting edge chip thinning effect at the exit
- Built-in wiper geometry for better surface finishing

Wiper
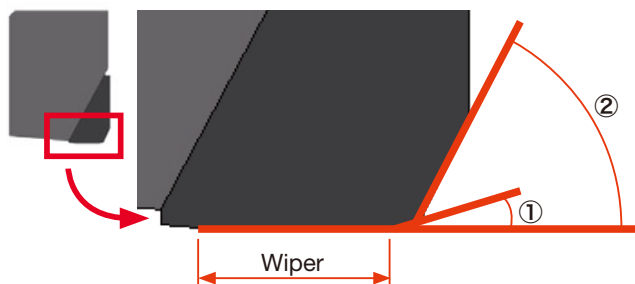
## Standard insert with edge preparation
(YDEN0603PDSR-D)

Strengthened edges for cutting gates or greater depths of cut

With edge preparation

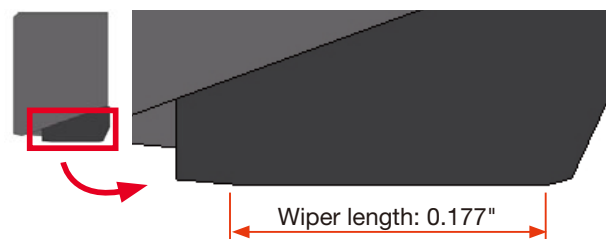## Deburring insert - Tungaloy's exclusive insert design
(YDEN0603PDFR-BD)

Use with standard inserts for enhanced burr-free machining

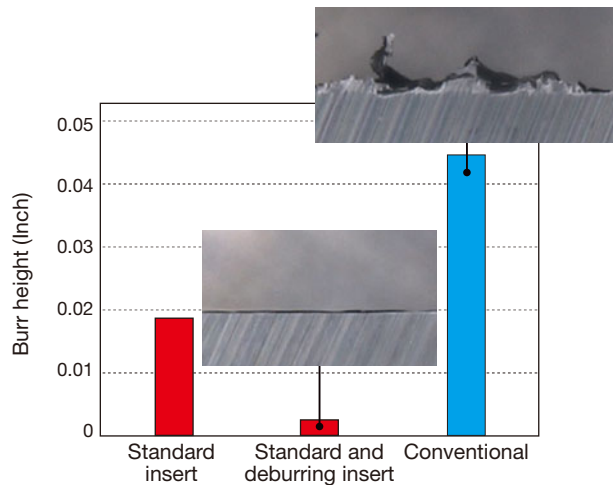## Wiper insert - for superior surface finishing
(YDEN0603PDFR-WD)

Use with standard inserts to improve the surface finishing quality. Number of wiper inserts on the cutter may depend on the feed rate

Wiper length: 0.177"

# CUTTING PERFORMANCE
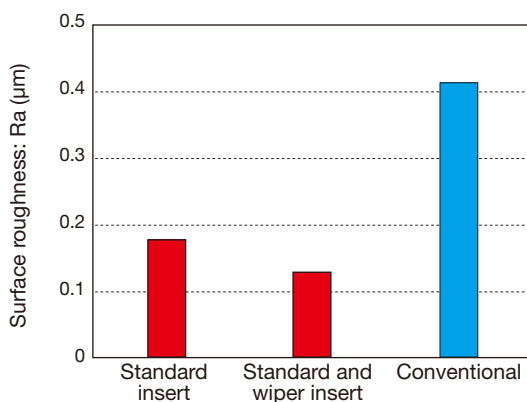
## Reduced burr formation

### 2 types of deburring inserts for burr-free milling



Burr height (Inch)

| | | |
|---|---|---|
| Standard insert | Standard and deburring insert | Conventional |

