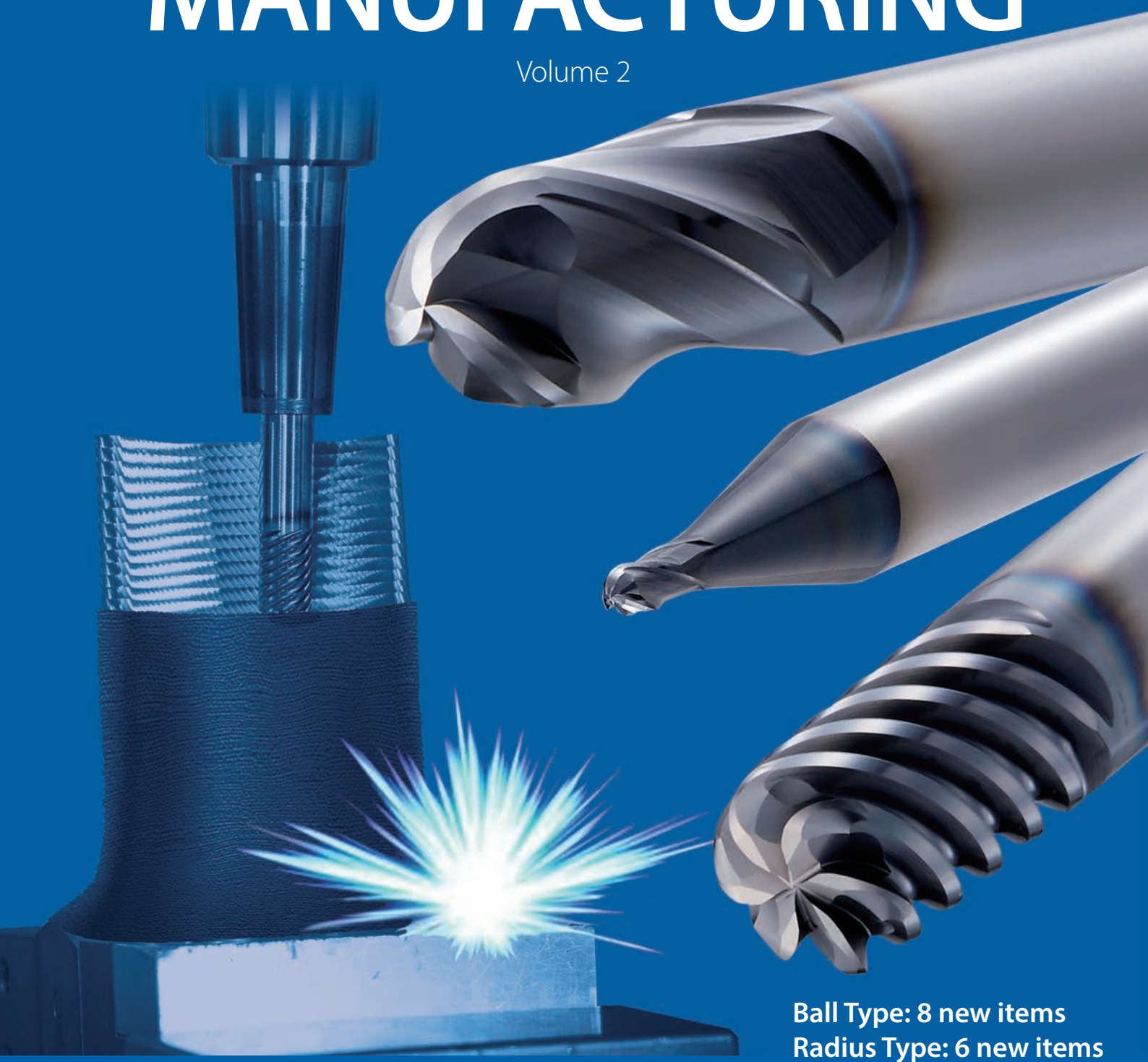
Endmills for milling built-up of welding parts

# ADDITIVE MANUFACTURING

Volume 2



**Ball Type: 8 new items**
**Radius Type: 6 new items**

# KEY FEATURES: AM-EBT • AM-CRE

Ball nose type (AM-EBT)
Three-dimensional negative robust geometry optimized for additive manufacturing, even applicable to large depth of cut.

