HOFMANN & VRATNY — EXN1 SERIES — NON-FERROUS MATERIALS EN

# EXN1 SERIES

2026 Expert

HOFMANN & VRATNY — EXPERTS IN CUTTING NON-FERROUS MATERIALS

# OUR EXN1 SERIES

# THE RIGHT TOOL. AT ALL TIMES.

Welcome to Hofmann & Vratny. As leading manufacturer of solid carbide tools, we enable companies throughout the world to manufacture their products.

**Every day,** our strong team works on our collective goal of producing the best tools in the world. Companies from the medical industry, semi-conductor industry, machine and plant construction, aviation, aerospace engineering and, not least, the automotive industry have been using our milling cutters for decades now. Quality – Made in Bavaria.

The success of our company is built on innovation, a culture of cooperation, open interaction with high respect and many years of successful and trustful collaboration with our business partners. You can always count on us, our tools and our irrepressible drive to shape the future of the industry together. To us, that means shaping tomorrow.

Andreas Vratny

Zdenek Vratny

Marius Heinemann-Grüder

OUR
**EXN1 SERIES**

**50**
YEARS OF EXPERIENCE

**2 Mio.**
TOOLS PRODUCED EVERY YEAR

MILLING CUTTERS

DRILLS

MADE IN BAVARIA

MADE IN CZECHIA

PROVEN QUALITY

PROVEN QUALITY

- Manufacturer of solid carbide cutting tools for a wide range of materials
- Founded 1976
- 2 locations in Bavaria and 1 location in Czechia
  - Headquarters with milling cutter production in Aßling near Munich
  - Regrinding center in Nuremberg
  - Location with drill production in Ivančice near Brno

# BEHIND THE SCENES

## PRODUCTION ENVIRONMENT:
ALWAYS UP TO DATE

**On** a production area of 3,751m², we produce around 2 million tools per year. In order to guarantee the precise manufacture of our tools, our clean production halls are kept at a constant temperature of 24 °C.

### PLANT FOR MACRO TOOLS

- Manufacturing of diameter 8 - 32 mm
- Use of 5 & 6-axis CNC grinding machines with 12-position grinding wheel changer enable us to manufacture complex tool geometries
- Radius tolerance of less than 5 µm
- Laser micrometer with measuring ranges up to 50 mm covers a wide product range

### PLANT FOR MICRO TOOLS

- Manufacturing from diameter 0.1 - 6 mm
- Use of 5 & 6-axis CNC grinding machines especially with linear and hydrostatic technology
- Tolerances are 3 µm for concentricity and radii and 5 µm for diameter
- CNC measuring machines for recording and measuring the smallest geometries up to 0.1 mm diameter

### PLANT FOR SC DRILLS

- Production of standard and special drills
- Use of 5 & 6-axis grinding machines with steady rest
- Measuring technology for particularly long tools

### DEPARTMENT FOR SPECIAL TOOLS

- Production of a wide range of semi-standard and special tools
- The delivery times for the special milling cutters are as follows:
  - 3 weeks uncoated
  - 4 weeks coated
  - 6 weeks diamond-coated

### REGRINDING CENTRE

- Original reconditioning of Hofmann & Vratny tools
- Regrinding of third-party tools
- The delivery times for reground tools are as follows:
  - without colour coating: 21 calendar days
  - with colour coating: 28 calendar days



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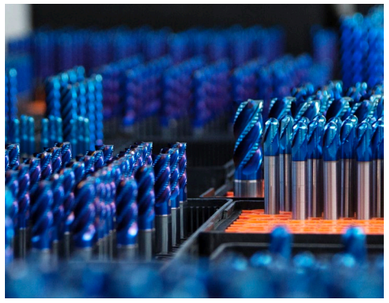
## RESEARCH & DEVELOPMENT:
THE ORIGIN OF OUR INNOVATIONS

**In** our R&D department, we develop various milling cutter geometries and work together with our partners on innovative coatings and high-performance substrates. Furthermore, on a total of four CNC milling machines, our milling cutters and those of our competitors are tested here every day in order to develop our tools in the best possible way for state-of-the-art production processes.

## WAREHOUSE & LOGISTICS:
SHIPPING TOGETHER



**Through** our global partner and trading network, we supply the manufacturing industries worldwide and work hand in hand to develop tools that meet customer requirements and market demands. In our warehouse and logistics department, our tools go through a multi-stage process every day to ensure that they reach the customer in perfect condition. With a stock availability of over 98.5 %, we guarantee same-day dispatch for orders received by 3 pm.

## PEOPLE ARE THE CENTRE OF ALL OUR ACTIVITIES

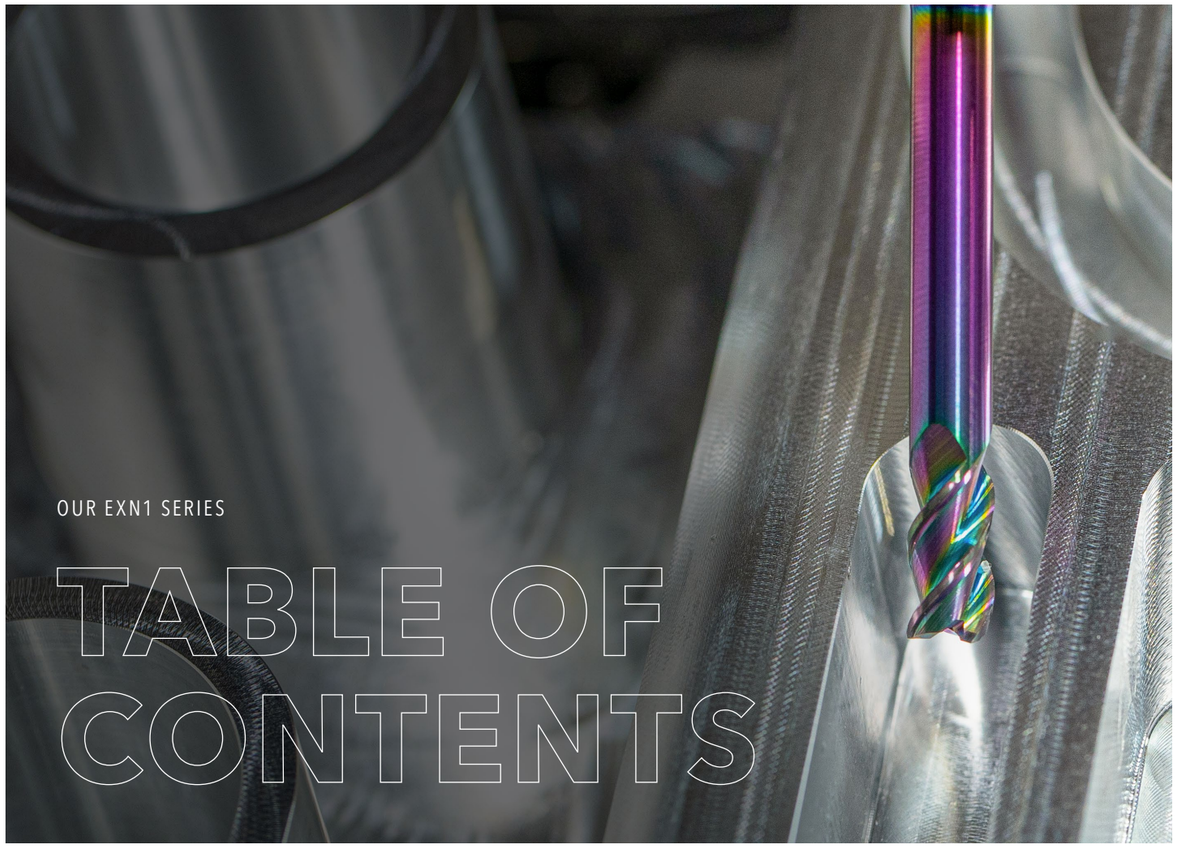
**Every** day, our team makes a significant contribution to the success of our company, which is why it is all the more important to us that our employees feel comfortable and enjoy their work alongside their day-to-day tasks. To contribute to the well-being of our employees, we offer:

- a daily free hot lunch in our canteen
- free hot and cold drinks
- many social benefits

### WOULD YOU LIKE TO GET YOUR OWN IMPRESSION OF US?

**Then come and visit us with our partner.**

GET EVEN MORE INSIGHTS BEHIND THE SCENES:



OUR EXN1 SERIES

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## EXN1-M01 PERFORMMAKER | END MILL CUTTER


**EXN1-M01-0013** | EXN1 Performmaker Z2-3 ASR 36

**EXN1-M01-0043** | EXN1 Performmaker Z2 2xD ASR 38

**EXN1-M01-0093** | EXN1 Performmaker Z3 2xD ASR 40

**EXN1-M01-0094** | EXN1 Performmaker Z3 2xD ASR 42

**EXN1-M01-0103** | EXN1 Performmaker Z3 2xD ASR 44

**EXN1-M01-0104** | EXN1 Performmaker Z3 2xD ASR 46

**EXN1-M01-0113** | EXN1 Performmaker Z3 1.5xD long ASR 48

**EXN1-M01-0114** | EXN1 Performmaker Z3 1.5xD long ASR 50

**EXN1-M01-0123** | EXN1 Performmaker Z3 3xD ASR 52

**EXN1-M01-0124** | EXN1 Performmaker Z3 3xD ASR 54

**EXN1-M01-0133** | EXN1 Performmaker Z3 3xD ASR 56

**EXN1-M01-0134** | EXN1 Performmaker Z3 3xD ASR 58

**EXN1-M01-0203** | EXN1 Performmaker Z3 2xD IC ASR 60

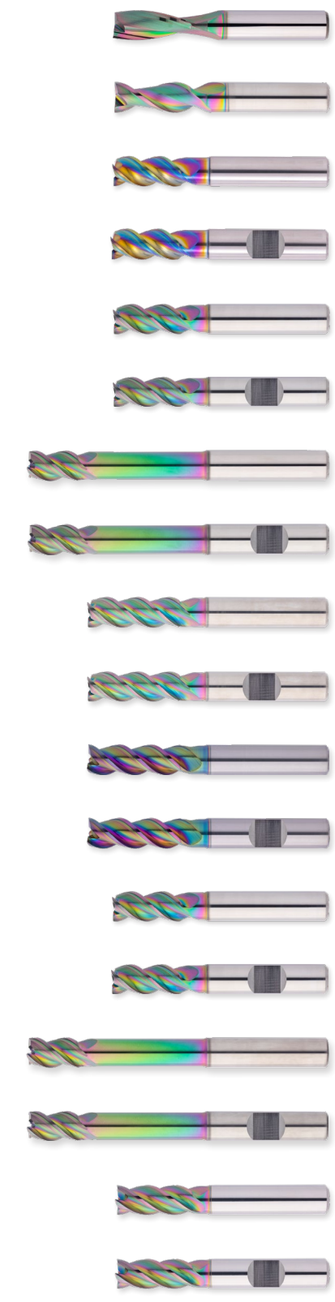
**EXN1-M01-0204** | EXN1 Performmaker Z3 2xD IC ASR 62

**EXN1-M01-0213** | EXN1 Performmaker Z3 1.5xD long IC ASR 64

**EXN1-M01-0214** | EXN1 Performmaker Z3 1.5xD long IC ASR 66

**EXN1-M01-0293** | EXN1 Performmaker Z4 2xD ASR 68

**EXN1-M01-0294** | EXN1 Performmaker Z4 2xD ASR 72

## EXN1-M02 SLOTMAKER | ROUGHING CUTTER


**EXN1-M02-0023** | EXN1 Slotmaker Z3 2xD ASR 76

**EXN1-M02-0024** | EXN1 Slotmaker Z3 2xD ASR 78

**EXN1-M02-0053** | EXN1 Slotmaker Z3 3xD ASR 80

**EXN1-M02-0054** | EXN1 Slotmaker Z3 3xD ASR 82

**EXN1-M02-0063** | EXN1 Slotmaker Z4 4xD ASR 84

**EXN1-M02-0064** | EXN1 Slotmaker Z4 4xD ASR 86

**EXN1-M02-0073** | EXN1 Slotmaker Z4 5xD ASR 88

**EXN1-M02-0074** | EXN1 Slotmaker Z4 5xD ASR 90

**EXN1-M02-0123** | EXN1 Slotmaker Z3 2xD IC ASR 92

**EXN1-M02-0124** | EXN1 Slotmaker Z3 2xD IC ASR 94

**EXN1-M02-0163** | EXN1 Slotmaker Z3 3xD IC ASR 96

**EXN1-M02-0164** | EXN1 Slotmaker Z3 3xD IC ASR 98

**EXN1-M02-0213** | EXN1 Slotmaker Z4 2xD long IC ASR 100

**EXN1-M02-0214** | EXN1 Slotmaker Z4 2xD long IC ASR 102

**EXN1-M02-0223** | EXN1 Slotmaker Z4 2xD overlong ASR 104

**EXN1-M02-0224** | EXN1 Slotmaker Z4 2xD overlong ASR 106

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## EXN1-M03 CHIPMAKER | TROCHOIDAL CUTTER


**EXN1-M03-0033** | EXN1 Chipmaker Z4 3xD ASR 108

**EXN1-M03-0034** | EXN1 Chipmaker Z4 3xD ASR 110

**EXN1-M03-0043** | EXN1 Chipmaker Z4 4xD ASR 112

**EXN1-M03-0044** | EXN1 Chipmaker Z4 4xD ASR 114

**EXN1-M03-0053** | EXN1 Chipmaker Z4 5xD ASR 116

**EXN1-M03-0054** | EXN1 Chipmaker Z4 5xD ASR 118

**EXN1-M03-0133** | EXN1 Chipmaker Z4 3.5xD IC ASR 120

## EXN1-M04 MIRRORMAKER | FINISHING CUTTER


**EXN1-M04-0033** | EXN1 Mirrormaker Z6 3xD ASR 122

**EXN1-M04-0043** | EXN1 Mirrormaker Z6 4xD ASR 124

**EXN1-M04-0053** | EXN1 Mirrormaker Z6 5xD ASR 126

**EXN1-M04-0133** | EXN1 Mirrormaker Z5 3.5xD IC ASR 128

## EXN1-M05 BALANCEMAKER | SINGLE FLUTE CUTTER


**EXN1-M05-0023** | EXN1 Balancemaker Z1 ASR 130

**EXN1-M05-0053** | EXN1 Balancemaker Z1 long ASR 132

## EXN1-M06 FORMMAKER | TORUS CUTTER


**EXN1-M06-0003** | EXN1 Formmaker Z3 2xD ASR 134

**EXN1-M06-0013** | EXN1 Formmaker Z3 1.5xD long ASR 138

**EXN1-M06-0103** | EXN1 Formmaker Z2 2xD ASR 142

**EXN1-M06-0213** | EXN1 Formmaker Z4 3xD ASR 144

## EXN1-M08 ROWMAKER | FULL RADIUS CUTTER


**EXN1-M08-0003** | EXN1 Rowmaker Z2 1xD short ASR 148

**EXN1-M08-0013** | EXN1 Rowmaker Z2 1xD long ASR 150

**EXN1-M08-0103** | EXN1 Rowmaker Z4 2xD short ASR 152

**EXN1-M08-0113** | EXN1 Rowmaker Z4 2xD long ASR 154

## EXN1-M15 PERFORMMAKER MICRO | MICRO END MILL CUTTER


**EXN1-M15-0003** | EXN1 Performmaker Micro Z2 ASR 156

## EXN1-M16 FORMMAKER MICRO | MICRO TORUS CUTTER


**EXN1-M16-0023** | EXN1 Formmaker Micro Z2 R0.05 ASR 162

**EXN1-M16-0063** | EXN1 Formmaker Micro Z2 R0.1 ASR 166

**EXN1-M16-0103** | EXN1 Formmaker Micro Z2 R0.2 ASR 172

**EXN1-M16-0143** | EXN1 Formmaker Micro Z2 R0.3 ASR 178

**EXN1-M16-0183** | EXN1 Formmaker Micro Z2 R0.5 ASR 182

## EXN1-M17 ROWMAKER MICRO | MICRO FULL RADIUS CUTTER


**EXN1-M17-0003** | EXN1 Rowmaker Micro Z2 ASR 186

**EXN1-M17-0013** | EXN1 Rowmaker Micro long Z2 ASR 190

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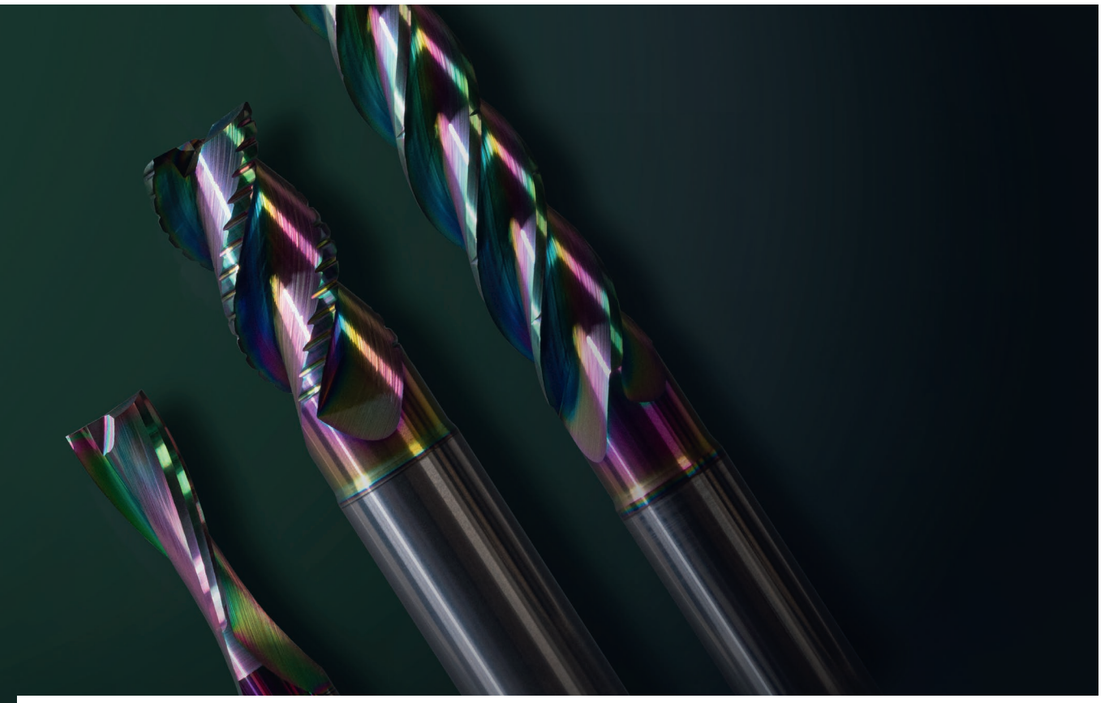
HOFMANN & VRATNY | EXN1 SERIES

# OUR EXN1 SERIES

Experts in cutting non-ferrous materials



OUR EXN1 SERIES IS RENOWNED FOR ITS PARTICULARLY IMPRESSIVE PERFORMANCE WHEN MACHINING ALUMINIUM

**Non-ferrous materials** are very versatile and range from aluminium to plastic to multi-layered materials. In spite of their easy machinability, they make extra demands on the cutting tools due to their use as a composite material or their tendency to adhesion.

**The** H&V Expert EXN1 Series was developed to enable potentially easy-to-machine materials to be safely processed and to meet the specific requirements of non-ferrous material cutting.

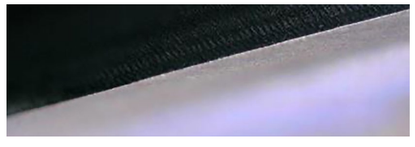
- Fine carbide grade, particularly suited to non-ferrous materials, for long-term retention of sharp edges and homogeneous wear
- Polished chip spaces for easy chip removal
- High-performance geometry tailored to volume machining and surface quality

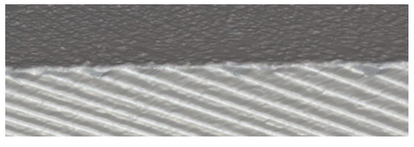
## A SPECIAL EDGE PREPARATION PROCESS ENSURES:

- Entirely homogeneous cutting edges
- Even distribution of cutting forces
- Improved surface quality of the component
- Controlled and even wear

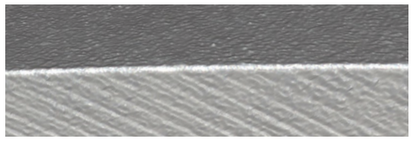
EXPERIENCE OUR EXN1 SERIES IN ACTION

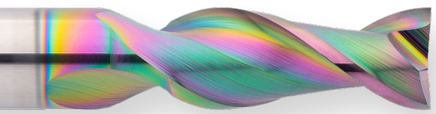
BEFORE EDGE PREPARATION





AFTER EDGE PREPARATION

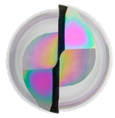




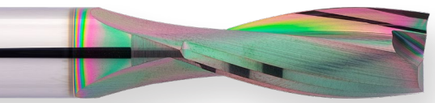
# EXPERT N1 PERFORMMAKER (M01) Z2

IN ACTION VIDEO

Customized face
for reliable ramping
and helical immersion



- Defined clearance angle for improved stability with high cutting depths
- Special helical pitch for smooth running and cutting
- Expanded chip chambers for extremely high chip volumes
- Developed for use in the high-speed range
- Available in 2xD
- Available as HA
- With ASR coating



# EXPERT N1 PERFORMMAKER (M01) Z2-3

Optimized face
for helical immersion
in all types of plastic

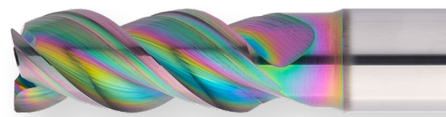
- Extra sharp cutting edges for smooth and even cutting in all types of plastic
- Highly polished chip spaces for optimized chip removal
- Special helical pitch for smooth running
- Available as HA
- Now with improved ASR coating





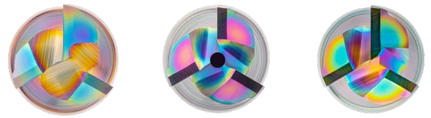
# EXPERT N1 PERFORMMAKER (M01) Z3

IN ACTION VIDEO



Customized face
for reliable ramping and
helical immersion

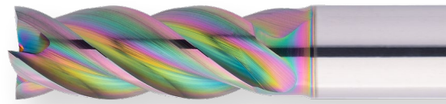
Available with and without
central internal cooling



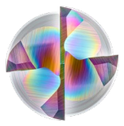
- Defined clearance angle for improved stability with high cutting depths
- Special helical pitch for smooth running and cutting
- Expanded chip chambers for extremely high chip volumes
- Available as a sharp-edged version and with edge protection
- Available in 2xD and 3xD in normal version as well as in 1,5xD in long version
- Available as HA and HB
- With ASR coating

# EXPERT N1 PERFORMMAKER (M01) Z4

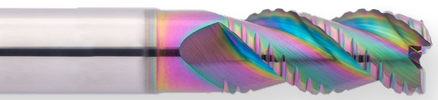
IN ACTION VIDEO



Reinforced face
with two cutting edges
to the center,
for reliable ramping and
helical immersion



- Extra large chip chambers for optimum chip removal, even with full slots and high radial depth of cutting
- Variable helical pitch for smooth running
- Special unequal tooth pitch for smooth cutting
- Available in 2xD
- Available as HA and HB
- With ASR coating

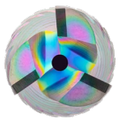


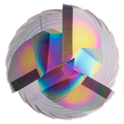
# EXPERT N1 SLOTMAKER (M02) Z3

IN ACTION VIDEO

Customized face
for reliable ramping and
helical immersion

Available with and without
central internal cooling



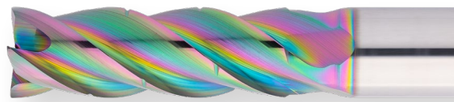


- Roughing teeth for the smallest chips in volume machining
- Special helical pitch for smooth running and cutting
- Expanded chip chambers for extremely high chip volumes
- Available in 2xD and 3xD
- Available as HA and HB
- With ASR coating

HOFMANN & VRATNY | EXN1 SERIES

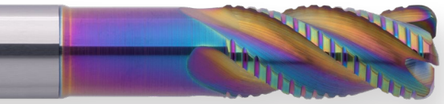
# EXPERT N1 CHIPMAKER (M03) Z4

IN ACTION VIDEO



Reinforced face
with two cutting edges
to the center,
for reliable ramping and
helical immersion

- Chip breaker for predefined chip length and preventing chip accumulations
- Customized chip chambers for optimum chip removal, even with high radial depth of cutting
- Variable helical pitch for smooth running
- Special unequal tooth pitch for smooth cutting
- Available in 3xD, 4xD and 5xD
- Available as HA and HB
- With ASR coating

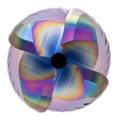


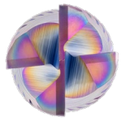
# EXPERT N1 SLOTMAKER (M02) Z4

Adapted face for process-
reliable helical plunging

Long version with internal
cooling and corner radii
up to R = 4.0 mm

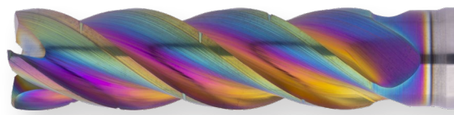
Radius tolerance depending
on corner radius
≤ 1.5 mm: ± 0.003 mm
> 1.5 mm: ± 0.005 mm





- Special roughing teeth combined with 4 cutting edges for maximum performance in volume cutting
- Adapted helical pitch for smooth running and soft cutting, even with particularly long overhang or depth infeed
- Extra large chip chambers for an extremely high chip volume
- Available in 4xD and 5xD as well as in 2xD as long and extra-long version
- Available as HA and HB
- With ASR coating

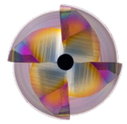
# EXPERT N1 CHIPMAKER (M03) Z4



Reinforced face for
reliable ramping and
helical immersion

With central internal cooling
and large corner radius

Radius tolerance is
determined by the
corner radius
≤ 1.5mm = ± 0.003mm
> 1.5mm = ± 0.005mm

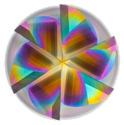


- Special aerospace design optimised for vibration-free milling and ideal chip removal for thin-walled components and complex internal machining operations
- Adapted chip breakers for defined chip length and maximum tool life
- Variable helical pitch combined with special unequal tooth pitch for smooth running and a soft cut
- Available in 3.5xD
- Available as HA
- With ASR coating

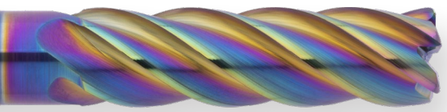
# EXPERT N1 MIRRORMAKER (M04) Z6

IN ACTION VIDEO

Face-finish-bevel
for smooth workpiece
surfaces



- Six ultra-sharp and lapped cutting edges to ensure excellent surface finishes and perfect dimensional accuracy
- Special chip chambers designed for the evacuation of particularly long and fine chips
- Variable helical pitch for smooth cutting
- Available in 3xD, 4xD and 5xD
- Available as HA
- ASR coating approved for use in the food industry

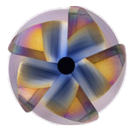


# EXPERT N1 MIRRORMAKER (M04) Z5

Face-finish bevel for smooth
workpiece surfaces

With central internal cooling
and large corner radius

Radius tolerance is
determined by the
corner radius
≤ 1.5 mm = ± 0.003 mm
> 1.5 mm = ± 0.005 mm



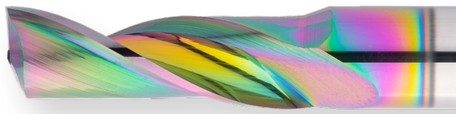
- Special aerospace design optimised for vibration-free milling and ideal chip removal for thin-walled components and complex internal machining operations
- Five ultra-sharp and lapped cutting edges ensure excellent surfaces and highest shape accuracy
- Special chip chambers designed for the removal of very long and fine chips
- Available in 3.5xD
- Available as HA
- With ASR coating



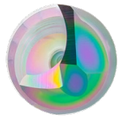


# EXPERT N1 BALANCEMAKER (M05) Z1

IN ACTION VIDEO



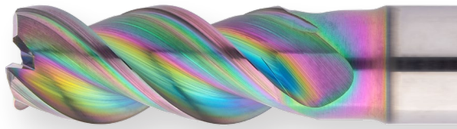
Customized face
for reliable grooving
and milling



- Defined clearance angle for improved stability with high cutting depths
- Optimized cutting geometry for smooth running and minimal imbalance
- Developed for use in the high-speed range
- Expanded chip chambers for extremely high chip volumes
- Available in normal and long versions
- Available as HA
- With ASR coating

# EXPERT N1 FORMMAKER (M06) Z3

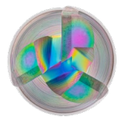
IN ACTION VIDEO



Customized face for
reliable ramping and helical
immersion

Corner radis up to R = 4.0
available for contour milling

Radius tolerance is
determined by
the corner radius
≤ 1.5 mm = ± 0.003 mm
> 1.5 mm = ± 0.005 mm



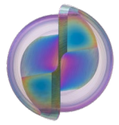
- Defined clearance angle for improved stability with high cutting depths
- Special helical pitch for smooth running and cutting
- Expanded chip chambers for extremely high chip volumes
- Available in 2xD in normal version as well as in 1.5xD in long version
- Available as HA
- With ASR coating

# EXPERT N1 FORMMAKER (M06) Z2

Customized face for reliable ramping and helical immersion

Corner radii up to R = 2.0 available for contour milling

Radius tolerance is determined by the corner radius
≤ 1.5 mm = ± 0.003 mm
> 1.5 mm = ± 0.005 mm



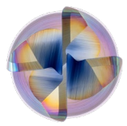
- Defined clearance angle for improved stability with high cutting depths
- Special helical pitch for smooth running and cutting
- Extra large chip chambers for extremely high chip volumes
- Developed for use in the high-speed range
- Available in 2xD
- Available as HA
- With ASR coating

# EXPERT N1 FORMMAKER (M06) Z4

Reinforced face with two cutting edges to the center, for reliable ramping and helical immersion

Corner radii up to R = 4.0 available for contour milling

Radius tolerance is determined by the corner radius
≤ 1.5 mm = ± 0.003 mm
> 1.5 mm = ± 0.005 mm



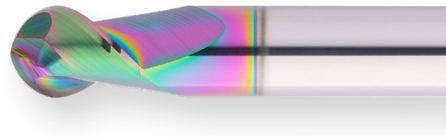
- Four cutting edges for best performance and stability
- Extra large chip chambers for optimum chip removal, even with full slots and high radial depth of cutting
- Variable helical pitch for smooth running
- Special unequal tooth pitch for smooth cutting
- Available in 3xD
- Available as HA
- With ASR coating





# EXPERT N1 ROWMAKER (M08) Z2

▶ IN ACTION VIDEO



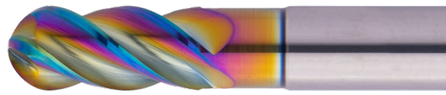
Optimized face design for excellent surface finishes and perfect dimensional accuracy when multipass milling

Radius tolerance is determined by the radius
≤ 2 mm = ± 0.003 mm
> 2 mm = ± 0.005 mm

- Developed for use in the high-speed range
- Defined microbevel for support and stabilisation
- Special chip chambers designed for optimal chip removal when roughing and finishing
- Available in 1xD in short and long versions
- Available as HA
- With ASR coating

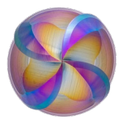
# EXPERT N1 ROWMAKER (M08) Z4

▶ IN ACTION VIDEO

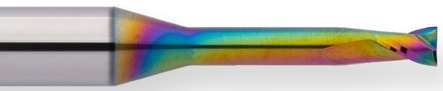


Optimized face design for excellent surface finishes and perfect dimensional accuracy when multipass milling

Radius tolerance is determined by the radius
≤ 2 mm = ± 0.003 mm
> 2 mm = ± 0.005 mm



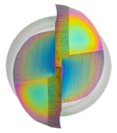
- Developed for use in the high-speed range
- Four cutting edges with defined microbevel for best dimensional accuracy at high rates of removal
- Optimized chip chambers designed for optimal chip removal when roughing and finishing
- Available in 2xD in short and long versions
- Available as HA
- With ASR coating



# EXPERT N1 PERFORMMAKER MICRO (M15) Z2

Optimized face design for excellent surface finishes and perfect dimensional accuracy

Available with cutting edges
Ø 0.2 – 2.5 mm



- Defined microbevel for support and stabilisation
- Customized core for smooth running
- Polished chip spaces for optimum chip removal
- The tightest tolerances for high-precision manufacturing
  - Clearance diameter: 0/-0.02 mm
  - Cutting diameter: -0.001/-0.006 mm
- Available as HA
- With ASR coating

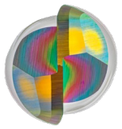
# EXPERT N1 FORMMAKER MICRO (M16) Z2

Optimized face design for excellent surface finishes and perfect dimensional accuracy when multipass milling

Available with cutting edges
Ø 0.2 – 3 mm

Available with
R=0.05 mm to R=0.5 mm

Radius tolerance
0/-0.003 mm
(measured from 0 – 90°)







# EXPERT N1 ROWMAKER MICRO (M17) Z2

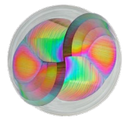
▶ IN ACTION VIDEO

- Defined microbevel for support and stabilisation
- Customized core for smooth running
- Polished chip spaces for optimum chip removal
- Available in normal and long versions
- The tightest tolerances for high-precision manufacturing
  - Clearance diameter: 0/-0.02 mm
  - Cutting diameter: -0.001/-0.006 mm
- Available as HA
- With ASR coating

Optimized face design for excellent surface finishes and perfect dimensional accuracy when multipass milling

Available with cutting edges
Ø 0.1 – 3 mm

Radius tolerance
0/-0.003 mm
(measured from 0 – 90°)



APPLICATION EXAMPLES

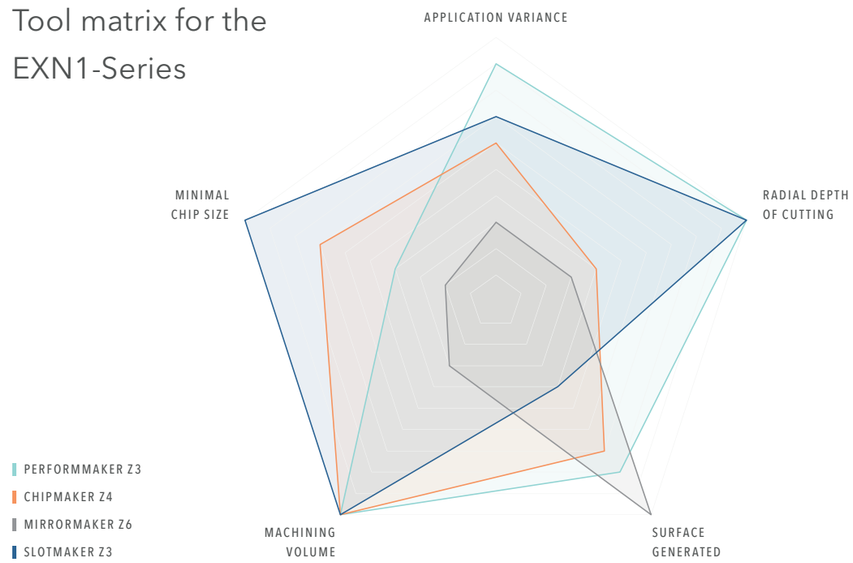
# THE EXN1 SERIES IN OPERATION

**Manufacture** of high-precision rails made of AlMg3 with 240 N/mm².
To date, the customer has been using standard aluminium milling cutters with a ZrN coating. By switching to the H&V EXN1 Series (PERFORMMAKER & MIRRORMAKER), the production time per component was able to be reduced by more than 50 %. Thanks to higher cutting depths and higher feed rates, the surface quality was also improved to a roughness (Ra) of less than 1 µm.