Cutter : TPYD06U3.00B1.00R16 (ø = 3", z = 16)
Insert : YDEN0603PDFR-D DX110 (Standard insert)
: YDEN0603PDFR-BD DX110 (Deburring insert)
Workpiece : 1100
Cutting speed : $V$c = 8245 sfm
Number of revolutions : $n$ = 10,000 rpm
Feed per tooth : $f$z = 0.004 ipt
Feed speed : $V$f = 640 ipm (Standard insert)
: $V$f = 320 ipm (Standard and deburring insert)
Insert runout : < 1 µm
Depth of cut : $a$p = 0.020"
Depth of width : $a$e = 1.181"
Coolant : Wet
Machining : Face milling（on center）
Machine : Vertical M/C, CAT40

## Better surface roughness

### Wiper inserts improve surface roughness



Surface roughness: Ra (µm)

| | | |
|---|---|---|
| Standard insert | Standard and wiper insert | Conventional |

Cutter : TPYD06U3.00B1.00R16 (ø = 3", z = 16)
Insert : YDEN0603PDFR-D DX110 (Standard insert)
: YDEN0603PDFR-WD DX110 (Wiper insert)
Workpiece : 1100
Cutting speed : $V$c = 8245 sfm
Number of revolutions : $n$ = 10,000 rpm
Feed per tooth : $f$z = 0.004 ipt
Feed speed : $V$f = 640 ipm
Insert runout : < 1 µm (<0.00004")
Depth of cut : $a$p = 0.020"
Depth of width : $a$e = 1.181"
Coolant : Wet
Machining : Face milling（on center）
Machine : Vertical M/C, CAT40

Standard and wiper insert    Conventional

length (µm)
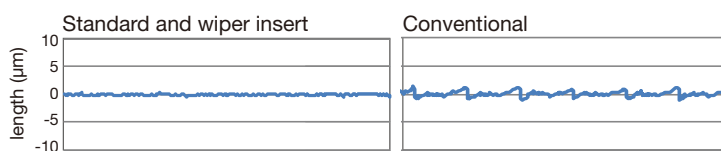
# CUTTING PERFORMANCE

## Strong cutting edge

Optimized edge preparation ensures machining security during heavy interrupted cutting



Flank wear: VB / Inch — Machining time (min.)
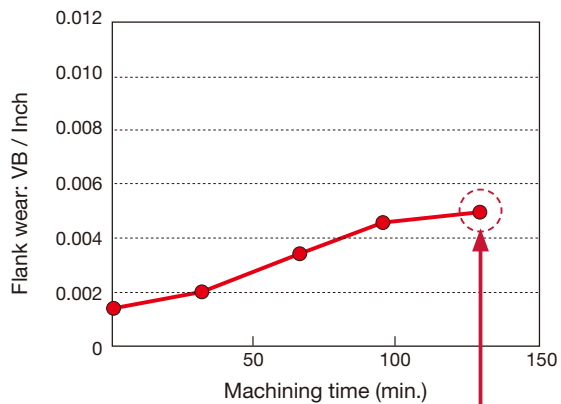
| | |
|---|---|
| Cutter | : TPYD06U4.00B1.25R22 (ø = 4", z = 1) |
| Insert | : YDEN0603PDSR-D DX110 (with edge preparation) |
| Workpiece | : 380 (with holes) |
| Cutting speed | : $V_c$ = 10472 sfm |
| Number of revolutions | : $n$ = 10,000 rpm |
| Feed per tooth | : $f_z$ = 0.0035 ipt |
| Insert runout | : < 1 μm (<0.00004") |
| Depth of cut | : $a_p$ = 0.008" |
| Depth of width | : $a_e$ = 3" |
| Coolant | : Wet |
| Machining | : Face milling (down cut) |
| Machine | : Vertical M/C, CAT40 |

**After 130 min.**
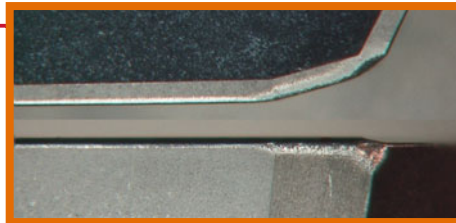
## Mounting of deburring inserts

To make the best of the cutter's deburring ability, make sure to place a deburring insert immediately behind every standard insert on the cutter.
Note that, since a deburring insert has no cutting edge on the periphery, the effective cutting edges of the cutter will be divided by 2.