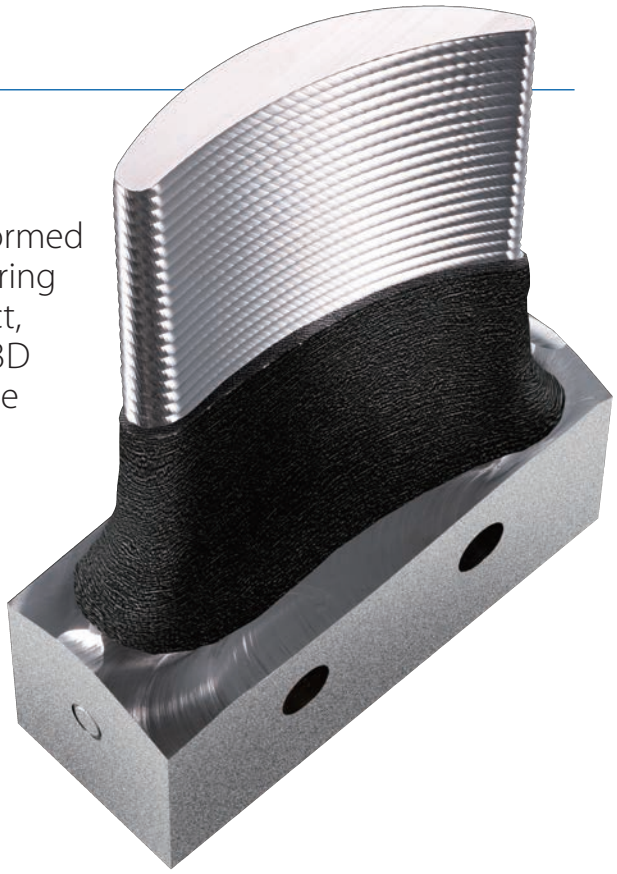
Radius type (AM-CRE)
6-Flute/8-Flute

1 For milling of additive manufactured parts

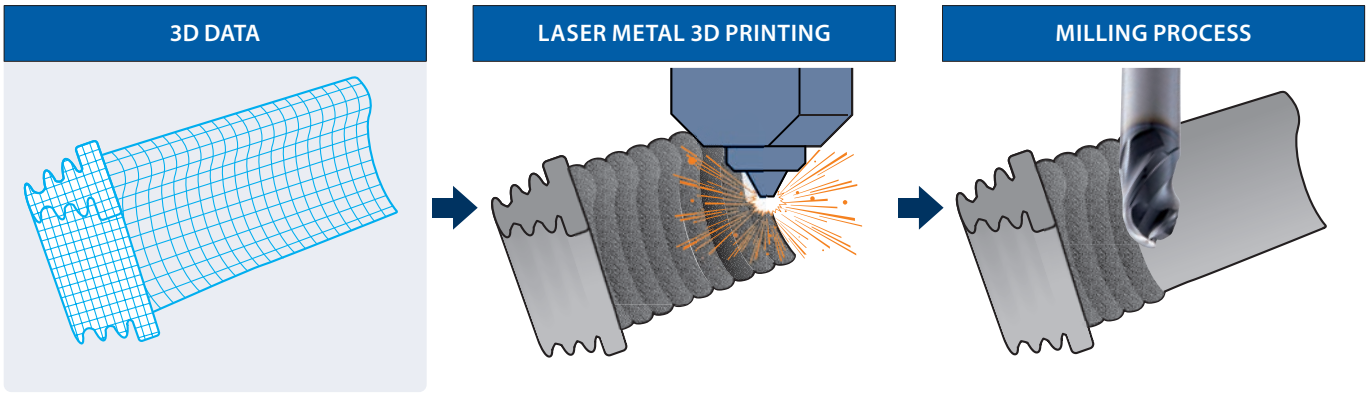
2 Durorey coating

## What is additive manufacturing ?

Unlike conventional processing, where an object is formed by removing excessive materials, additive manufacturing deposits materials layer upon layer to create an object, which is a process similar to 3D printing. By utilizing 3D data, short delivery and low production cost are made possible.