**EXAMPLES OF MACHINING PARAMETERS WHEN ROUGHING WITH A FULL-SLOT**
3-CUTTING EDGE END MILL CUTTER, Ø 12, 2XD

| | Ae | Ap | Fz (mm/Z) | Vc (m/min) |
|---|---|---|---|---|
| EXN1 Performmaker Z3 2XD ASR | 1xD | 1.5xD | 0.25 | 480 |
| ZrN Z3 competitor | 1xD | 1.5xD | 0.1 | 480 |
| TAC Z3 competitor | 1xD | 1.5xD | 0.12 | 480 |

## Tool matrix for the EXN1-Series



# ALPHA SLIDE RAINBOW

NEW

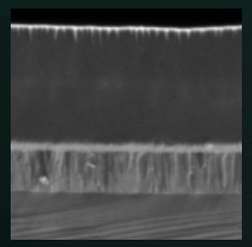
## ASR | Innovative coating – Our new coating made of tetragonal carbon

**Traditional** TAC coatings are usually characterized by their high degree of hardness, very good wear resistance and stable slide characteristics. Our previous TAC Alpha coating met all of these criteria.

**Now,** our new AlphaSlide Rainbow (ASR) takes TAC coatings to the next level. Thanks to a new coating process that completely dispenses with hydrogen, among other things, we were able to:

- Increase sp3 bonds to over 85 %
- Reduce the coating thickness to less than 1 µm
- Reduce the coating hardness to approx. 4500 HV

STRUCTURE OF THE ALPHASLIDE RAINBOW (ASR)






HOFMANN & VRATNY | EXN1 SERIES

ASR

## Improvements to the traditional TAC coating (TAC Alpha)

- Increased tool life when roughing with full slots, trimming and multipass milling
- Better surface quality of the workpiece in finishing, trimming and multipass milling
- Increased smoothness (virtually free from droplets) and thus reduced friction coefficient. Ensures optimum chip removal, even in unpolished chip spaces
- Perfect retention of the sharp cutting edges thanks to the natural geometry and defined edge preparation
- High stability of the coating and cutting edges, even in unstable machining situations (e.g. vibrations)
- Prevention of built-up edges, even in unfavourable application scenarios involving adhesive alloys

ALPHASLIDE RAINBOW ASR AT A GLANCE

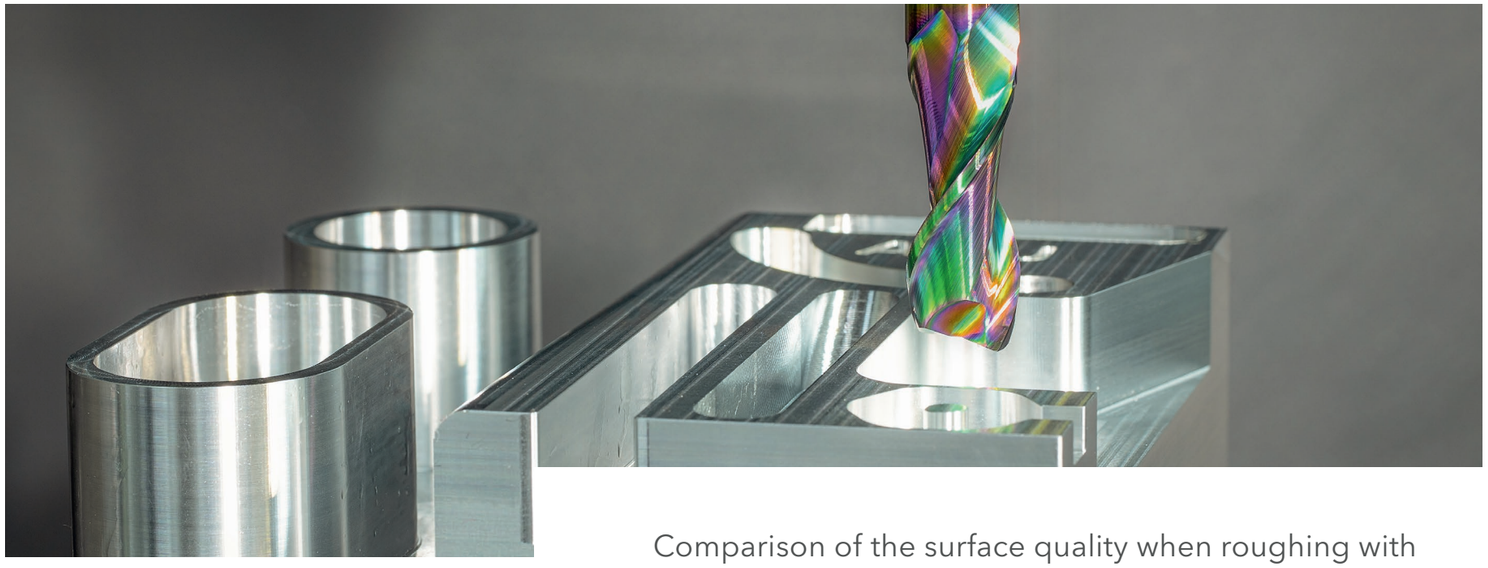
| | |
|---|---|
| **Structure** | Completely hydrogen-free |
| **Layer thickness** | < 1 µm |
| **Sp3 bonds** | > 85 % |
| **Layer hardness** | approx. 4500 HV |
| **Biocompatibility** | 100 %* |
| **Friction coefficient** | Friction coefficient: approx. 0.05 (dry on steel) |
| **Max. operating temperature** | approx. 420 – 450 °C, dry and wet |
| **Main application** | Aluminium (wrought alloys and cast alloys), plastic, copper |
| **Secondary application (limited suitability)** | CFRP/GFRP, graphite, Ti alloys and wood |

* Biocompatibility must be checked independently by the customer for the respective application

HOFMANN & VRATNY | EXN1 SERIES

OUR EXN1 SERIES

# DETAILED COATING COMPARISON



## Comparison of the tool life when roughing in AlMg3

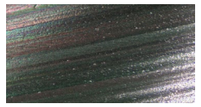
**In addition,** our new AlphaSlide Rainbow coating successfully prevailed over our previous TAC Alpha coating and the coatings of competitors in the comprehensive field test with regard to tool life.

TOOL LIFE CRITERION = BUILT-UP EDGE AND BREAKOUTS

| **EXN1-M01-0103-16** (3-cutting edge end mill cutter, Ø 16, 2xD) | **Number of components** |
|---|---|
| AlphaSlide Rainbow | 1500 |
| TAC Alpha (previous coating) | 1150 |
| TAC competitor | 1200 |
| ZrN competitor | 1050 |

| **Technical parameters for roughing** | |
|---|---|
| **Vc** | 450 m/min |
| **fz** | 0.14 mm/Z |
| **ap** | 30 mm |
| **ae** | 4 mm |
| **Tension** | Hydraulic chuck |
| **Cooling** | Cooling lubricant |

## Comparison of the surface quality when roughing with a subsequent finishing process in AlMg3



| **Measured value*** | **AlphaSlide Rainbow (ASR)** | **TAC Alpha** (previous coating) | **TAC competitor** | **ZrN competitor** |
|---|---|---|---|---|
| Straightness | 0.0012 mm | 0.0026 mm | 0.0097 mm | 0.0092 mm |
| Roughness (Ra) | 0.810 µm | 1.06 µm | 1.821 µm | 2.133 µm |

| **Technical parameters for roughing** | | **Technical parameters for finishing** | |
|---|---|---|---|
| **Vc** | 450 m/min | **Vc** | 450 m/min |
| **fz** | 0.14 mm/Z | **fz** | 0.05 mm/Z |
| **ap** | 30 mm | **ap** | 30 mm |
| **ae** | 4 mm | **ae** | 0.2 mm |
| **Tension** | Hydraulic chuck | **Tension** | Hydraulic chuck |
| **Cooling** | Cooling lubricant | | |

*Determined using a measuring sensor on the machined workpiece

# DIGITAL SERVICES

## DISTRIBUTION PARTNERS

**We** enable companies around the world to manufacture their products. Therefore we work with reliable partners all over the world to ensure that our milling cutters are always available exactly where they are needed and can be delivered straight into your hands.

FIND OUT MORE ABOUT OUR GLOBAL SALES PARTNERS

Browse all EXN1 Series products in our shop

**Discover** the products in the EXN1 Series online or search for the ideal tool for your application based on various product features. We guarantee, that you will find the perfect milling cutter for your machining needs using our online platform.

WHAT ARE YOU WAITING FOR?

## STILL CAN'T FIND A SUITABLE MILLING CUTTER?

**No problem** – simply customize an existing tool. Using our configurator for special milling cutters, you can customize existing tools to your needs in an instant or create your own tools based on predefined types.

WE WILL RESPOND TO ALL REQUESTS SUBMITTED VIA THE CONFIGURATOR WITHIN ONE WORKING DAY AT THE LATEST





# NUMBERING SYSTEM

### DISTINGUISHING FEATURES

**EX N 1 - M 01 - 0293**

**PRODUCT LINE**

- **BC** Basic
- **EX** Expert

**TOOL TYPE**

- **D** Drilling
- **M** Milling
- **T** Threading
- **R** Reaming

**TOOL VERSION**

- **M01** End mill cutter | PERFORMMAKER
- **M02** Roughing cutter | SLOTMAKER
- **M03** Trochoidal cutter | CHIPMAKER
- **M04** Finishing cutter | MIRRORMAKER
- **M05** Single flute cutter | BALANCEMAKER
- **M06** Torus cutter | FORMMAKER
- **M07** Face torus cutter | BLADEMAKER
- **M08** Full radius cutter | ROWMAKER
- **M09** Deburring cutter | CHAMFMAKER
- **M10** Forward and backward deburring cutter | FB CHAMFMAKER
- **M11** Corner rounding cutter | ROUNDMAKER
- **M12** Forward and backward corner rounding cutter | FB ROUNDMAKER
- **M13** Engraving cutter | TEXTMAKER
- **M14** Conical cutter | SLOPEMAKER
- **M15** Micro end mill cutter | PERFORMMAKER MICRO
- **M16** Micro torus cutter | FORMMAKER MICRO
- **M17** Micro full radius cutter | ROWMAKER MICRO
- **M26** Ball cutter | SMOOTHMAKER
- **M27** Chamfer cutter | BEVELMAKER
- **D01** Spiral drill | COREMAKER

**MAIN APPLICATION**

- **PK** Steel & Cast Iron
- **H** Hardened Steel
- **M** Stainless Steel
- **O** Graphite, CRP/GRP
- **T** Titanium
- **S** Superalloy
- **N** NF Material
- **U** Universal

**VERSION**

- **1** Version 1.0
- **2** Version 2.0
- **3** Version 3.0

### OTHER DISTINGUISHING FEATURES

**EX N 1 - M 01 - 0293 - 12/0,5**

**PRODUCT IDENT**

**e.g.** 0023

**DIMENSION**

- **3x10** Cutting diameter x length of undercut
- **12/0,5** Cutting diameter / corner radius
- **10** Diameter

# EXPLANATION OF CUTTING DATA

## EXAMPLE FOR SIDE MILLING OF 3.2151 WITH Ø10:

N 2.1 – N 2.3 **ALUMINIUM |** cast <600 N/mm²

| Materialnumber | Germany \| DIN | Europe \| EN | France \| AFNOR | Great Britain \| BS | Italy \| UNI | Sweden \| SIS | Spain \| UNE | Japan \| JIS | USA \| AISI |
|---|---|---|---|---|---|---|---|---|---|
| **3.1841** | G-AlCu 4 Ti | | | | | | | AC1A | A 295.0 |
| **3.1871** | G-AlCu 4 TiMg | | | | | | | | |
| **3.2131** | G-AlSiCu1 | | | | | | | | |
| **3.2151** | G-AlSi 6 Cu 4 | AC-45000 | A-S5UZ | LM 4 | | | | AC4B | A 319.0 |
| **3.2161** | G-AlSi 8 Cu 3 | AC-46200 | A-S9U3A-Y4 | LM 24 | 5075 | | | AC4D | A 328.0 |

THE MATERIAL KEY WITH DETAILED BREAKDOWN OF MATERIALS BY MATERIAL GROUP CAN BE FOUND ON PAGE 196 - 199.

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | ETC | Materialgroup Factor fz / α | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 560 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 540 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 510 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 200 | 260 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 560 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 460 | 0.7 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 410 | 0.6 | 0.7 |

OVERVIEW OF THE DIFFERENT MATERIAL GROUPS FOR THIS TOOL INCLUDING FACTORS

**Material N 1.1**

| D1 Ø | L2 mm | Immersion Angle α° | Full Slot fz (mm/Z) | Full Slot ae = 1xD (mm) | Full Slot ap = 1xD (mm) | Side Milling fz (mm/Z) | Side Milling ae = 0.3xD (mm) | Side Milling ap (mm) | Finishing fz (mm/Z) | Finishing ae (mm) | Finishing ap (mm) | ETC fz (mm/Z) | ETC ae = 0.25xD (mm) | ETC ap (mm) | ETC hmax (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 6 | 1° | 0.02 | 2 | 2 | 0.03 | 0.6 | L2max | 0.018 | 0.2 | L2max | 0.045 | 0.5 | L2max | 0.039 |
| 3 | 10 | 1° | 0.03 | 3 | 3 | 0.04 | 0.9 | L2max | 0.02 | 0.2 | L2max | 0.055 | 0.75 | L2max | 0.0476 |
| 4 | 13 | 1.2° | 0.04 | 4 | 4 | 0.05 | 1.2 | L2max | 0.021 | 0.2 | L2max | 0.07 | 1 | L2max | 0.0606 |
| 5 | 14 | 1.2° | 0.045 | 5 | 5 | 0.065 | 1.5 | L2max | 0.023 | 0.2 | L2max | 0.08 | 1.25 | L2max | 0.0693 |
| 6 | 16 | 1.5° | 0.05 | 6 | 6 | 0.07 | 1.8 | L2max | 0.025 | 0.2 | L2max | 0.1 | 1.5 | L2max | 0.0866 |
| 8 | 22 | 2° | 0.07 | 8 | 8 | 0.09 | 2.4 | L2max | 0.03 | 0.2 | L2max | 0.12 | 2 | L2max | 0.1039 |
| 10 | 25 | 2.5° | 0.09 | 10 | 10 | 0.1 | 3 | L2max | 0.035 | 0.2 | L2max | 0.14 | 2.5 | L2max | 0.1212 |
| 12 | 28 | 3° | 0.1 | 12 | 12 | 0.13 | 3.6 | L2max | 0.04 | 0.2 | L2max | 0.16 | 3 | L2max | 0.1386 |
| 16 | 36 | 4° | 0.12 | 16 | 16 | 0.15 | 4.8 | L2max | 0.045 | 0.2 | L2max | 0.18 | 4 | L2max | 0.1559 |
| 20 | 41 | 5° | 0.15 | 20 | 20 | 0.18 | 6 | L2max | 0.05 | 0.2 | L2max | 0.22 | 5 | L2max | 0.1905 |

ALL DATA GIVEN HERE IS FOR THE FIRST GROUP N1.1 IN THE MATERIAL GROUP OVERVIEW

**DETERMINATION OF CUTTING DATA:**

From the material key (page 196 - 199) results: **material group N2.1-2.3**
Vc= 450 m/min (as indicated in the table)
fz= 0.1 mm/Z (as indicated in the table) x Factor fz 0.9 = **fz 0.09 mm/Z**





VIDEO EXPLANATION

## EXAMPLE FOR ETC MILLING OF PE WITH Ø10:

N 5.1 **PLASTICS |** thermoplastics <100 N/mm²

| Materialnumber | Germany \| DIN | Europe \| EN | France \| AFNOR | Great Britain \| BS | Italy \| UNI | Sweden \| SIS | Spain \| UNE | Japan \| JIS | USA \| AISI |
|---|---|---|---|---|---|---|---|---|---|
| **PC** | Makralon | | Orgalan | Sinvet | | | | | Lexan |
| **PC** | Nuclon | | | | | | | | Merlon |
| **PC** | Plastocarbon | | | | | | | | |
| **PE** | Baylon | | | Fertene | Carlona | | | | Althon |
| **PE** | Dekalen | | | Eraclene | Escorene | | | | Bakellite |

THE MATERIAL KEY WITH DETAILED BREAKDOWN OF MATERIALS BY MATERIAL GROUP CAN BE FOUND ON PAGE 196 - 199.

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | ETC | Materialgroup Factor fz / α | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 560 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 540 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 510 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 200 | 260 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 560 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 460 | 0.7 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 410 | 0.6 | 0.7 |

OVERVIEW OF THE DIFFERENT MATERIAL GROUPS FOR THIS TOOL INCLUDING FACTORS

**Material N 1.1**

| D1 Ø | L2 mm | Immersion Angle α° | Full Slot fz (mm/Z) | Full Slot ae = 1xD (mm) | Full Slot ap = 1xD (mm) | Side Milling fz (mm/Z) | Side Milling ae = 0.3xD (mm) | Side Milling ap (mm) | Finishing fz (mm/Z) | Finishing ae (mm) | Finishing ap (mm) | ETC fz (mm/Z) | ETC ae = 0.25xD (mm) | ETC ap (mm) | ETC hmax (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 6 | 1° | 0.02 | 2 | 2 | 0.03 | 0.6 | L2max | 0.018 | 0.2 | L2max | 0.045 | 0.5 | L2max | 0.039 |
| 3 | 10 | 1° | 0.03 | 3 | 3 | 0.04 | 0.9 | L2max | 0.02 | 0.2 | L2max | 0.055 | 0.75 | L2max | 0.0476 |
| 4 | 13 | 1.2° | 0.04 | 4 | 4 | 0.05 | 1.2 | L2max | 0.021 | 0.2 | L2max | 0.07 | 1 | L2max | 0.0606 |
| 5 | 14 | 1.2° | 0.045 | 5 | 5 | 0.065 | 1.5 | L2max | 0.023 | 0.2 | L2max | 0.08 | 1.25 | L2max | 0.0693 |
| 6 | 16 | 1.5° | 0.05 | 6 | 6 | 0.07 | 1.8 | L2max | 0.025 | 0.2 | L2max | 0.1 | 1.5 | L2max | 0.0866 |
| 8 | 22 | 2° | 0.07 | 8 | 8 | 0.09 | 2.4 | L2max | 0.03 | 0.2 | L2max | 0.12 | 2 | L2max | 0.1039 |
| 10 | 25 | 2.5° | 0.09 | 10 | 10 | 0.1 | 3 | L2max | 0.035 | 0.2 | L2max | 0.14 | 2.5 | L2max | 0.1212 |
| 12 | 28 | 3° | 0.1 | 12 | 12 | 0.13 | 3.6 | L2max | 0.04 | 0.2 | L2max | 0.16 | 3 | L2max | 0.1386 |
| 16 | 36 | 4° | 0.12 | 16 | 16 | 0.15 | 4.8 | L2max | 0.045 | 0.2 | L2max | 0.18 | 4 | L2max | 0.1559 |
| 20 | 41 | 5° | 0.15 | 20 | 20 | 0.18 | 6 | L2max | 0.05 | 0.2 | L2max | 0.22 | 5 | L2max | 0.1905 |

ALL DATA GIVEN HERE IS FOR THE FIRST GROUP N1.1 IN THE MATERIAL GROUP OVERVIEW

**DETERMINATION OF CUTTING DATA:**

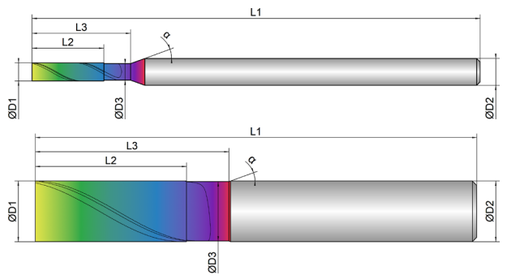
From the material key (page 196 - 199) results: **material group N5.1**
Vc= 460 m/min (as indicated in the table)
fz= 0.14 mm/Z (as indicated in the table) x Factor fz 0.7 = **fz 0.098 mm/Z**
ae= 2.5 mm (as indicated in the table) x Factor ae 0.8 = **2.0 mm ae**

| | |
|---|---|
| Cooling | |
| Tolerance | e8 |
| Coating | AlphaSlide Rainbow |

| | |
|---|---|
| Strategy | ETC HPC |
| Application | |
| Features | HA 90° |

Expert

- Extra sharp cutting edges for a smooth and soft cut in all plastics
- Highly polished chip space for optimized chip evacuation
- Special helical pitch for smooth running




| Roughing | Finishing |
|---|---|
| inappropriate — optimal | inappropriate — optimal |

| EXN1-M01-0013 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.0 | 0.9 | 5.0 | 8.0 | 50.0 | 3.0 | 2 | 20 | 20 |
| 2 | 2.0 | 1.85 | 8.0 | 11.0 | 50.0 | 3.0 | 2 | 20 | 20 |
| 3 | 3.0 | 2.8 | 11.0 | 14.0 | 50.0 | 3.0 | 2 | 20 | 20 |
| 4 | 4.0 | 3.8 | 13.0 | 16.0 | 54.0 | 4.0 | 2 | 20 | 20 |
| 5 | 5.0 | 4.8 | 15.0 | 18.0 | 54.0 | 5.0 | 2 | 20 | 20 |
| 6 | 6.0 | 5.8 | 16.0 | 21.0 | 65.0 | 6.0 | 2 | 20 | 20 |
| 8 | 8.0 | 7.8 | 22.0 | 27.0 | 70.0 | 8.0 | 2 | 20 | 20 |
| 10 | 10.0 | 9.8 | 25.0 | 32.0 | 72.0 | 10.0 | 2 | 20 | 20 |
| 12 | 12.0 | 11.8 | 28.0 | 38.0 | 83.0 | 12.0 | 3 | 20 | 20 |
| 14 | 14.0 | 13.8 | 30.0 | 42.0 | 83.0 | 14.0 | 3 | 20 | 20 |
| 16 | 16.0 | 15.8 | 36.0 | 44.0 | 92.0 | 16.0 | 3 | 20 | 20 |
| 20 | 20.0 | 19.8 | 41.0 | 54.0 | 104.0 | 20.0 | 3 | 20 | 20 |





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| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | Vc = m/min | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | | | | | | |
| 1.2 | ALUMINIUM \| alloyed | <600 | | | | | | |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | | | | | | |
| 3.1-3.3 | COPPER \| alloyed | <650 | | | | | | |
| 4.1 | MAGNESIUM \| alloyed | <250 | | | | | | |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 480 | 480 | 480 | 525 | 1 | 1 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 420 | 420 | 420 | 465 | 0.9 | 0.8 |

**ADVICE |** All fz/a values in the table for material group 5.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 5.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | Finishing | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 1 | 5 | 1° | 0.004 | 1 | 1 | 0.007 | 0.3 | L2max | 0.018 | 0.2 | L2max | 0.0098 | 0.25 | L2max | 0.0085 |
| 2 | 8 | 1° | 0.006 | 2 | 2 | 0.01 | 0.6 | L2max | 0.02 | 0.2 | L2max | 0.014 | 0.5 | L2max | 0.0121 |
| 3 | 11 | 1.2° | 0.008 | 3 | 3 | 0.012 | 0.9 | L2max | 0.021 | 0.2 | L2max | 0.0168 | 0.75 | L2max | 0.0145 |
| 4 | 13 | 1.2° | 0.012 | 4 | 4 | 0.02 | 1.2 | L2max | 0.023 | 0.2 | L2max | 0.028 | 1 | L2max | 0.0242 |
| 5 | 15 | 1.5° | 0.015 | 5 | 5 | 0.025 | 1.5 | L2max | 0.025 | 0.2 | L2max | 0.035 | 1.25 | L2max | 0.0303 |
| 6 | 16 | 2° | 0.025 | 6 | 6 | 0.04 | 1.8 | L2max | 0.03 | 0.2 | L2max | 0.056 | 1.5 | L2max | 0.0485 |
| 8 | 22 | 2.5° | 0.03 | 8 | 8 | 0.05 | 2.4 | L2max | 0.035 | 0.2 | L2max | 0.07 | 2 | L2max | 0.0606 |
| 10 | 25 | 3° | 0.04 | 10 | 10 | 0.055 | 3 | L2max | 0.04 | 0.2 | L2max | 0.077 | 2.5 | L2max | 0.0667 |
| 12 | 28 | 4° | 0.048 | 12 | 12 | 0.075 | 3.6 | L2max | 0.045 | 0.2 | L2max | 0.105 | 3 | L2max | 0.0909 |
| 14 | 30 | 4.5° | 0.05 | 14 | 14 | 0.085 | 4.2 | L2max | 0.048 | 0.2 | L2max | 0.119 | 3.5 | L2max | 0.1031 |
| 16 | 36 | 5° | 0.055 | 16 | 16 | 0.09 | 4.8 | L2max | 0.05 | 0.2 | L2max | 0.126 | 4 | L2max | 0.1091 |
| 20 | 41 | 5° | 0.06 | 20 | 20 | 0.11 | 6 | L2max | 0.055 | 0.2 | L2max | 0.154 | 5 | L2max | 0.1334 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

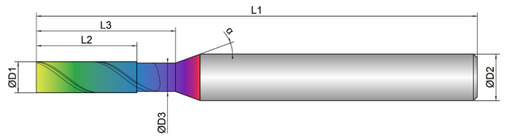
| | |
|---|---|
| Strategy | ETC, HSC, HPC |
| Application | |
| Features | HA, 2xD, 90° |

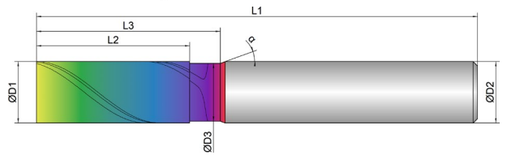
Expert

- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For roughing and finishing, up to 1.5xD full slot
- For process reliable, helical diving and immersion

- For use in high speed milling machines




| Roughing | Finishing |
|---|---|
| inappropriate — optimal | inappropriate — optimal |

| EXN1-M01-0043 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.0 | 0.9 | 3.0 | 5.0 | 57.0 | 6.0 | 2 | 38 | 20 |
| 2 | 2.0 | 1.8 | 6.0 | 8.0 | 57.0 | 6.0 | 2 | 38 | 20 |
| 3 | 3.0 | 2.8 | 8.0 | 13.0 | 57.0 | 6.0 | 2 | 38 | 20 |
| 4 | 4.0 | 3.7 | 13.0 | 18.0 | 57.0 | 6.0 | 2 | 38 | 20 |
| 6 | 6.0 | 5.5 | 16.0 | 21.0 | 57.0 | 6.0 | 2 | 38 | 20 |
| 8 | 8.0 | 7.5 | 22.0 | 27.0 | 63.0 | 8.0 | 2 | 38 | 20 |
| 10 | 10.0 | 9.4 | 25.0 | 30.0 | 72.0 | 10.0 | 2 | 38 | 20 |
| 12 | 12.0 | 11.4 | 28.0 | 33.0 | 83.0 | 12.0 | 2 | 38 | 20 |
| 16 | 16.0 | 15.4 | 36.0 | 41.0 | 92.0 | 16.0 | 2 | 38 | 20 |
| 20 | 20.0 | 19.4 | 41.0 | 51.0 | 104.0 | 20.0 | 2 | 38 | 20 |



EXN1-M01-0043 | EXN1 PERFORMMAKER Z2 2XD ASR

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| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | Vc = m/min | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 560 | 1 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 540 | 1 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 510 | 0.9 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 200 | 200 | 200 | 260 | 0.8 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 560 | 1 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 460 | 0.7 | 0.8 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 410 | 0.6 | 0.7 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 Ø | L2 mm | Immersion Angle a° | Full Slot fz (mm/Z) | Full Slot ae = 1xD (mm) | Full Slot ap = 1xD (mm) | Side Milling fz (mm/Z) | Side Milling ae = 0.3xD (mm) | Side Milling ap (mm) | Finishing fz (mm/Z) | Finishing ae (mm) | Finishing ap (mm) | ETC fz (mm/Z) | ETC ae = 0.25xD (mm) | ETC ap (mm) | ETC hmax (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 1° | 0.018 | 1 | 1 | 0.025 | 0.3 | L2max | 0.018 | 0.2 | L2max | 0.035 | 0.25 | L2max | 0.0303 |
| 2 | 6 | 1° | 0.025 | 2 | 2 | 0.035 | 0.6 | L2max | 0.02 | 0.2 | L2max | 0.05 | 0.5 | L2max | 0.0433 |
| 3 | 8 | 1.2° | 0.035 | 3 | 3 | 0.05 | 0.9 | L2max | 0.021 | 0.2 | L2max | 0.07 | 0.75 | L2max | 0.0606 |
| 4 | 13 | 1.2° | 0.05 | 4 | 4 | 0.06 | 1.2 | L2max | 0.023 | 0.2 | L2max | 0.08 | 1 | L2max | 0.0693 |
| 6 | 16 | 1.5° | 0.06 | 6 | 6 | 0.08 | 1.8 | L2max | 0.025 | 0.2 | L2max | 0.11 | 1.5 | L2max | 0.0953 |
| 8 | 22 | 2° | 0.08 | 8 | 8 | 0.09 | 2.4 | L2max | 0.03 | 0.2 | L2max | 0.12 | 2 | L2max | 0.1039 |
| 10 | 25 | 2.5° | 0.09 | 10 | 10 | 0.11 | 3 | L2max | 0.035 | 0.2 | L2max | 0.14 | 2.5 | L2max | 0.1212 |
| 12 | 28 | 3° | 0.1 | 12 | 12 | 0.13 | 3.6 | L2max | 0.04 | 0.2 | L2max | 0.16 | 3 | L2max | 0.1386 |
| 16 | 36 | 4° | 0.14 | 16 | 16 | 0.16 | 4.8 | L2max | 0.045 | 0.2 | L2max | 0.19 | 4 | L2max | 0.1645 |
| 20 | 41 | 5° | 0.18 | 20 | 20 | 0.2 | 6 | L2max | 0.05 | 0.2 | L2max | 0.23 | 5 | L2max | 0.1992 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

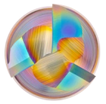
| | |
|---|---|
| Strategy | ETC HPC |
| Application | |
| Features | HA ≠ 2xD 90° |

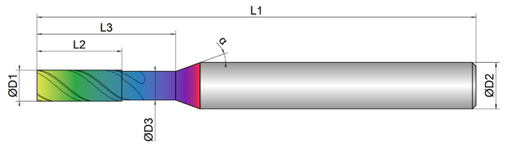
Expert

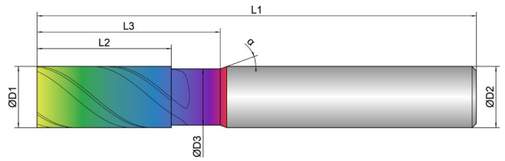
- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For process reliable, helical diving and immersion
- For roughing and finishing, up to 2xD full slot

- Sharp-edged version without edge protection






**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M01-0093 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 2.0 | 1.8 | 6.0 | 12.0 | 57.0 | 6.0 | 3 | 45 | 20 |
| 3 | 3.0 | 2.7 | 8.0 | 14.0 | 57.0 | 6.0 | 3 | 45 | 20 |
| 4 | 4.0 | 3.7 | 11.0 | 16.0 | 57.0 | 6.0 | 3 | 45 | 20 |
| 5 | 5.0 | 4.7 | 13.0 | 18.0 | 57.0 | 6.0 | 3 | 45 | 20 |
| 6 | 6.0 | 5.7 | 13.0 | 20.0 | 57.0 | 6.0 | 3 | 45 | 20 |
| 8 | 8.0 | 7.4 | 21.0 | 26.0 | 63.0 | 8.0 | 3 | 45 | 20 |
| 10 | 10.0 | 9.2 | 22.0 | 31.0 | 72.0 | 10.0 | 3 | 45 | 20 |
| 12 | 12.0 | 11.0 | 26.0 | 37.0 | 83.0 | 12.0 | 3 | 45 | 20 |
| 16 | 16.0 | 15.0 | 36.0 | 43.0 | 92.0 | 16.0 | 3 | 45 | 20 |
| 20 | 20.0 | 19.0 | 41.0 | 53.0 | 104.0 | 20.0 | 3 | 45 | 20 |



EXN1-M01-0093 | EXN1 PERFORMMAKER Z3 2XD ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | Vc = m/min | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 560 | 1 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 540 | 1 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 510 | 0.9 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 200 | 200 | 200 | 260 | 0.8 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 560 | 1 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 460 | 0.7 | 0.8 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 410 | 0.6 | 0.7 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | Finishing | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 2 | 6 | 1° | 0.025 | 2 | 2 | 0.04 | 0.6 | L2max | 0.018 | 0.2 | L2max | 0.06 | 0.5 | L2max | 0.052 |
| 3 | 8 | 1° | 0.04 | 3 | 3 | 0.05 | 0.9 | L2max | 0.02 | 0.2 | L2max | 0.07 | 0.75 | L2max | 0.0606 |
| 4 | 11 | 1.2° | 0.05 | 4 | 4 | 0.06 | 1.2 | L2max | 0.021 | 0.2 | L2max | 0.08 | 1 | L2max | 0.0693 |
| 5 | 13 | 1.2° | 0.055 | 5 | 5 | 0.07 | 1.5 | L2max | 0.023 | 0.2 | L2max | 0.09 | 1.25 | L2max | 0.0779 |
| 6 | 13 | 1.5° | 0.06 | 6 | 6 | 0.08 | 1.8 | L2max | 0.025 | 0.2 | L2max | 0.11 | 1.5 | L2max | 0.0953 |
| 8 | 21 | 2° | 0.08 | 8 | 8 | 0.09 | 2.4 | L2max | 0.03 | 0.2 | L2max | 0.12 | 2 | L2max | 0.1039 |
| 10 | 22 | 2.5° | 0.09 | 10 | 10 | 0.11 | 3 | L2max | 0.035 | 0.2 | L2max | 0.14 | 2.5 | L2max | 0.1212 |
| 12 | 26 | 3° | 0.1 | 12 | 12 | 0.13 | 3.6 | L2max | 0.04 | 0.2 | L2max | 0.16 | 3 | L2max | 0.1386 |
| 16 | 36 | 4° | 0.14 | 16 | 16 | 0.16 | 4.8 | L2max | 0.045 | 0.2 | L2max | 0.19 | 4 | L2max | 0.1645 |
| 20 | 41 | 5° | 0.18 | 20 | 20 | 0.2 | 6 | L2max | 0.05 | 0.2 | L2max | 0.23 | 5 | L2max | 0.1992 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

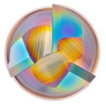
| | |
|---|---|
| Strategy | ETC HPC |
| Application | |
| Features | HB ≠ 2xD 90° |

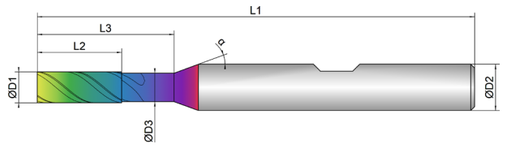
Expert

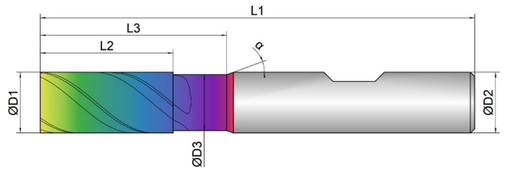
- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For process reliable, helical diving and immersion
- For roughing and finishing, up to 2xD full slot

- Sharp-edged version without edge protection






**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M01-0094 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|
| **2** | 2.0 | 1.8 | 6.0 | 12.0 | 57.0 | 6.0 | 3 | 45 | 20 |
| **3** | 3.0 | 2.7 | 8.0 | 14.0 | 57.0 | 6.0 | 3 | 45 | 20 |
| **4** | 4.0 | 3.7 | 11.0 | 16.0 | 57.0 | 6.0 | 3 | 45 | 20 |
| **5** | 5.0 | 4.7 | 13.0 | 18.0 | 57.0 | 6.0 | 3 | 45 | 20 |
| **6** | 6.0 | 5.7 | 13.0 | 20.0 | 57.0 | 6.0 | 3 | 45 | 20 |
| **8** | 8.0 | 7.4 | 21.0 | 26.0 | 63.0 | 8.0 | 3 | 45 | 20 |
| **10** | 10.0 | 9.2 | 22.0 | 31.0 | 72.0 | 10.0 | 3 | 45 | 20 |
| **12** | 12.0 | 11.0 | 26.0 | 37.0 | 83.0 | 12.0 | 3 | 45 | 20 |
| **16** | 16.0 | 15.0 | 36.0 | 43.0 | 92.0 | 16.0 | 3 | 45 | 20 |
| **20** | 20.0 | 19.0 | 41.0 | 53.0 | 104.0 | 20.0 | 3 | 45 | 20 |