Example:
For ø4" cutter with Z = 22, number of effective cutting edges would be Z = 11.  (standard inserts x 11 and deburring inserts x 11)
The order of insert installation is as follows:
Standard → Deburring → Standard → Deburring...

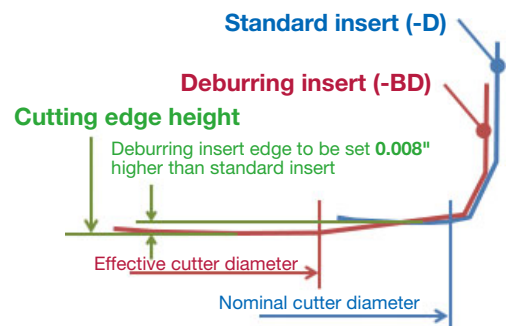**Location of deburring inserts on the cutter**

■ **Standard insert** (YDEN0603PDF/SR-D)
■ **Deburring insert** (YDEN0603PDFR-BD)

## Proper cutting edge setting

- For the best surface finishing results, wiper insert's (-WD) cutting edge should be set 0.0024" higher than that of the standard insert's (-D). For deburring inserts (-BD), set 0.008" higher than that of the standard insert (-D).
- Effective cutter diameter will vary in accordance with wiper insert (-WD) or deburring insert (-BD) dimensions.  Refer to the table below for an effective cutter diameter in each specific case.

**Standard insert (-D)**
**Wiper insert (-WD)**
**Cutting edge height**
Wiper insert to be set **0.0024"** higher than standard insert
Effective cutter diameter
Nominal cutter diameter

| Cutter diameter (Inch) | Effective cutter diameter (Inch) | | |
|---|---|---|---|
| | Standard (-D) only | Standard (-D) and wipers (-WD) | Standard (-D) and deburrers (-BD) |
| 2 | 2 | 1.976 | 1.740 |
| 2.5 | 2.5 | 2.476 | 2.240 |
| 3 | 3 | 2.976 | 2.740 |
| 4 | 4 | 3.976 | 3.740 |
| 5 | 5 | 4.976 | 4.740 |
| 6 | 6 | 5.976 | 5.740 |

**Standard insert (-D)**
**Deburring insert (-BD)**
**Cutting edge height**
Deburring insert edge to be set **0.008"** higher than standard insert
Effective cutter diameter
Nominal cutter diameter