## Suitable for milling of built-up welding parts




The name of Additive Manufacturing was established by the American Society for Testing and Materials (ASTM) in 2009.

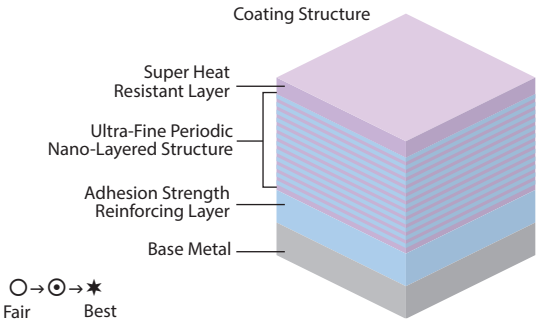
# DUROREY COATING

### Super heat resistance and high toughness DUROREY coating

Super heat resistant layer and ultra-fine periodic nano-layered structure provide superior toughness while maintaining high heat resistance and abrasion resistance. Also suppresses chipping even in high hardness milling and achieves long tool life.

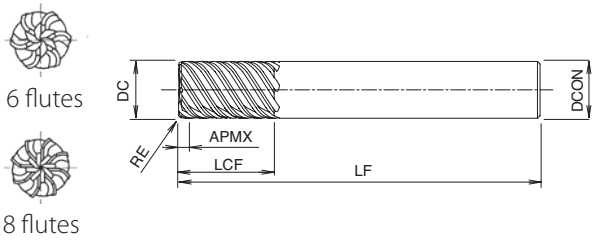
| Coating Color | Coating Structure | Hardness | Oxidation Temperature | Heat Resistance |
|---|---|---|---|---|
| Black Gray | Ultra-Fine Periodic Nano-Layered | 41 | 1.300 | ✶ |

| Adhesion Strength | Surface Roughness | Wear Resistance | Welding Resistance | Toughness |
|---|---|---|---|---|
| ⊙ | ○ | ✶ | ⊙ | ⊙ |



# AM-CRE NEW SIZES

**Milling | Additive manufacturing**




- Carbide end mill with Durorey coating
- For challenging applications, removing welding seams
- 6-8 flutes, radius type

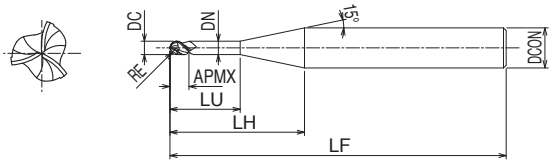


| EDP | DC x RE | ZEFP | DCON | APMX | LF | LCF | Price |
|---|---|---|---|---|---|---|---|
| 3183010 NEW | 6 × R1 | 6 | 6 | 1 | 60 | 9 | |
| 3183015 | 6 × R1,5 | 6 | 6 | 1,5 | 60 | 9 | |
| 3183018 NEW | 8 × R1 | 6 | 8 | 1 | 70 | 12 | |
| 3183020 | 8 × R2 | 6 | 8 | 2 | 70 | 12 | |
| 3183110 NEW | 10 × R1 | 6 | 10 | 1 | 80 | 15 | |
| 3183120 | 10 × R2 | 6 | 10 | 2 | 80 | 15 | |
| 3183210 NEW | 12 × R1 | 8 | 12 | 1 | 90 | 18 | |
| 3183220 | 12 × R2 | 8 | 12 | 2 | 90 | 18 | |
| 3183226 NEW | 16 × R1 | 8 | 16 | 1 | 105 | 24 | |
| 3183230 | 16 × R3 | 8 | 16 | 3 | 105 | 24 | |
| 3183310 NEW | 20 × R1 | 8 | 20 | 1 | 110 | 30 | |
| 3183330 | 20 × R3 | 8 | 20 | 3 | 110 | 30 | |

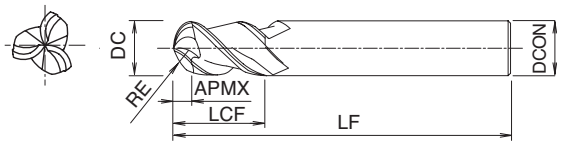
# AM-EBT NEW SIZES

**Milling | Additive manufacturing**

**Type 1**

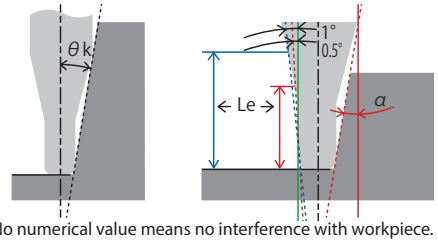



**Type 2**




- Carbide end mill with Durorey coating
- For challenging applications, removing welding seams
- 3 flutes, ball type

Effective Neck length (Le) depending on Inclined Angle (α) of workpiece




No numerical value means no interference with workpiece.