EXN1-M01-0094 | EXN1 PERFORMMAKER Z3 2XD ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 560 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 540 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 510 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 200 | 260 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 560 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 460 | 0.7 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 410 | 0.6 | 0.7 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | Finishing | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 2 | 6 | 1° | 0.025 | 2 | 2 | 0.04 | 0.6 | L2max | 0.018 | 0.2 | L2max | 0.06 | 0.5 | L2max | 0.052 |
| 3 | 8 | 1° | 0.04 | 3 | 3 | 0.05 | 0.9 | L2max | 0.02 | 0.2 | L2max | 0.07 | 0.75 | L2max | 0.0606 |
| 4 | 11 | 1.2° | 0.05 | 4 | 4 | 0.06 | 1.2 | L2max | 0.021 | 0.2 | L2max | 0.08 | 1 | L2max | 0.0693 |
| 5 | 13 | 1.2° | 0.055 | 5 | 5 | 0.07 | 1.5 | L2max | 0.023 | 0.2 | L2max | 0.09 | 1.25 | L2max | 0.0779 |
| 6 | 13 | 1.5° | 0.06 | 6 | 6 | 0.08 | 1.8 | L2max | 0.025 | 0.2 | L2max | 0.11 | 1.5 | L2max | 0.0953 |
| 8 | 21 | 2° | 0.08 | 8 | 8 | 0.09 | 2.4 | L2max | 0.03 | 0.2 | L2max | 0.12 | 2 | L2max | 0.1039 |
| 10 | 22 | 2.5° | 0.09 | 10 | 10 | 0.11 | 3 | L2max | 0.035 | 0.2 | L2max | 0.14 | 2.5 | L2max | 0.1212 |
| 12 | 26 | 3° | 0.1 | 12 | 12 | 0.13 | 3.6 | L2max | 0.04 | 0.2 | L2max | 0.16 | 3 | L2max | 0.1386 |
| 16 | 36 | 4° | 0.14 | 16 | 16 | 0.16 | 4.8 | L2max | 0.045 | 0.2 | L2max | 0.19 | 4 | L2max | 0.1645 |
| 20 | 41 | 5° | 0.18 | 20 | 20 | 0.2 | 6 | L2max | 0.05 | 0.2 | L2max | 0.23 | 5 | L2max | 0.1992 |

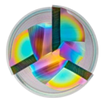
| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

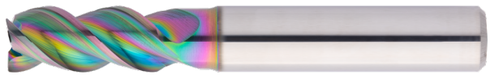
| | |
|---|---|
| Strategy | ETC HPC |
| Application | |
| Features | HA ≠ 2xD 45° |

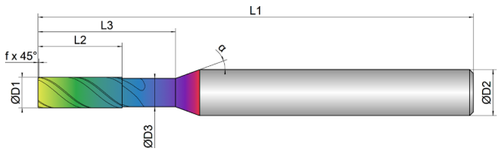
Expert

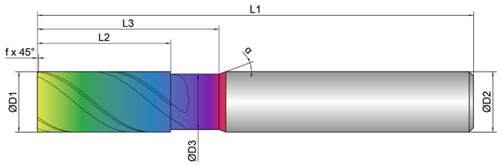
- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For process reliable, helical diving and immersion
- For roughing and finishing, up to 2xD full slot








**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M01-0103 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | 45° mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| **2** | 2.0 | 1.8 | 5.0 | 10.0 | 57.0 | 6.0 | 3 | 0.05 | 45 | 20 |
| **3** | 3.0 | 2.7 | 8.0 | 12.0 | 57.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| **4** | 4.0 | 3.7 | 11.0 | 18.0 | 57.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| **5** | 5.0 | 4.7 | 13.0 | 18.0 | 57.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| **6** | 6.0 | 5.7 | 13.0 | 18.0 | 57.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| **8** | 8.0 | 7.4 | 21.0 | 25.0 | 63.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| **10** | 10.0 | 9.2 | 22.0 | 30.0 | 72.0 | 10.0 | 3 | 0.20 | 45 | 20 |
| **12** | 12.0 | 11.0 | 26.0 | 36.0 | 83.0 | 12.0 | 3 | 0.20 | 45 | 20 |
| **16** | 16.0 | 15.0 | 36.0 | 42.0 | 92.0 | 16.0 | 3 | 0.20 | 45 | 20 |
| **20** | 20.0 | 19.0 | 41.0 | 52.0 | 104.0 | 20.0 | 3 | 0.20 | 45 | 20 |



EXN1-M01-0103 | EXN1 PERFORMMAKER Z3 2XD ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 560 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 540 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 510 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 200 | 260 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 560 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 460 | 0.7 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 410 | 0.6 | 0.7 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | Finishing | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 2 | 5 | 1° | 0.025 | 2 | 2 | 0.04 | 0.6 | L2max | 0.018 | 0.2 | L2max | 0.06 | 0.5 | L2max | 0.052 |
| 3 | 8 | 1° | 0.04 | 3 | 3 | 0.05 | 0.9 | L2max | 0.02 | 0.2 | L2max | 0.07 | 0.75 | L2max | 0.0606 |
| 4 | 11 | 1.2° | 0.05 | 4 | 4 | 0.06 | 1.2 | L2max | 0.021 | 0.2 | L2max | 0.08 | 1 | L2max | 0.0693 |
| 5 | 13 | 1.2° | 0.055 | 5 | 5 | 0.07 | 1.5 | L2max | 0.023 | 0.2 | L2max | 0.09 | 1.25 | L2max | 0.0779 |
| 6 | 13 | 1.5° | 0.06 | 6 | 6 | 0.08 | 1.8 | L2max | 0.025 | 0.2 | L2max | 0.11 | 1.5 | L2max | 0.0953 |
| 8 | 21 | 2° | 0.08 | 8 | 8 | 0.09 | 2.4 | L2max | 0.03 | 0.2 | L2max | 0.12 | 2 | L2max | 0.1039 |
| 10 | 22 | 2.5° | 0.09 | 10 | 10 | 0.11 | 3 | L2max | 0.035 | 0.2 | L2max | 0.14 | 2.5 | L2max | 0.1212 |
| 12 | 26 | 3° | 0.1 | 12 | 12 | 0.13 | 3.6 | L2max | 0.04 | 0.2 | L2max | 0.16 | 3 | L2max | 0.1386 |
| 16 | 36 | 4° | 0.14 | 16 | 16 | 0.16 | 4.8 | L2max | 0.045 | 0.2 | L2max | 0.19 | 4 | L2max | 0.1645 |
| 20 | 41 | 5° | 0.18 | 20 | 20 | 0.2 | 6 | L2max | 0.05 | 0.2 | L2max | 0.23 | 5 | L2max | 0.1992 |

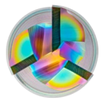
| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

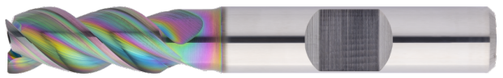
| | |
|---|---|
| Strategy | ETC HPC |
| Application | |
| Features | HB ≠ 2xD 45° |

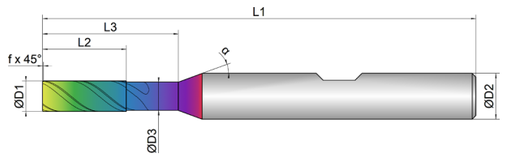
Expert

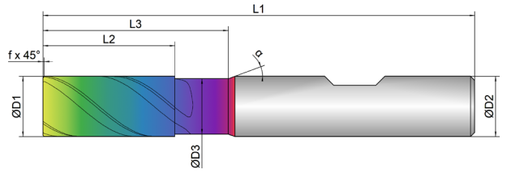
- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For process reliable, helical diving and immersion
- For roughing and finishing, up to 2xD full slot








**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M01-0104 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | 45° mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 2.0 | 1.8 | 5.0 | 10.0 | 57.0 | 6.0 | 3 | 0.05 | 45 | 20 |
| 3 | 3.0 | 2.7 | 8.0 | 12.0 | 57.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| 4 | 4.0 | 3.7 | 11.0 | 18.0 | 57.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| 5 | 5.0 | 4.7 | 13.0 | 18.0 | 57.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| 6 | 6.0 | 5.7 | 13.0 | 18.0 | 57.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| 8 | 8.0 | 7.4 | 21.0 | 25.0 | 63.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| 10 | 10.0 | 9.2 | 22.0 | 30.0 | 72.0 | 10.0 | 3 | 0.20 | 45 | 20 |
| 12 | 12.0 | 11.0 | 26.0 | 36.0 | 83.0 | 12.0 | 3 | 0.20 | 45 | 20 |
| 16 | 16.0 | 15.0 | 36.0 | 42.0 | 92.0 | 16.0 | 3 | 0.20 | 45 | 20 |
| 20 | 20.0 | 19.0 | 41.0 | 52.0 | 104.0 | 20.0 | 3 | 0.20 | 45 | 20 |



EXN1-M01-0104 | EXN1 PERFORMMAKER Z3 2XD ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | Vc = m/min | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 560 | 1 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 540 | 1 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 510 | 0,9 | 0,8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 200 | 200 | 200 | 260 | 0,8 | 0,7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 560 | 1 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 460 | 0,7 | 0,8 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 410 | 0,6 | 0,7 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | Finishing | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0,3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) | fz (mm/Z) | ae = 0,25xD (mm) | ap (mm) | hmax (mm) |
| 2 | 5 | 1° | 0,025 | 2 | 2 | 0,04 | 0,6 | L2max | 0,018 | 0,2 | L2max | 0,06 | 0,5 | L2max | 0,052 |
| 3 | 8 | 1° | 0,04 | 3 | 3 | 0,05 | 0,9 | L2max | 0,02 | 0,2 | L2max | 0,07 | 0,75 | L2max | 0,0606 |
| 4 | 11 | 1,2° | 0,05 | 4 | 4 | 0,06 | 1,2 | L2max | 0,021 | 0,2 | L2max | 0,08 | 1 | L2max | 0,0693 |
| 5 | 13 | 1,2° | 0,055 | 5 | 5 | 0,07 | 1,5 | L2max | 0,023 | 0,2 | L2max | 0,09 | 1,25 | L2max | 0,0779 |
| 6 | 13 | 1,5° | 0,06 | 6 | 6 | 0,08 | 1,8 | L2max | 0,025 | 0,2 | L2max | 0,11 | 1,5 | L2max | 0,0953 |
| 8 | 21 | 2° | 0,08 | 8 | 8 | 0,09 | 2,4 | L2max | 0,03 | 0,2 | L2max | 0,12 | 2 | L2max | 0,1039 |
| 10 | 22 | 2,5° | 0,09 | 10 | 10 | 0,11 | 3 | L2max | 0,035 | 0,2 | L2max | 0,14 | 2,5 | L2max | 0,1212 |
| 12 | 26 | 3° | 0,1 | 12 | 12 | 0,13 | 3,6 | L2max | 0,04 | 0,2 | L2max | 0,16 | 3 | L2max | 0,1386 |
| 16 | 36 | 4° | 0,14 | 16 | 16 | 0,16 | 4,8 | L2max | 0,045 | 0,2 | L2max | 0,19 | 4 | L2max | 0,1645 |
| 20 | 41 | 5° | 0,18 | 20 | 20 | 0,2 | 6 | L2max | 0,05 | 0,2 | L2max | 0,23 | 5 | L2max | 0,1992 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

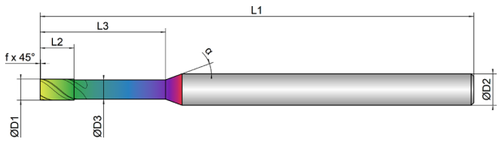
| | |
|---|---|
| Strategy | HPC |
| Application | |
| Features | HA, ≠, 1,5xD, 45° |

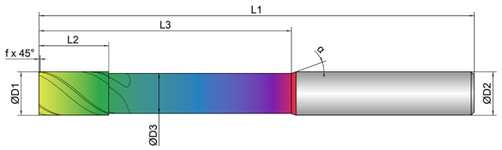
Expert

- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For process reliable, helical diving and immersion
- For roughing and finishing

- Long version for deeper cavities




**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M01-0113 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | 45° mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 2.0 | 1.8 | 4.0 | 13.0 | 83.0 | 6.0 | 3 | 0.05 | 45 | 20 |
| 3 | 3.0 | 2.7 | 5.0 | 18.0 | 83.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| 4 | 4.0 | 3.7 | 6.5 | 24.0 | 83.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| 5 | 5.0 | 4.7 | 8.0 | 30.0 | 83.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| 6 | 6.0 | 5.7 | 10.0 | 42.0 | 83.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| 8 | 8.0 | 7.4 | 13.0 | 62.0 | 100.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| 10 | 10.0 | 9.2 | 16.0 | 58.0 | 100.0 | 10.0 | 3 | 0.20 | 45 | 20 |
| 12 | 12.0 | 11.0 | 19.0 | 73.0 | 120.0 | 12.0 | 3 | 0.20 | 45 | 20 |
| 16 | 16.0 | 15.0 | 25.0 | 100.0 | 150.0 | 16.0 | 3 | 0.20 | 45 | 20 |
| 20 | 20.0 | 19.0 | 32.0 | 98.0 | 150.0 | 20.0 | 3 | 0.20 | 45 | 20 |



EXN1-M01-0113 | EXN1 PERFORMMAKER Z3 1.5XD LONG ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | Materialgroup Factor fz / a |
|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 280 | 280 | 280 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 260 | 260 | 260 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 240 | 240 | 240 | 0.9 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 120 | 120 | 120 | 0.8 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 280 | 280 | 280 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 200 | 200 | 200 | 0.7 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 170 | 170 | 170 | 0.6 |

**ADVICE |** All fz/α values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 Ø | L2 mm | Immersion Angle α° | Full Slot fz (mm/Z) | Full Slot ae = 1xD (mm) | Full Slot ap = 1xD (mm) | Side Milling fz (mm/Z) | Side Milling ae = 0.3xD (mm) | Side Milling ap (mm) | Finishing fz (mm/Z) | Finishing ae (mm) | Finishing ap (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 4 | 1° | 0.012 | 2 | 2 | 0.03 | 0.6 | L2max | 0.018 | 0.2 | L2max |
| 3 | 5 | 1° | 0.02 | 3 | 3 | 0.04 | 0.9 | L2max | 0.02 | 0.2 | L2max |
| 4 | 6.5 | 1.2° | 0.025 | 4 | 4 | 0.05 | 1.2 | L2max | 0.021 | 0.2 | L2max |
| 5 | 8 | 1.2° | 0.035 | 5 | 5 | 0.065 | 1.5 | L2max | 0.023 | 0.2 | L2max |
| 6 | 10 | 1.5° | 0.04 | 6 | 6 | 0.07 | 1.8 | L2max | 0.025 | 0.2 | L2max |
| 8 | 13 | 2° | 0.045 | 8 | 8 | 0.075 | 2.4 | L2max | 0.03 | 0.2 | L2max |
| 10 | 16 | 2.5° | 0.05 | 10 | 10 | 0.09 | 3 | L2max | 0.035 | 0.2 | L2max |
| 12 | 19 | 3° | 0.055 | 12 | 12 | 0.1 | 3.6 | L2max | 0.04 | 0.2 | L2max |
| 16 | 25 | 4° | 0.06 | 16 | 16 | 0.12 | 4.8 | L2max | 0.045 | 0.2 | L2max |
| 20 | 32 | 5° | 0.07 | 20 | 20 | 0.14 | 6 | L2max | 0.05 | 0.2 | L2max |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

| | |
|---|---|
| Strategy | HPC |
| Application | |
| Features | HB, ≠, 1,5xD, 45° |

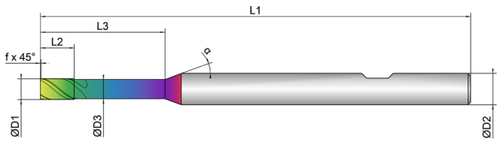
Expert

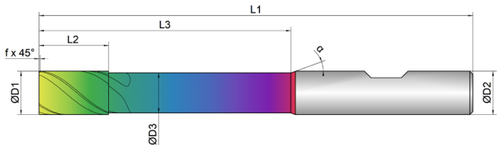
Download Catalog Pages (PDF)

- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For process reliable, helical diving and immersion
- For roughing and finishing

- Long version for deeper cavities




**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M01-0114 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | 45° mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| **2** | 2.0 | 1.8 | 4.0 | 13.0 | 83.0 | 6.0 | 3 | 0.05 | 45 | 20 |
| **3** | 3.0 | 2.7 | 5.0 | 18.0 | 83.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| **4** | 4.0 | 3.7 | 6.5 | 24.0 | 83.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| **5** | 5.0 | 4.7 | 8.0 | 30.0 | 83.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| **6** | 6.0 | 5.7 | 10.0 | 42.0 | 83.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| **8** | 8.0 | 7.4 | 13.0 | 62.0 | 100.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| **10** | 10.0 | 9.2 | 16.0 | 58.0 | 100.0 | 10.0 | 3 | 0.20 | 45 | 20 |
| **12** | 12.0 | 11.0 | 19.0 | 73.0 | 120.0 | 12.0 | 3 | 0.20 | 45 | 20 |
| **16** | 16.0 | 15.0 | 25.0 | 100.0 | 150.0 | 16.0 | 3 | 0.20 | 45 | 20 |
| **20** | 20.0 | 19.0 | 32.0 | 98.0 | 150.0 | 20.0 | 3 | 0.20 | 45 | 20 |



EXN1-M01-0114 | EXN1 PERFORMMAKER Z3 1.5XD LONG ASR

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | Materialgroup Factor fz / a |
|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 280 | 280 | 280 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 260 | 260 | 260 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 240 | 240 | 240 | 0.9 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 120 | 120 | 120 | 0.8 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 280 | 280 | 280 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 200 | 200 | 200 | 0.7 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 170 | 170 | 170 | 0.6 |

**ADVICE |** All fz/α values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 Ø | L2 mm | Immersion Angle α° | Full Slot fz (mm/Z) | Full Slot ae = 1xD (mm) | Full Slot ap = 1xD (mm) | Side Milling fz (mm/Z) | Side Milling ae = 0.3xD (mm) | Side Milling ap (mm) | Finishing fz (mm/Z) | Finishing ae (mm) | Finishing ap (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 4 | 1° | 0.012 | 2 | 2 | 0.03 | 0.6 | L2max | 0.018 | 0.2 | L2max |
| 3 | 5 | 1° | 0.02 | 3 | 3 | 0.04 | 0.9 | L2max | 0.02 | 0.2 | L2max |
| 4 | 6.5 | 1.2° | 0.025 | 4 | 4 | 0.05 | 1.2 | L2max | 0.021 | 0.2 | L2max |
| 5 | 8 | 1.2° | 0.035 | 5 | 5 | 0.065 | 1.5 | L2max | 0.023 | 0.2 | L2max |
| 6 | 10 | 1.5° | 0.04 | 6 | 6 | 0.07 | 1.8 | L2max | 0.025 | 0.2 | L2max |
| 8 | 13 | 2° | 0.045 | 8 | 8 | 0.075 | 2.4 | L2max | 0.03 | 0.2 | L2max |
| 10 | 16 | 2.5° | 0.05 | 10 | 10 | 0.09 | 3 | L2max | 0.035 | 0.2 | L2max |
| 12 | 19 | 3° | 0.055 | 12 | 12 | 0.1 | 3.6 | L2max | 0.04 | 0.2 | L2max |
| 16 | 25 | 4° | 0.06 | 16 | 16 | 0.12 | 4.8 | L2max | 0.045 | 0.2 | L2max |
| 20 | 32 | 5° | 0.07 | 20 | 20 | 0.14 | 6 | L2max | 0.05 | 0.2 | L2max |

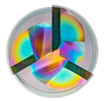
| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

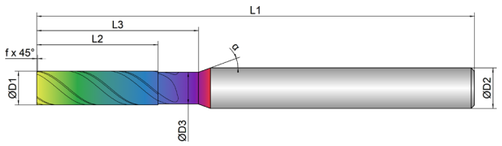
| | |
|---|---|
| Strategy | ETC HPC |
| Application | |
| Features | HA ≠ 3xD 45° |

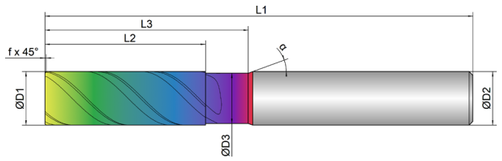
Expert

- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For process reliable, helical diving and immersion
- For roughing and finishing






**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M01-0123 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | 45° mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 2.0 | 1.8 | 7.0 | 12.0 | 65.0 | 6.0 | 3 | 0.05 | 45 | 20 |
| 3 | 3.0 | 2.7 | 10.0 | 14.0 | 65.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| 4 | 4.0 | 3.7 | 13.0 | 18.0 | 65.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| 5 | 5.0 | 4.7 | 18.0 | 24.0 | 65.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| 6 | 6.0 | 5.5 | 20.0 | 24.0 | 65.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| 8 | 8.0 | 7.5 | 26.0 | 30.0 | 70.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| 10 | 10.0 | 9.4 | 30.0 | 38.0 | 80.0 | 10.0 | 3 | 0.20 | 45 | 20 |
| 12 | 12.0 | 11.4 | 36.0 | 46.0 | 93.0 | 12.0 | 3 | 0.20 | 45 | 20 |
| 16 | 16.0 | 15.4 | 48.0 | 58.0 | 110.0 | 16.0 | 3 | 0.20 | 45 | 20 |
| 20 | 20.0 | 19.4 | 60.0 | 74.0 | 125.0 | 20.0 | 3 | 0.20 | 45 | 20 |



EXN1-M01-0123 | EXN1 PERFORMMAKER Z3 3XD ASR

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| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | Vc = m/min | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 560 | 1 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 540 | 1 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 510 | 0.9 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 200 | 200 | 200 | 260 | 0.8 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 560 | 1 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 460 | 0.7 | 0.8 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 410 | 0.6 | 0.7 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | Finishing | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 2 | 7 | 1° | 0.02 | 2 | 2 | 0.03 | 0.6 | L2max | 0.018 | 0.2 | L2max | 0.045 | 0.5 | L2max | 0.039 |
| 3 | 10 | 1° | 0.025 | 3 | 3 | 0.04 | 0.9 | L2max | 0.02 | 0.2 | L2max | 0.055 | 0.75 | L2max | 0.0476 |
| 4 | 13 | 1.2° | 0.035 | 4 | 4 | 0.05 | 1.2 | L2max | 0.021 | 0.2 | L2max | 0.07 | 1 | L2max | 0.0606 |
| 5 | 18 | 1.2° | 0.045 | 5 | 5 | 0.06 | 1.5 | L2max | 0.023 | 0.2 | L2max | 0.08 | 1.25 | L2max | 0.0693 |
| 6 | 20 | 1.5° | 0.05 | 6 | 6 | 0.07 | 1.8 | L2max | 0.025 | 0.2 | L2max | 0.1 | 1.5 | L2max | 0.0866 |
| 8 | 26 | 2° | 0.07 | 8 | 8 | 0.08 | 2.4 | L2max | 0.03 | 0.2 | L2max | 0.11 | 2 | L2max | 0.0953 |
| 10 | 30 | 2.5° | 0.08 | 10 | 10 | 0.1 | 3 | L2max | 0.035 | 0.2 | L2max | 0.13 | 2.5 | L2max | 0.1126 |
| 12 | 36 | 3° | 0.09 | 12 | 12 | 0.12 | 3.6 | L2max | 0.04 | 0.2 | L2max | 0.15 | 3 | L2max | 0.1299 |
| 16 | 48 | 4° | 0.13 | 16 | 16 | 0.14 | 4.8 | L2max | 0.045 | 0.2 | L2max | 0.17 | 4 | L2max | 0.1472 |
| 20 | 60 | 5° | 0.16 | 20 | 20 | 0.18 | 6 | L2max | 0.05 | 0.2 | L2max | 0.21 | 5 | L2max | 0.1819 |

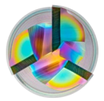
| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

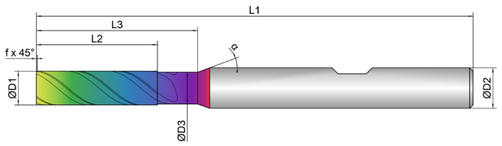
| | |
|---|---|
| Strategy | ETC HPC |
| Application | |
| Features | HB ≠ 3xD 45° |

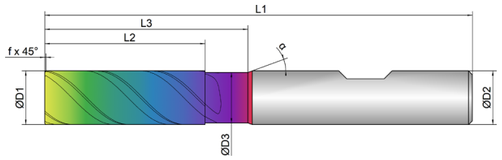
Expert

- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For process reliable, helical diving and immersion
- For roughing and finishing






**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M01-0124 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | 45° mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 2.0 | 1.8 | 7.0 | 12.0 | 65.0 | 6.0 | 3 | 0.05 | 45 | 20 |
| 3 | 3.0 | 2.7 | 10.0 | 14.0 | 65.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| 4 | 4.0 | 3.7 | 13.0 | 18.0 | 65.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| 5 | 5.0 | 4.7 | 18.0 | 24.0 | 65.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| 6 | 6.0 | 5.5 | 20.0 | 24.0 | 65.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| 8 | 8.0 | 7.5 | 26.0 | 30.0 | 70.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| 10 | 10.0 | 9.4 | 30.0 | 38.0 | 80.0 | 10.0 | 3 | 0.20 | 45 | 20 |
| 12 | 12.0 | 11.4 | 36.0 | 46.0 | 93.0 | 12.0 | 3 | 0.20 | 45 | 20 |
| 16 | 16.0 | 15.4 | 48.0 | 58.0 | 110.0 | 16.0 | 3 | 0.20 | 45 | 20 |
| 20 | 20.0 | 19.4 | 60.0 | 74.0 | 125.0 | 20.0 | 3 | 0.20 | 45 | 20 |



EXN1-M01-0124 | EXN1 PERFORMMAKER Z3 3XD ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | Vc = m/min | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 560 | 1 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 540 | 1 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 510 | 0.9 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 200 | 200 | 200 | 260 | 0.8 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 560 | 1 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 460 | 0.7 | 0.8 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 410 | 0.6 | 0.7 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | Finishing | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 2 | 7 | 1° | 0.02 | 2 | 2 | 0.03 | 0.6 | L2max | 0.018 | 0.2 | L2max | 0.045 | 0.5 | L2max | 0.039 |
| 3 | 10 | 1° | 0.025 | 3 | 3 | 0.04 | 0.9 | L2max | 0.02 | 0.2 | L2max | 0.055 | 0.75 | L2max | 0.0476 |
| 4 | 13 | 1.2° | 0.035 | 4 | 4 | 0.05 | 1.2 | L2max | 0.021 | 0.2 | L2max | 0.07 | 1 | L2max | 0.0606 |
| 5 | 18 | 1.2° | 0.045 | 5 | 5 | 0.06 | 1.5 | L2max | 0.023 | 0.2 | L2max | 0.08 | 1.25 | L2max | 0.0693 |
| 6 | 20 | 1.5° | 0.05 | 6 | 6 | 0.07 | 1.8 | L2max | 0.025 | 0.2 | L2max | 0.1 | 1.5 | L2max | 0.0866 |
| 8 | 26 | 2° | 0.07 | 8 | 8 | 0.08 | 2.4 | L2max | 0.03 | 0.2 | L2max | 0.11 | 2 | L2max | 0.0953 |
| 10 | 30 | 2.5° | 0.08 | 10 | 10 | 0.1 | 3 | L2max | 0.035 | 0.2 | L2max | 0.13 | 2.5 | L2max | 0.1126 |
| 12 | 36 | 3° | 0.09 | 12 | 12 | 0.12 | 3.6 | L2max | 0.04 | 0.2 | L2max | 0.15 | 3 | L2max | 0.1299 |
| 16 | 48 | 4° | 0.13 | 16 | 16 | 0.14 | 4.8 | L2max | 0.045 | 0.2 | L2max | 0.17 | 4 | L2max | 0.1472 |
| 20 | 60 | 5° | 0.16 | 20 | 20 | 0.18 | 6 | L2max | 0.05 | 0.2 | L2max | 0.21 | 5 | L2max | 0.1819 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

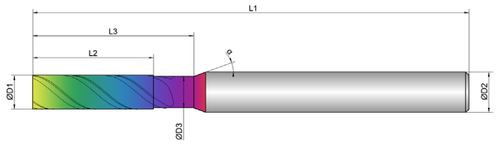
| | |
|---|---|
| Strategy | ETC HPC |
| Application | |
| Features | HA ≠ 3xD 90° |

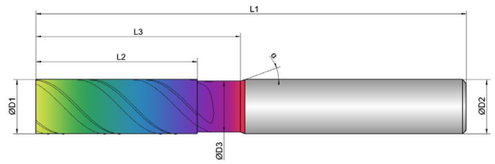
Expert

- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For process reliable, helical diving and immersion
- For roughing and finishing

- Sharp-edged version without edge protection




**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M01-0133 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|
| **2** | 2.0 | 1.8 | 7.0 | 12.0 | 65.0 | 6.0 | 3 | 45 | 20 |
| **3** | 3.0 | 2.7 | 10.0 | 14.0 | 65.0 | 6.0 | 3 | 45 | 20 |
| **4** | 4.0 | 3.7 | 13.0 | 18.0 | 65.0 | 6.0 | 3 | 45 | 20 |
| **5** | 5.0 | 4.7 | 18.0 | 24.0 | 65.0 | 6.0 | 3 | 45 | 20 |
| **6** | 6.0 | 5.5 | 20.0 | 24.0 | 65.0 | 6.0 | 3 | 45 | 20 |
| **8** | 8.0 | 7.5 | 26.0 | 30.0 | 70.0 | 8.0 | 3 | 45 | 20 |
| **10** | 10.0 | 9.4 | 30.0 | 38.0 | 80.0 | 10.0 | 3 | 45 | 20 |
| **12** | 12.0 | 11.4 | 36.0 | 46.0 | 93.0 | 12.0 | 3 | 45 | 20 |
| **16** | 16.0 | 15.4 | 48.0 | 58.0 | 110.0 | 16.0 | 3 | 45 | 20 |
| **20** | 20.0 | 19.4 | 60.0 | 74.0 | 125.0 | 20.0 | 3 | 45 | 20 |



EXN1-M01-0133 | EXN1 PERFORMMAKER Z3 3XD ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | Vc = m/min | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 560 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 540 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 510 | 0,9 | 0,8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 200 | 260 | 0,8 | 0,7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 560 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 460 | 0,7 | 0,8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 410 | 0,6 | 0,7 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 Ø | L2 mm | Immersion Angle a° | Full Slot fz (mm/Z) | Full Slot ae = 1xD (mm) | Full Slot ap = 1xD (mm) | Side Milling fz (mm/Z) | Side Milling ae = 0.3xD (mm) | Side Milling ap (mm) | Finishing fz (mm/Z) | Finishing ae (mm) | Finishing ap (mm) | ETC fz (mm/Z) | ETC ae = 0.25xD (mm) | ETC ap (mm) | ETC hmax (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 7 | 1° | 0.02 | 2 | 2 | 0.03 | 0.6 | L2max | 0.018 | 0.2 | L2max | 0.045 | 0.5 | L2max | 0.039 |
| 3 | 10 | 1° | 0.025 | 3 | 3 | 0.04 | 0.9 | L2max | 0.02 | 0.2 | L2max | 0.055 | 0.75 | L2max | 0.0476 |
| 4 | 13 | 1.2° | 0.035 | 4 | 4 | 0.05 | 1.2 | L2max | 0.021 | 0.2 | L2max | 0.07 | 1 | L2max | 0.0606 |
| 5 | 18 | 1.2° | 0.045 | 5 | 5 | 0.06 | 1.5 | L2max | 0.023 | 0.2 | L2max | 0.08 | 1.25 | L2max | 0.0693 |
| 6 | 20 | 1.5° | 0.05 | 6 | 6 | 0.07 | 1.8 | L2max | 0.025 | 0.2 | L2max | 0.1 | 1.5 | L2max | 0.0866 |
| 8 | 26 | 2° | 0.07 | 8 | 8 | 0.08 | 2.4 | L2max | 0.03 | 0.2 | L2max | 0.11 | 2 | L2max | 0.0953 |
| 10 | 30 | 2.5° | 0.08 | 10 | 10 | 0.1 | 3 | L2max | 0.035 | 0.2 | L2max | 0.13 | 2.5 | L2max | 0.1126 |
| 12 | 36 | 3° | 0.09 | 12 | 12 | 0.12 | 3.6 | L2max | 0.04 | 0.2 | L2max | 0.15 | 3 | L2max | 0.1299 |
| 16 | 48 | 4° | 0.13 | 16 | 16 | 0.14 | 4.8 | L2max | 0.045 | 0.2 | L2max | 0.17 | 4 | L2max | 0.1472 |
| 20 | 60 | 5° | 0.16 | 20 | 20 | 0.18 | 6 | L2max | 0.05 | 0.2 | L2max | 0.21 | 5 | L2max | 0.1819 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

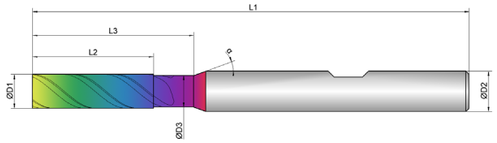
| | |
|---|---|
| Strategy | ETC, HPC |
| Application | |
| Features | HB, ≠, 3xD, 90° |

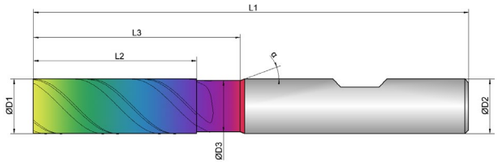
Expert

- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For process reliable, helical diving and immersion
- For roughing and finishing

- Sharp-edged version without edge protection




**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M01-0134 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|
| **2** | 2.0 | 1.8 | 7.0 | 12.0 | 65.0 | 6.0 | 3 | 45 | 20 |
| **3** | 3.0 | 2.7 | 10.0 | 14.0 | 65.0 | 6.0 | 3 | 45 | 20 |
| **4** | 4.0 | 3.7 | 13.0 | 18.0 | 65.0 | 6.0 | 3 | 45 | 20 |
| **5** | 5.0 | 4.7 | 18.0 | 24.0 | 65.0 | 6.0 | 3 | 45 | 20 |
| **6** | 6.0 | 5.5 | 20.0 | 24.0 | 65.0 | 6.0 | 3 | 45 | 20 |
| **8** | 8.0 | 7.5 | 26.0 | 30.0 | 70.0 | 8.0 | 3 | 45 | 20 |
| **10** | 10.0 | 9.4 | 30.0 | 38.0 | 80.0 | 10.0 | 3 | 45 | 20 |
| **12** | 12.0 | 11.4 | 36.0 | 46.0 | 93.0 | 12.0 | 3 | 45 | 20 |
| **16** | 16.0 | 15.4 | 48.0 | 58.0 | 110.0 | 16.0 | 3 | 45 | 20 |
| **20** | 20.0 | 19.4 | 60.0 | 74.0 | 125.0 | 20.0 | 3 | 45 | 20 |



EXN1-M01-0134 | EXN1 PERFORMMAKER Z3 3XD ASR

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| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | Vc = m/min | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 560 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 540 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 510 | 0,9 | 0,8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 200 | 260 | 0,8 | 0,7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 560 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 460 | 0,7 | 0,8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 410 | 0,6 | 0,7 |

**ADVICE |** All fz/α values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | Finishing | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | α° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 2 | 7 | 1° | 0.02 | 2 | 2 | 0.03 | 0.6 | L2max | 0.018 | 0.2 | L2max | 0.045 | 0.5 | L2max | 0.039 |
| 3 | 10 | 1° | 0.025 | 3 | 3 | 0.04 | 0.9 | L2max | 0.02 | 0.2 | L2max | 0.055 | 0.75 | L2max | 0.0476 |
| 4 | 13 | 1.2° | 0.035 | 4 | 4 | 0.05 | 1.2 | L2max | 0.021 | 0.2 | L2max | 0.07 | 1 | L2max | 0.0606 |
| 5 | 18 | 1.2° | 0.045 | 5 | 5 | 0.06 | 1.5 | L2max | 0.023 | 0.2 | L2max | 0.08 | 1.25 | L2max | 0.0693 |
| 6 | 20 | 1.5° | 0.05 | 6 | 6 | 0.07 | 1.8 | L2max | 0.025 | 0.2 | L2max | 0.1 | 1.5 | L2max | 0.0866 |
| 8 | 26 | 2° | 0.07 | 8 | 8 | 0.08 | 2.4 | L2max | 0.03 | 0.2 | L2max | 0.11 | 2 | L2max | 0.0953 |
| 10 | 30 | 2.5° | 0.08 | 10 | 10 | 0.1 | 3 | L2max | 0.035 | 0.2 | L2max | 0.13 | 2.5 | L2max | 0.1126 |
| 12 | 36 | 3° | 0.09 | 12 | 12 | 0.12 | 3.6 | L2max | 0.04 | 0.2 | L2max | 0.15 | 3 | L2max | 0.1299 |
| 16 | 48 | 4° | 0.13 | 16 | 16 | 0.14 | 4.8 | L2max | 0.045 | 0.2 | L2max | 0.17 | 4 | L2max | 0.1472 |
| 20 | 60 | 5° | 0.16 | 20 | 20 | 0.18 | 6 | L2max | 0.05 | 0.2 | L2max | 0.21 | 5 | L2max | 0.1819 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