# TUNGSPEED MILL

TUNGALOY
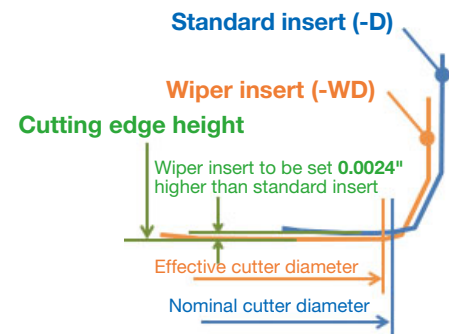
## TPYD06

Face milling cutter for non-ferrous applications, bore type, with PCD inserts

GAMP = +9°, GAMF = +4°
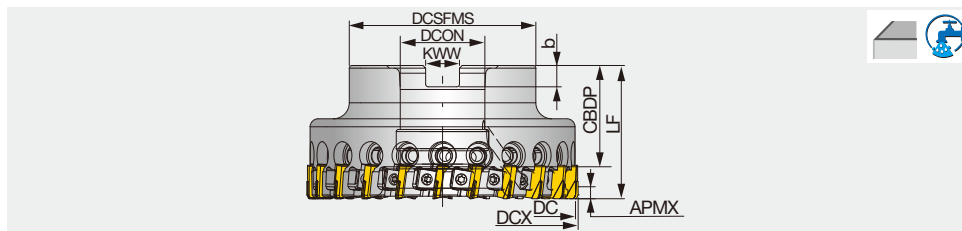


| Inch | APMX | DC | DCX | CICT | DCSFMS | LF | DCON | CBDP | KWW | b | WT(lb) | Air hole | RPMX(rpm) | Insert |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TPYD06U2.50B0.75R10 | 0.177 | 2.500 | 2.579 | 10 | 1.772 | 1.575 | 0.750 | 0.750 | 0.315 | 0.197 | 1.340 | with | 19000 | YDEN0603... |
| TPYD06U3.00B1.00R16 | 0.177 | 3.000 | 3.079 | 16 | 2.362 | 1.969 | 1.000 | 1.024 | 0.374 | 0.236 | 2.560 | with | 17000 | YDEN0603... |
| TPYD06U4.00B1.25R22 | 0.177 | 4.000 | 4.079 | 22 | 2.756 | 1.969 | 1.250 | 0.827 | 0.500 | 0.315 | 4.300 | with | 15000 | YDEN0603... |
| TPYD06U5.00B1.50R26 | 0.177 | 5.000 | 5.079 | 26 | 3.543 | 2.362 | 1.500 | 1.299 | 0.626 | 0.394 | 8.030 | with | 14000 | YDEN0603... |
| TPYD06U6.00B1.50R34 | 0.177 | 6.000 | 6.079 | 34 | 3.543 | 2.362 | 1.500 | 1.299 | 0.626 | 0.394 | 10.760 | with | 12000 | YDEN0603... |

## SPARE PARTS

| Designation | Insert locking wedge | Wedge fixing screw | Adjusting cam | Torx bit | Cam tightening screw | Wrench | Grip |
|---|---|---|---|---|---|---|---|
| TPYD06U2.50B0.75R10 | WF875N | DS-5T | AJC08 | BLDT10/S7-A | SSHM4-4 | P-2 | H-TB2W |
| TPYD06U3.00B1.00R16 | WF875N | DS-5T | AJC08 | BLDT10/S7-A | SSHM4-4 | P-2 | H-TB2W |
| TPYD06U4.00B1.25R22 | WF875N | DS-5T | AJC08 | BLDT10/S7-A | SSHM4-4 | P-2 | H-TB2W |
| TPYD06U5.00B1.50R26 | WF875N | DS-5T | AJC08 | BLDT10/S7-A | SSHM4-4 | P-2 | H-TB2W |
| TPYD06U6.00B1.50R34 | WF875N | DS-5T | AJC08 | BLDT10/S7-A | SSHM4-4 | P-2 | H-TB2W |

## EPYD06

Face milling cutter for non-ferrous applications, shank type, with PCD inserts

GAMP = +9°, GAMF = +4°
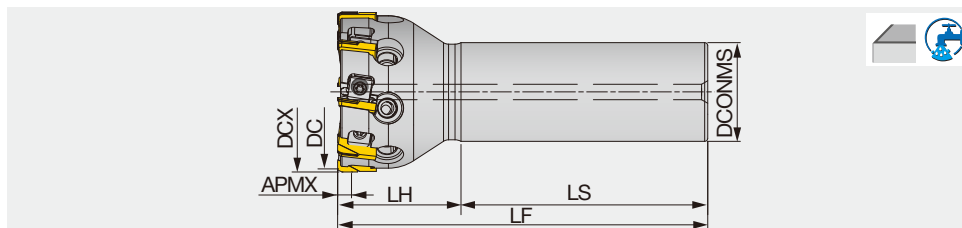


| Inch | APMX | DC | DCX | CICT | DCONMS | LF | LH | LS | WT(lb) | Air hole | RPMX(rpm) | Insert |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EPYD06U2.00C1.25R08 | 0.177 | 2.000 | 2.079 | 8 | 1.250 | 4.500 | 1.575 | 2.925 | 1.920 | with | 20000 | YDEN0603... |