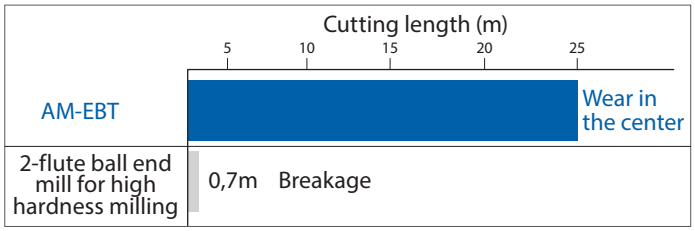
P ~45 HRC | P ~55 HRC | M ~35 HRC | S Ti | S Ni | H ~65 HRC

CARBIDE | DURAREY | 30° | R ± 0.01 | SHRINK FIT

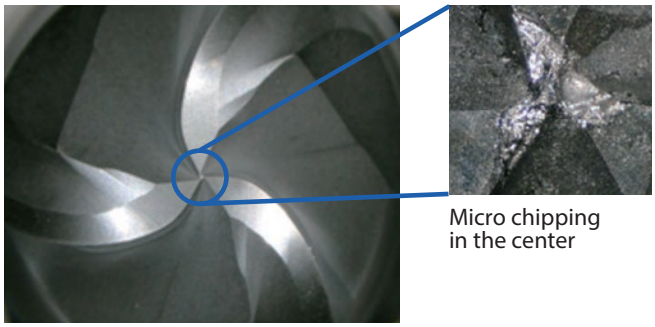
| EDP | RE x DC x LU | ZEFP | DCON | APMX | LH | DN | LF | LCF | ØK | Effective length by inclined angles (Le) | | | | | Type | Price |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | 0,5° | 1° | 1,5° | 2° | 3° | | |
| 3187240 NEW | R1 × 2× 4 | 3 | 6 | 2 | 11,9 | 1,95 | 60 | - | 10,64° | 4,19 | 4,3 | 4,42 | 4,55 | 4,85 | 1 | |
| 3187280 NEW | R1 × 2× 8 | 3 | 6 | 2 | 15,9 | 1,95 | 60 | - | 7,79° | 8,33 | 8,58 | 8,86 | 9,15 | 9,82 | 1 | |
| 3187360 NEW | R1,5× 3× 6 | 3 | 6 | 3 | 11,8 | 2,85 | 60 | - | 8,15° | 6,44 | 6,61 | 6,79 | 7 | 7,45 | 1 | |
| 3187392 NEW | R1,5× 3×12 | 3 | 6 | 3 | 17,8 | 2,85 | 60 | - | 5,22° | 12,64 | 13,03 | 13,44 | 13,89 | 14,91 | 1 | |
| 3187408 NEW | R2 × 4× 8 | 3 | 6 | 4 | 12 | 3,85 | 60 | - | 5,65° | 8,49 | 8,71 | 8,96 | 9,22 | 9,81 | 1 | |
| 3187416 NEW | R2 × 4×16 | 3 | 6 | 4 | 20 | 3,85 | 60 | - | 3,17° | 16,76 | 17,27 | 17,82 | 18,42 | 19,76 | 1 | |
| 3187510 NEW | R2,5× 5×10 | 3 | 6 | 5 | 12,1 | 4,85 | 60 | - | 2,95° | 10,54 | 10,82 | 11,12 | 11,45 | - | 1 | |
| 3187520 NEW | R2,5× 5×20 | 3 | 6 | 5 | 22,1 | 4,85 | 60 | - | 1,46° | 20,87 | 21,52 | - | - | - | 1 | |
| 3188060 | R3 × 6 | 3 | 6 | 3 | - | | 60 | 9 | - | - | - | - | - | - | 2 | |
| 3188080 | R4 × 8 | 3 | 8 | 4 | - | | 70 | 12 | - | - | - | - | - | - | 2 | |
| 3188100 | R5 ×10 | 3 | 10 | 5 | - | | 80 | 15 | - | - | - | - | - | - | 2 | |
| 3188120 | R6 ×12 | 3 | 12 | 6 | - | | 90 | 18 | - | - | - | - | - | - | 2 | |
| 3188160 | R8 ×16 | 3 | 16 | 8 | - | | 105 | 24 | - | - | - | - | - | - | 2 | |
| 3188200 | R10 ×20 | 3 | 20 | 10 | - | | 110 | 30 | - | - | - | - | - | - | 2 | |