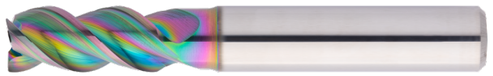
| | |
|---|---|
| Strategy | ETC, HPC |
| Application | |
| Features | HA, ≠, 2xD, 45° |

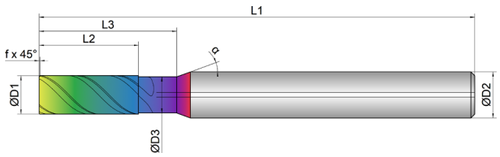
Expert

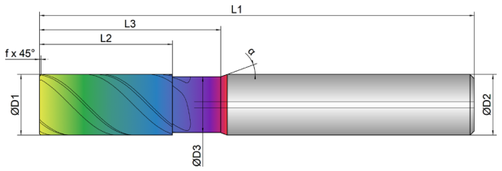
- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For process reliable, helical diving and immersion
- For roughing and finishing, up to 2xD full slot

- With central inner cooling






**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M01-0203 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | 45° mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| **5** | 5.0 | 4.7 | 13.0 | 18.0 | 57.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| **6** | 6.0 | 5.7 | 13.0 | 18.0 | 57.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| **8** | 8.0 | 7.4 | 21.0 | 25.0 | 63.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| **10** | 10.0 | 9.2 | 22.0 | 30.0 | 72.0 | 10.0 | 3 | 0.20 | 45 | 20 |
| **12** | 12.0 | 11.0 | 26.0 | 36.0 | 83.0 | 12.0 | 3 | 0.20 | 45 | 20 |
| **16** | 16.0 | 15.0 | 36.0 | 42.0 | 92.0 | 16.0 | 3 | 0.20 | 45 | 20 |
| **20** | 20.0 | 19.0 | 41.0 | 52.0 | 104.0 | 20.0 | 3 | 0.20 | 45 | 20 |



EXN1-M01-0203 | EXN1 PERFORMMAKER Z3 2XD IC ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 560 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 540 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 510 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 200 | 260 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 560 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 460 | 0.7 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 410 | 0.6 | 0.7 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | Finishing | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 5 | 13 | 1.2° | 0.055 | 5 | 5 | 0.07 | 1.5 | L2max | 0.023 | 0.2 | L2max | 0.09 | 1.25 | L2max | 0.0779 |
| 6 | 13 | 1.5° | 0.06 | 6 | 6 | 0.08 | 1.8 | L2max | 0.025 | 0.2 | L2max | 0.11 | 1.5 | L2max | 0.0953 |
| 8 | 21 | 2° | 0.08 | 8 | 8 | 0.09 | 2.4 | L2max | 0.03 | 0.2 | L2max | 0.12 | 2 | L2max | 0.1039 |
| 10 | 22 | 2.5° | 0.09 | 10 | 10 | 0.11 | 3 | L2max | 0.035 | 0.2 | L2max | 0.14 | 2.5 | L2max | 0.1212 |
| 12 | 26 | 3° | 0.1 | 12 | 12 | 0.13 | 3.6 | L2max | 0.04 | 0.2 | L2max | 0.16 | 3 | L2max | 0.1386 |
| 16 | 36 | 4° | 0.14 | 16 | 16 | 0.16 | 4.8 | L2max | 0.045 | 0.2 | L2max | 0.19 | 4 | L2max | 0.1645 |
| 20 | 41 | 5° | 0.18 | 20 | 20 | 0.2 | 6 | L2max | 0.05 | 0.2 | L2max | 0.23 | 5 | L2max | 0.1992 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

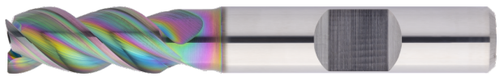
| | |
|---|---|
| Strategy | ETC HPC |
| Application | |
| Features | HB ≠ 2xD 45° |

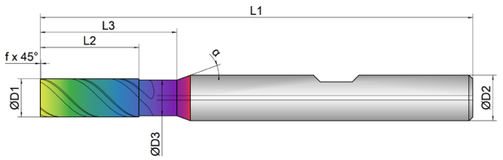
Expert

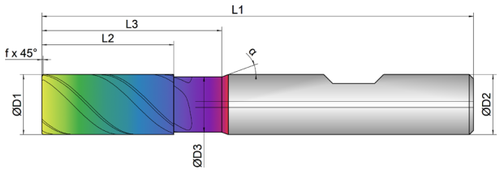
- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For process reliable, helical diving and immersion
- For roughing and finishing, up to 2xD full slot

- With central inner cooling






**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M01-0204 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | 45° mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| **5** | 5.0 | 4.7 | 13.0 | 18.0 | 57.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| **6** | 6.0 | 5.7 | 13.0 | 18.0 | 57.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| **8** | 8.0 | 7.4 | 21.0 | 25.0 | 63.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| **10** | 10.0 | 9.2 | 22.0 | 30.0 | 72.0 | 10.0 | 3 | 0.20 | 45 | 20 |
| **12** | 12.0 | 11.0 | 26.0 | 36.0 | 83.0 | 12.0 | 3 | 0.20 | 45 | 20 |
| **16** | 16.0 | 15.0 | 36.0 | 42.0 | 92.0 | 16.0 | 3 | 0.20 | 45 | 20 |
| **20** | 20.0 | 19.0 | 41.0 | 52.0 | 104.0 | 20.0 | 3 | 0.20 | 45 | 20 |



EXN1-M01-0204 | EXN1 PERFORMMAKER Z3 2XD IC ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 560 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 540 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 510 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 200 | 260 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 560 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 460 | 0.7 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 410 | 0.6 | 0.7 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | Finishing | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 5 | 13 | 1.2° | 0.055 | 5 | 5 | 0.07 | 1.5 | L2max | 0.023 | 0.2 | L2max | 0.09 | 1.25 | L2max | 0.0779 |
| 6 | 13 | 1.5° | 0.06 | 6 | 6 | 0.08 | 1.8 | L2max | 0.025 | 0.2 | L2max | 0.11 | 1.5 | L2max | 0.0953 |
| 8 | 21 | 2° | 0.08 | 8 | 8 | 0.09 | 2.4 | L2max | 0.03 | 0.2 | L2max | 0.12 | 2 | L2max | 0.1039 |
| 10 | 22 | 2.5° | 0.09 | 10 | 10 | 0.11 | 3 | L2max | 0.035 | 0.2 | L2max | 0.14 | 2.5 | L2max | 0.1212 |
| 12 | 26 | 3° | 0.1 | 12 | 12 | 0.13 | 3.6 | L2max | 0.04 | 0.2 | L2max | 0.16 | 3 | L2max | 0.1386 |
| 16 | 36 | 4° | 0.14 | 16 | 16 | 0.16 | 4.8 | L2max | 0.045 | 0.2 | L2max | 0.19 | 4 | L2max | 0.1645 |
| 20 | 41 | 5° | 0.18 | 20 | 20 | 0.2 | 6 | L2max | 0.05 | 0.2 | L2max | 0.23 | 5 | L2max | 0.1992 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

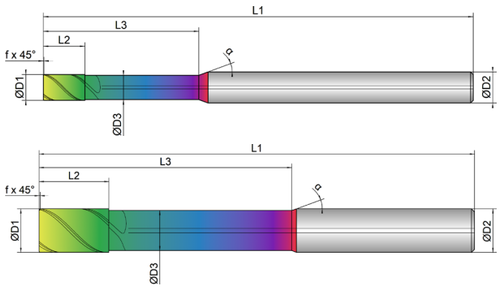
| | |
|---|---|
| Strategy | HPC |
| Application | |
| Features | HA, ≠, 1,5xD, 45° |

Expert

- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For process reliable, helical diving and immersion
- For roughing and finishing

- With central inner cooling
- Long version for deeper cavities




**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M01-0213 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | 45° mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| **5** | 5.0 | 4.7 | 8.0 | 30.0 | 83.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| **6** | 6.0 | 5.7 | 10.0 | 42.0 | 83.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| **8** | 8.0 | 7.4 | 13.0 | 62.0 | 100.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| **10** | 10.0 | 9.2 | 16.0 | 58.0 | 100.0 | 10.0 | 3 | 0.20 | 45 | 20 |
| **12** | 12.0 | 11.0 | 19.0 | 73.0 | 119.0 | 12.0 | 3 | 0.20 | 45 | 20 |
| **16** | 16.0 | 15.0 | 25.0 | 100.0 | 150.0 | 16.0 | 3 | 0.20 | 45 | 20 |
| **20** | 20.0 | 19.0 | 32.0 | 98.0 | 150.0 | 20.0 | 3 | 0.20 | 45 | 20 |



EXN1-M01-0213 | EXN1 PERFORMMAKER Z3 1,5XD LONG IC ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | Materialgroup Factor fz / a |
|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 280 | 280 | 280 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 260 | 260 | 260 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 240 | 240 | 240 | 0.9 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 120 | 120 | 120 | 0.8 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 280 | 280 | 280 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 200 | 200 | 200 | 0.7 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 170 | 170 | 170 | 0.6 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 Ø | L2 mm | Immersion Angle a° | Full Slot fz (mm/Z) | Full Slot ae = 1xD (mm) | Full Slot ap = 1xD (mm) | Side Milling fz (mm/Z) | Side Milling ae = 0.3xD (mm) | Side Milling ap (mm) | Finishing fz (mm/Z) | Finishing ae (mm) | Finishing ap (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 8 | 1.2° | 0.035 | 5 | 5 | 0.065 | 1.5 | L2max | 0.023 | 0.2 | L2max |
| 6 | 10 | 1.5° | 0.04 | 6 | 6 | 0.07 | 1.8 | L2max | 0.025 | 0.2 | L2max |
| 8 | 13 | 2° | 0.045 | 8 | 8 | 0.075 | 2.4 | L2max | 0.03 | 0.2 | L2max |
| 10 | 16 | 2.5° | 0.05 | 10 | 10 | 0.09 | 3 | L2max | 0.035 | 0.2 | L2max |
| 12 | 19 | 3° | 0.055 | 12 | 12 | 0.1 | 3.6 | L2max | 0.04 | 0.2 | L2max |
| 16 | 25 | 4° | 0.06 | 16 | 16 | 0.12 | 4.8 | L2max | 0.045 | 0.2 | L2max |
| 20 | 32 | 5° | 0.07 | 20 | 20 | 0.14 | 6 | L2max | 0.05 | 0.2 | L2max |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

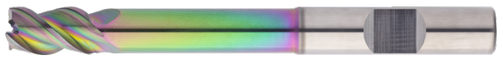
| | |
|---|---|
| Strategy | HPC |
| Application | |
| Features | HB, ≠, 1,5xD, 45° |

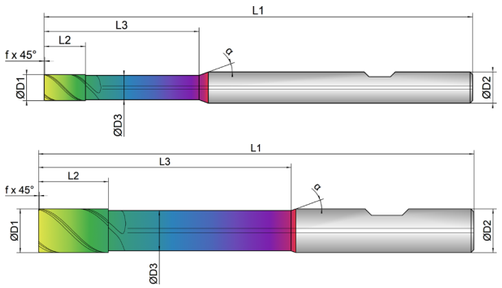
Expert

- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For process reliable, helical diving and immersion
- For roughing and finishing

- With central inner cooling
- Long version for deeper cavities






**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M01-0214 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | 45° mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| **5** | 5.0 | 4.7 | 8.0 | 30.0 | 83.0 | 6.0 | 3 | 0.10 | 45 | 20 |
| **6** | 6.0 | 5.7 | 10.0 | 42.0 | 83.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| **8** | 8.0 | 7.4 | 13.0 | 62.0 | 100.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| **10** | 10.0 | 9.2 | 16.0 | 58.0 | 100.0 | 10.0 | 3 | 0.20 | 45 | 20 |
| **12** | 12.0 | 11.0 | 19.0 | 73.0 | 119.0 | 12.0 | 3 | 0.20 | 45 | 20 |
| **16** | 16.0 | 15.0 | 25.0 | 100.0 | 150.0 | 16.0 | 3 | 0.20 | 45 | 20 |
| **20** | 20.0 | 19.0 | 32.0 | 98.0 | 150.0 | 20.0 | 3 | 0.20 | 45 | 20 |



EXN1-M01-0214 | EXN1 PERFORMMAKER Z3 1,5XD LONG IC ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | Materialgroup Factor fz / a |
|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 280 | 280 | 280 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 260 | 260 | 260 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 240 | 240 | 240 | 0.9 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 120 | 120 | 120 | 0.8 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 280 | 280 | 280 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 200 | 200 | 200 | 0.7 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 170 | 170 | 170 | 0.6 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | Finishing | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) |
| 5 | 8 | 1.2° | 0.035 | 5 | 5 | 0.065 | 1.5 | L2max | 0.023 | 0.2 | L2max |
| 6 | 10 | 1.5° | 0.04 | 6 | 6 | 0.07 | 1.8 | L2max | 0.025 | 0.2 | L2max |
| 8 | 13 | 2° | 0.045 | 8 | 8 | 0.075 | 2.4 | L2max | 0.03 | 0.2 | L2max |
| 10 | 16 | 2.5° | 0.05 | 10 | 10 | 0.09 | 3 | L2max | 0.035 | 0.2 | L2max |
| 12 | 19 | 3° | 0.055 | 12 | 12 | 0.1 | 3.6 | L2max | 0.04 | 0.2 | L2max |
| 16 | 25 | 4° | 0.06 | 16 | 16 | 0.12 | 4.8 | L2max | 0.045 | 0.2 | L2max |
| 20 | 32 | 5° | 0.07 | 20 | 20 | 0.14 | 6 | L2max | 0.05 | 0.2 | L2max |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

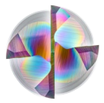
| | |
|---|---|
| Strategy | ETC HPC |
| Application | |
| Features | HA ≠ 2xD 90° |

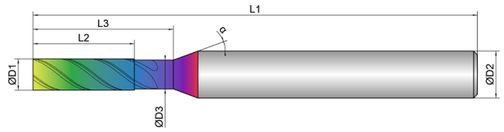
Expert

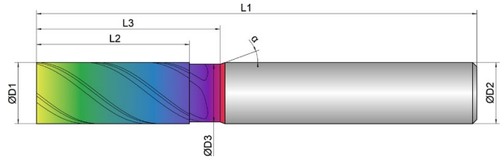
- Extra large chip chambers for ideal chip evacuation
- Unequal tooth pitch combined with variable helical pitch for smooth running
- Reinforced face with 2 cutting edges to the center

- For process reliable, helical diving and immersion
- For roughing and finishing, up to 1.5xD full slot

- Perfected for high radial depth of cutting and full slot milling






**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M01-0293 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 2.0 | 1.8 | 6.0 | 13.0 | 57.0 | 6.0 | 4 | 38 | 20 |
| 3 | 3.0 | 2.7 | 10.0 | 14.0 | 57.0 | 6.0 | 4 | 38 | 20 |
| 4 | 4.0 | 3.7 | 13.0 | 18.0 | 57.0 | 6.0 | 4 | 38 | 20 |
| 5 | 5.0 | 4.5 | 14.0 | 18.0 | 57.0 | 6.0 | 4 | 38 | 20 |
| 6 | 6.0 | 5.5 | 16.0 | 21.0 | 57.0 | 6.0 | 4 | 38 | 20 |
| 7 | 7.0 | 6.5 | 16.0 | 25.0 | 63.0 | 8.0 | 4 | 38 | 20 |
| 8 | 8.0 | 7.5 | 22.0 | 27.0 | 63.0 | 8.0 | 4 | 38 | 20 |
| 10 | 10.0 | 9.4 | 25.0 | 30.0 | 72.0 | 10.0 | 4 | 38 | 20 |
| 12 | 12.0 | 11.4 | 28.0 | 33.0 | 83.0 | 12.0 | 4 | 38 | 20 |
| 14 | 14.0 | 13.0 | 30.0 | 36.0 | 83.0 | 14.0 | 4 | 38 | 20 |
| 16 | 16.0 | 15.4 | 36.0 | 41.0 | 92.0 | 16.0 | 4 | 38 | 20 |
| 18 | 18.0 | 17.0 | 38.0 | 42.0 | 92.0 | 18.0 | 4 | 38 | 20 |
| 20 | 20.0 | 19.4 | 41.0 | 51.0 | 104.0 | 20.0 | 4 | 38 | 20 |



EXN1-M01-0293 | EXN1 PERFORMMAKER Z4 2XD ASR

| EXN1-M01-0293 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|
| 25 | 25.0 | 24.0 | 52.0 | 62.0 | 125.0 | 25.0 | 4 | 38 | 20 |

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 560 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 540 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 510 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 200 | 260 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 560 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 460 | 0.7 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 410 | 0.6 | 0.7 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | Finishing | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 2 | 6 | 1° | 0.02 | 2 | 2 | 0.03 | 0.6 | L2max | 0.018 | 0.2 | L2max | 0.045 | 0.5 | L2max | 0.039 |
| 3 | 10 | 1° | 0.03 | 3 | 3 | 0.04 | 0.9 | L2max | 0.02 | 0.2 | L2max | 0.055 | 0.75 | L2max | 0.0476 |
| 4 | 13 | 1.2° | 0.04 | 4 | 4 | 0.05 | 1.2 | L2max | 0.021 | 0.2 | L2max | 0.07 | 1 | L2max | 0.0606 |
| 5 | 14 | 1.2° | 0.045 | 5 | 5 | 0.065 | 1.5 | L2max | 0.023 | 0.2 | L2max | 0.08 | 1.25 | L2max | 0.0693 |
| 6 | 16 | 1.5° | 0.05 | 6 | 6 | 0.07 | 1.8 | L2max | 0.025 | 0.2 | L2max | 0.1 | 1.5 | L2max | 0.0866 |
| 7 | 16 | 1.8° | 0.06 | 7 | 7 | 0.08 | 2.1 | L2max | 0.028 | 0.2 | L2max | 0.11 | 1.75 | L2max | 0.0953 |
| 8 | 22 | 2° | 0.07 | 8 | 8 | 0.09 | 2.4 | L2max | 0.03 | 0.2 | L2max | 0.12 | 2 | L2max | 0.1039 |
| 10 | 25 | 2.5° | 0.09 | 10 | 10 | 0.1 | 3 | L2max | 0.035 | 0.2 | L2max | 0.14 | 2.5 | L2max | 0.1212 |
| 12 | 28 | 3° | 0.1 | 12 | 12 | 0.13 | 3.6 | L2max | 0.04 | 0.2 | L2max | 0.16 | 3 | L2max | 0.1386 |
| 14 | 30 | 3.5° | 0.11 | 14 | 14 | 0.14 | 4.2 | L2max | 0.042 | 0.2 | L2max | 0.17 | 3.5 | L2max | 0.1472 |
| 16 | 36 | 4° | 0.12 | 16 | 16 | 0.15 | 4.8 | L2max | 0.045 | 0.2 | L2max | 0.18 | 4 | L2max | 0.1559 |
| 18 | 38 | 4.5° | 0.135 | 18 | 18 | 0.165 | 5.4 | L2max | 0.048 | 0.2 | L2max | 0.2 | 4.5 | L2max | 0.1732 |
| 20 | 41 | 5° | 0.15 | 20 | 20 | 0.18 | 6 | L2max | 0.05 | 0.2 | L2max | 0.22 | 5 | L2max | 0.1905 |
| 25 | 52 | 6° | 0.16 | 25 | 25 | 0.2 | 7.5 | L2max | 0.055 | 0.2 | L2max | 0.24 | 6.25 | L2max | 0.2078 |

## STILL CAN'T FIND A SUITABLE MILLING CUTTER?

**No problem** – simply customize an existing tool. Using our configurator for special milling cutters, you can customize existing tools to your needs in an instant or create your own tools based on predefined types.

WE WILL RESPOND TO ALL REQUESTS SUBMITTED VIA THE CONFIGURATOR WITHIN ONE WORKING DAY AT THE LATEST

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

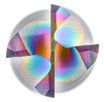
| | |
|---|---|
| Strategy | ETC HPC |
| Application | |
| Features | HB ≠ 2xD 90° |

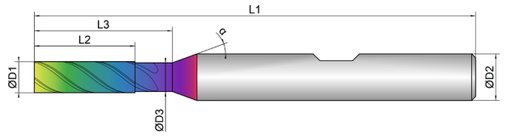
Expert

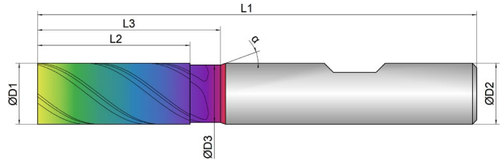
- Extra large chip chambers for ideal chip evacuation
- Unequal tooth pitch combined with variable helical pitch for smooth running
- Reinforced face with 2 cutting edges to the center

- For process reliable, helical diving and immersion
- For roughing and finishing, up to 1.5xD full slot

- Perfected for high radial depth of cutting and full slot milling






**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M01-0294 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 2.0 | 1.8 | 6.0 | 13.0 | 57.0 | 6.0 | 4 | 38 | 20 |
| 3 | 3.0 | 2.7 | 10.0 | 14.0 | 57.0 | 6.0 | 4 | 38 | 20 |
| 4 | 4.0 | 3.7 | 13.0 | 18.0 | 57.0 | 6.0 | 4 | 38 | 20 |
| 5 | 5.0 | 4.5 | 14.0 | 18.0 | 57.0 | 6.0 | 4 | 38 | 20 |
| 6 | 6.0 | 5.5 | 16.0 | 21.0 | 57.0 | 6.0 | 4 | 38 | 20 |
| 7 | 7.0 | 6.5 | 16.0 | 25.0 | 63.0 | 8.0 | 4 | 38 | 20 |
| 8 | 8.0 | 7.5 | 22.0 | 27.0 | 63.0 | 8.0 | 4 | 38 | 20 |
| 10 | 10.0 | 9.4 | 25.0 | 30.0 | 72.0 | 10.0 | 4 | 38 | 20 |
| 12 | 12.0 | 11.4 | 28.0 | 33.0 | 83.0 | 12.0 | 4 | 38 | 20 |
| 14 | 14.0 | 13.0 | 30.0 | 36.0 | 83.0 | 14.0 | 4 | 38 | 20 |
| 16 | 16.0 | 15.4 | 36.0 | 41.0 | 92.0 | 16.0 | 4 | 38 | 20 |
| 18 | 18.0 | 17.0 | 38.0 | 42.0 | 92.0 | 18.0 | 4 | 38 | 20 |
| 20 | 20.0 | 19.4 | 41.0 | 51.0 | 104.0 | 20.0 | 4 | 38 | 20 |



EXN1-M01-0294 | EXN1 PERFORMMAKER Z4 2XD ASR

| EXN1-M01-0294 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|
| 25 | 25.0 | 24.0 | 52.0 | 62.0 | 125.0 | 25.0 | 4 | 38 | 20 |

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 560 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 540 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 510 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 200 | 260 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 560 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 460 | 0.7 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 410 | 0.6 | 0.7 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | Finishing | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 2 | 6 | 1° | 0.02 | 2 | 2 | 0.03 | 0.6 | L2max | 0.018 | 0.2 | L2max | 0.045 | 0.5 | L2max | 0.039 |
| 3 | 10 | 1° | 0.03 | 3 | 3 | 0.04 | 0.9 | L2max | 0.02 | 0.2 | L2max | 0.055 | 0.75 | L2max | 0.0476 |
| 4 | 13 | 1.2° | 0.04 | 4 | 4 | 0.05 | 1.2 | L2max | 0.021 | 0.2 | L2max | 0.07 | 1 | L2max | 0.0606 |
| 5 | 14 | 1.2° | 0.045 | 5 | 5 | 0.065 | 1.5 | L2max | 0.023 | 0.2 | L2max | 0.08 | 1.25 | L2max | 0.0693 |
| 6 | 16 | 1.5° | 0.05 | 6 | 6 | 0.07 | 1.8 | L2max | 0.025 | 0.2 | L2max | 0.1 | 1.5 | L2max | 0.0866 |
| 7 | 16 | 1.8° | 0.06 | 7 | 7 | 0.08 | 2.1 | L2max | 0.028 | 0.2 | L2max | 0.11 | 1.75 | L2max | 0.0953 |
| 8 | 22 | 2° | 0.07 | 8 | 8 | 0.09 | 2.4 | L2max | 0.03 | 0.2 | L2max | 0.12 | 2 | L2max | 0.1039 |
| 10 | 25 | 2.5° | 0.09 | 10 | 10 | 0.1 | 3 | L2max | 0.035 | 0.2 | L2max | 0.14 | 2.5 | L2max | 0.1212 |
| 12 | 28 | 3° | 0.1 | 12 | 12 | 0.13 | 3.6 | L2max | 0.04 | 0.2 | L2max | 0.16 | 3 | L2max | 0.1386 |
| 14 | 30 | 3.5° | 0.11 | 14 | 14 | 0.14 | 4.2 | L2max | 0.042 | 0.2 | L2max | 0.17 | 3.5 | L2max | 0.1472 |
| 16 | 36 | 4° | 0.12 | 16 | 16 | 0.15 | 4.8 | L2max | 0.045 | 0.2 | L2max | 0.18 | 4 | L2max | 0.1559 |
| 18 | 38 | 4.5° | 0.135 | 18 | 18 | 0.165 | 5.4 | L2max | 0.048 | 0.2 | L2max | 0.2 | 4.5 | L2max | 0.1732 |
| 20 | 41 | 5° | 0.15 | 20 | 20 | 0.18 | 6 | L2max | 0.05 | 0.2 | L2max | 0.22 | 5 | L2max | 0.1905 |
| 25 | 52 | 6° | 0.16 | 25 | 25 | 0.2 | 7.5 | L2max | 0.055 | 0.2 | L2max | 0.24 | 6.25 | L2max | 0.2078 |

# DO YOU HAVE BLUNT MILLING CUTTERS THAT URGENTLY NEED REGRINDING?

**DISCOVER OUR H&V REGRINDING SERVICE**

... and have your tools reconditioned to their original state!

| | |
|---|---|
| Cooling | |
| Tolerance | e8 |
| Coating | AlphaSlide Rainbow |

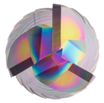
| | |
|---|---|
| Strategy | ETC, HPC |
| Application | |
| Features | HA, ≠, 2xD, R |

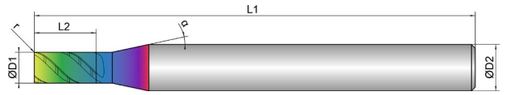
Expert

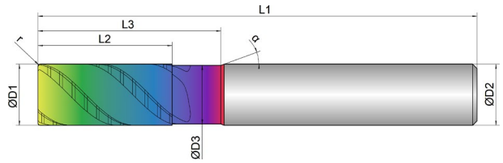
- Roughing teeth for the smallest chips in volume machining
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For roughing, up to 2xD full slot
- For process reliable, helical diving and immersion

- Also ideally designed for trochoidal milling






**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M02-0023 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 4.0 | 0.0 | 8.0 | 0.0 | 57.0 | 6.0 | 3 | 0.10 | 45 | 12 |
| 5 | 5.0 | 0.0 | 9.0 | 0.0 | 57.0 | 6.0 | 3 | 0.20 | 45 | 12 |
| 6 | 6.0 | 5.6 | 13.0 | 19.0 | 57.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| 8 | 8.0 | 7.6 | 19.0 | 25.0 | 63.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| 10 | 10.0 | 9.6 | 22.0 | 30.0 | 72.0 | 10.0 | 3 | 0.32 | 45 | 20 |
| 12 | 12.0 | 11.4 | 26.0 | 36.0 | 83.0 | 12.0 | 3 | 0.32 | 45 | 20 |
| 16 | 16.0 | 15.4 | 32.0 | 42.0 | 92.0 | 16.0 | 3 | 0.32 | 45 | 20 |
| 20 | 20.0 | 19.4 | 41.0 | 52.0 | 104.0 | 20.0 | 3 | 0.50 | 45 | 20 |



EXN1-M02-0023 | EXN1 SLOTMAKER Z3 2XD ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 500 | 560 | 1 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 480 | 540 | 1 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 450 | 510 | 0.9 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 200 | 200 | 260 | 0.8 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 500 | 560 | 1 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 350 | 350 | 410 | 0.7 | 0.8 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 300 | 300 | 350 | 0.6 | 0.7 |

**ADVICE |** The values marked in turquoise are side applications!
All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø mm | mm | α° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 4 | 8 | 1.2° | 0.035 | 4 | 4 | 0.05 | 1.2 | L2max | 0.07 | 1 | L2max | 0.0606 |
| 5 | 9 | 1.2° | 0.05 | 5 | 5 | 0.07 | 1.5 | L2max | 0.09 | 1.25 | L2max | 0.0779 |
| 6 | 13 | 1.5° | 0.07 | 6 | 6 | 0.09 | 1.8 | L2max | 0.11 | 1.5 | L2max | 0.0953 |
| 8 | 19 | 2° | 0.09 | 8 | 8 | 0.11 | 2.4 | L2max | 0.14 | 2 | L2max | 0.1212 |
| 10 | 22 | 2.5° | 0.11 | 10 | 10 | 0.13 | 3 | L2max | 0.16 | 2.5 | L2max | 0.1386 |
| 12 | 26 | 3° | 0.13 | 12 | 12 | 0.15 | 3.6 | L2max | 0.18 | 3 | L2max | 0.1559 |
| 16 | 32 | 4° | 0.14 | 16 | 16 | 0.16 | 4.8 | L2max | 0.19 | 4 | L2max | 0.1645 |
| 20 | 41 | 5° | 0.18 | 20 | 20 | 0.22 | 6 | L2max | 0.25 | 5 | L2max | 0.2165 |

| | |
|---|---|
| Cooling | |
| Tolerance | e8 |
| Coating | AlphaSlide Rainbow |

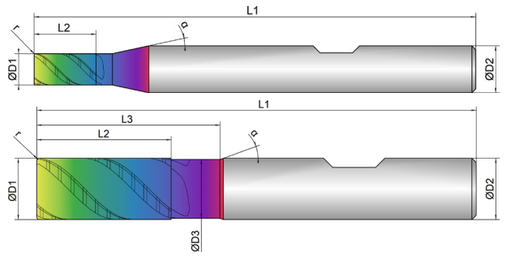
| | |
|---|---|
| Strategy | ETC, HPC |
| Application | |
| Features | HB, ≠, 2xD, R |

Expert

- Roughing teeth for the smallest chips in volume machining
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For roughing, up to 2xD full slot
- For process reliable, helical diving and immersion

- Also ideally designed for trochoidal milling




**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M02-0024 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| **4** | 4.0 | 0.0 | 8.0 | 0.0 | 57.0 | 6.0 | 3 | 0.10 | 45 | 12 |
| **5** | 5.0 | 0.0 | 9.0 | 0.0 | 57.0 | 6.0 | 3 | 0.20 | 45 | 12 |
| **6** | 6.0 | 5.6 | 13.0 | 19.0 | 57.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| **8** | 8.0 | 7.6 | 19.0 | 25.0 | 63.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| **10** | 10.0 | 9.6 | 22.0 | 30.0 | 72.0 | 10.0 | 3 | 0.32 | 45 | 20 |
| **12** | 12.0 | 11.4 | 26.0 | 36.0 | 83.0 | 12.0 | 3 | 0.32 | 45 | 20 |
| **16** | 16.0 | 15.4 | 32.0 | 42.0 | 92.0 | 16.0 | 3 | 0.32 | 45 | 20 |
| **20** | 20.0 | 19.4 | 41.0 | 52.0 | 104.0 | 20.0 | 3 | 0.50 | 45 | 20 |



EXN1-M02-0024 | EXN1 SLOTMAKER Z3 2XD ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 560 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 540 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 510 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 260 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 560 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 350 | 350 | 410 | 0.7 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 300 | 300 | 350 | 0.6 | 0.7 |

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Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø mm | mm | α° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 4 | 8 | 1.2° | 0.035 | 4 | 4 | 0.05 | 1.2 | L2max | 0.07 | 1 | L2max | 0.0606 |
| 5 | 9 | 1.2° | 0.05 | 5 | 5 | 0.07 | 1.5 | L2max | 0.09 | 1.25 | L2max | 0.0779 |
| 6 | 13 | 1.5° | 0.07 | 6 | 6 | 0.09 | 1.8 | L2max | 0.11 | 1.5 | L2max | 0.0953 |
| 8 | 19 | 2° | 0.09 | 8 | 8 | 0.11 | 2.4 | L2max | 0.14 | 2 | L2max | 0.1212 |
| 10 | 22 | 2.5° | 0.11 | 10 | 10 | 0.13 | 3 | L2max | 0.16 | 2.5 | L2max | 0.1386 |
| 12 | 26 | 3° | 0.13 | 12 | 12 | 0.15 | 3.6 | L2max | 0.18 | 3 | L2max | 0.1559 |
| 16 | 32 | 4° | 0.14 | 16 | 16 | 0.16 | 4.8 | L2max | 0.19 | 4 | L2max | 0.1645 |
| 20 | 41 | 5° | 0.18 | 20 | 20 | 0.22 | 6 | L2max | 0.25 | 5 | L2max | 0.2165 |

| | |
|---|---|
| Cooling | |
| Tolerance | e8 |
| Coating | AlphaSlide Rainbow |

| | |
|---|---|
| Strategy | ETC HPC |
| Application | |
| Features | HA ≠ 3xD R |

Expert

- Roughing teeth for the smallest chips in volume machining
- Special helical pitch for smooth running and soft cut
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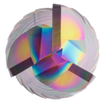

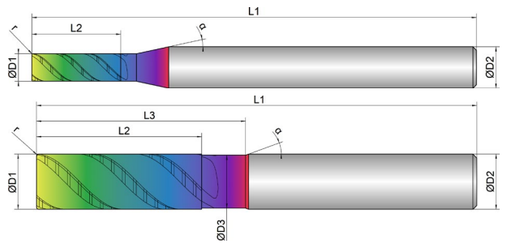


**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| | D1 | D3 | L2 | L3 | L1 | D2 | z | r | | α |
|---|---|---|---|---|---|---|---|---|---|---|
| EXN1-M02-0053 | mm ø | mm ø | mm | mm | mm | mm ø | # | mm | ° | ° |
| **4** | 4.0 | 0.0 | 13.0 | 0.0 | 65.0 | 6.0 | 3 | 0.10 | 45 | 12 |
| **5** | 5.0 | 0.0 | 16.0 | 0.0 | 65.0 | 6.0 | 3 | 0.20 | 45 | 12 |
| **6** | 6.0 | 5.6 | 18.0 | 24.0 | 65.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| **8** | 8.0 | 7.6 | 24.0 | 30.0 | 70.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| **10** | 10.0 | 9.6 | 30.0 | 38.0 | 80.0 | 10.0 | 3 | 0.32 | 45 | 20 |
| **12** | 12.0 | 11.4 | 36.0 | 46.0 | 93.0 | 12.0 | 3 | 0.32 | 45 | 20 |
| **16** | 16.0 | 15.4 | 48.0 | 58.0 | 110.0 | 16.0 | 3 | 0.32 | 45 | 20 |
| **20** | 20.0 | 19.4 | 60.0 | 74.0 | 125.0 | 20.0 | 3 | 0.50 | 45 | 20 |





Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 560 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 540 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 510 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 260 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 560 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 350 | 350 | 410 | 0.7 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 300 | 300 | 350 | 0.6 | 0.7 |