**SPARE PARTS**

| Designation | Insert locking wedge | Wedge fixing screw | Adjusting cam | Torx bit | Cam tightening screw | Wrench | Grip |
|---|---|---|---|---|---|---|---|
| EPYD06U2.00C1.25R08 | WF875N | DS-5T | AJC08 | BLDT10/S7-A | SSHM4-4 | P-2 | H-TB2W |

# INSERT

### YDEN0603PD(F/S)R-D

INSL
LE
BS
S
R7.87"
W1

### YDEN0603PDFR-WD

INSL
S
R15.75"
BS
W1

### YDEN0603PDFR-BD

INSL
S
R15.75"
BS
W1

| | | | PCD | | | | | | | | | | | | W1 | INSL | S | BS | LE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **P** | Steel | | | | | | | | | | | | | | | | | | |
| **M** | Stainless | | | | | | | | | | | | | | | | | | |
| **K** | Cast iron | | | | | | | | | | | | | | | | | | |
| **N** | Non-ferrous | ★ | | | | | | | | | | | | | | | | | |
| **S** | Superalloys | | | | | | | | | | | | | | | | | | |
| **H** | Hard materials | | | | | | | | | | | ★ : First choice | | | | | | | |

| Designation | APMX | Edge prep. | PCD DX110 | | | | | | | | | | | W1 | INSL | S | BS | LE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YDEN0603PDFR-D | 0.177 | Without | ● | | | | | | | | | | | 0.375 | 0.500 | 0.122 | 0.087 | 0.256 |
| YDEN0603PDSR-D | 0.177 | With | ● | | | | | | | | | | | 0.375 | 0.500 | 0.122 | 0.087 | 0.256 |
| YDEN0603PDFR-WD | - | Without | ● | | | | | | | | | | | 0.364 | 0.504 | 0.122 | 0.177 | - |
| YDEN0603PDFR-BD | - | Without | ● | | | | | | | | | | | 0.364 | 0.508 | 0.122 | 0.157 | - |

Note: Tungaloy provides refurbishing service of PCD inserts upon request.        Package quantity = 1 pc. per box

## Managing re-ground inserts

- To maintain its minimum insert capability, re-grinding over 0.031" off the original cutting edge profile is not provided.
- Regrinding will change the dimension of the wiper edge and may affect the surface finishing quality.
- Used PCD inserts are reground as a batch from the same cutter in order to maintain the dimensional uniformity of all inserts in the same batch.
- When inserts from a different batch are accidently mixed, the cutter balance may collapse and the tool or machine may fracture.
- Re-check the cutter diameter as needed, after re-grinding inserts are mounted to offset the tool.

Max. 0.031"

Max. 0.031"    Wiper length

# STANDARD CUTTING CONDITIONS

| ISO | Workpiece materials | Grades | Designation | Cutting speed $V_c$ (sfm) | Feed per tooth $f_z$ (ipt) |
|---|---|---|---|---|---|
| **N** | Cast aluminum alloy / Die-cast (Si < 13%) | DX110 | YDEN0603PDFR-D | 1640 - 13123 | 0.002 - 0.008 |
| | Cast aluminum alloy / Die-cast (Si > 13%) | DX110 | YDEN0603PDFR-D | 656 - 2625 | 0.002 - 0.008 |
| | Aluminum alloy | DX110 | YDEN0603PDFR-D | 1640 - 13123 | 0.002 - 0.008 |
| | Copper alloy | DX110 | YDEN0603PDFR-D | 656 - 1640 | 0.002 - 0.008 |

- The values in the above list are of standard recommendations and may require adjustments in consideration with cutting depths and/or workpiece/machine rigidity.
- Use wiper inserts (-WD) for better surface requirements and deburring inserts (-BD) to remove burrs.
- Always use wet cutting (emulsion coolant) for machining aluminum or copper alloys.