# Long tool life even in milling of built-up welding parts with large depth of cut

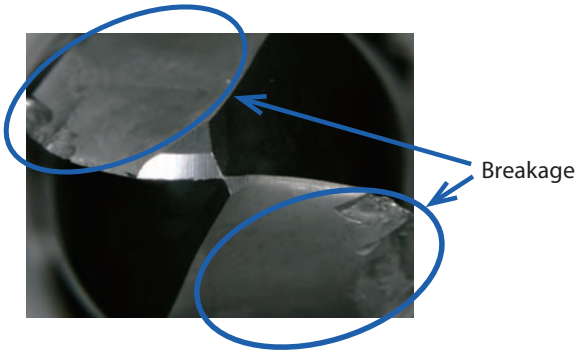
| | | |
|---|---|---|
| **Tool** | AM-EBT R6X12 | 2-flute ball end mill for high hardness milling |
| **Work Material** | BK-660R | |
| **Milling Method** | Linear Machining | |
| **Cutting Speed** | 37 m/min (1.000 min$^{-1}$) | |
| **Feed** | 1.000 mm/min (0,33 mm/t) | 666 mm/min (0,33 mm/t) |
| **Depth of Cut** | ap=3 mm<br>ae=0,5 mm | |
| **Coolant** | Air Blow | |
| **Machine** | Vertical Machining Center | |




AM-EBT After milling 25m

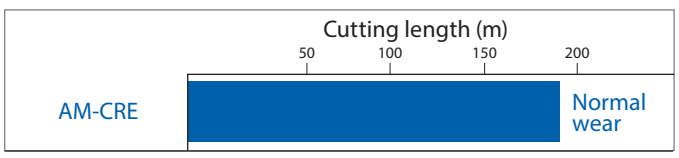


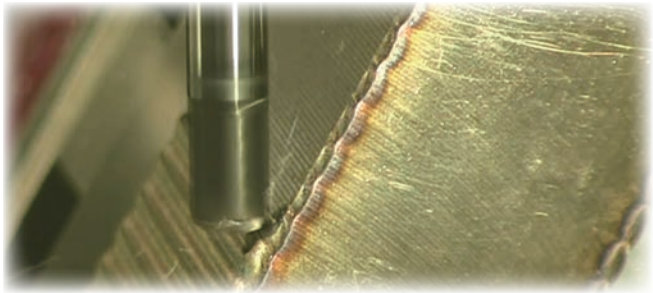

2 flutes ball end mill for high hardness milling
After milling 0,7m



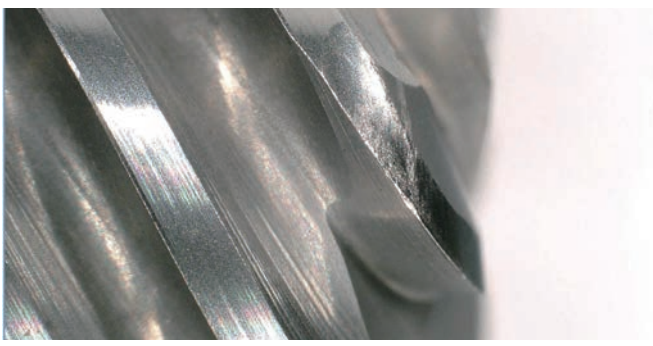

# Milling example in Stellite Alloys

| | |
|---|---|
| **Tool** | AM-CRE Ø8XR2 (6FL) |
| **Work Material** | Stellite (48HRC) |
| **Milling Method** | Contour Line Operation |
| **Cutting Speed** | 50 m/min (2.000 min$^{-1}$) |
| **Feed** | 600 mm/min (0,05 mm/t) |
| **Depth of Cut** | ap=0,5 mm<br>ae=0,5 mm |
| **Coolant** | Air Blow |
| **Machine** | Vertical Machining Center |