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When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | α° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 4 | 13 | 1.2° | 0.03 | 4 | 4 | 0.04 | 1.2 | L2max | 0.06 | 1 | L2max | 0.052 |
| 5 | 16 | 1.2° | 0.04 | 5 | 5 | 0.06 | 1.5 | L2max | 0.08 | 1.25 | L2max | 0.0693 |
| 6 | 18 | 1.5° | 0.06 | 6 | 6 | 0.08 | 1.8 | L2max | 0.1 | 1.5 | L2max | 0.0866 |
| 8 | 24 | 2° | 0.08 | 8 | 8 | 0.1 | 2.4 | L2max | 0.13 | 2 | L2max | 0.1126 |
| 10 | 30 | 2.5° | 0.1 | 10 | 10 | 0.12 | 3 | L2max | 0.15 | 2.5 | L2max | 0.1299 |
| 12 | 36 | 3° | 0.12 | 12 | 12 | 0.14 | 3.6 | L2max | 0.17 | 3 | L2max | 0.1472 |
| 16 | 48 | 4° | 0.13 | 16 | 16 | 0.15 | 4.8 | L2max | 0.18 | 4 | L2max | 0.1559 |
| 20 | 60 | 5° | 0.16 | 20 | 20 | 0.2 | 6 | L2max | 0.23 | 5 | L2max | 0.1992 |

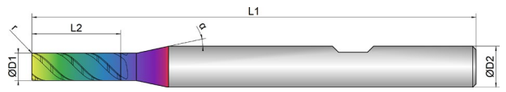
| | |
|---|---|
| Cooling | |
| Tolerance | e8 |
| Coating | AlphaSlide Rainbow |

| | |
|---|---|
| Strategy | ETC HPC |
| Application | |
| Features | HB ≠ 3xD R |

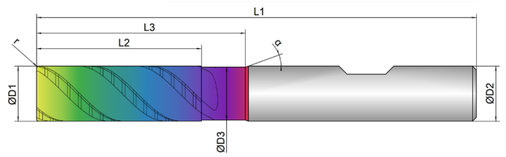
Expert

- Roughing teeth for the smallest chips in volume machining
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For roughing, up to 3xD full slot
- For process reliable, helical diving and immersion




- Also ideally designed for trochoidal milling




**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| | D1 | D3 | L2 | L3 | L1 | D2 | z | r | | α |
|---|---|---|---|---|---|---|---|---|---|---|
| **EXN1-M02-0054** | mm ø | mm ø | mm | mm | mm | mm ø | # | mm | ° | ° |
| **4** | 4.0 | 0.0 | 13.0 | 0.0 | 65.0 | 6.0 | 3 | 0.10 | 45 | 12 |
| **5** | 5.0 | 0.0 | 16.0 | 0.0 | 65.0 | 6.0 | 3 | 0.20 | 45 | 12 |
| **6** | 6.0 | 5.6 | 18.0 | 24.0 | 65.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| **8** | 8.0 | 7.6 | 24.0 | 30.0 | 70.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| **10** | 10.0 | 9.6 | 30.0 | 38.0 | 80.0 | 10.0 | 3 | 0.32 | 45 | 20 |
| **12** | 12.0 | 11.4 | 36.0 | 46.0 | 93.0 | 12.0 | 3 | 0.32 | 45 | 20 |
| **16** | 16.0 | 15.4 | 48.0 | 58.0 | 110.0 | 16.0 | 3 | 0.32 | 45 | 20 |
| **20** | 20.0 | 19.4 | 60.0 | 74.0 | 125.0 | 20.0 | 3 | 0.50 | 45 | 20 |



EXN1-M02-0054 | EXN1 SLOTMAKER Z3 3XD ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 560 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 540 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 510 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 260 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 560 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 350 | 350 | 410 | 0.7 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 300 | 300 | 350 | 0.6 | 0.7 |

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To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | α° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 4 | 13 | 1.2° | 0.03 | 4 | 4 | 0.04 | 1.2 | L2max | 0.06 | 1 | L2max | 0.052 |
| 5 | 16 | 1.2° | 0.04 | 5 | 5 | 0.06 | 1.5 | L2max | 0.08 | 1.25 | L2max | 0.0693 |
| 6 | 18 | 1.5° | 0.06 | 6 | 6 | 0.08 | 1.8 | L2max | 0.1 | 1.5 | L2max | 0.0866 |
| 8 | 24 | 2° | 0.08 | 8 | 8 | 0.1 | 2.4 | L2max | 0.13 | 2 | L2max | 0.1126 |
| 10 | 30 | 2.5° | 0.1 | 10 | 10 | 0.12 | 3 | L2max | 0.15 | 2.5 | L2max | 0.1299 |
| 12 | 36 | 3° | 0.12 | 12 | 12 | 0.14 | 3.6 | L2max | 0.17 | 3 | L2max | 0.1472 |
| 16 | 48 | 4° | 0.13 | 16 | 16 | 0.15 | 4.8 | L2max | 0.18 | 4 | L2max | 0.1559 |
| 20 | 60 | 5° | 0.16 | 20 | 20 | 0.2 | 6 | L2max | 0.23 | 5 | L2max | 0.1992 |

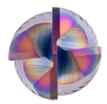
| | |
|---|---|
| Cooling | |
| Tolerance | e8 |
| Coating | AlphaSlide Rainbow |

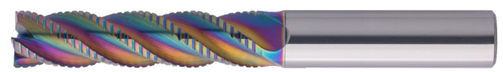
| | |
|---|---|
| Strategy | ETC, HPC |
| Application | |
| Features | HA, ≠, 4xD, R |

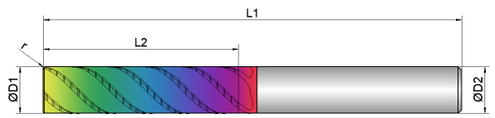
Expert

Download Catalog Pages (PDF)

- Special roughing profile combined with 4 teeth for the highest performance in volume machining
- Special helical pitch for smooth running and soft cut
- Excellent for trochoidal milling
- For process reliable helical immersion








| Roughing | Finishing |
|---|---|
| inappropriate – optimal | inappropriate – optimal |

| EXN1-M02-0063 | D1 mm ø | L2 mm | L1 mm | D2 mm ø | z # | r mm | ° |
|---|---|---|---|---|---|---|---|
| 6 | 6.0 | 25.0 | 68.0 | 6.0 | 4 | 0.20 | 45 |
| 8 | 8.0 | 34.0 | 75.0 | 8.0 | 4 | 0.25 | 45 |
| 10 | 10.0 | 42.0 | 90.0 | 10.0 | 4 | 0.25 | 45 |
| 12 | 12.0 | 50.0 | 100.0 | 12.0 | 4 | 0.30 | 45 |
| 16 | 16.0 | 66.0 | 125.0 | 16.0 | 4 | 0.40 | 45 |
| 20 | 20.0 | 82.0 | 150.0 | 20.0 | 4 | 0.50 | 45 |



EXN1-M02-0063 | EXN1 SLOTMAKER Z4 4XD ASR

| | Material | Strength (N/mm²) | Side Milling | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 560 | 1 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 540 | 1 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 510 | 0.9 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 200 | 260 | 0.8 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 560 | 1 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 350 | 410 | 0.7 | 0.8 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 300 | 350 | 0.6 | 0.7 |

**ADVICE |** The values marked in turquoise are side applications!
All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.
For coarser roughing operations we recommend a Weldon in conjunction with a Weldon chuck.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Side Milling | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | fz (mm/Z) | ae =0.2xD (mm) | ap (mm) | hmax (mm) |
| 6 | 25 | 1° | 0.065 | 1.5 | L2max | 0.08 | 1.2 | L2max | 0.064 |
| 8 | 34 | 1.2° | 0.08 | 2 | L2max | 0.105 | 1.6 | L2max | 0.084 |
| 10 | 42 | 1.5° | 0.095 | 2.5 | L2max | 0.12 | 2 | L2max | 0.096 |
| 12 | 50 | 1.5° | 0.11 | 3 | L2max | 0.135 | 2.4 | L2max | 0.108 |
| 16 | 66 | 2° | 0.12 | 4 | L2max | 0.145 | 3.2 | L2max | 0.116 |
| 20 | 82 | 3° | 0.16 | 5 | L2max | 0.185 | 4 | L2max | 0.148 |

| | |
|---|---|
| Cooling | |
| Tolerance | e8 |
| Coating | AlphaSlide Rainbow |

| | |
|---|---|
| Strategy | ETC, HPC |
| Application | |
| Features | HB, ≠, 4xD, R |

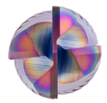
Expert

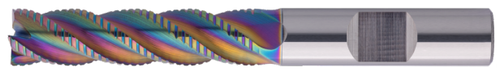
Download Catalog Pages (PDF)

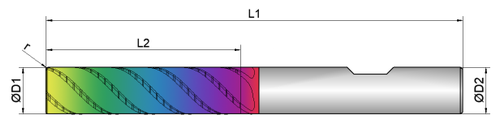
- Special roughing profile combined with 4 teeth for the highest performance in volume machining
- Special helical pitch for smooth running and soft cut

- For process reliable helical immersion

- Excellent for trochoidal milling








**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| | D1 | L2 | L1 | D2 | z | r | |
|---|---|---|---|---|---|---|---|
| EXN1-M02-0064 | mm ø | mm | mm | mm ø | # | mm | ° |
| 6 | 6.0 | 25.0 | 68.0 | 6.0 | 4 | 0.20 | 45 |
| 8 | 8.0 | 34.0 | 75.0 | 8.0 | 4 | 0.25 | 45 |
| 10 | 10.0 | 42.0 | 90.0 | 10.0 | 4 | 0.25 | 45 |
| 12 | 12.0 | 50.0 | 100.0 | 12.0 | 4 | 0.30 | 45 |
| 16 | 16.0 | 66.0 | 125.0 | 16.0 | 4 | 0.40 | 45 |
| 20 | 20.0 | 82.0 | 150.0 | 20.0 | 4 | 0.50 | 45 |



EXN1-M02-0064 | EXN1 SLOTMAKER Z4 4XD ASR

| | Material | Strength (N/mm²) | Side Milling | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 560 | 1 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 540 | 1 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 510 | 0.9 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 200 | 260 | 0.8 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 560 | 1 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 350 | 410 | 0.7 | 0.8 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 300 | 350 | 0.6 | 0.7 |

**ADVICE |** The values marked in turquoise are side applications!
All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Side Milling | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | fz (mm/Z) | ae =0.2xD (mm) | ap (mm) | hmax (mm) |
| 6 | 25 | 1° | 0.065 | 1.5 | L2max | 0.08 | 1.2 | L2max | 0.064 |
| 8 | 34 | 1.2° | 0.08 | 2 | L2max | 0.105 | 1.6 | L2max | 0.084 |
| 10 | 42 | 1.5° | 0.095 | 2.5 | L2max | 0.12 | 2 | L2max | 0.096 |
| 12 | 50 | 1.5° | 0.11 | 3 | L2max | 0.135 | 2.4 | L2max | 0.108 |
| 16 | 66 | 2° | 0.12 | 4 | L2max | 0.145 | 3.2 | L2max | 0.116 |
| 20 | 82 | 3° | 0.16 | 5 | L2max | 0.185 | 4 | L2max | 0.148 |

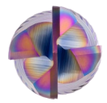
| | |
|---|---|
| Cooling | |
| Tolerance | e8 |
| Coating | AlphaSlide Rainbow |

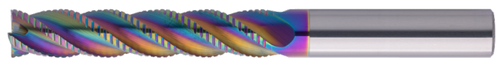
| | |
|---|---|
| Strategy | ETC HPC |
| Application | |
| Features | HA ≠ 5xD R |

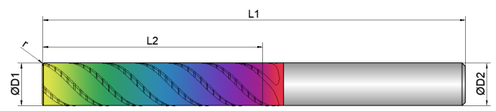
Expert

Download Catalog Pages (PDF)

- Special roughing profile combined with 4 teeth for the highest performance in volume machining
- Special helical pitch for smooth running and soft cut
- For process reliable helical immersion
- Excellent for trochoidal milling








**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M02-0073 | D1 mm Ø | L2 mm | L1 mm | D2 mm Ø | z # | r mm | ° |
|---|---|---|---|---|---|---|---|
| **6** | 6.0 | 31.0 | 75.0 | 6.0 | 4 | 0.20 | 45 |
| **8** | 8.0 | 42.0 | 90.0 | 8.0 | 4 | 0.25 | 45 |
| **10** | 10.0 | 52.0 | 100.0 | 10.0 | 4 | 0.25 | 45 |
| **12** | 12.0 | 62.0 | 120.0 | 12.0 | 4 | 0.30 | 45 |
| **16** | 16.0 | 82.0 | 134.0 | 16.0 | 4 | 0.40 | 45 |
| **20** | 20.0 | 102.0 | 160.0 | 20.0 | 4 | 0.50 | 45 |



EXN1-M02-0073 | EXN1 SLOTMAKER Z4 5XD ASR

| | Material | Strength (N/mm²) | Side Milling | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | Vc = m/min | Vc = m/min | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 540 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 520 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 490 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 240 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 540 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 350 | 390 | 0.7 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 300 | 330 | 0.6 | 0.7 |

**ADVICE |** The values marked in turquoise are side applications!
All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.
For coarser roughing operations we recommend a Weldon in conjunction with a Weldon chuck.

**Material N 1.1**

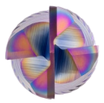
| D1 Ø | L2 mm | Immersion Angle a° | Side Milling fz (mm/Z) | Side Milling ae = 0.2xD (mm) | Side Milling ap (mm) | ETC fz (mm/Z) | ETC ae =0.15xD (mm) | ETC ap (mm) | ETC hmax (mm) |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 31 | 1° | 0.045 | 1.2 | L2max | 0.055 | 0.9 | L2max | 0.0393 |
| 8 | 42 | 1.2° | 0.065 | 1.6 | L2max | 0.075 | 1.2 | L2max | 0.0536 |
| 10 | 52 | 1.5° | 0.075 | 2 | L2max | 0.095 | 1.5 | L2max | 0.0678 |
| 12 | 62 | 1.5° | 0.09 | 2.4 | L2max | 0.11 | 1.8 | L2max | 0.0786 |
| 16 | 82 | 2° | 0.11 | 3.2 | L2max | 0.125 | 2.4 | L2max | 0.0893 |
| 20 | 102 | 3° | 0.13 | 4 | L2max | 0.145 | 3 | L2max | 0.1036 |

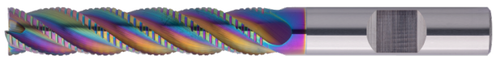
| | |
|---|---|
| Cooling | |
| Tolerance | e8 |
| Coating | AlphaSlide Rainbow |

| | |
|---|---|
| Strategy | ETC, HPC |
| Application | |
| Features | HB, ≠, 5xD, R |

Expert

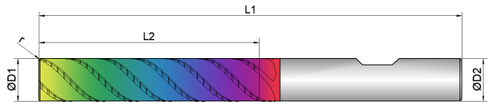
- Special roughing profile combined with 4 teeth for the highest performance in volume machining
- Special helical pitch for smooth running and soft cut





- For process reliable helical immersion

- Excellent for trochoidal milling




**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M02-0074 | D1 mm ø | L2 mm | L1 mm | D2 mm ø | z # | r mm | ° |
|---|---|---|---|---|---|---|---|
| **6** | 6.0 | 31.0 | 75.0 | 6.0 | 4 | 0.20 | 45 |
| **8** | 8.0 | 42.0 | 90.0 | 8.0 | 4 | 0.25 | 45 |
| **10** | 10.0 | 52.0 | 100.0 | 10.0 | 4 | 0.25 | 45 |
| **12** | 12.0 | 62.0 | 120.0 | 12.0 | 4 | 0.30 | 45 |
| **16** | 16.0 | 82.0 | 134.0 | 16.0 | 4 | 0.40 | 45 |
| **20** | 20.0 | 102.0 | 160.0 | 20.0 | 4 | 0.50 | 45 |



EXN1-M02-0074 | EXN1 SLOTMAKER Z4 5XD ASR

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| | Material | Strength (N/mm²) | Side Milling | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | **Vc = m/min** | **Vc = m/min** | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 540 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 520 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 490 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 240 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 540 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 350 | 390 | 0.7 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 300 | 330 | 0.6 | 0.7 |

**ADVICE |** The values marked in turquoise are side applications!
All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 Ø | L2 mm | Immersion Angle a° | Side Milling fz (mm/Z) | Side Milling ae = 0.2xD (mm) | Side Milling ap (mm) | ETC fz (mm/Z) | ETC ae =0.15xD (mm) | ETC ap (mm) | ETC hmax (mm) |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 31 | 1° | 0.045 | 1.2 | L2max | 0.055 | 0.9 | L2max | 0.0393 |
| 8 | 42 | 1.2° | 0.065 | 1.6 | L2max | 0.075 | 1.2 | L2max | 0.0536 |
| 10 | 52 | 1.5° | 0.075 | 2 | L2max | 0.095 | 1.5 | L2max | 0.0678 |
| 12 | 62 | 1.5° | 0.09 | 2.4 | L2max | 0.11 | 1.8 | L2max | 0.0786 |
| 16 | 82 | 2° | 0.11 | 3.2 | L2max | 0.125 | 2.4 | L2max | 0.0893 |
| 20 | 102 | 3° | 0.13 | 4 | L2max | 0.145 | 3 | L2max | 0.1036 |

| | |
|---|---|
| Cooling | |
| Tolerance | e8 |
| Coating | AlphaSlide Rainbow |

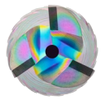
| | |
|---|---|
| Strategy | ETC HPC |
| Application | |
| Features | HA 2xD R |

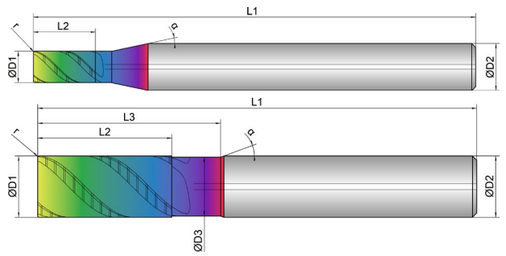
Expert

- Roughing teeth for the smallest chips in volume machining
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For roughing, up to 2xD full slot
- For process reliable, helical diving and immersion

- With central inner cooling
- Also ideally designed for trochoidal milling






| Roughing | Finishing |
|---|---|
| inappropriate — optimal | inappropriate — optimal |

| EXN1-M02-0123 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 4.0 | 0.0 | 8.0 | 0.0 | 57.0 | 6.0 | 3 | 0.10 | 45 | 12 |
| 5 | 5.0 | 0.0 | 9.0 | 0.0 | 57.0 | 6.0 | 3 | 0.20 | 45 | 12 |
| 6 | 6.0 | 5.6 | 13.0 | 19.0 | 57.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| 8 | 8.0 | 7.6 | 19.0 | 25.0 | 63.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| 10 | 10.0 | 9.6 | 22.0 | 30.0 | 72.0 | 10.0 | 3 | 0.32 | 45 | 20 |
| 12 | 12.0 | 11.4 | 26.0 | 36.0 | 83.0 | 12.0 | 3 | 0.32 | 45 | 20 |
| 16 | 16.0 | 15.4 | 32.0 | 42.0 | 92.0 | 16.0 | 3 | 0.32 | 45 | 20 |
| 20 | 20.0 | 19.4 | 41.0 | 52.0 | 104.0 | 20.0 | 3 | 0.50 | 45 | 20 |



EXN1-M02-0123 | EXN1 SLOTMAKER Z3 2XD IC ASR

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| | Material | Strength (N/mm²) | Full Slot | Side Milling | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 500 | 560 | 1 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 480 | 540 | 1 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 450 | 510 | 0.9 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 200 | 200 | 260 | 0.8 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 500 | 560 | 1 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 350 | 350 | 410 | 0.7 | 0.8 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 300 | 300 | 350 | 0.6 | 0.7 |

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Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | α° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 4 | 8 | 1.2° | 0.035 | 4 | 4 | 0.05 | 1.2 | L2max | 0.07 | 1 | L2max | 0.0606 |
| 5 | 9 | 1.2° | 0.05 | 5 | 5 | 0.07 | 1.5 | L2max | 0.09 | 1.25 | L2max | 0.0779 |
| 6 | 13 | 1.5° | 0.07 | 6 | 6 | 0.09 | 1.8 | L2max | 0.11 | 1.5 | L2max | 0.0953 |
| 8 | 19 | 2° | 0.09 | 8 | 8 | 0.11 | 2.4 | L2max | 0.14 | 2 | L2max | 0.1212 |
| 10 | 22 | 2.5° | 0.11 | 10 | 10 | 0.13 | 3 | L2max | 0.16 | 2.5 | L2max | 0.1386 |
| 12 | 26 | 3° | 0.13 | 12 | 12 | 0.15 | 3.6 | L2max | 0.18 | 3 | L2max | 0.1559 |
| 16 | 32 | 4° | 0.14 | 16 | 16 | 0.16 | 4.8 | L2max | 0.19 | 4 | L2max | 0.1645 |
| 20 | 41 | 5° | 0.18 | 20 | 20 | 0.22 | 6 | L2max | 0.25 | 5 | L2max | 0.2165 |

| | |
|---|---|
| Cooling | |
| Tolerance | e8 |
| Coating | AlphaSlide Rainbow |

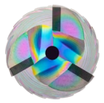
| | |
|---|---|
| Strategy | ETC, HPC |
| Application | |
| Features | HB, 2xD, R |

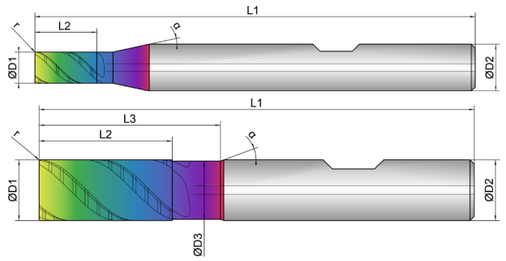
Expert

- Roughing teeth for the smallest chips in volume machining
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For roughing, up to 2xD full slot
- For process reliable, helical diving and immersion

- With central inner cooling
- Also ideally designed for trochoidal milling






**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M02-0124 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| **4** | 4.0 | 0.0 | 8.0 | 0.0 | 57.0 | 6.0 | 3 | 0.10 | 45 | 12 |
| **5** | 5.0 | 0.0 | 9.0 | 0.0 | 57.0 | 6.0 | 3 | 0.20 | 45 | 12 |
| **6** | 6.0 | 5.6 | 13.0 | 19.0 | 57.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| **8** | 8.0 | 7.6 | 19.0 | 25.0 | 63.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| **10** | 10.0 | 9.6 | 22.0 | 30.0 | 72.0 | 10.0 | 3 | 0.32 | 45 | 20 |
| **12** | 12.0 | 11.4 | 26.0 | 36.0 | 83.0 | 12.0 | 3 | 0.32 | 45 | 20 |
| **16** | 16.0 | 15.4 | 32.0 | 42.0 | 92.0 | 16.0 | 3 | 0.32 | 45 | 20 |
| **20** | 20.0 | 19.4 | 41.0 | 52.0 | 104.0 | 20.0 | 3 | 0.50 | 45 | 20 |



EXN1-M02-0124 | EXN1 SLOTMAKER Z3 2XD IC ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 560 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 540 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 510 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 260 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 560 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 350 | 350 | 410 | 0.7 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 300 | 300 | 350 | 0.6 | 0.7 |

**ADVICE |** The values marked in turquoise are side applications!
All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 4 | 8 | 1.2° | 0.035 | 4 | 4 | 0.05 | 1.2 | L2max | 0.07 | 1 | L2max | 0.0606 |
| 5 | 9 | 1.2° | 0.05 | 5 | 5 | 0.07 | 1.5 | L2max | 0.09 | 1.25 | L2max | 0.0779 |
| 6 | 13 | 1.5° | 0.07 | 6 | 6 | 0.09 | 1.8 | L2max | 0.11 | 1.5 | L2max | 0.0953 |
| 8 | 19 | 2° | 0.09 | 8 | 8 | 0.11 | 2.4 | L2max | 0.14 | 2 | L2max | 0.1212 |
| 10 | 22 | 2.5° | 0.11 | 10 | 10 | 0.13 | 3 | L2max | 0.16 | 2.5 | L2max | 0.1386 |
| 12 | 26 | 3° | 0.13 | 12 | 12 | 0.15 | 3.6 | L2max | 0.18 | 3 | L2max | 0.1559 |
| 16 | 32 | 4° | 0.14 | 16 | 16 | 0.16 | 4.8 | L2max | 0.19 | 4 | L2max | 0.1645 |
| 20 | 41 | 5° | 0.18 | 20 | 20 | 0.22 | 6 | L2max | 0.25 | 5 | L2max | 0.2165 |

| | |
|---|---|
| Cooling | |
| Tolerance | e8 |
| Coating | AlphaSlide Rainbow |

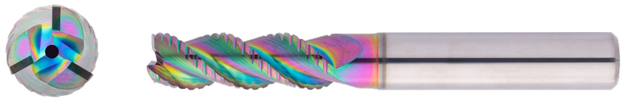
| | |
|---|---|
| Strategy | ETC, HPC |
| Application | |
| Features | HA, 3xD, R |

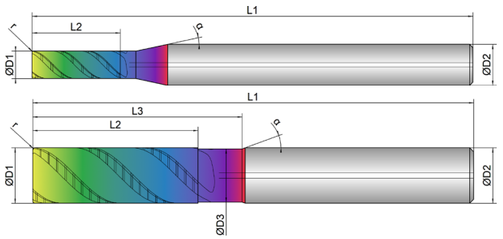
Expert

- Roughing teeth for the smallest chips in volume machining
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For roughing, up to 3xD full slot
- For process reliable, helical diving and immersion

- With central inner cooling
- Also ideally designed for trochoidal milling






| Roughing | Finishing |
|---|---|
| inappropriate – optimal | inappropriate – optimal |

| EXN1-M02-0163 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 4.0 | 0.0 | 13.0 | 0.0 | 65.0 | 6.0 | 3 | 0.10 | 45 | 12 |
| 5 | 5.0 | 0.0 | 16.0 | 0.0 | 65.0 | 6.0 | 3 | 0.20 | 45 | 12 |
| 6 | 6.0 | 5.6 | 18.0 | 24.0 | 65.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| 8 | 8.0 | 7.6 | 24.0 | 30.0 | 70.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| 10 | 10.0 | 9.6 | 30.0 | 38.0 | 80.0 | 10.0 | 3 | 0.32 | 45 | 20 |
| 12 | 12.0 | 11.4 | 36.0 | 46.0 | 93.0 | 12.0 | 3 | 0.32 | 45 | 20 |
| 16 | 16.0 | 15.4 | 48.0 | 58.0 | 110.0 | 16.0 | 3 | 0.32 | 45 | 20 |
| 20 | 20.0 | 19.4 | 60.0 | 74.0 | 125.0 | 20.0 | 3 | 0.50 | 45 | 20 |



EXN1-M02-0163 | EXN1 SLOTMAKER Z3 3XD IC ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 500 | 560 | 1 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 480 | 540 | 1 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 450 | 510 | 0.9 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 200 | 200 | 260 | 0.8 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 500 | 560 | 1 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 350 | 350 | 410 | 0.7 | 0.8 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 300 | 300 | 350 | 0.6 | 0.7 |

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Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 4 | 13 | 1.2° | 0.03 | 4 | 4 | 0.04 | 1.2 | L2max | 0.06 | 1 | L2max | 0.052 |
| 5 | 16 | 1.2° | 0.04 | 5 | 5 | 0.06 | 1.5 | L2max | 0.08 | 1.25 | L2max | 0.0693 |
| 6 | 18 | 1.5° | 0.06 | 6 | 6 | 0.08 | 1.8 | L2max | 0.1 | 1.5 | L2max | 0.0866 |
| 8 | 24 | 2° | 0.08 | 8 | 8 | 0.1 | 2.4 | L2max | 0.13 | 2 | L2max | 0.1126 |
| 10 | 30 | 2.5° | 0.1 | 10 | 10 | 0.12 | 3 | L2max | 0.15 | 2.5 | L2max | 0.1299 |
| 12 | 36 | 3° | 0.12 | 12 | 12 | 0.14 | 3.6 | L2max | 0.17 | 3 | L2max | 0.1472 |
| 16 | 48 | 4° | 0.13 | 16 | 16 | 0.15 | 4.8 | L2max | 0.18 | 4 | L2max | 0.1559 |
| 20 | 60 | 5° | 0.16 | 20 | 20 | 0.2 | 6 | L2max | 0.23 | 5 | L2max | 0.1992 |

| | |
|---|---|
| Cooling | |
| Tolerance | e8 |
| Coating | AlphaSlide Rainbow |

| | |
|---|---|
| Strategy | ETC, HPC |
| Application | |
| Features | HB, 3xD, R |

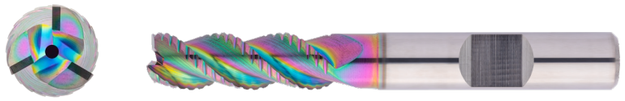
Expert

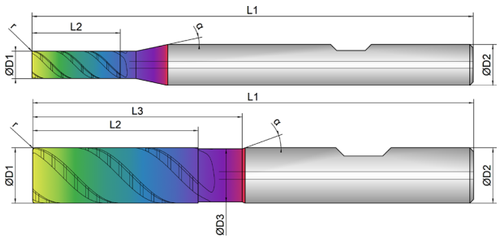
Download Catalog Pages (PDF)

- Roughing teeth for the smallest chips in volume machining
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For roughing, up to 3xD full slot
- For process reliable, helical diving and immersion

- With central inner cooling
- Also ideally designed for trochoidal milling






| Roughing | Finishing |
|---|---|
| inappropriate – optimal | inappropriate – optimal |

| EXN1-M02-0164 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 4.0 | 0.0 | 13.0 | 0.0 | 65.0 | 6.0 | 3 | 0.10 | 45 | 12 |
| 5 | 5.0 | 0.0 | 16.0 | 0.0 | 65.0 | 6.0 | 3 | 0.20 | 45 | 12 |
| 6 | 6.0 | 5.6 | 18.0 | 24.0 | 65.0 | 6.0 | 3 | 0.20 | 45 | 20 |
| 8 | 8.0 | 7.6 | 24.0 | 30.0 | 70.0 | 8.0 | 3 | 0.20 | 45 | 20 |
| 10 | 10.0 | 9.6 | 30.0 | 38.0 | 80.0 | 10.0 | 3 | 0.32 | 45 | 20 |
| 12 | 12.0 | 11.4 | 36.0 | 46.0 | 93.0 | 12.0 | 3 | 0.32 | 45 | 20 |
| 16 | 16.0 | 15.4 | 48.0 | 58.0 | 110.0 | 16.0 | 3 | 0.32 | 45 | 20 |
| 20 | 20.0 | 19.4 | 60.0 | 74.0 | 125.0 | 20.0 | 3 | 0.50 | 45 | 20 |



EXN1-M02-0164 | EXN1 SLOTMAKER Z3 3XD IC ASR

| | Material | Strength (N/mm²) | Full Slot | Side Milling | ETC | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 500 | 560 | 1 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 480 | 540 | 1 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 450 | 510 | 0.9 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 200 | 200 | 260 | 0.8 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 500 | 560 | 1 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 350 | 350 | 410 | 0.7 | 0.8 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 300 | 300 | 350 | 0.6 | 0.7 |

**ADVICE |** The values marked in turquoise are side applications!
All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

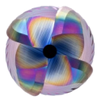
| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae = 0.25xD (mm) | ap (mm) | hmax (mm) |
| 4 | 13 | 1.2° | 0.03 | 4 | 4 | 0.04 | 1.2 | L2max | 0.06 | 1 | L2max | 0.052 |
| 5 | 16 | 1.2° | 0.04 | 5 | 5 | 0.06 | 1.5 | L2max | 0.08 | 1.25 | L2max | 0.0693 |
| 6 | 18 | 1.5° | 0.06 | 6 | 6 | 0.08 | 1.8 | L2max | 0.1 | 1.5 | L2max | 0.0866 |
| 8 | 24 | 2° | 0.08 | 8 | 8 | 0.1 | 2.4 | L2max | 0.13 | 2 | L2max | 0.1126 |
| 10 | 30 | 2.5° | 0.1 | 10 | 10 | 0.12 | 3 | L2max | 0.15 | 2.5 | L2max | 0.1299 |
| 12 | 36 | 3° | 0.12 | 12 | 12 | 0.14 | 3.6 | L2max | 0.17 | 3 | L2max | 0.1472 |
| 16 | 48 | 4° | 0.13 | 16 | 16 | 0.15 | 4.8 | L2max | 0.18 | 4 | L2max | 0.1559 |
| 20 | 60 | 5° | 0.16 | 20 | 20 | 0.2 | 6 | L2max | 0.23 | 5 | L2max | 0.1992 |

| | |
|---|---|
| Cooling | |
| Tolerance | e8 |
| Coating | AlphaSlide Rainbow |

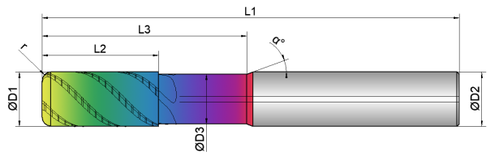
| | |
|---|---|
| Strategy | ETC, HPC |
| Application | |
| Features | HA, ≠, 2xD, R |

Expert

- Special roughing profile combined with 4 teeth for the highest performance in volume machining
- Special helical pitch for smooth running and soft cut



- For roughing, up to 2xD full slot
- For process reliable, helical diving and immersion




- With central inner cooling
- Also ideally designed for trochoidal milling

**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| | D1 | D3 | L2 | L3 | L1 | D2 | z | r | | α |
|---|---|---|---|---|---|---|---|---|---|---|
| EXN1-M02-0213 | mm ⌀ | mm ⌀ | mm | mm | mm | mm ⌀ | # | mm | ° | ° |
| **12/2** | 12.0 | 11.0 | 26.0 | 46.0 | 93.0 | 12.0 | 4 | 2.00 | 45 | 20 |
| **16/2** | 16.0 | 15.0 | 34.0 | 60.0 | 110.0 | 16.0 | 4 | 2.00 | 45 | 20 |
| **16/3** | 16.0 | 15.0 | 34.0 | 60.0 | 110.0 | 16.0 | 4 | 3.00 | 45 | 20 |
| **20/2** | 20.0 | 19.0 | 42.0 | 72.0 | 125.0 | 20.0 | 4 | 2.00 | 45 | 20 |
| **20/3** | 20.0 | 19.0 | 42.0 | 72.0 | 125.0 | 20.0 | 4 | 3.00 | 45 | 20 |
| **20/4** | 20.0 | 19.0 | 42.0 | 72.0 | 125.0 | 20.0 | 4 | 4.00 | 45 | 20 |
| **25/2** | 25.0 | 24.0 | 52.0 | 68.0 | 125.0 | 25.0 | 4 | 2.00 | 45 | 20 |
| **25/3** | 25.0 | 24.0 | 52.0 | 68.0 | 125.0 | 25.0 | 4 | 3.00 | 45 | 20 |
| **25/4** | 25.0 | 24.0 | 52.0 | 68.0 | 125.0 | 25.0 | 4 | 4.00 | 45 | 20 |



EXN1-M02-0213 | EXN1 SLOTMAKER Z4 2XD LONG IC ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | ETC | Materialgroup Factor fz / a |
|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 560 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 540 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 510 | 0.9 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 260 | 0.8 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 560 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 350 | 350 | 410 | 0.7 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 300 | 300 | 350 | 0.6 |

**ADVICE |** The values marked in turquoise are side applications!
All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping use fz 50 % of the full slot.
The specified values represent starting values for a solid clamping situation.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

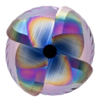
| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | α° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae =0.2xD (mm) | ap (mm) | hmax (mm) |
| 12 | 26 | 2° | 0.1 | 12 | 12 | 0.12 | 3.6 | L2max | 0.15 | 2.4 | L2max | 0.12 |
| 16 | 34 | 2.5° | 0.12 | 16 | 16 | 0.14 | 4.8 | L2max | 0.17 | 3.2 | L2max | 0.136 |
| 20 | 42 | 3° | 0.14 | 20 | 20 | 0.16 | 6 | L2max | 0.19 | 4 | L2max | 0.152 |
| 25 | 52 | 4° | 0.16 | 25 | 25 | 0.18 | 7.5 | L2max | 0.21 | 5 | L2max | 0.168 |

| | |
|---|---|
| Cooling | |
| Tolerance | e8 |
| Coating | AlphaSlide Rainbow |