# APPLICATION RANGE
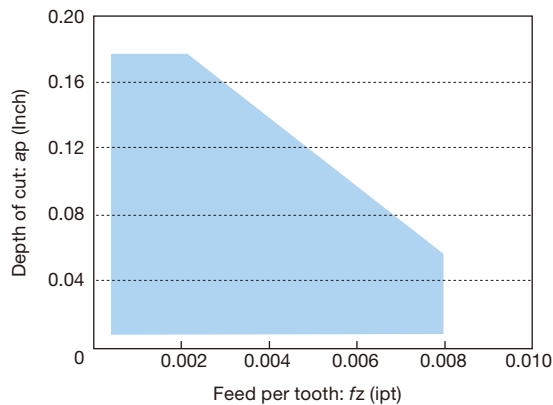


| | |
|---|---|
| Cutter | : TPYD06U3.00B1.00R16 (ø = 3", z = 16) |
| Insert | : YDEN0603PDFR-D DX110 |
| Workpiece material | : 383 (Die-cast) |
| Cutting speed | : $V_c$ = 7854 sfm |
| Coolant | : Wet |
| Machine | : Vertical M/C, CAT40, 18.5 kW |

# INSERT SETTING PROCEDURE

## ❶ Mounting the inserts

Place the insert in the pocket and LIGHTLY tighten the screw at 0.74 ft·lb (1 N·m).
Do not fully tighten the screw at this point.
Note: Press the insert firmly to the pocket while clamping to eliminate the gap.

Direction to place the insert

## ❷ House to utilize the key

The recessed part of the cam should be placed on the insert bottom. Make sure to place the cam all the way in.

Recess
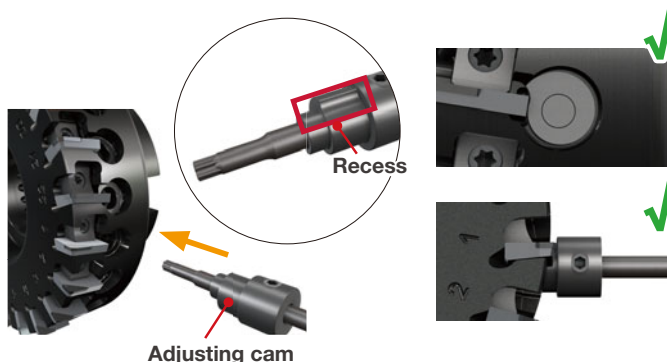
Adjusting cam

## ❸ Adjusting the axial height

Place the adjusting cam in the hole located at the bottom of the pocket. Make sure that the cam is in contact with the insert bottom. Adjust the insert axial height by rotating the cam in the CW direction to gradually increase the axial measure. Stop when it reaches 30-40 μm (0.0012" - 0.0016") just below the desired position. Then, slightly rotate the cam in the CCW direction before removing the cam from the cutter body.

Axial adjustment
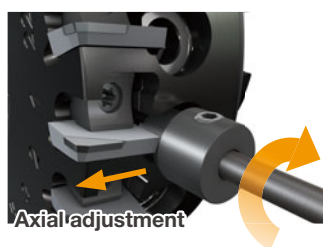
## ❹ Tighten the insert clamping screws

Firmly tighten the insert clamping screws at 2.58 ft·lb (3.5 N·m) . In order to prevent the body deformation by tightening, it is recommended that the final tightening is done by alternating. (e.g. For ø4",z22cutter, 1,3,5,7...21, then 2,4,6,8,...22). For the best balanced insert installation, repeat this tightening procedure for every other insert until all inserts are securely fixed.
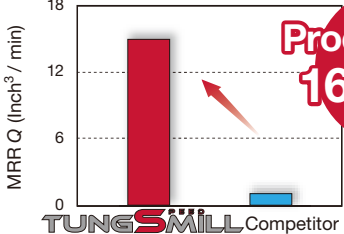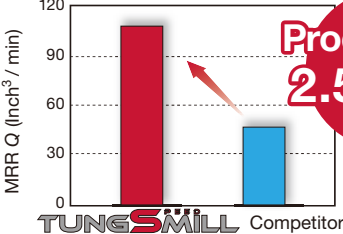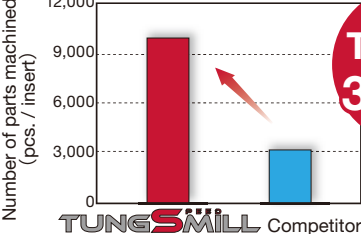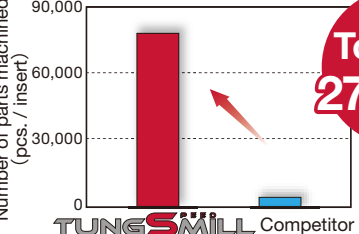
① ② ③ ④ ⑤ ⑥