AM-CRE • After milling 190 m



# CUTTING CONDITIONS

**Milling | Cutting conditions**

## AM-EBT

### Ball type

| | Prehardened Steel • Hardened Steel ~45HRC | | Hardened Steel ~65HRC | | Hardened Steel ~70HRC | | Stainless Steel ≤200HB | | Cobalt Chromium Based Alloy (Stellite) | | Titanium Alloy | | Ni based Alloy (Inconel 718) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vc | 50~70m/min | | 40~60m/min | | 20~40m/min | | 60~80m/min | | 50~70m/min | | 40~60m/min | | 20~40m/min | |
| R / Lu (mm) | S ($min^{-1}$) | F (mm/min) | S ($min^{-1}$) | F (mm/min) | S ($min^{-1}$) | F (mm/min) | S ($min^{-1}$) | F (mm/min) | S ($min^{-1}$) | F (mm/min) | S ($min^{-1}$) | F (mm/min) | S ($min^{-1}$) | F (mm/min) |
| 1 / 4 | 9.500 | 940 | 8.000 | 790 | 4.800 | 480 | 11.100 | 1.100 | 9.500 | 940 | 8.000 | 790 | 4.800 | 480 |
| 1 / 8 | 4.800 | 430 | 4.300 | 390 | 2.600 | 230 | 5.600 | 500 | 4.800 | 430 | 4.300 | 390 | 2.600 | 230 |
| 1,5 / 6 | 6.400 | 960 | 5.300 | 800 | 3.200 | 480 | 7.400 | 1.110 | 6.400 | 960 | 5.300 | 800 | 3.200 | 480 |
| 1,5 / 12 | 3.800 | 510 | 3.300 | 450 | 2.000 | 270 | 4.400 | 590 | 3.800 | 510 | 3.300 | 450 | 2.000 | 270 |
| 2 / 8 | 4.800 | 930 | 4.000 | 770 | 2.400 | 470 | 5.600 | 1.080 | 4.800 | 930 | 4.000 | 770 | 2.400 | 470 |
| 2 / 16 | 2.900 | 490 | 2.500 | 420 | 1.500 | 250 | 3.400 | 570 | 2.900 | 490 | 2.500 | 420 | 1.500 | 250 |
| 2,5 / 10 | 3.800 | 910 | 3.200 | 770 | 1.900 | 460 | 4.500 | 1.080 | 3.800 | 910 | 3.200 | 770 | 1.900 | 460 |
| 2,5 / 20 | 2.400 | 550 | 2.000 | 430 | 1.200 | 280 | 2.800 | 600 | 2.400 | 520 | 2.000 | 430 | 1.200 | 280 |
| 3 / - | 3.200 | 960 | 2.700 | 800 | 1.600 | 480 | 3.700 | 1.120 | 3.200 | 960 | 2.700 | 800 | 1.600 | 480 |
| 4 / - | 2.400 | 860 | 2.000 | 720 | 1.200 | 430 | 2.800 | 1.000 | 2.400 | 860 | 2.000 | 720 | 1.200 | 430 |
| 5 / - | 1.900 | 860 | 1.600 | 720 | 960 | 430 | 2.200 | 1.000 | 1.900 | 860 | 1.600 | 720 | 960 | 430 |
| 6 / - | 1.600 | 960 | 1.300 | 800 | 800 | 480 | 1.900 | 1.120 | 1.600 | 960 | 1.300 | 800 | 800 | 480 |
| 8 / - | 1.200 | 790 | 1.000 | 660 | 600 | 390 | 1.400 | 920 | 1.200 | 790 | 1.000 | 660 | 600 | 390 |
| 10 / - | 1.000 | 720 | 800 | 600 | 480 | 360 | 1.100 | 840 | 1.000 | 720 | 800 | 600 | 480 | 360 |