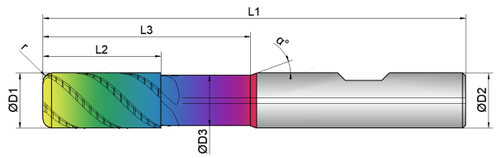
| | |
|---|---|
| Strategy | ETC, HPC |
| Application | |
| Features | HB, ≠, 2xD, R |

Expert

- Special roughing profile combined with 4 teeth for the highest performance in volume machining
- Special helical pitch for smooth running and soft cut



- For roughing, up to 2xD full slot
- For process reliable, helical diving and immersion




- With central inner cooling
- Also ideally designed for trochoidal milling

**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| | D1 | D3 | L2 | L3 | L1 | D2 | z | r | | α |
|---|---|---|---|---|---|---|---|---|---|---|
| EXN1-M02-0214 | mm ø | mm ø | mm | mm | mm | mm ø | # | mm | ° | ° |
| 12/2 | 12.0 | 11.0 | 26.0 | 46.0 | 93.0 | 12.0 | 4 | 2.00 | 45 | 20 |
| 16/2 | 16.0 | 15.0 | 34.0 | 60.0 | 110.0 | 16.0 | 4 | 2.00 | 45 | 20 |
| 16/3 | 16.0 | 15.0 | 34.0 | 60.0 | 110.0 | 16.0 | 4 | 3.00 | 45 | 20 |
| 20/2 | 20.0 | 19.0 | 42.0 | 72.0 | 125.0 | 20.0 | 4 | 2.00 | 45 | 20 |
| 20/3 | 20.0 | 19.0 | 42.0 | 72.0 | 125.0 | 20.0 | 4 | 3.00 | 45 | 20 |
| 20/4 | 20.0 | 19.0 | 42.0 | 72.0 | 125.0 | 20.0 | 4 | 4.00 | 45 | 20 |
| 25/2 | 25.0 | 24.0 | 52.0 | 68.0 | 125.0 | 25.0 | 4 | 2.00 | 45 | 20 |
| 25/3 | 25.0 | 24.0 | 52.0 | 68.0 | 125.0 | 25.0 | 4 | 3.00 | 45 | 20 |
| 25/4 | 25.0 | 24.0 | 52.0 | 68.0 | 125.0 | 25.0 | 4 | 4.00 | 45 | 20 |



EXN1-M02-0214 | EXN1 SLOTMAKER Z4 2XD LONG IC ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | ETC | Materialgroup Factor fz / a |
|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 500 | 560 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 480 | 540 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 450 | 510 | 0.9 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 200 | 200 | 260 | 0.8 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 500 | 560 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 350 | 350 | 410 | 0.7 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 300 | 300 | 350 | 0.6 |

**ADVICE |** The values marked in turquoise are side applications!
All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping use fz 50 % of the full slot.
The specified values represent starting values for a solid clamping situation.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

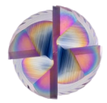
| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | ETC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | α° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae =0.2xD (mm) | ap (mm) | hmax (mm) |
| 12 | 26 | 2° | 0.1 | 12 | 12 | 0.12 | 3.6 | L2max | 0.15 | 2.4 | L2max | 0.12 |
| 16 | 34 | 2.5° | 0.12 | 16 | 16 | 0.14 | 4.8 | L2max | 0.17 | 3.2 | L2max | 0.136 |
| 20 | 42 | 3° | 0.14 | 20 | 20 | 0.16 | 6 | L2max | 0.19 | 4 | L2max | 0.152 |
| 25 | 52 | 4° | 0.16 | 25 | 25 | 0.18 | 7.5 | L2max | 0.21 | 5 | L2max | 0.168 |

| | |
|---|---|
| Cooling | |
| Tolerance | e8 |
| Coating | AlphaSlide Rainbow |

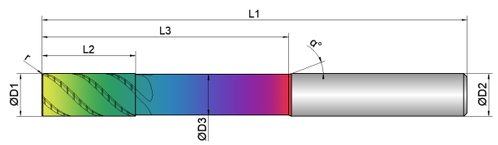
| | |
|---|---|
| Strategy | HPC |
| Application | |
| Features | HA, ≠, 2xD, R |

Expert

- Special roughing profile combined with 4 teeth for the highest performance in volume machining
- Special helical pitch for smooth running and soft cut



- For roughing, up to 2xD full slot
- For process reliable helical immersion




| Roughing | Finishing |
|---|---|
| inappropriate — optimal | inappropriate — optimal |

| EXN1-M02-0223 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 6.0 | 5.5 | 13.0 | 42.0 | 80.0 | 6.0 | 4 | 0.20 | 45 | 20 |
| 8 | 8.0 | 7.5 | 19.0 | 52.0 | 100.0 | 8.0 | 4 | 0.25 | 45 | 20 |
| 10 | 10.0 | 9.5 | 22.0 | 58.0 | 100.0 | 10.0 | 4 | 0.25 | 45 | 20 |
| 12 | 12.0 | 11.0 | 26.0 | 72.0 | 120.0 | 12.0 | 4 | 0.30 | 45 | 20 |
| 16 | 16.0 | 15.0 | 34.0 | 94.0 | 150.0 | 16.0 | 4 | 0.40 | 45 | 20 |
| 20 | 20.0 | 19.0 | 42.0 | 98.0 | 150.0 | 20.0 | 4 | 0.50 | 45 | 20 |



EXN1-M02-0223 | EXN1 SLOTMAKER Z4 2XD OVERLONG ASR

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| | Material | Strength (N/mm²) | Full Slot | Side Milling | Materialgroup Factor fz / a |
|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 280 | 280 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 260 | 260 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 240 | 240 | 0.9 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 120 | 120 | 0.8 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 280 | 280 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 200 | 200 | 0.7 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 170 | 170 | 0.6 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping use fz 50 % of the full slot.
The specified values represent starting values for a solid clamping situation.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

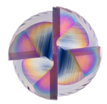
| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | |
|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) |
| 6 | 13 | 1.5° | 0.045 | 6 | 6 | 0.075 | 1.8 | L2max |
| 8 | 19 | 2° | 0.05 | 8 | 8 | 0.08 | 2.4 | L2max |
| 10 | 22 | 2.5° | 0.055 | 10 | 10 | 0.095 | 3 | L2max |
| 12 | 26 | 3° | 0.06 | 12 | 12 | 0.11 | 3.6 | L2max |
| 16 | 34 | 4° | 0.065 | 16 | 16 | 0.13 | 4.8 | L2max |
| 20 | 42 | 5° | 0.075 | 20 | 20 | 0.15 | 6 | L2max |

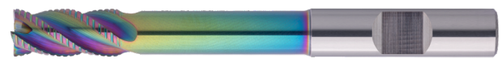
| | |
|---|---|
| Cooling | |
| Tolerance | e8 |
| Coating | AlphaSlide Rainbow |

| | |
|---|---|
| Strategy | HPC |
| Application | |
| Features | HB, ≠, 2xD, R |

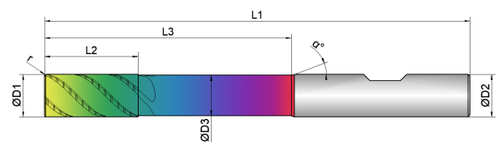
Expert

- Special roughing profile combined with 4 teeth for the highest performance in volume machining
- Special helical pitch for smooth running and soft cut





- For roughing, up to 2xD full slot
- For process reliable helical immersion




**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M02-0224 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| **6** | 6.0 | 5.5 | 13.0 | 42.0 | 80.0 | 6.0 | 4 | 0.20 | 45 | 20 |
| **8** | 8.0 | 7.5 | 19.0 | 52.0 | 100.0 | 8.0 | 4 | 0.25 | 45 | 20 |
| **10** | 10.0 | 9.5 | 22.0 | 58.0 | 100.0 | 10.0 | 4 | 0.25 | 45 | 20 |
| **12** | 12.0 | 11.0 | 26.0 | 72.0 | 120.0 | 12.0 | 4 | 0.30 | 45 | 20 |
| **16** | 16.0 | 15.0 | 34.0 | 94.0 | 150.0 | 16.0 | 4 | 0.40 | 45 | 20 |
| **20** | 20.0 | 19.0 | 42.0 | 98.0 | 150.0 | 20.0 | 4 | 0.50 | 45 | 20 |



EXN1-M02-0224 | EXN1 SLOTMAKER Z4 2XD OVERLONG ASR

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| N | Material | Strength (N/mm²) | Full Slot | Side Milling | Materialgroup Factor fz / a |
|---|---|---|---|---|---|
| | | | Vc = m/min | Vc = m/min | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 280 | 280 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 260 | 260 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 240 | 240 | 0.9 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 120 | 120 | 0.8 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 280 | 280 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 200 | 200 | 0.7 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 170 | 170 | 0.6 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping use fz 50 % of the full slot.
The specified values represent starting values for a solid clamping situation.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 Ø | L2 mm | Immersion Angle a° | Full Slot fz (mm/Z) | Full Slot ae = 1xD (mm) | Full Slot ap = 1xD (mm) | Side Milling fz (mm/Z) | Side Milling ae = 0.3xD (mm) | Side Milling ap (mm) |
|---|---|---|---|---|---|---|---|---|
| 6 | 13 | 1.5° | 0.045 | 6 | 6 | 0.075 | 1.8 | L2max |
| 8 | 19 | 2° | 0.05 | 8 | 8 | 0.08 | 2.4 | L2max |
| 10 | 22 | 2.5° | 0.055 | 10 | 10 | 0.095 | 3 | L2max |
| 12 | 26 | 3° | 0.06 | 12 | 12 | 0.11 | 3.6 | L2max |
| 16 | 34 | 4° | 0.065 | 16 | 16 | 0.13 | 4.8 | L2max |
| 20 | 42 | 5° | 0.075 | 20 | 20 | 0.15 | 6 | L2max |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

| | |
|---|---|
| Strategy | ETC |
| Application | |
| Features | HA, ≠, 3xD, R |

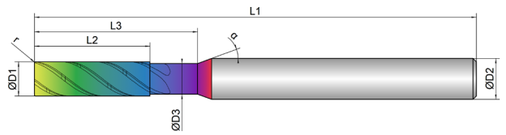
Expert

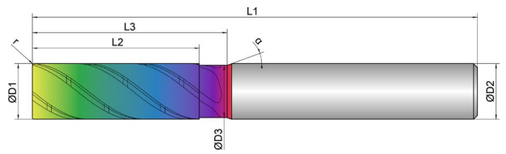
Download Catalog Pages (PDF)

- Chip breaker for short, defined chip length
- Unequal tooth pitch combined with variable helical pitch for smooth running
- Reinforced face with 2 cutting edges to the center

- For roughing and finishing under ETC conditions
- For process reliable, helical diving and immersion

- Ideal chip evacuation, even with high radial depth of cutting




| Roughing | Finishing |
|---|---|
| inappropriate | optimal / inappropriate / optimal |

| EXN1-M03-0033 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 5.0 | 4.5 | 17.0 | 24.0 | 65.0 | 6.0 | 4 | 0.15 | 38 | 20 |
| 6 | 6.0 | 5.5 | 18.0 | 25.0 | 65.0 | 6.0 | 4 | 0.15 | 38 | 20 |
| 8 | 8.0 | 7.5 | 24.0 | 30.0 | 70.0 | 8.0 | 4 | 0.20 | 38 | 20 |
| 10 | 10.0 | 9.4 | 30.0 | 35.0 | 80.0 | 10.0 | 4 | 0.20 | 38 | 20 |
| 12 | 12.0 | 11.4 | 36.0 | 45.0 | 93.0 | 12.0 | 4 | 0.20 | 38 | 20 |
| 16 | 16.0 | 15.4 | 48.0 | 55.0 | 110.0 | 16.0 | 4 | 0.30 | 38 | 20 |
| 20 | 20.0 | 19.4 | 60.0 | 70.0 | 125.0 | 20.0 | 4 | 0.30 | 38 | 20 |



EXN1-M03-0033 | EXN1 CHIPMAKER Z4 3XD ASR

| | Material | Strength (N/mm²) | ETC | Finishing | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 520 | 380 | 1 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 500 | 360 | 1 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 480 | 320 | 0.9 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 160 | 0.8 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 520 | 350 | 1 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | | | | |
| 5.2 | PLASTICS \| Duroplastic | <150 | | | | |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.
For coarser roughing operations we recommend a Weldon in conjunction with a Weldon chuck.

**Material N 1.1**

| D1 | L2 | Immersion Angle | ETC high dynamic | | | | ETC low dynamic | | | | Finishing | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 0.15xD (mm) | ap (mm) | hmax (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | hmax (mm) | fz (mm/Z) | ae (mm) |
| 5 | 17 | 1° | 0.07 | 0.75 | L2max | 0.05 | 0.043 | 1.5 | L2max | 0.0394 | 0.028 | 0.2 |
| 6 | 18 | 1° | 0.09 | 0.9 | L2max | 0.0643 | 0.056 | 1.8 | L2max | 0.0513 | 0.03 | 0.2 |
| 8 | 24 | 1.2° | 0.11 | 1.2 | L2max | 0.0786 | 0.068 | 2.4 | L2max | 0.0623 | 0.032 | 0.2 |
| 10 | 30 | 1.5° | 0.13 | 1.5 | L2max | 0.0928 | 0.081 | 3 | L2max | 0.0742 | 0.034 | 0.2 |
| 12 | 36 | 1.5° | 0.15 | 1.8 | L2max | 0.1071 | 0.093 | 3.6 | L2max | 0.0852 | 0.036 | 0.2 |
| 16 | 48 | 2° | 0.18 | 2.4 | L2max | 0.1285 | 0.112 | 4.8 | L2max | 0.1026 | 0.038 | 0.2 |
| 20 | 60 | 3° | 0.21 | 3 | L2max | 0.15 | 0.130 | 6 | L2max | 0.1191 | 0.04 | 0.2 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

| | |
|---|---|
| Strategy | ETC |
| Application | |
| Features | HB, ≠, 3xD, R |

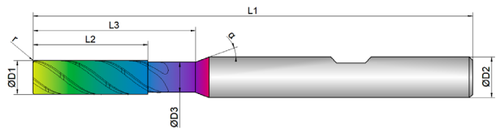
Expert

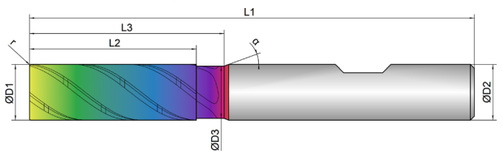
Download Catalog Pages (PDF)

- Chip breaker for short, defined chip length
- Unequal tooth pitch combined with variable helical pitch for smooth running
- Reinforced face with 2 cutting edges to the center

- For roughing and finishing under ETC conditions
- For process reliable, helical diving and immersion

- Ideal chip evacuation, even with high radial depth of cutting




Roughing: inappropriate — optimal

Finishing: inappropriate — optimal

| EXN1-M03-0034 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 5.0 | 4.5 | 17.0 | 24.0 | 65.0 | 6.0 | 4 | 0.15 | 38 | 20 |
| 6 | 6.0 | 5.5 | 18.0 | 25.0 | 65.0 | 6.0 | 4 | 0.15 | 38 | 20 |
| 8 | 8.0 | 7.5 | 24.0 | 30.0 | 70.0 | 8.0 | 4 | 0.20 | 38 | 20 |
| 10 | 10.0 | 9.4 | 30.0 | 35.0 | 80.0 | 10.0 | 4 | 0.20 | 38 | 20 |
| 12 | 12.0 | 11.4 | 36.0 | 45.0 | 93.0 | 12.0 | 4 | 0.20 | 38 | 20 |
| 16 | 16.0 | 15.4 | 48.0 | 55.0 | 110.0 | 16.0 | 4 | 0.30 | 38 | 20 |
| 20 | 20.0 | 19.4 | 60.0 | 70.0 | 125.0 | 20.0 | 4 | 0.30 | 38 | 20 |



EXN1-M03-0034 | EXN1 CHIPMAKER Z4 3XD ASR

| | Material | Strength (N/mm²) | ETC | Finishing | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 520 | 380 | 1 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 500 | 360 | 1 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 480 | 320 | 0.9 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 160 | 0.8 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 520 | 350 | 1 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | | | | |
| 5.2 | PLASTICS \| Duroplastic | <150 | | | | |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | ETC high dynamic | | | | ETC low dynamic | | | | Finishing | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 0.15xD (mm) | ap (mm) | hmax (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | hmax (mm) | fz (mm/Z) | ae (mm) |
| 5 | 17 | 1° | 0.07 | 0.75 | L2max | 0.05 | 0.043 | 1.5 | L2max | 0.0394 | 0.028 | 0.2 |
| 6 | 18 | 1° | 0.09 | 0.9 | L2max | 0.0643 | 0.056 | 1.8 | L2max | 0.0513 | 0.03 | 0.2 |
| 8 | 24 | 1.2° | 0.11 | 1.2 | L2max | 0.0786 | 0.068 | 2.4 | L2max | 0.0623 | 0.032 | 0.2 |
| 10 | 30 | 1.5° | 0.13 | 1.5 | L2max | 0.0928 | 0.081 | 3 | L2max | 0.0742 | 0.034 | 0.2 |
| 12 | 36 | 1.5° | 0.15 | 1.8 | L2max | 0.1071 | 0.093 | 3.6 | L2max | 0.0852 | 0.036 | 0.2 |
| 16 | 48 | 2° | 0.18 | 2.4 | L2max | 0.1285 | 0.112 | 4.8 | L2max | 0.1026 | 0.038 | 0.2 |
| 20 | 60 | 3° | 0.21 | 3 | L2max | 0.15 | 0.130 | 6 | L2max | 0.1191 | 0.04 | 0.2 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

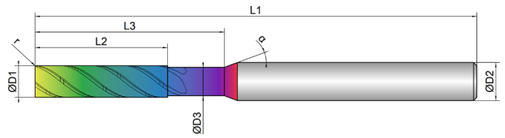
| | |
|---|---|
| Strategy | ETC |
| Application | |
| Features | HA, ≠, 4xD, R |

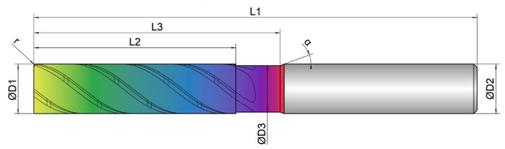
Expert

- Chip breaker for short, defined chip length
- Unequal tooth pitch combined with variable helical pitch for smooth running
- Reinforced face with 2 cutting edges to the center

- For roughing and finishing under ETC conditions
- For process reliable, helical immersion

- Ideal chip evacuation, even with high radial depth of cutting




| Roughing | Finishing |
|---|---|
| inappropriate | optimal / inappropriate / optimal |

| EXN1-M03-0043 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 5.0 | 4.5 | 21.0 | 30.0 | 70.0 | 6.0 | 4 | 0.15 | 38 | 20 |
| 6 | 6.0 | 5.5 | 25.0 | 30.0 | 70.0 | 6.0 | 4 | 0.15 | 38 | 20 |
| 8 | 8.0 | 7.5 | 33.0 | 40.0 | 80.0 | 8.0 | 4 | 0.20 | 38 | 20 |
| 10 | 10.0 | 9.4 | 41.0 | 50.0 | 90.0 | 10.0 | 4 | 0.20 | 38 | 20 |
| 12 | 12.0 | 11.4 | 49.0 | 60.0 | 110.0 | 12.0 | 4 | 0.20 | 38 | 20 |
| 16 | 16.0 | 15.4 | 65.0 | 80.0 | 130.0 | 16.0 | 4 | 0.30 | 38 | 20 |
| 20 | 20.0 | 19.4 | 82.0 | 100.0 | 150.0 | 20.0 | 4 | 0.30 | 38 | 20 |





Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | ETC | Finishing | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 520 | 380 | 1 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 500 | 360 | 1 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 480 | 320 | 0.9 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 160 | 0.8 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 520 | 350 | 1 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | | | | |
| 5.2 | PLASTICS \| Duroplastic | <150 | | | | |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.
For coarser roughing operations we recommend a Weldon in conjunction with a Weldon chuck.

**Material N 1.1**

| D1 | L2 | Immersion Angle | ETC high dynamic | | | | ETC low dynamic | | | | Finishing | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 0.15xD (mm) | ap (mm) | hmax (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | hmax (mm) | fz (mm/Z) | ae (mm) |
| 5 | 21 | 1° | 0.065 | 0.75 | L2max | 0.0464 | 0.040 | 1.5 | L2max | 0.0367 | 0.028 | 0.2 |
| 6 | 25 | 1° | 0.085 | 0.9 | L2max | 0.0607 | 0.053 | 1.8 | L2max | 0.0486 | 0.03 | 0.2 |
| 8 | 33 | 1.2° | 0.1 | 1.2 | L2max | 0.0714 | 0.062 | 2.4 | L2max | 0.0568 | 0.032 | 0.2 |
| 10 | 41 | 1.5° | 0.12 | 1.5 | L2max | 0.0857 | 0.074 | 3 | L2max | 0.0678 | 0.034 | 0.2 |
| 12 | 49 | 1.5° | 0.14 | 1.8 | L2max | 0.1 | 0.087 | 3.6 | L2max | 0.0797 | 0.036 | 0.2 |
| 16 | 65 | 2° | 0.17 | 2.4 | L2max | 0.1214 | 0.105 | 4.8 | L2max | 0.0962 | 0.038 | 0.2 |
| 20 | 82 | 3° | 0.2 | 3 | L2max | 0.1428 | 0.124 | 6 | L2max | 0.1136 | 0.04 | 0.2 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

| | |
|---|---|
| Strategy | ETC |
| Application | |
| Features | HB, ≠, 4xD, R |

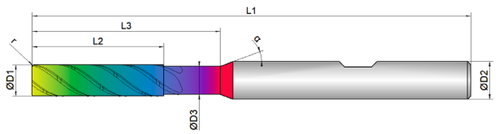
Expert

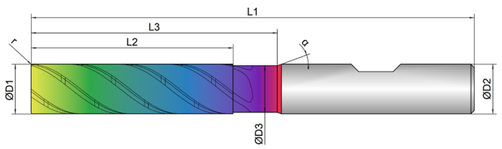
Download Catalog Pages (PDF)

- Chip breaker for short, defined chip length
- Unequal tooth pitch combined with variable helical pitch for smooth running
- Reinforced face with 2 cutting edges to the center

- For roughing and finishing under ETC conditions
- For process reliable, helical immersion

- Ideal chip evacuation, even with high radial depth of cutting




| Roughing | Finishing |
|---|---|
| inappropriate | optimal / inappropriate / optimal |

| EXN1-M03-0044 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 5.0 | 4.5 | 21.0 | 30.0 | 70.0 | 6.0 | 4 | 0.15 | 38 | 20 |
| 6 | 6.0 | 5.5 | 25.0 | 30.0 | 70.0 | 6.0 | 4 | 0.15 | 38 | 20 |
| 8 | 8.0 | 7.5 | 33.0 | 40.0 | 80.0 | 8.0 | 4 | 0.20 | 38 | 20 |
| 10 | 10.0 | 9.4 | 41.0 | 50.0 | 90.0 | 10.0 | 4 | 0.20 | 38 | 20 |
| 12 | 12.0 | 11.4 | 49.0 | 60.0 | 110.0 | 12.0 | 4 | 0.20 | 38 | 20 |
| 16 | 16.0 | 15.4 | 65.0 | 80.0 | 130.0 | 16.0 | 4 | 0.30 | 38 | 20 |
| 20 | 20.0 | 19.4 | 82.0 | 100.0 | 150.0 | 20.0 | 4 | 0.30 | 38 | 20 |



EXN1-M03-0044 | EXN1 CHIPMAKER Z4 4XD ASR

| | Material | Strength (N/mm²) | ETC | Finishing | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 520 | 380 | 1 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 500 | 360 | 1 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 480 | 320 | 0.9 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 160 | 0.8 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 520 | 350 | 1 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | | | | |
| 5.2 | PLASTICS \| Duroplastic | <150 | | | | |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | ETC high dynamic | | | | ETC low dynamic | | | | Finishing | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 0.15xD (mm) | ap (mm) | hmax (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | hmax (mm) | fz (mm/Z) | ae (mm) |
| 5 | 21 | 1° | 0.065 | 0.75 | L2max | 0.0464 | 0.040 | 1.5 | L2max | 0.0367 | 0.028 | 0.2 |
| 6 | 25 | 1° | 0.085 | 0.9 | L2max | 0.0607 | 0.053 | 1.8 | L2max | 0.0486 | 0.03 | 0.2 |
| 8 | 33 | 1.2° | 0.1 | 1.2 | L2max | 0.0714 | 0.062 | 2.4 | L2max | 0.0568 | 0.032 | 0.2 |
| 10 | 41 | 1.5° | 0.12 | 1.5 | L2max | 0.0857 | 0.074 | 3 | L2max | 0.0678 | 0.034 | 0.2 |
| 12 | 49 | 1.5° | 0.14 | 1.8 | L2max | 0.1 | 0.087 | 3.6 | L2max | 0.0797 | 0.036 | 0.2 |
| 16 | 65 | 2° | 0.17 | 2.4 | L2max | 0.1214 | 0.105 | 4.8 | L2max | 0.0962 | 0.038 | 0.2 |
| 20 | 82 | 3° | 0.2 | 3 | L2max | 0.1428 | 0.124 | 6 | L2max | 0.1136 | 0.04 | 0.2 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

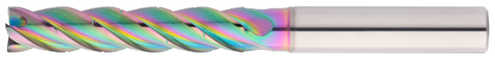
| | |
|---|---|
| Strategy | ETC |
| Application | |
| Features | HA, ≠, 5xD, R |

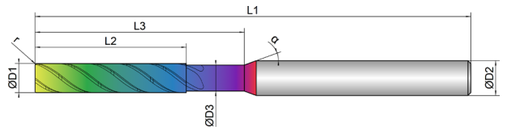
Expert

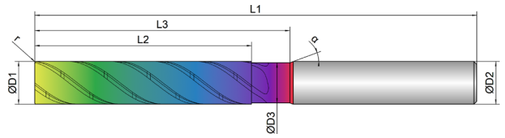
- Chip breaker for short, defined chip length
- Unequal tooth pitch combined with variable helical pitch for smooth running
- Reinforced face with 2 cutting edges to the center

- For roughing and finishing under ETC conditions
- For process reliable, helical immersion

- Ideal chip evacuation, even with high radial depth of cutting






**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M03-0053 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| **5** | 5.0 | 4.5 | 26.0 | 36.0 | 75.0 | 6.0 | 4 | 0.15 | 38 | 20 |
| **6** | 6.0 | 5.5 | 31.0 | 36.0 | 75.0 | 6.0 | 4 | 0.15 | 38 | 20 |
| **8** | 8.0 | 7.5 | 41.0 | 48.0 | 90.0 | 8.0 | 4 | 0.20 | 38 | 20 |
| **10** | 10.0 | 9.5 | 51.0 | 60.0 | 104.0 | 10.0 | 4 | 0.20 | 38 | 20 |
| **12** | 12.0 | 11.0 | 61.0 | 72.0 | 120.0 | 12.0 | 4 | 0.20 | 38 | 20 |
| **16** | 16.0 | 15.0 | 81.0 | 96.0 | 150.0 | 16.0 | 4 | 0.30 | 38 | 20 |
| **20** | 20.0 | 19.0 | 102.0 | 120.0 | 175.0 | 20.0 | 4 | 0.30 | 38 | 20 |



EXN1-M03-0053 | EXN1 CHIPMAKER Z4 5XD ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | ETC | Finishing | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | Vc = m/min | Vc = m/min | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 380 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 360 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 460 | 320 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 160 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 350 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | | | | |
| **5.2** | PLASTICS \| Duroplastic | <150 | | | | |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.
For coarser roughing operations we recommend a Weldon in conjunction with a Weldon chuck.

**Material N 1.1**

| D1 | L2 | Immersion Angle | ETC high dynamic | | | | ETC low dynamic | | | | Finishing | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 0.1xD (mm) | ap (mm) | hmax (mm) | fz (mm/Z) | ae = 0.2xD (mm) | ap (mm) | hmax (mm) | fz (mm/Z) | ae (mm) |
| 5 | 26 | 1° | 0.05 | 0.5 | L2max | 0.03 | 0.031 | 1 | L2max | 0.0248 | 0.024 | 0.2 |
| 6 | 31 | 1° | 0.06 | 0.6 | L2max | 0.036 | 0.037 | 1.2 | L2max | 0.0296 | 0.026 | 0.2 |
| 8 | 41 | 1.2° | 0.08 | 0.8 | L2max | 0.048 | 0.050 | 1.6 | L2max | 0.04 | 0.028 | 0.2 |
| 10 | 51 | 1.5° | 0.1 | 1 | L2max | 0.06 | 0.062 | 2 | L2max | 0.0496 | 0.03 | 0.2 |
| 12 | 61 | 1.5° | 0.12 | 1.2 | L2max | 0.072 | 0.074 | 2.4 | L2max | 0.0592 | 0.032 | 0.2 |
| 16 | 81 | 2° | 0.15 | 1.6 | L2max | 0.09 | 0.093 | 3.2 | L2max | 0.0744 | 0.034 | 0.2 |
| 20 | 102 | 3° | 0.18 | 2 | L2max | 0.108 | 0.112 | 4 | L2max | 0.0896 | 0.036 | 0.2 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

| | |
|---|---|
| Strategy | ETC |
| Application | |
| Features | HB, ≠, 5xD, R |

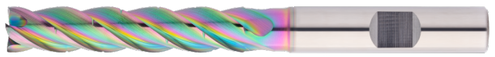
Expert

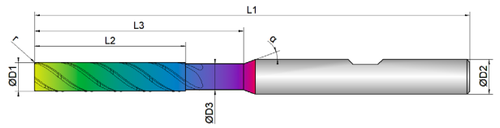
Download Catalog Pages (PDF)

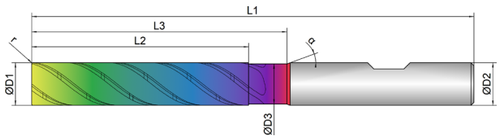
- Chip breaker for short, defined chip length
- Unequal tooth pitch combined with variable helical pitch for smooth running
- Reinforced face with 2 cutting edges to the center

- For roughing and finishing under ETC conditions
- For process reliable, helical immersion

- Ideal chip evacuation, even with high radial depth of cutting






**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M03-0054 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| **5** | 5.0 | 4.5 | 26.0 | 36.0 | 75.0 | 6.0 | 4 | 0.15 | 38 | 20 |
| **6** | 6.0 | 5.5 | 31.0 | 36.0 | 75.0 | 6.0 | 4 | 0.15 | 38 | 20 |
| **8** | 8.0 | 7.5 | 41.0 | 48.0 | 90.0 | 8.0 | 4 | 0.20 | 38 | 20 |
| **10** | 10.0 | 9.5 | 51.0 | 60.0 | 104.0 | 10.0 | 4 | 0.20 | 38 | 20 |
| **12** | 12.0 | 11.0 | 61.0 | 72.0 | 120.0 | 12.0 | 4 | 0.20 | 38 | 20 |
| **16** | 16.0 | 15.0 | 81.0 | 96.0 | 150.0 | 16.0 | 4 | 0.30 | 38 | 20 |
| **20** | 20.0 | 19.0 | 102.0 | 120.0 | 175.0 | 20.0 | 4 | 0.30 | 38 | 20 |



EXN1-M03-0054 | EXN1 CHIPMAKER Z4 5XD ASR

| | Material | Strength (N/mm²) | ETC | Finishing | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | Vc = m/min | Vc = m/min | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 380 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 360 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 460 | 320 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 160 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 350 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | | | | |
| **5.2** | PLASTICS \| Duroplastic | <150 | | | | |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

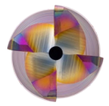
| D1 | L2 | Immersion Angle | ETC high dynamic | | | | ETC low dynamic | | | | Finishing | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 0.1xD (mm) | ap (mm) | hmax (mm) | fz (mm/Z) | ae = 0.2xD (mm) | ap (mm) | hmax (mm) | fz (mm/Z) | ae (mm) |
| 5 | 26 | 1° | 0.05 | 0.5 | L2max | 0.03 | 0.031 | 1 | L2max | 0.0248 | 0.024 | 0.2 |
| 6 | 31 | 1° | 0.06 | 0.6 | L2max | 0.036 | 0.037 | 1.2 | L2max | 0.0296 | 0.026 | 0.2 |
| 8 | 41 | 1.2° | 0.08 | 0.8 | L2max | 0.048 | 0.050 | 1.6 | L2max | 0.04 | 0.028 | 0.2 |
| 10 | 51 | 1.5° | 0.1 | 1 | L2max | 0.06 | 0.062 | 2 | L2max | 0.0496 | 0.03 | 0.2 |
| 12 | 61 | 1.5° | 0.12 | 1.2 | L2max | 0.072 | 0.074 | 2.4 | L2max | 0.0592 | 0.032 | 0.2 |
| 16 | 81 | 2° | 0.15 | 1.6 | L2max | 0.09 | 0.093 | 3.2 | L2max | 0.0744 | 0.034 | 0.2 |
| 20 | 102 | 3° | 0.18 | 2 | L2max | 0.108 | 0.112 | 4 | L2max | 0.0896 | 0.036 | 0.2 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

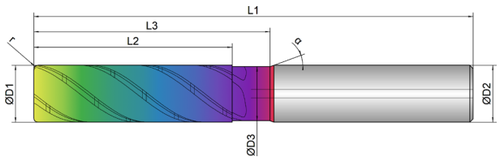
| | |
|---|---|
| Strategy | ETC |
| Application | |
| Features | HA, ≠, 3,5xD, R |

Expert

- Special aerospace geometry optimized for vibration-free milling and ideal chip removal for thin-walled workpieces and complex internal machining



- Adapted chip breaker for defined chip length and maximum tool life
- Unequal tooth pitch combined with variable helical pitch for smooth running and a soft cut




- Radius tolerance r ≤ 1.5 mm: ± 0.003 mm
- Radius tolerance r > 1.5 mm: ± 0.005 mm

**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M03-0133 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 12/0,8 | 12.0 | 11.4 | 42.0 | 50.0 | 93.0 | 12.0 | 4 | 0.80 | 38 | 20 |
| 16/1 | 16.0 | 15.4 | 55.0 | 66.0 | 110.0 | 16.0 | 4 | 1.00 | 38 | 20 |





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| | Material | Strength (N/mm²) | ETC | Finishing | Materialgroup Factor fz / a | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 520 | 380 | 1 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 500 | 360 | 1 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 480 | 320 | 0.9 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 160 | 0.8 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 520 | 350 | 1 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | | | | |
| 5.2 | PLASTICS \| Duroplastic | <150 | | | | |

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The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | ETC high dynamic | | | | ETC low dynamic | | | | Finishing | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae =0.15xD (mm) | ap (mm) | hmax (mm) | fz (mm/Z) | ae =0.3xD (mm) | ap (mm) | hmax (mm) | fz (mm/Z) | ae (mm) |
| 12 | 42 | 1.5° | 0.15 | 1.8 | L2max | 0.1071 | 0.093 | 3.6 | L2max | 0.0852 | 0.036 | 0.2 |
| 16 | 55 | 2° | 0.18 | 2.4 | L2max | 0.1285 | 0.112 | 4.8 | L2max | 0.1026 | 0.038 | 0.2 |

## STILL CAN'T FIND A SUITABLE MILLING CUTTER?

**No problem** – simply customize an existing tool. Using our configurator for special milling cutters, you can customize existing tools to your needs in an instant or create your own tools based on predefined types.