… and on

skip
② ①

## ❺ Final adjustments

For the final axial adjustment, instead of setting the insert height close to the target position, set so that it reaches approximately 8 μm (0.0003") above the target. Slightly rotate the cam CCW to remove the key off the body. The insert will go down by 8 μm (0.0003") to the target height when the cam is removed.
The inserts are recommended to set to < 5 μm (0.0002") axially in relation to one another.

# PRACTICAL EXAMPLES

| Workpiece type | Hoist body part | Crank casing |
|---|---|---|
| Cutter | TPYD06U3.00B1.00R16 (ø3", z = 16) | TPYD06U4.00B1.25R2 (ø4", z = 22) |
| Insert | YDEN0603PDFR-D | YDEN0603PDFR-D |
| Grade | DX110 | DX110 |
| Workpiece material | High pressure aluminum die cast (383) N | High pressure aluminum die cast (383) N |

| Cutting conditions | | Hoist body part | Crank casing |
|---|---|---|---|
| | Cutting speed: $Vc$ (sfm) | 6598 | 10300 |
| | Feed per tooth: $fz$ (ipt) | 0.004 | 0.035 |
| | Feed speed: $Vf$ (ipm) | 504 | 770 |
| | Depth of cut: $ap$ (Inch) | 0.04 - 0.16 | 0.06 - 0.18 |
| | Width of cut: $ae$ (Inch) | 0.197 - 0.787 | 0.394 - 2.756 |
| | Machining | Face milling | Face milling |
| | Coolant | Wet (External) | Wet (Internal) |
| | Machine | Vertical M/C, CAT50 | Vertical M/C, CAT40 |

**Results**

Productivity 16 times!

MRR was improved by 16x, with increased table feed and reduced number of passes. Deburing inserts eliminated burr formation.

Productivity 2.5 times!

MRR was improved by 2.5x thanks to super high density cutter design.

| Workpiece type | Cam housing | Cylinder head |
|---|---|---|
| Cutter | Special TPYD06 body (ø61 mm, z = 10) | Special TPYD06 body (ø75 mm, z = 15) |
| Insert | YDEN0603PDSR-D | YDEN0603PDSR-D |
| Grade | DX110 | DX110 |
| Workpiece material | High pressure aluminum die cast (383) N | Cast aluminum alloy (380) N |

| Cutting conditions | | Cam housing | Cylinder head |
|---|---|---|---|
| | Cutting speed: $Vc$ (sfm) | 6286 | 3248 |
| | Feed per tooth: $fz$ (ipt) | 0.004 | 0.0016 |
| | Feed speed: $Vf$ (ipm) | 449 | 112 |
| | Depth of cut: $ap$ (Inch) | 0.020 | 0.020 |
| | Width of cut: $ae$ (Inch) | 0.197 | 2.756 |
| | Machining | Face milling | Face milling |
| | Coolant | Wet (Internal) | Wet (Internal) |
| | Machine | Vertical M/C, CAT30 | Specialized machine |

**Results**

Tool life 3 times!

Thanks to high tooth density, more teeth are engaged in cut, reducing the load per insert, and as a result, the insert life tripled.

Tool life 27 times!

Wear resistant DX110 PCD grade dramatically improved the tool life by 27x.

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