Depth of cut

| Dc | ap | pf |
|---|---|---|
| R≤6 | Max:0,15D | 0,05D |
| 8≤R | Max:3mm | |

1. This tool is recommended for the roughing of additive manufacturing and mold overlay surfaces.
2. Please use machines and holders that are rigid and highly accurate.
3. The values listed above are for reference. Please set the cutting condition in accordance with the actual machining environment.
4.Please reduce the feed rate when the depth of cut is greater than specified.
5. Please adjust the speed, feed and depth of cut accordingly when the overhang length is longer than specified.
6. Please use a suitable fluid with high smoke retardant properties.
7. During dry (no fluid) milling, please use air blow to remove disposable chips from the milling area and to eliminate chip packing.
8. Please use water-soluble coolant when machining stainless steel, cobalt-chromium based alloy, titanium alloy, and Ni-based alloy.
9. Tool runout should be kept to a minimum for maximum accuracy.
10. When the cutting load fluctuates in areas such as the corners, please reduce the rotational speed.

## AM-CRE

### Radius type

| | Prehardened Steel • Hardened Steel ~45HRC | | Hardened Steel ~60HRC | | Hardened Steel ~70HRC | | Stainless Steel ≤200HB | | Cobalt Chromium Based Alloy (Stellite) | | Titanium Alloy | | Ni based Alloy (Inconel 718) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vc | 50~70m/min | | 40~60m/min | | 20~40m/min | | 60~80m/min | | 50~70m/min | | 40~60m/min | | 20~40m/min | |
| DC x RE | S ($min^{-1}$) | F (mm/min) | S ($min^{-1}$) | F (mm/min) | S ($min^{-1}$) | F (mm/min) | S ($min^{-1}$) | F (mm/min) | S ($min^{-1}$) | F (mm/min) | S ($min^{-1}$) | F (mm/min) | S ($min^{-1}$) | F (mm/min) |
| 6×R1 | 3.700 | 1.330 | 3.200 | 1.150 | 1.910 | 690 | 4.240 | 1.530 | 3.700 | 1.330 | 3.200 | 1.150 | 1.910 | 690 |
| 6×R1.5 | 3.200 | 960 | 2.700 | 800 | 1.600 | 480 | 3.700 | 1.120 | 3.200 | 960 | 2.700 | 800 | 1.600 | 480 |
| 8×R1 | 2.780 | 1.250 | 2.400 | 1.080 | 1.430 | 640 | 3.180 | 1.430 | 2.780 | 1.250 | 2.400 | 1.080 | 1.430 | 640 |
| 8×R2 | 2.400 | 720 | 2.000 | 600 | 1.200 | 360 | 2.800 | 840 | 2.400 | 720 | 2.000 | 600 | 1.200 | 360 |
| 10×R1 | 2.220 | 1.600 | 1.900 | 1.370 | 1.150 | 830 | 2.540 | 1.830 | 2.220 | 1.600 | 1.900 | 1.370 | 1.150 | 830 |
| 10×R2 | 1.900 | 920 | 1.600 | 760 | 960 | 460 | 2.200 | 1.070 | 1.900 | 920 | 1.600 | 760 | 960 | 460 |
| 12×R1 | 1.850 | 2.220 | 1.600 | 1.920 | 960 | 1.150 | 2.120 | 2.540 | 1.850 | 2.220 | 1.600 | 1.920 | 960 | 1.150 |
| 12×R2 | 1.600 | 1.270 | 1.300 | 1.060 | 800 | 640 | 1.900 | 1.490 | 1.600 | 1.270 | 1.300 | 1.060 | 800 | 640 |
| 16×R1 | 1.380 | 2.430 | 1.200 | 2.110 | 720 | 1.270 | 1.590 | 2.800 | 1.380 | 2.430 | 1.200 | 2.110 | 720 | 1.270 |
| 16×R3 | 1.200 | 1.430 | 1.000 | 1.190 | 600 | 720 | 1.400 | 1.670 | 1.200 | 1.430 | 1.000 | 1.190 | 600 | 720 |
| 20×R1 | 1.110 | 2.490 | 1.000 | 2.240 | 570 | 1.280 | 1.270 | 2.840 | 1.110 | 2.490 | 1.000 | 2.240 | 570 | 1.280 |
| 20×R3 | 1.000 | 1.530 | 800 | 1.270 | 480 | 760 | 1.100 | 1.780 | 1.000 | 1.530 | 800 | 1.270 | 480 | 760 |