WE WILL RESPOND TO ALL REQUESTS SUBMITTED VIA THE CONFIGURATOR WITHIN ONE WORKING DAY AT THE LATEST

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

| | |
|---|---|
| Strategy | HPC |
| Application | |
| Features | HA, ≠, 3xD, 90° |

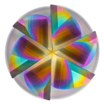
Expert

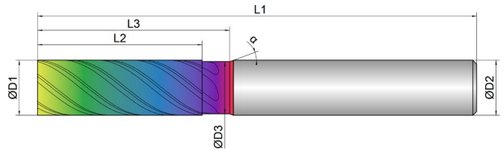
Download Catalog Pages (PDF)

- Ultra-sharp and lapped cutting edges
- Special chip chambers designed for the evacuation of extra long and fine chips
- Face-Finish-bevel for smooth workpiece surfaces

- For excellent surfaces and maximum dimensional accuracy

- 6 cutting edges for highest feed rates






**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M04-0033 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|
| **6** | 6.0 | 5.8 | 18.0 | 25.0 | 65.0 | 6.0 | 6 | 39 | 20 |
| **8** | 8.0 | 7.8 | 24.0 | 30.0 | 70.0 | 8.0 | 6 | 39 | 20 |
| **10** | 10.0 | 9.5 | 30.0 | 35.0 | 80.0 | 10.0 | 6 | 39 | 20 |
| **12** | 12.0 | 11.5 | 36.0 | 45.0 | 93.0 | 12.0 | 6 | 39 | 20 |
| **16** | 16.0 | 15.5 | 48.0 | 55.0 | 110.0 | 16.0 | 6 | 39 | 20 |
| **20** | 20.0 | 19.5 | 60.0 | 70.0 | 125.0 | 20.0 | 6 | 39 | 20 |



EXN1-M04-0033 | EXN1 MIRRORMAKER Z6 3XD ASR

| | Material | Strength (N/mm²) | Finishing Vc = m/min | Materialgroup Factor fz |
|---|---|---|---|---|
| **N** | NON-FERROUS | | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 380 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 360 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 320 | 0.9 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 160 | 0.8 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 350 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 300 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 260 | 0.7 |

**ADVICE |** All fz/α values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
For a very good straightness of the surface, an additional blank path is recommended.
The specified values represent starting values for finishing.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

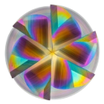
| D1 Ø | L2 mm | Semi Finishing fz (mm/Z) | Semi Finishing ae (mm) | Finishing fz (mm/Z) | Finishing ae (mm) |
|---|---|---|---|---|---|
| 6 | 18 | 0.04 | 0.2 | 0.03 | 0.2 |
| 8 | 24 | 0.044 | 0.2 | 0.032 | 0.2 |
| 10 | 30 | 0.046 | 0.2 | 0.034 | 0.2 |
| 12 | 36 | 0.048 | 0.2 | 0.036 | 0.2 |
| 16 | 48 | 0.05 | 0.2 | 0.038 | 0.2 |
| 20 | 60 | 0.052 | 0.2 | 0.04 | 0.2 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

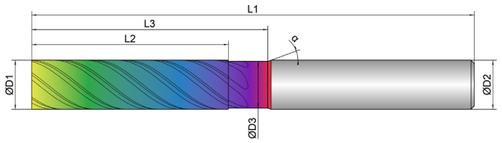
| | |
|---|---|
| Strategy | HPC |
| Application | |
| Features | HA, ≠, 4xD, 90° |

Expert

- Ultra-sharp and lapped cutting edges
- Special chip chambers designed for the evacuation of extra long and fine chips
- Face-Finish-bevel for smooth workpiece surfaces



- For excellent surfaces and maximum dimensional accuracy




- 6 cutting edges for highest feed rates

**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M04-0043 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|
| **6** | 6.0 | 5.8 | 24.0 | 32.0 | 65.0 | 6.0 | 6 | 39 | 20 |
| **8** | 8.0 | 7.8 | 32.0 | 40.0 | 75.0 | 8.0 | 6 | 39 | 20 |
| **10** | 10.0 | 9.5 | 40.0 | 48.0 | 90.0 | 10.0 | 6 | 39 | 20 |
| **12** | 12.0 | 11.5 | 48.0 | 56.0 | 100.0 | 12.0 | 6 | 39 | 20 |
| **16** | 16.0 | 15.5 | 64.0 | 72.0 | 125.0 | 16.0 | 6 | 39 | 20 |
| **20** | 20.0 | 19.5 | 80.0 | 88.0 | 150.0 | 20.0 | 6 | 39 | 20 |



EXN1-M04-0043 | EXN1 MIRRORMAKER Z6 4XD ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Finishing Vc = m/min | Materialgroup Factor fz |
|---|---|---|---|---|
| **N** | NON-FERROUS | | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 380 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 360 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 320 | 0.9 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 160 | 0.8 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 350 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 300 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 260 | 0.7 |

**ADVICE |** All fz/α values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
For a very good straightness of the surface, an additional blank path is recommended.
The specified values represent starting values for finishing.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 Ø | L2 mm | Semi Finishing fz (mm/Z) | Semi Finishing ae (mm) | Finishing fz (mm/Z) | Finishing ae (mm) |
|---|---|---|---|---|---|
| 6 | 24 | 0.04 | 0.2 | 0.03 | 0.2 |
| 8 | 32 | 0.044 | 0.2 | 0.032 | 0.2 |
| 10 | 40 | 0.046 | 0.2 | 0.034 | 0.2 |
| 12 | 48 | 0.048 | 0.2 | 0.036 | 0.2 |
| 16 | 64 | 0.05 | 0.2 | 0.038 | 0.2 |
| 20 | 80 | 0.052 | 0.2 | 0.04 | 0.2 |

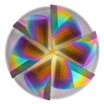
| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

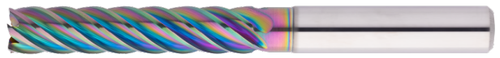
| | |
|---|---|
| Strategy | HPC |
| Application | |
| Features | HA, ≠, 5xD, 90° |

Expert

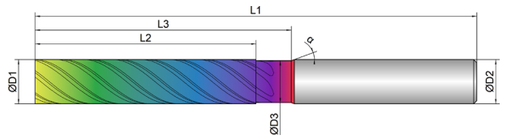
Download Catalog Pages (PDF)

- Ultra-sharp and lapped cutting edges
- Special chip chambers designed for the evacuation of extra long and fine chips
- Face-Finish-bevel for smooth workpiece surfaces





- For excellent surfaces and maximum dimensional accuracy




- 6 cutting edges for highest feed rates

**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M04-0053 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|
| **6** | 6.0 | 5.8 | 30.0 | 38.0 | 75.0 | 6.0 | 6 | 39 | 20 |
| **8** | 8.0 | 7.8 | 40.0 | 48.0 | 80.0 | 8.0 | 6 | 39 | 20 |
| **10** | 10.0 | 9.5 | 50.0 | 58.0 | 100.0 | 10.0 | 6 | 39 | 20 |
| **12** | 12.0 | 11.5 | 60.0 | 68.0 | 120.0 | 12.0 | 6 | 39 | 20 |
| **16** | 16.0 | 15.5 | 80.0 | 88.0 | 134.0 | 16.0 | 6 | 39 | 20 |
| **20** | 20.0 | 19.5 | 100.0 | 108.0 | 175.0 | 20.0 | 6 | 39 | 20 |



EXN1-M04-0053 | EXN1 MIRRORMAKER Z6 5XD ASR

| | Material | Strength (N/mm²) | Finishing Vc = m/min | Materialgroup Factor fz |
|---|---|---|---|---|
| **N** | NON-FERROUS | | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 380 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 360 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 320 | 0.9 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 160 | 0.8 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 350 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 300 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 260 | 0.7 |

**ADVICE |** All fz/α values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
For a very good straightness of the surface, an additional blank path is recommended.
The specified values represent starting values for finishing.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

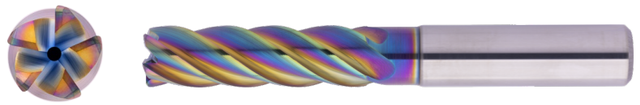
| D1 Ø | L2 mm | Semi Finishing fz (mm/Z) | Semi Finishing ae (mm) | Finishing fz (mm/Z) | Finishing ae (mm) |
|---|---|---|---|---|---|
| 6 | 30 | 0.038 | 0.2 | 0.026 | 0.2 |
| 8 | 40 | 0.04 | 0.2 | 0.028 | 0.2 |
| 10 | 50 | 0.042 | 0.2 | 0.03 | 0.2 |
| 12 | 60 | 0.044 | 0.2 | 0.032 | 0.2 |
| 16 | 80 | 0.046 | 0.2 | 0.034 | 0.2 |
| 20 | 100 | 0.048 | 0.2 | 0.036 | 0.2 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

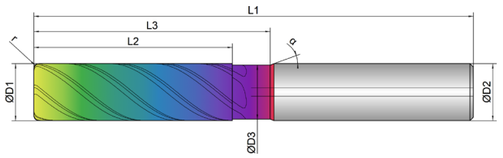
| | |
|---|---|
| Strategy | HPC |
| Application | |
| Features | HA, ≠, 3,5xD, R |

Expert

- Special aerospace geometry optimized for vibration-free milling and ideal chip removal for thin-walled workpieces and complex internal machining



- Special chip chambers designed for the evacuation of extra long and fine chips
- For excellent surfaces and maximum dimensional accuracy




- Radius tolerance r ≤ 1.5 mm: ± 0.003 mm
- Radius tolerance r > 1.5 mm: ± 0.005 mm

**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| | D1 | D3 | L2 | L3 | L1 | D2 | z | r | | α |
|---|---|---|---|---|---|---|---|---|---|---|
| EXN1-M04-0133 | mm ø | mm ø | mm | mm | mm | mm ø | # | mm | ° | ° |
| 12/1 | 12.0 | 11.4 | 42.0 | 50.0 | 93.0 | 12.0 | 5 | 1.00 | 39 | 20 |
| 16/3 | 16.0 | 15.5 | 55.0 | 66.0 | 110.0 | 16.0 | 5 | 3.00 | 39 | 20 |



EXN1-M04-0133 | EXN1 MIRRORMAKER Z5 3.5XD IC ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Finishing Vc = m/min | Materialgroup Factor fz |
|---|---|---|---|---|
| N | NON-FERROUS | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 380 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 360 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 320 | 0.9 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 160 | 0.8 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 350 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 300 | 0.8 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 260 | 0.7 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
For a very good straightness of the surface, an additional blank path is recommended.
The specified values represent starting values for finishing.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Semi Finishing | | Finishing | |
|---|---|---|---|---|---|
| Ø | mm | fz (mm/Z) | ae (mm) | fz (mm/Z) | ae (mm) |
| 12 | 42 | 0.048 | 0.2 | 0.036 | 0.2 |
| 16 | 55 | 0.05 | 0.2 | 0.038 | 0.2 |

## STILL CAN'T FIND A SUITABLE MILLING CUTTER?

**No problem** – simply customize an existing tool. Using our configurator for special milling cutters, you can customize existing tools to your needs in an instant or create your own tools based on predefined types.

WE WILL RESPOND TO ALL REQUESTS SUBMITTED VIA THE CONFIGURATOR WITHIN ONE WORKING DAY AT THE LATEST

| | |
|---|---|
| Cooling | |
| Tolerance | h10 |
| Coating | AlphaSlide Rainbow |

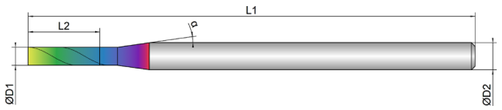
| | |
|---|---|
| Strategy | HSC HPC |
| Application | |
| Features | HA 90° |

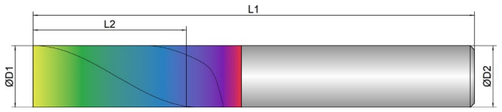
Expert

- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Balanced for maximum smoothness

- For roughing and finishing, up to 1.5xD full slot
- For process reliable, helical diving and immersion

- For use in high speed milling machines




**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| | D1 | L2 | L1 | D2 | z | | α |
|---|---|---|---|---|---|---|---|
| EXN1-M05-0023 | mm ø | mm | mm | mm ø | # | ° | ° |
| **1** | 1.0 | 4.0 | 50.0 | 3.0 | 1 | 30 | 8 |
| **1,5** | 1.5 | 6.0 | 50.0 | 3.0 | 1 | 30 | 8 |
| **2** | 2.0 | 8.0 | 50.0 | 3.0 | 1 | 30 | 8 |
| **3** | 3.0 | 12.0 | 50.0 | 3.0 | 1 | 30 | 0 |
| **4** | 4.0 | 15.0 | 54.0 | 4.0 | 1 | 30 | 0 |
| **5** | 5.0 | 17.0 | 54.0 | 5.0 | 1 | 30 | 0 |
| **6** | 6.0 | 20.0 | 65.0 | 6.0 | 1 | 30 | 0 |
| **8** | 8.0 | 22.0 | 63.0 | 8.0 | 1 | 30 | 0 |
| **10** | 10.0 | 25.0 | 72.0 | 10.0 | 1 | 30 | 0 |
| **12** | 12.0 | 30.0 | 83.0 | 12.0 | 1 | 30 | 0 |



EXN1-M05-0023 | EXN1 BALANCEMAKER Z1 ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | Materialgroup Factor fz / a |
|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 0.9 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 200 | 0.8 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 0.7 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 0.6 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
Reduce fz by 50 % when plunging 90°.
The specified values represent starting values for a solid clamping situation.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | Finishing | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) |
| 1 | 4 | 90° | 0.015 | 1 | 1 | 0.02 | 0.3 | L2max | 0.018 | 0.2 | L2max |
| 1.5 | 6 | 90° | 0.015 | 1.5 | 1.5 | 0.02 | 0.45 | L2max | 0.02 | 0.2 | L2max |
| 2 | 8 | 90° | 0.02 | 2 | 2 | 0.025 | 0.6 | L2max | 0.021 | 0.2 | L2max |
| 3 | 12 | 90° | 0.025 | 3 | 3 | 0.035 | 0.9 | L2max | 0.023 | 0.2 | L2max |
| 4 | 15 | 90° | 0.03 | 4 | 4 | 0.04 | 1.2 | L2max | 0.025 | 0.2 | L2max |
| 5 | 17 | 90° | 0.035 | 5 | 5 | 0.045 | 1.5 | L2max | 0.03 | 0.2 | L2max |
| 6 | 20 | 90° | 0.045 | 6 | 6 | 0.055 | 1.8 | L2max | 0.035 | 0.2 | L2max |
| 8 | 22 | 90° | 0.05 | 8 | 8 | 0.06 | 2.4 | L2max | 0.04 | 0.2 | L2max |
| 10 | 25 | 90° | 0.06 | 10 | 10 | 0.07 | 3 | L2max | 0.045 | 0.2 | L2max |
| 12 | 30 | 90° | 0.075 | 12 | 12 | 0.1 | 3.6 | L2max | 0.05 | 0.2 | L2max |

| | |
|---|---|
| Cooling | |
| Tolerance | h10 |
| Coating | AlphaSlide Rainbow |

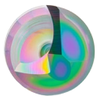
| | |
|---|---|
| Strategy | HSC HPC |
| Application | |
| Features | HA 90° |

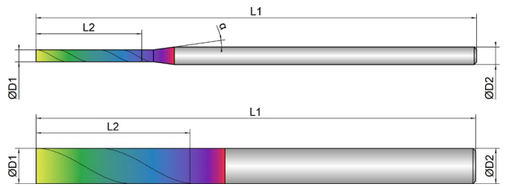
Expert

- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Balanced for maximum smoothness

- For roughing and finishing, up to 1.5xD full slot
- For process reliable, helical diving and immersion

- For use in high speed milling machines
- Long version with extra long cutting length






**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| | D1 | L2 | L1 | D2 | z | | α |
|---|---|---|---|---|---|---|---|
| EXN1-M05-0053 | mm ⌀ | mm | mm | mm ⌀ | # | ° | ° |
| 1 | 1.0 | 8.0 | 75.0 | 3.0 | 1 | 30 | 8 |
| 1,5 | 1.5 | 12.0 | 75.0 | 3.0 | 1 | 30 | 8 |
| 2 | 2.0 | 18.0 | 75.0 | 3.0 | 1 | 30 | 8 |
| 3 | 3.0 | 22.0 | 75.0 | 3.0 | 1 | 30 | 0 |
| 4 | 4.0 | 25.0 | 75.0 | 4.0 | 1 | 30 | 0 |
| 5 | 5.0 | 25.0 | 75.0 | 5.0 | 1 | 30 | 0 |
| 6 | 6.0 | 30.0 | 100.0 | 6.0 | 1 | 30 | 0 |
| 8 | 8.0 | 35.0 | 100.0 | 8.0 | 1 | 30 | 0 |
| 10 | 10.0 | 40.0 | 100.0 | 10.0 | 1 | 30 | 0 |
| 12 | 12.0 | 45.0 | 120.0 | 12.0 | 1 | 30 | 0 |



EXN1-M05-0053 | EXN1 BALANCEMAKER Z1 LONG ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing | Materialgroup Factor fz / a |
|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 450 | 450 | 450 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 425 | 425 | 425 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 400 | 400 | 400 | 0.9 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 170 | 170 | 170 | 0.8 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 450 | 450 | 450 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 350 | 350 | 350 | 0.7 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 300 | 300 | 300 | 0.6 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
Reduce fz by 50 % when plunging 90°.
The specified values represent starting values for a solid clamping situation.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | Finishing | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | a° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) |
| 1 | 8 | 90° | 0.008 | 1 | 1 | 0.012 | 0.3 | L2max | 0.018 | 0.2 | L2max |
| 1.5 | 12 | 90° | 0.008 | 1.5 | 1.5 | 0.012 | 0.45 | L2max | 0.02 | 0.2 | L2max |
| 2 | 18 | 90° | 0.015 | 2 | 2 | 0.02 | 0.6 | L2max | 0.021 | 0.2 | L2max |
| 3 | 22 | 90° | 0.02 | 3 | 3 | 0.025 | 0.9 | L2max | 0.023 | 0.2 | L2max |
| 4 | 25 | 90° | 0.025 | 4 | 4 | 0.03 | 1.2 | L2max | 0.025 | 0.2 | L2max |
| 5 | 25 | 90° | 0.03 | 5 | 5 | 0.038 | 1.5 | L2max | 0.03 | 0.2 | L2max |
| 6 | 30 | 90° | 0.038 | 6 | 6 | 0.048 | 1.8 | L2max | 0.035 | 0.2 | L2max |
| 8 | 35 | 90° | 0.043 | 8 | 8 | 0.053 | 2.4 | L2max | 0.04 | 0.2 | L2max |
| 10 | 40 | 90° | 0.05 | 10 | 10 | 0.06 | 3 | L2max | 0.045 | 0.2 | L2max |
| 12 | 45 | 90° | 0.065 | 12 | 12 | 0.09 | 3.6 | L2max | 0.05 | 0.2 | L2max |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

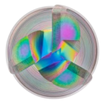
| | |
|---|---|
| Strategy | ETC HSC HPC |
| Application | |
| Features | HA ≠ 2xD R |

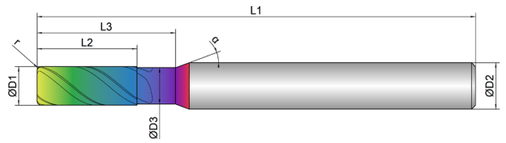
Expert

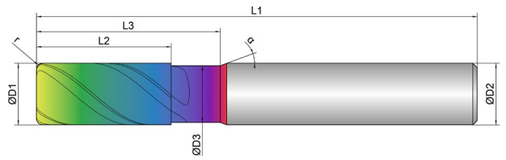
- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- For process reliable, helical diving and immersion
- For roughing and finishing, up to 1.5xD full slot
- Multipass milling of 3D contours

- Radius tolerance r ≤ 1.5 mm: ± 0.003 mm
- Radius tolerance r > 1.5 mm: ± 0.005 mm






**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M06-0003 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 5/0,5 | 5.0 | 4.7 | 13.0 | 18.0 | 57.0 | 6.0 | 3 | 0.50 | 45 | 20 |
| 5/1 | 5.0 | 4.7 | 13.0 | 18.0 | 57.0 | 6.0 | 3 | 1.00 | 45 | 20 |
| 6/0,5 | 6.0 | 5.7 | 13.0 | 18.0 | 57.0 | 6.0 | 3 | 0.50 | 45 | 20 |
| 6/1 | 6.0 | 5.7 | 13.0 | 18.0 | 57.0 | 6.0 | 3 | 1.00 | 45 | 20 |
| 8/0,5 | 8.0 | 7.4 | 21.0 | 25.0 | 63.0 | 8.0 | 3 | 0.50 | 45 | 20 |
| 8/1 | 8.0 | 7.4 | 21.0 | 25.0 | 63.0 | 8.0 | 3 | 1.00 | 45 | 20 |
| 10/0,5 | 10.0 | 9.2 | 22.0 | 30.0 | 72.0 | 10.0 | 3 | 0.50 | 45 | 20 |
| 10/1 | 10.0 | 9.2 | 22.0 | 30.0 | 72.0 | 10.0 | 3 | 1.00 | 45 | 20 |
| 10/1,5 | 10.0 | 9.2 | 22.0 | 30.0 | 72.0 | 10.0 | 3 | 1.50 | 45 | 20 |
| 10/2 | 10.0 | 9.2 | 22.0 | 30.0 | 72.0 | 10.0 | 3 | 2.00 | 45 | 20 |



EXN1-M06-0003 | EXN1 FORMMAKER Z3 2XD ASR

| EXN1-M06-0003 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 10/2,5 | 10.0 | 9.2 | 22.0 | 30.0 | 72.0 | 10.0 | 3 | 2.50 | 45 | 20 |
| 10/3 | 10.0 | 9.2 | 22.0 | 30.0 | 72.0 | 10.0 | 3 | 3.00 | 45 | 20 |
| 12/0,5 | 12.0 | 11.0 | 26.0 | 36.0 | 83.0 | 12.0 | 3 | 0.50 | 45 | 20 |
| 12/1 | 12.0 | 11.0 | 26.0 | 36.0 | 83.0 | 12.0 | 3 | 1.00 | 45 | 20 |
| 12/1,5 | 12.0 | 11.0 | 26.0 | 36.0 | 83.0 | 12.0 | 3 | 1.50 | 45 | 20 |
| 12/2 | 12.0 | 11.0 | 26.0 | 36.0 | 83.0 | 12.0 | 3 | 2.00 | 45 | 20 |
| 12/2,5 | 12.0 | 11.0 | 26.0 | 36.0 | 83.0 | 12.0 | 3 | 2.50 | 45 | 20 |
| 12/3 | 12.0 | 11.0 | 26.0 | 36.0 | 83.0 | 12.0 | 3 | 3.00 | 45 | 20 |
| 12/4 | 12.0 | 11.0 | 26.0 | 36.0 | 83.0 | 12.0 | 3 | 4.00 | 45 | 20 |
| 16/1 | 16.0 | 15.0 | 36.0 | 42.0 | 92.0 | 16.0 | 3 | 1.00 | 45 | 20 |
| 16/1,5 | 16.0 | 15.0 | 36.0 | 42.0 | 92.0 | 16.0 | 3 | 1.50 | 45 | 20 |
| 16/2 | 16.0 | 15.0 | 36.0 | 42.0 | 92.0 | 16.0 | 3 | 2.00 | 45 | 20 |
| 16/2,5 | 16.0 | 15.0 | 36.0 | 42.0 | 92.0 | 16.0 | 3 | 2.50 | 45 | 20 |
| 16/3 | 16.0 | 15.0 | 36.0 | 42.0 | 92.0 | 16.0 | 3 | 3.00 | 45 | 20 |
| 16/4 | 16.0 | 15.0 | 36.0 | 42.0 | 92.0 | 16.0 | 3 | 4.00 | 45 | 20 |
| 20/1 | 20.0 | 19.0 | 41.0 | 52.0 | 104.0 | 20.0 | 3 | 1.00 | 45 | 20 |
| 20/2 | 20.0 | 19.0 | 41.0 | 52.0 | 104.0 | 20.0 | 3 | 2.00 | 45 | 20 |
| 20/3 | 20.0 | 19.0 | 41.0 | 52.0 | 104.0 | 20.0 | 3 | 3.00 | 45 | 20 |
| 20/4 | 20.0 | 19.0 | 41.0 | 52.0 | 104.0 | 20.0 | 3 | 4.00 | 45 | 20 |

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing / Multipass Milling | ETC | Materialgroup Factor fz / α | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 560 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 540 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 510 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 200 | 260 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 560 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 460 | 0.7 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 410 | 0.6 | 0.7 |

**ADVICE |** All fz/α values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | Finishing | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | α° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) |
| 5 | 13 | 1.2° | 0.055 | 5 | 5 | 0.07 | 1.5 | L2max | 0.023 | 0.2 | L2max |
| 6 | 13 | 1.5° | 0.06 | 6 | 6 | 0.08 | 1.8 | L2max | 0.025 | 0.2 | L2max |
| 8 | 21 | 2° | 0.08 | 8 | 8 | 0.09 | 2.4 | L2max | 0.03 | 0.2 | L2max |
| 10 | 22 | 2.5° | 0.09 | 10 | 10 | 0.11 | 3 | L2max | 0.035 | 0.2 | L2max |
| 12 | 26 | 3° | 0.1 | 12 | 12 | 0.13 | 3.6 | L2max | 0.04 | 0.2 | L2max |
| 16 | 36 | 4° | 0.14 | 16 | 16 | 0.16 | 4.8 | L2max | 0.045 | 0.2 | L2max |
| 20 | 41 | 5° | 0.18 | 20 | 20 | 0.2 | 6 | L2max | 0.05 | 0.2 | L2max |

| D1 | L2 | ETC | | | | Multipass Milling | | |
|---|---|---|---|---|---|---|---|---|
| Ø | mm | fz (mm/Z) | ae =0.25xD (mm) | ap (mm) | hmax (mm) | fz (mm/Z) | ae = 0.04xD (mm) | ap = 0.04xD (mm) |
| 5 | 13 | 0.09 | 1.25 | L2max | 0.0779 | 0.08 | 0.2 | 0.2 |
| 6 | 13 | 0.11 | 1.5 | L2max | 0.0953 | 0.09 | 0.24 | 0.24 |
| 8 | 21 | 0.12 | 2 | L2max | 0.1039 | 0.11 | 0.32 | 0.32 |
| 10 | 22 | 0.14 | 2.5 | L2max | 0.1212 | 0.13 | 0.4 | 0.4 |
| 12 | 26 | 0.16 | 3 | L2max | 0.1386 | 0.16 | 0.48 | 0.48 |
| 16 | 36 | 0.19 | 4 | L2max | 0.1645 | 0.2 | 0.64 | 0.64 |
| 20 | 41 | 0.23 | 5 | L2max | 0.1992 | 0.24 | 0.8 | 0.8 |

## STILL CAN'T FIND A SUITABLE MILLING CUTTER?

**No problem** – simply customize an existing tool. Using our configurator for special milling cutters, you can customize existing tools to your needs in an instant or create your own tools based on predefined types.

WE WILL RESPOND TO ALL REQUESTS SUBMITTED VIA THE CONFIGURATOR WITHIN ONE WORKING DAY AT THE LATEST

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

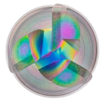
| | |
|---|---|
| Strategy | HSC HPC |
| Application | |
| Features | HA ≠ 1,5xD R |

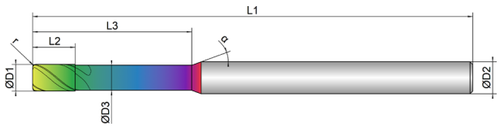
Expert

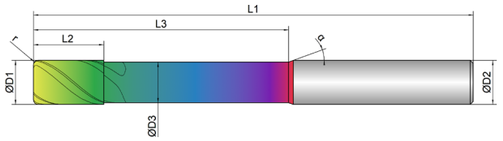
- Defined clearance angle for ideal stabilization with high cutting depths
- Special helical pitch for smooth running and soft cut
- Extra large chip chambers for an extreme chip volume

- Long version for deeper cavities
- For roughing and finishing
- Multipass milling of 3D contours

- Radius tolerance r ≤ 1.5 mm: ± 0.003 mm
- Radius tolerance r > 1.5 mm: ± 0.005 mm






**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M06-0013 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 5/0,5 | 5.0 | 4.7 | 8.0 | 30.0 | 83.0 | 6.0 | 3 | 0.50 | 45 | 20 |
| 5/1 | 5.0 | 4.7 | 8.0 | 30.0 | 83.0 | 6.0 | 3 | 1.00 | 45 | 20 |
| 6/0,5 | 6.0 | 5.7 | 10.0 | 42.0 | 83.0 | 6.0 | 3 | 0.50 | 45 | 20 |
| 6/1 | 6.0 | 5.7 | 10.0 | 42.0 | 83.0 | 6.0 | 3 | 1.00 | 45 | 20 |
| 8/0,5 | 8.0 | 7.4 | 13.0 | 62.0 | 100.0 | 8.0 | 3 | 0.50 | 45 | 20 |
| 8/1 | 8.0 | 7.4 | 13.0 | 62.0 | 100.0 | 8.0 | 3 | 1.00 | 45 | 20 |
| 10/0,5 | 10.0 | 9.2 | 16.0 | 58.0 | 100.0 | 10.0 | 3 | 0.50 | 45 | 20 |
| 10/1 | 10.0 | 9.2 | 16.0 | 58.0 | 100.0 | 10.0 | 3 | 1.00 | 45 | 20 |
| 10/1,5 | 10.0 | 9.2 | 16.0 | 58.0 | 100.0 | 10.0 | 3 | 1.50 | 45 | 20 |
| 10/2 | 10.0 | 9.2 | 16.0 | 58.0 | 100.0 | 10.0 | 3 | 2.00 | 45 | 20 |
| 10/2,5 | 10.0 | 9.2 | 16.0 | 58.0 | 100.0 | 10.0 | 3 | 2.50 | 45 | 20 |



EXN1-M06-0013 | EXN1 FORMMAKER Z3 1.5XD LONG ASR

| EXN1-M06-0013 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 10/3 | 10.0 | 9.2 | 16.0 | 58.0 | 100.0 | 10.0 | 3 | 3.00 | 45 | 20 |
| 12/0,5 | 12.0 | 11.0 | 19.0 | 73.0 | 119.0 | 12.0 | 3 | 0.50 | 45 | 20 |
| 12/1 | 12.0 | 11.0 | 19.0 | 73.0 | 119.0 | 12.0 | 3 | 1.00 | 45 | 20 |
| 12/1,5 | 12.0 | 11.0 | 19.0 | 73.0 | 119.0 | 12.0 | 3 | 1.50 | 45 | 20 |
| 12/2 | 12.0 | 11.0 | 19.0 | 73.0 | 119.0 | 12.0 | 3 | 2.00 | 45 | 20 |
| 12/2,5 | 12.0 | 11.0 | 19.0 | 73.0 | 119.0 | 12.0 | 3 | 2.50 | 45 | 20 |
| 12/3 | 12.0 | 11.0 | 19.0 | 73.0 | 119.0 | 12.0 | 3 | 3.00 | 45 | 20 |
| 12/4 | 12.0 | 11.0 | 19.0 | 73.0 | 119.0 | 12.0 | 3 | 4.00 | 45 | 20 |
| 16/1 | 16.0 | 15.0 | 25.0 | 100.0 | 150.0 | 16.0 | 3 | 1.00 | 45 | 20 |
| 16/1,5 | 16.0 | 15.0 | 25.0 | 100.0 | 150.0 | 16.0 | 3 | 1.50 | 45 | 20 |
| 16/2 | 16.0 | 15.0 | 25.0 | 100.0 | 150.0 | 16.0 | 3 | 2.00 | 45 | 20 |
| 16/2,5 | 16.0 | 15.0 | 25.0 | 100.0 | 150.0 | 16.0 | 3 | 2.50 | 45 | 20 |
| 16/3 | 16.0 | 15.0 | 25.0 | 100.0 | 150.0 | 16.0 | 3 | 3.00 | 45 | 20 |
| 16/4 | 16.0 | 15.0 | 25.0 | 100.0 | 150.0 | 16.0 | 3 | 4.00 | 45 | 20 |
| 20/1 | 20.0 | 19.0 | 32.0 | 98.0 | 150.0 | 20.0 | 3 | 1.00 | 45 | 20 |
| 20/2 | 20.0 | 19.0 | 32.0 | 98.0 | 150.0 | 20.0 | 3 | 2.00 | 45 | 20 |
| 20/3 | 20.0 | 19.0 | 32.0 | 98.0 | 150.0 | 20.0 | 3 | 3.00 | 45 | 20 |
| 20/4 | 20.0 | 19.0 | 32.0 | 98.0 | 150.0 | 20.0 | 3 | 4.00 | 45 | 20 |

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Side Milling | Finishing / Multipass Milling | Materialgroup Factor fz / α |
|---|---|---|---|---|---|
| **N** | NON-FERROUS | | **Vc = m/min** | **Vc = m/min** | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 280 | 280 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 260 | 260 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 240 | 240 | 0.9 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 120 | 120 | 0.8 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 280 | 280 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 200 | 200 | 0.7 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 170 | 170 | 0.6 |

**ADVICE |** All fz/α values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping reduce fz by 50 %.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Side Milling | | | Finishing | | | Multipass Milling | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | α° | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) | fz (mm/Z) | ae = 0.04xD (mm) | ap = 0.04xD (mm) |
| 5 | 8 | 1.2° | 0.065 | 1.5 | L2max | 0.023 | 0.2 | L2max | 0.075 | 0.2 | 0.2 |
| 6 | 10 | 1.5° | 0.065 | 1.8 | L2max | 0.025 | 0.2 | L2max | 0.075 | 0.24 | 0.24 |
| 8 | 13 | 2° | 0.075 | 2.4 | L2max | 0.03 | 0.2 | L2max | 0.085 | 0.32 | 0.32 |
| 10 | 16 | 2.5° | 0.09 | 3 | L2max | 0.035 | 0.2 | L2max | 0.1 | 0.4 | 0.4 |
| 12 | 19 | 3° | 0.1 | 3.6 | L2max | 0.04 | 0.2 | L2max | 0.12 | 0.48 | 0.48 |
| 16 | 25 | 4° | 0.12 | 4.8 | L2max | 0.045 | 0.2 | L2max | 0.14 | 0.64 | 0.64 |
| 20 | 32 | 5° | 0.14 | 6 | L2max | 0.05 | 0.2 | L2max | 0.16 | 0.8 | 0.8 |

# DO YOU HAVE BLUNT MILLING CUTTERS THAT URGENTLY NEED REGRINDING?

**DISCOVER OUR H&V REGRINDING SERVICE**

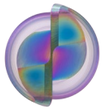
... and have your tools reconditioned to their original state!