Depth of cut

| ae | ap |
|---|---|
| Max:0,5xDmm | Max:0,2xRmm |

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*shaping your dreams*


**OSG EUROPE LOGISTICS**
Avenue Lavoisier 1
B-1300 Z.I. Wavre - Nord - Belgium
Tel: +32 10 23 05 07
Fax: +32 10 23 05 51
info@osgeurope.com

**OSG BELUX**
Avenue Lavoisier 1
B-1300 Z.I. Wavre - Nord - Belgium
Tel: +32 10 23 05 11
Fax: +32 10 23 05 31
info@osg-belgium.com

**OSG FRANCE**
Parc Icade, Paris Nord 2
Immeuble "Le Rimbaud"
22 Avenue des Nations
CS66191 - 93420 Villepinte - France
Tel: +33 1 49 90 10 10
Fax: +33 1 49 90 10 15
sales@osg-france.com

**OSG NETHERLANDS**
Bedrijfsweg 5 - 3481 MG Harmelen
Tel: +31 348 44 2764
Fax: +31 348 44 2144
info@osg-nl.com

**OSG UK**
Shelton house, 5 Bentalls
Pipps Hill Ind Est, Basildon Essex SS14 3BY
Tel: +44 1268 567 660
Fax: +44 1268 567 661
sales@osg-uk.com

**CZECH, SLOVAKIA, HUNGARY**
OSG Europe Logistics S.A.
Slovakia organizacna zlozka
Racianská 22/A, SK-83102 Bratislava
Slovakia
Tel. +421 24 32 91 295
Orders-osgsvk@osgeurope.com

**OSG POLAND Sp. z.o.o.**
Spółdzielcza 57
05-074 Halinów - Poland
Tel: +22 760 82 71
Fax: +22 760 82 71
osg@osg-poland.com

**OSG GERMANY**
Karl-Ehmann-Str. 25
D - 73037 Göppingen - Germany
Tel: +49 7161 6064 - 0
Fax: +49 7161 6064 - 444
info@osg-germany.de

**OSG SCANDINAVIA**
(For Scandinavian countries)
Langebjergvaenget 16
4000 Roskilde - Denmark
Tel: +45 46 75 65 55
Fax: +45 46 75 67 00
osg@osg-scandinavia.com

**SWEDEN**
Branch office of OSG SCANDINAVIA
Abrahams Gränd 8
295 35 Bromölla - Sweden
Tel: +46 40 41 22 55
Fax: +46 40 41 32 55
osg@osg-scandinavia.com

**OSG IBERICA**
Bekolarra 4
E - 01010 Vitoria-Gasteiz - Spain
Tel: +34 945 242 400
Fax: +34 945 228 883
osg.iberica@osg-ib.com

**RUSSIA**
Butlerova street, 17B, office 5069
117342 Moscow - Russia
Tel: +7 (495) 150 41 54
info@osg-russia.com

**OSG TURKEY**
Rami Kişla Cad.No:56 Eyüp
Istanbul 34056 - Turkey
Tel+90 212 565 24 00
Fax: +90 212 565 44 00
info@osg-turkey.com

**ROMSAN INTERNATIONAL CO. SRL**
**Reprezentant Exclusiv OSG**
25C, Bucuresti-Magurele Street
051431 Bucuresti - România
Tel: +40 21 322 07 47
Fax: +40 21 321 56 00
romsan.int@romsan.ro

**AUSTRIA**
Branch office of OSG GERMANY
Messestraße 11
A-6850 Dornbirn
Tel: +49 7161 6064-0
Fax: + 49 7161 6064-444
info@osg-germany.de

**OSG ITALIA**
Via Ferrero, 65 A/B
I - 10098 Rivoli - Italy
Tel: +39 0117705211
Fax: +39 0117705215
info@osg-italia.it

**Vischer & Bolli AG**
Machining and Workholding
Im Schossacher 17
CH-8600 Dübendorf
T +41 44 802 15 15
F +41 44 802 15 95
info@vb-tools.com


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**www.osgeurope.com**