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

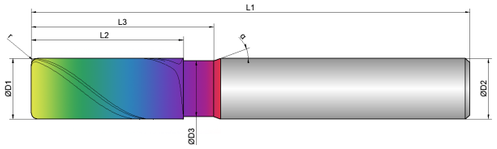
| | |
|---|---|
| Strategy | ETC HSC HPC |
| Application | |
| Features | HA 2xD R |

Expert

- Defined clearance angle for ideal stabilization with high cutting depths
- Special helix pitch for smooth running and a soft cut
- Extra large chip chambers for an extreme chip volume



- For multipass milling of 3D contours




- Radius tolerance r ≤ 1.5 mm: ± 0.003 mm
- Radius tolerance r > 1.5 mm: ± 0.005 mm

**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M06-0103 | D1 | D3 | L2 | L3 | L1 | D2 | z | r | | α |
|---|---|---|---|---|---|---|---|---|---|---|
| | mm ø | mm ø | mm | mm | mm | mm ø | # | mm | ° | ° |
| **6/0,5** | 6.0 | 5.5 | 16.0 | 21.0 | 57.0 | 6.0 | 2 | 0.50 | 38 | 20 |
| **6/1** | 6.0 | 5.5 | 16.0 | 21.0 | 57.0 | 6.0 | 2 | 1.00 | 38 | 20 |
| **6/2** | 6.0 | 5.5 | 16.0 | 21.0 | 57.0 | 6.0 | 2 | 2.00 | 38 | 20 |
| **8/0,5** | 8.0 | 7.5 | 22.0 | 27.0 | 63.0 | 8.0 | 2 | 0.50 | 38 | 20 |
| **8/1** | 8.0 | 7.5 | 22.0 | 27.0 | 63.0 | 8.0 | 2 | 1.00 | 38 | 20 |
| **8/2** | 8.0 | 7.5 | 22.0 | 27.0 | 63.0 | 8.0 | 2 | 2.00 | 38 | 20 |
| **10/0,5** | 10.0 | 9.4 | 25.0 | 30.0 | 72.0 | 10.0 | 2 | 0.50 | 38 | 20 |
| **10/1** | 10.0 | 9.4 | 25.0 | 30.0 | 72.0 | 10.0 | 2 | 1.00 | 38 | 20 |
| **10/2** | 10.0 | 9.4 | 25.0 | 30.0 | 72.0 | 10.0 | 2 | 2.00 | 38 | 20 |
| **12/0,5** | 12.0 | 11.4 | 28.0 | 33.0 | 83.0 | 12.0 | 2 | 0.50 | 38 | 20 |
| **12/1** | 12.0 | 11.4 | 28.0 | 33.0 | 83.0 | 12.0 | 2 | 1.00 | 38 | 20 |
| **12/2** | 12.0 | 11.4 | 28.0 | 33.0 | 83.0 | 12.0 | 2 | 2.00 | 38 | 20 |
| **16/0,5** | 16.0 | 15.4 | 36.0 | 41.0 | 92.0 | 16.0 | 2 | 0.50 | 38 | 20 |
| **16/1** | 16.0 | 15.4 | 36.0 | 41.0 | 92.0 | 16.0 | 2 | 1.00 | 38 | 20 |
| **16/2** | 16.0 | 15.4 | 36.0 | 41.0 | 92.0 | 16.0 | 2 | 2.00 | 38 | 20 |
| **20/0,5** | 20.0 | 19.4 | 41.0 | 51.0 | 104.0 | 20.0 | 2 | 0.50 | 38 | 20 |
| **20/1** | 20.0 | 19.4 | 41.0 | 51.0 | 104.0 | 20.0 | 2 | 1.00 | 38 | 20 |
| **20/2** | 20.0 | 19.4 | 41.0 | 51.0 | 104.0 | 20.0 | 2 | 2.00 | 38 | 20 |



EXN1-M06-0103 | EXN1 FORMMAKER Z2 2XD ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Full Slot | Side Milling | Finishing / Multipass Milling | ETC | Materialgroup Factor fz / α | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 500 | 560 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 480 | 540 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 450 | 510 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 200 | 260 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 500 | 560 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 400 | 460 | 0.7 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 350 | 350 | 350 | 410 | 0.6 | 0.7 |

**ADVICE |** All fz/α values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping, use fz 50% of the full slot.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Full Slot | | | Side Milling | | | Finishing | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | α° | fz (mm/Z) | ae = 1xD (mm) | ap = 1xD (mm) | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) |
| 6 | 16 | 1.5° | 0.06 | 6 | 6 | 0.08 | 1.8 | L2max | 0.025 | 0.2 | L2max |
| 8 | 22 | 2° | 0.08 | 8 | 8 | 0.09 | 2.4 | L2max | 0.03 | 0.2 | L2max |
| 10 | 25 | 2.5° | 0.09 | 10 | 10 | 0.11 | 3 | L2max | 0.035 | 0.2 | L2max |
| 12 | 28 | 3° | 0.1 | 12 | 12 | 0.13 | 3.6 | L2max | 0.04 | 0.2 | L2max |
| 16 | 36 | 4° | 0.14 | 16 | 16 | 0.16 | 4.8 | L2max | 0.045 | 0.2 | L2max |
| 20 | 41 | 5° | 0.18 | 20 | 20 | 0.2 | 6 | L2max | 0.05 | 0.2 | L2max |

**Material N 1.1**

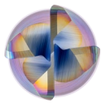
| D1 | L2 | ETC | | | | Multipass Milling | | |
|---|---|---|---|---|---|---|---|---|
| Ø | mm | fz (mm/Z) | ae =0.25xD (mm) | ap (mm) | hmax (mm) | fz (mm/Z) | ae = 0.04xD (mm) | ap = 0.04xD (mm) |
| 6 | 16 | 0.11 | 1.5 | L2max | 0.0953 | 0.09 | 0.24 | 0.24 |
| 8 | 22 | 0.12 | 2 | L2max | 0.1039 | 0.1 | 0.32 | 0.32 |
| 10 | 25 | 0.14 | 2.5 | L2max | 0.1212 | 0.12 | 0.4 | 0.4 |
| 12 | 28 | 0.16 | 3 | L2max | 0.1386 | 0.14 | 0.48 | 0.48 |
| 16 | 36 | 0.19 | 4 | L2max | 0.1645 | 0.18 | 0.64 | 0.64 |
| 20 | 41 | 0.23 | 5 | L2max | 0.1992 | 0.22 | 0.8 | 0.8 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

| | |
|---|---|
| Strategy | ETC, HSC, HPC |
| Application | |
| Features | HA, ≠, 3xD, R |

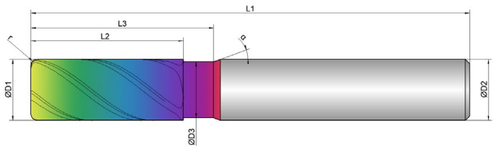
Expert

- Four cutting edges for best performance and stability
- Extra large chip chambers for ideal chip evacuation, also in the full slot and when milling with high radial depth of cut



- For multipass milling of 3D contours

- Radius tolerance r ≤ 1.5 mm: ± 0.003 mm
- Radius tolerance r > 1.5 mm: ± 0.005 mm




**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M06-0213 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 6/0,5 | 6.0 | 5.5 | 20.0 | 24.0 | 65.0 | 6.0 | 4 | 0.50 | 38 | 20 |
| 6/1 | 6.0 | 5.5 | 20.0 | 24.0 | 65.0 | 6.0 | 4 | 1.00 | 38 | 20 |
| 6/1,5 | 6.0 | 5.5 | 20.0 | 24.0 | 65.0 | 6.0 | 4 | 1.50 | 38 | 20 |
| 6/2 | 6.0 | 5.5 | 20.0 | 24.0 | 65.0 | 6.0 | 4 | 2.00 | 38 | 20 |
| 8/0,5 | 8.0 | 7.5 | 26.0 | 30.0 | 70.0 | 8.0 | 4 | 0.50 | 38 | 20 |
| 8/1 | 8.0 | 7.5 | 26.0 | 30.0 | 70.0 | 8.0 | 4 | 1.00 | 38 | 20 |
| 8/2 | 8.0 | 7.5 | 26.0 | 30.0 | 70.0 | 8.0 | 4 | 2.00 | 38 | 20 |
| 8/3 | 8.0 | 7.5 | 26.0 | 30.0 | 70.0 | 8.0 | 4 | 3.00 | 38 | 20 |
| 10/0,5 | 10.0 | 9.4 | 32.0 | 38.0 | 80.0 | 10.0 | 4 | 0.50 | 38 | 20 |
| 10/1 | 10.0 | 9.4 | 32.0 | 38.0 | 80.0 | 10.0 | 4 | 1.00 | 38 | 20 |
| 10/2 | 10.0 | 9.4 | 32.0 | 38.0 | 80.0 | 10.0 | 4 | 2.00 | 38 | 20 |
| 10/3 | 10.0 | 9.4 | 32.0 | 38.0 | 80.0 | 10.0 | 4 | 3.00 | 38 | 20 |



EXN1-M06-0213 | EXN1 FORMMAKER Z4 3XD ASR

| EXN1-M06-0213 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 12/0,5 | 12.0 | 11.4 | 38.0 | 46.0 | 93.0 | 12.0 | 4 | 0.50 | 38 | 20 |
| 12/1 | 12.0 | 11.4 | 38.0 | 46.0 | 93.0 | 12.0 | 4 | 1.00 | 38 | 20 |
| 12/2 | 12.0 | 11.4 | 38.0 | 46.0 | 93.0 | 12.0 | 4 | 2.00 | 38 | 20 |
| 12/3 | 12.0 | 11.4 | 38.0 | 46.0 | 93.0 | 12.0 | 4 | 3.00 | 38 | 20 |
| 16/0,5 | 16.0 | 15.4 | 50.0 | 58.0 | 110.0 | 16.0 | 4 | 0.50 | 38 | 20 |
| 16/1 | 16.0 | 15.4 | 50.0 | 58.0 | 110.0 | 16.0 | 4 | 1.00 | 38 | 20 |
| 16/2 | 16.0 | 15.4 | 50.0 | 58.0 | 110.0 | 16.0 | 4 | 2.00 | 38 | 20 |
| 16/3 | 16.0 | 15.4 | 50.0 | 58.0 | 110.0 | 16.0 | 4 | 3.00 | 38 | 20 |
| 20/0,5 | 20.0 | 19.4 | 62.0 | 74.0 | 125.0 | 20.0 | 4 | 0.50 | 38 | 20 |
| 20/1 | 20.0 | 19.4 | 62.0 | 74.0 | 125.0 | 20.0 | 4 | 1.00 | 38 | 20 |
| 20/2 | 20.0 | 19.4 | 62.0 | 74.0 | 125.0 | 20.0 | 4 | 2.00 | 38 | 20 |
| 20/3 | 20.0 | 19.4 | 62.0 | 74.0 | 125.0 | 20.0 | 4 | 3.00 | 38 | 20 |
| 20/4 | 20.0 | 19.4 | 62.0 | 74.0 | 125.0 | 20.0 | 4 | 4.00 | 38 | 20 |

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Side Milling | Finishing / Multipass Milling | ETC | Materialgroup Factor fz / α | Materialgroup Factor ae ETC |
|---|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | **Vc = m/min** | **Vc = m/min** | **Vc = m/min** | | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 500 | 500 | 560 | 1 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 480 | 480 | 540 | 1 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 450 | 450 | 510 | 0.9 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 200 | 200 | 260 | 0.8 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 500 | 500 | 560 | 1 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 400 | 400 | 460 | 0.7 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 350 | 350 | 410 | 0.6 | 0.7 |

**ADVICE |** All fz/α values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
When helical and ramping, use fz 30% of side milling.
The specified values represent starting values for a solid clamping situation.
To determine the hmax values, please use the provided formula.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | L2 | Immersion Angle | Side Milling | | | Finishing | | | ETC | | | | Multipass Milling | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ø | mm | α° | fz (mm/Z) | ae = 0.3xD (mm) | ap (mm) | fz (mm/Z) | ae (mm) | ap (mm) | fz (mm/Z) | ae =0.2xD (mm) | ap (mm) | hmax (mm) | fz (mm/Z) | ae = 0.04xD (mm) | ap = 0.04xD (mm) |
| 6 | 20 | 1° | 0.06 | 1.8 | L2max | 0.025 | 0.2 | L2max | 0.09 | 1.2 | L2max | 0.072 | 0.065 | 0.24 | 0.24 |
| 8 | 26 | 1.2° | 0.07 | 2.4 | L2max | 0.03 | 0.2 | L2max | 0.1 | 1.6 | L2max | 0.08 | 0.08 | 0.32 | 0.32 |
| 10 | 32 | 1.5° | 0.09 | 3 | L2max | 0.035 | 0.2 | L2max | 0.12 | 2 | L2max | 0.096 | 0.1 | 0.4 | 0.4 |
| 12 | 38 | 1.5° | 0.11 | 3.6 | L2max | 0.04 | 0.2 | L2max | 0.13 | 2.4 | L2max | 0.104 | 0.12 | 0.48 | 0.48 |
| 16 | 50 | 2° | 0.12 | 4.8 | L2max | 0.045 | 0.2 | L2max | 0.15 | 3.2 | L2max | 0.12 | 0.13 | 0.64 | 0.64 |
| 20 | 62 | 3° | 0.16 | 6 | L2max | 0.05 | 0.2 | L2max | 0.19 | 4 | L2max | 0.152 | 0.18 | 0.8 | 0.8 |

## STILL CAN'T FIND A SUITABLE MILLING CUTTER?

**No problem** – simply customize an existing tool. Using our configurator for special milling cutters, you can customize existing tools to your needs in an instant or create your own tools based on predefined types.

WE WILL RESPOND TO ALL REQUESTS SUBMITTED VIA THE CONFIGURATOR WITHIN ONE WORKING DAY AT THE LATEST

| | |
|---|---|
| Cooling | |
| Tolerance | f8 |
| Coating | AlphaSlide Rainbow |

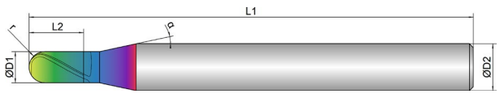
| | |
|---|---|
| Strategy | HSC |
| Application | |
| Features | HA, 1xD, R |

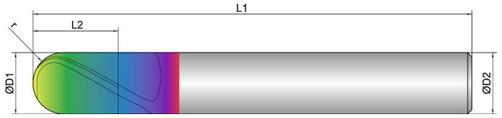
Expert

- Optimized face geometry for excellent surfaces
- Defined microbevel for support and stabilization
- Special chip chambers designed for optimal chip evacuation

- For use in HSC milling
- For roughing and finishing

- Radius tolerance r ≤ 2 mm: ± 0.003 mm
- Radius tolerance r > 2 mm: ± 0.005 mm




**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M08-0003 | D1 mm ⌀ | L2 mm | L1 mm | D2 mm ⌀ | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|
| **0,5** | 0.5 | 1.0 | 55.0 | 6.0 | 2 | 0.25 | 45 | 12 |
| **1** | 1.0 | 2.0 | 55.0 | 6.0 | 2 | 0.50 | 45 | 12 |
| **2** | 2.0 | 4.0 | 55.0 | 6.0 | 2 | 1.00 | 45 | 12 |
| **3** | 3.0 | 6.0 | 55.0 | 6.0 | 2 | 1.50 | 45 | 12 |
| **4** | 4.0 | 7.0 | 55.0 | 6.0 | 2 | 2.00 | 45 | 12 |
| **5** | 5.0 | 8.0 | 55.0 | 6.0 | 2 | 2.50 | 45 | 12 |
| **6** | 6.0 | 10.0 | 55.0 | 6.0 | 2 | 3.00 | 45 | 0 |
| **8** | 8.0 | 12.0 | 63.0 | 8.0 | 2 | 4.00 | 45 | 0 |
| **10** | 10.0 | 14.0 | 72.0 | 10.0 | 2 | 5.00 | 45 | 0 |
| **12** | 12.0 | 16.0 | 74.0 | 12.0 | 2 | 6.00 | 45 | 0 |



EXN1-M08-0003 | EXN1 ROWMAKER Z2 1XD SHORT ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Roughing | Semi Fininshing | Finishing | Materialgroup Factor fz |
|---|---|---|---|---|---|---|
| **N** | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | |
| **1.1** | ALUMINIUM \| alloyed | <500 | 620 | 640 | 650 | 1 |
| **1.2** | ALUMINIUM \| alloyed | <600 | 590 | 610 | 620 | 1 |
| **2.1-2.3** | ALUMINIUM \| cast | <600 | 520 | 540 | 550 | 0.8 |
| **3.1-3.3** | COPPER \| alloyed | <650 | 250 | 270 | 280 | 0.7 |
| **4.1** | MAGNESIUM \| alloyed | <250 | 620 | 640 | 650 | 1 |
| **5.1** | PLASTICS \| Thermoplastic | <100 | 470 | 490 | 500 | 0.8 |
| **5.2** | PLASTICS \| Duroplastic | <150 | 370 | 390 | 400 | 0.7 |

**ADVICE |** All fz/α values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
The specified values represent starting values.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | Roughing | | | Semi Finishing | | | Finishing | | |
|---|---|---|---|---|---|---|---|---|---|
| Ø | fz (mm/Z) | ae 0.3xD (mm) | ap 0.3xD (mm) | fz (mm/Z) | ae 0.1xD (mm) | ap 0.1xD (mm) | fz (mm/Z) | ae 0.05xD (mm) | ap 0.05xD (mm) |
| 0.5 | 0.013 | 0.15 | 0.15 | 0.023 | 0.05 | 0.05 | 0.02 | 0.025 | 0.025 |
| 1 | 0.016 | 0.3 | 0.3 | 0.029 | 0.1 | 0.1 | 0.025 | 0.05 | 0.05 |
| 2 | 0.020 | 0.6 | 0.6 | 0.035 | 0.2 | 0.2 | 0.03 | 0.1 | 0.1 |
| 3 | 0.026 | 0.9 | 0.9 | 0.046 | 0.3 | 0.3 | 0.04 | 0.15 | 0.15 |
| 4 | 0.039 | 1.2 | 1.2 | 0.069 | 0.4 | 0.4 | 0.06 | 0.2 | 0.2 |
| 5 | 0.046 | 1.5 | 1.5 | 0.081 | 0.5 | 0.5 | 0.07 | 0.25 | 0.25 |
| 6 | 0.052 | 1.8 | 1.8 | 0.092 | 0.6 | 0.6 | 0.08 | 0.3 | 0.3 |
| 8 | 0.065 | 2.4 | 2.4 | 0.115 | 0.8 | 0.8 | 0.1 | 0.4 | 0.4 |
| 10 | 0.078 | 3 | 3 | 0.138 | 1 | 1 | 0.12 | 0.5 | 0.5 |
| 12 | 0.085 | 3.6 | 3.6 | 0.150 | 1.2 | 1.2 | 0.13 | 0.6 | 0.6 |

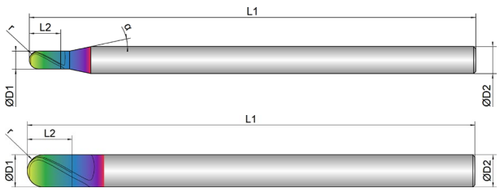
| | |
|---|---|
| Cooling | |
| Tolerance | f8 |
| Coating | AlphaSlide Rainbow |

| | |
|---|---|
| Strategy | HSC |
| Application | |
| Features | HA, 1xD, R |

Expert

- Optimized face geometry for excellent surfaces
- Defined microbevel for support and stabilization
- Special chip chambers designed for optimal chip evacuation

- Long version for deeper cavities
- For use in HSC milling
- For roughing and finishing




- Radius tolerance r ≤ 2 mm: ± 0.003 mm
- Radius tolerance r > 2 mm: ± 0.005 mm

**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| | D1 | L2 | L1 | D2 | z | r | | α |
|---|---|---|---|---|---|---|---|---|
| EXN1-M08-0013 | mm ⌀ | mm | mm | mm ⌀ | # | mm | ° | ° |
| 0,5 | 0.5 | 1.0 | 75.0 | 6.0 | 2 | 0.25 | 45 | 12 |
| 1 | 1.0 | 2.0 | 75.0 | 6.0 | 2 | 0.50 | 45 | 12 |
| 2 | 2.0 | 4.0 | 75.0 | 6.0 | 2 | 1.00 | 45 | 12 |
| 3 | 3.0 | 6.0 | 75.0 | 6.0 | 2 | 1.50 | 45 | 12 |
| 4 | 4.0 | 7.0 | 75.0 | 6.0 | 2 | 2.00 | 45 | 12 |
| 5 | 5.0 | 8.0 | 100.0 | 6.0 | 2 | 2.50 | 45 | 12 |
| 6 | 6.0 | 10.0 | 100.0 | 6.0 | 2 | 3.00 | 45 | 0 |
| 8 | 8.0 | 12.0 | 100.0 | 8.0 | 2 | 4.00 | 45 | 0 |
| 10 | 10.0 | 14.0 | 100.0 | 10.0 | 2 | 5.00 | 45 | 0 |
| 12 | 12.0 | 16.0 | 100.0 | 12.0 | 2 | 6.00 | 45 | 0 |



EXN1-M08-0013 | EXN1 ROWMAKER Z2 1XD LONG ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Roughing | Semi Fininshing | Finishing | Materialgroup Factor fz |
|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 520 | 540 | 550 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 495 | 515 | 525 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 430 | 450 | 460 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 210 | 230 | 240 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 520 | 540 | 550 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 390 | 410 | 420 | 0.8 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 310 | 330 | 340 | 0.7 |

**ADVICE |** All fz/α values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
The specified values represent starting values.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 | Roughing | | | Semi Finishing | | | Finishing | | |
|---|---|---|---|---|---|---|---|---|---|
| Ø | fz (mm/Z) | ae 0.3xD (mm) | ap 0.3xD (mm) | fz (mm/Z) | ae 0.1xD (mm) | ap 0.1xD (mm) | fz (mm/Z) | ae 0.05xD (mm) | ap 0.05xD (mm) |
| 0.5 | 0.010 | 0.15 | 0.15 | 0.017 | 0.05 | 0.05 | 0.015 | 0.025 | 0.025 |
| 1 | 0.013 | 0.3 | 0.3 | 0.023 | 0.1 | 0.1 | 0.02 | 0.05 | 0.05 |
| 2 | 0.016 | 0.6 | 0.6 | 0.029 | 0.2 | 0.2 | 0.025 | 0.1 | 0.1 |
| 3 | 0.023 | 0.9 | 0.9 | 0.040 | 0.3 | 0.3 | 0.035 | 0.15 | 0.15 |
| 4 | 0.036 | 1.2 | 1.2 | 0.063 | 0.4 | 0.4 | 0.055 | 0.2 | 0.2 |
| 5 | 0.042 | 1.5 | 1.5 | 0.075 | 0.5 | 0.5 | 0.065 | 0.25 | 0.25 |
| 6 | 0.049 | 1.8 | 1.8 | 0.086 | 0.6 | 0.6 | 0.075 | 0.3 | 0.3 |
| 8 | 0.059 | 2.4 | 2.4 | 0.104 | 0.8 | 0.8 | 0.09 | 0.4 | 0.4 |
| 10 | 0.072 | 3 | 3 | 0.127 | 1 | 1 | 0.11 | 0.5 | 0.5 |
| 12 | 0.078 | 3.6 | 3.6 | 0.138 | 1.2 | 1.2 | 0.12 | 0.6 | 0.6 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

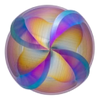
| | |
|---|---|
| Strategy | HSC |
| Application | |
| Features | HA, 2xD, R |

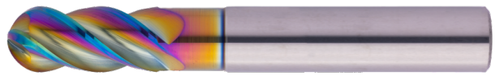
Expert

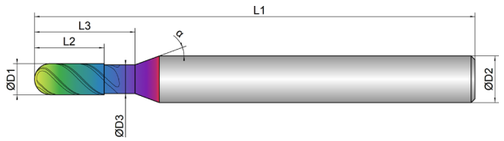
- Four cutting edges to the center for the best dimensional accuracy at high material removal rates
- Defined microbevel and optimized face geometry for excellent surface quality

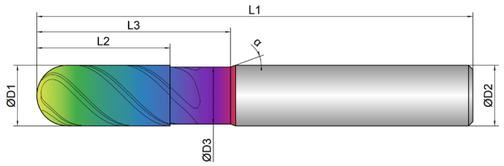
- For use in HSC milling
- For roughing and finishing

- Radius tolerance r ≤ 2 mm: ± 0.003 mm
- Radius tolerance r > 2 mm: ± 0.005 mm








**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M08-0103 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 3.0 | 2.7 | 7.0 | 10.0 | 57.0 | 6.0 | 4 | 1.50 | 45 | 20 |
| 4 | 4.0 | 3.7 | 9.0 | 13.0 | 57.0 | 6.0 | 4 | 2.00 | 45 | 20 |
| 5 | 5.0 | 4.6 | 11.0 | 16.0 | 57.0 | 6.0 | 4 | 2.50 | 45 | 20 |
| 6 | 6.0 | 5.5 | 13.0 | 18.0 | 57.0 | 6.0 | 4 | 3.00 | 45 | 20 |
| 8 | 8.0 | 7.5 | 18.0 | 26.0 | 63.0 | 8.0 | 4 | 4.00 | 45 | 20 |
| 10 | 10.0 | 9.4 | 22.0 | 32.0 | 72.0 | 10.0 | 4 | 5.00 | 45 | 20 |
| 12 | 12.0 | 11.4 | 26.0 | 36.0 | 83.0 | 12.0 | 4 | 6.00 | 45 | 20 |
| 16 | 16.0 | 15.0 | 34.0 | 48.0 | 92.0 | 16.0 | 4 | 8.00 | 45 | 20 |



EXN1-M08-0103 | EXN1 ROWMAKER Z4 2XD SHORT ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Roughing | Semi Fininshing | Finishing | Materialgroup Factor fz |
|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 620 | 640 | 650 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 590 | 610 | 620 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 520 | 540 | 550 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 250 | 270 | 280 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 620 | 640 | 650 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 470 | 490 | 500 | 0.8 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 370 | 390 | 400 | 0.7 |

**ADVICE |** All fz/a values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
The specified values represent starting values.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

| D1 Ø | Roughing fz (mm/Z) | Roughing ae 0.3xD (mm) | Roughing ap 0.3xD (mm) | Semi Finishing fz (mm/Z) | Semi Finishing ae 0.1xD (mm) | Semi Finishing ap 0.1xD (mm) | Finishing fz (mm/Z) | Finishing ae 0.05xD (mm) | Finishing ap 0.05xD (mm) |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 0.020 | 0.9 | 0.9 | 0.035 | 0.3 | 0.3 | 0.03 | 0.15 | 0.15 |
| 4 | 0.026 | 1.2 | 1.2 | 0.046 | 0.4 | 0.4 | 0.04 | 0.2 | 0.2 |
| 5 | 0.039 | 1.5 | 1.5 | 0.069 | 0.5 | 0.5 | 0.06 | 0.25 | 0.25 |
| 6 | 0.046 | 1.8 | 1.8 | 0.081 | 0.6 | 0.6 | 0.07 | 0.3 | 0.3 |
| 8 | 0.052 | 2.4 | 2.4 | 0.092 | 0.8 | 0.8 | 0.08 | 0.4 | 0.4 |
| 10 | 0.065 | 3 | 3 | 0.115 | 1 | 1 | 0.1 | 0.5 | 0.5 |
| 12 | 0.078 | 3.6 | 3.6 | 0.138 | 1.2 | 1.2 | 0.12 | 0.6 | 0.6 |
| 16 | 0.085 | 4.8 | 4.8 | 0.150 | 1.6 | 1.6 | 0.13 | 0.8 | 0.8 |

| | |
|---|---|
| Cooling | |
| Tolerance | h6 |
| Coating | AlphaSlide Rainbow |

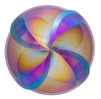
| | |
|---|---|
| Strategy | HSC |
| Application | |
| Features | HA, 2xD, R |

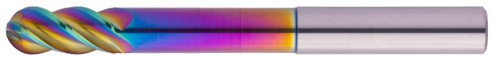
Expert

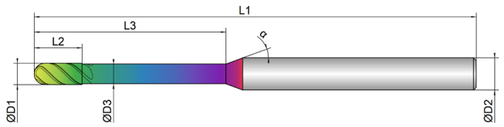
- Four cutting edges to the center for the best dimensional accuracy at high material removal rates
- Defined microbevel and optimized face geometry for excellent surface quality

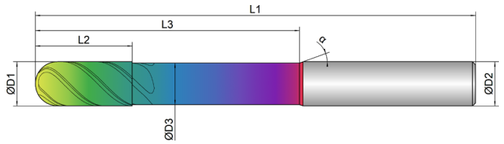
- Long version for deeper cavities
- For use in HSC milling
- For roughing and finishing

- Radius tolerance r ≤ 2 mm: ± 0.003 mm
- Radius tolerance r > 2 mm: ± 0.005 mm








**Roughing** — inappropriate … optimal

**Finishing** — inappropriate … optimal

| EXN1-M08-0113 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 3.0 | 2.7 | 7.0 | 32.0 | 83.0 | 6.0 | 4 | 1.50 | 45 | 20 |
| 4 | 4.0 | 3.7 | 9.0 | 36.0 | 83.0 | 6.0 | 4 | 2.00 | 45 | 20 |
| 5 | 5.0 | 4.6 | 11.0 | 40.0 | 83.0 | 6.0 | 4 | 2.50 | 45 | 20 |
| 6 | 6.0 | 5.5 | 13.0 | 44.0 | 83.0 | 6.0 | 4 | 3.00 | 45 | 20 |
| 8 | 8.0 | 7.5 | 18.0 | 54.0 | 100.0 | 8.0 | 4 | 4.00 | 45 | 20 |
| 10 | 10.0 | 9.4 | 22.0 | 60.0 | 100.0 | 10.0 | 4 | 5.00 | 45 | 20 |
| 12 | 12.0 | 11.4 | 26.0 | 60.0 | 100.0 | 12.0 | 4 | 6.00 | 45 | 20 |
| 16 | 16.0 | 15.0 | 34.0 | 92.0 | 150.0 | 16.0 | 4 | 8.00 | 45 | 20 |



EXN1-M08-0113 | EXN1 ROWMAKER Z4 2XD LONG ASR

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Roughing | Semi Fininshing | Finishing | Materialgroup Factor fz |
|---|---|---|---|---|---|---|
| N | NON-FERROUS | | Vc = m/min | Vc = m/min | Vc = m/min | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 520 | 540 | 550 | 1 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 495 | 515 | 525 | 1 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 430 | 450 | 460 | 0.8 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 210 | 230 | 240 | 0.7 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 520 | 540 | 550 | 1 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 390 | 410 | 420 | 0.8 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 310 | 330 | 340 | 0.7 |

**ADVICE |** All fz/α values in the table for material group 1.1, consider factors for the other groups!
Depending on the material, it may be necessary to change the Vc or Fz value.
The specified values represent starting values.
The use of cooling lubricant is recommended for high process reliability.

**Material N 1.1**

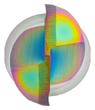
| D1 Ø | Roughing fz (mm/Z) | Roughing ae 0.3xD (mm) | Roughing ap 0.3xD (mm) | Semi Finishing fz (mm/Z) | Semi Finishing ae 0.1xD (mm) | Semi Finishing ap 0.1xD (mm) | Finishing fz (mm/Z) | Finishing ae 0.05xD (mm) | Finishing ap 0.05xD (mm) |
|---|---|---|---|---|---|---|---|---|---|
| 3 | 0.016 | 0.9 | 0.9 | 0.029 | 0.3 | 0.3 | 0.025 | 0.15 | 0.15 |
| 4 | 0.023 | 1.2 | 1.2 | 0.040 | 0.4 | 0.4 | 0.035 | 0.2 | 0.2 |
| 5 | 0.036 | 1.5 | 1.5 | 0.063 | 0.5 | 0.5 | 0.055 | 0.25 | 0.25 |
| 6 | 0.039 | 1.8 | 1.8 | 0.069 | 0.6 | 0.6 | 0.06 | 0.3 | 0.3 |
| 8 | 0.046 | 2.4 | 2.4 | 0.081 | 0.8 | 0.8 | 0.07 | 0.4 | 0.4 |
| 10 | 0.059 | 3 | 3 | 0.104 | 1 | 1 | 0.09 | 0.5 | 0.5 |
| 12 | 0.072 | 3.6 | 3.6 | 0.127 | 1.2 | 1.2 | 0.11 | 0.6 | 0.6 |
| 16 | 0.078 | 4.8 | 4.8 | 0.138 | 1.6 | 1.6 | 0.12 | 0.8 | 0.8 |

| | |
|---|---|
| Cooling | |
| Tolerance | d04 |
| Coating | AlphaSlide Rainbow |

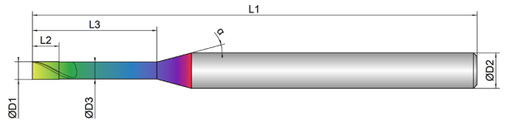
| | |
|---|---|
| Strategy | HSC |
| Application | |
| Features | HA, 90° |

Expert

- Optimized face geometry for excellent surfaces
- Defined microbevel for support and stabilization
- Polished chip space for ideal chip evacuation



- Tolerance D1: -0.001/-0.006 mm
- Tolerance D3: 0/-0.02 mm




**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M15-0003 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|
| 0,2X0,5 | 0.2 | 0.18 | 0.3 | 0.5 | 45.0 | 4.0 | 2 | 30 | 16 |
| 0,2X1 | 0.2 | 0.18 | 0.3 | 1.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 0,2X1,5 | 0.2 | 0.18 | 0.3 | 1.5 | 45.0 | 4.0 | 2 | 30 | 16 |
| 0,3X1 | 0.3 | 0.28 | 0.4 | 1.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 0,3X2 | 0.3 | 0.28 | 0.4 | 2.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 0,4X2 | 0.4 | 0.38 | 0.6 | 2.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 0,4X3 | 0.4 | 0.38 | 0.6 | 3.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 0,5X2 | 0.5 | 0.48 | 0.7 | 2.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 0,5X4 | 0.5 | 0.48 | 0.7 | 4.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 0,5X6 | 0.5 | 0.48 | 0.7 | 6.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 0,6X2 | 0.6 | 0.58 | 0.9 | 2.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 0,6X4 | 0.6 | 0.58 | 0.9 | 4.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 0,6X6 | 0.6 | 0.58 | 0.9 | 6.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 0,7X2 | 0.7 | 0.68 | 1.0 | 2.0 | 45.0 | 4.0 | 2 | 30 | 16 |





| EXN1-M15-0003 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|
| 0,7X4 | 0.7 | 0.68 | 1.0 | 4.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 0,8X4 | 0.8 | 0.78 | 1.2 | 4.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 0,8X6 | 0.8 | 0.78 | 1.2 | 6.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 0,8X8 | 0.8 | 0.78 | 1.2 | 8.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1X4 | 1.0 | 0.95 | 1.5 | 4.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1X6 | 1.0 | 0.95 | 1.5 | 6.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1X8 | 1.0 | 0.95 | 1.5 | 8.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1X10 | 1.0 | 0.95 | 1.5 | 10.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1X12 | 1.0 | 0.95 | 1.5 | 12.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1X14 | 1.0 | 0.95 | 1.5 | 14.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1X16 | 1.0 | 0.95 | 1.5 | 16.0 | 50.0 | 4.0 | 2 | 30 | 16 |
| 1X25 | 1.0 | 0.95 | 1.5 | 25.0 | 70.0 | 4.0 | 2 | 30 | 16 |
| 1,2X6 | 1.2 | 1.14 | 1.8 | 6.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1,2X8 | 1.2 | 1.14 | 1.8 | 8.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1,2X10 | 1.2 | 1.14 | 1.8 | 10.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1,4X6 | 1.4 | 1.34 | 2.1 | 6.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1,4X8 | 1.4 | 1.34 | 2.1 | 8.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1,5X6 | 1.5 | 1.44 | 2.3 | 6.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1,5X8 | 1.5 | 1.44 | 2.3 | 8.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1,5X10 | 1.5 | 1.44 | 2.3 | 10.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1,5X12 | 1.5 | 1.44 | 2.3 | 12.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1,5X14 | 1.5 | 1.44 | 2.3 | 14.0 | 50.0 | 4.0 | 2 | 30 | 16 |
| 1,5X16 | 1.5 | 1.44 | 2.3 | 16.0 | 50.0 | 4.0 | 2 | 30 | 16 |
| 1,5X20 | 1.5 | 1.44 | 2.3 | 20.0 | 55.0 | 4.0 | 2 | 30 | 16 |
| 1,5X25 | 1.5 | 1.44 | 2.3 | 25.0 | 70.0 | 4.0 | 2 | 30 | 16 |

| EXN1-M15-0003 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|
| 1,6X6 | 1.6 | 1.51 | 2.4 | 6.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1,6X10 | 1.6 | 1.51 | 2.4 | 10.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1,8X6 | 1.8 | 1.71 | 2.7 | 6.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1,8X8 | 1.8 | 1.71 | 2.7 | 8.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 1,8X10 | 1.8 | 1.71 | 2.7 | 10.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 2X6 | 2.0 | 1.91 | 3.0 | 6.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 2X8 | 2.0 | 1.91 | 3.0 | 8.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 2X10 | 2.0 | 1.91 | 3.0 | 10.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 2X12 | 2.0 | 1.91 | 3.0 | 12.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 2X14 | 2.0 | 1.91 | 3.0 | 14.0 | 50.0 | 4.0 | 2 | 30 | 16 |
| 2X16 | 2.0 | 1.91 | 3.0 | 16.0 | 50.0 | 4.0 | 2 | 30 | 16 |
| 2X20 | 2.0 | 1.91 | 3.0 | 20.0 | 55.0 | 4.0 | 2 | 30 | 16 |
| 2X25 | 2.0 | 1.91 | 3.0 | 25.0 | 60.0 | 4.0 | 2 | 30 | 16 |
| 2X30 | 2.0 | 1.91 | 3.0 | 30.0 | 70.0 | 4.0 | 2 | 30 | 16 |
| 2X35 | 2.0 | 1.91 | 3.0 | 35.0 | 80.0 | 4.0 | 2 | 30 | 16 |
| 2,5X8 | 2.5 | 2.41 | 3.7 | 8.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 2,5X12 | 2.5 | 2.41 | 3.7 | 12.0 | 45.0 | 4.0 | 2 | 30 | 16 |
| 2,5X16 | 2.5 | 2.41 | 3.7 | 16.0 | 50.0 | 4.0 | 2 | 30 | 16 |
| 2,5X20 | 2.5 | 2.41 | 3.7 | 20.0 | 55.0 | 4.0 | 2 | 30 | 16 |
| 2,5X25 | 2.5 | 2.41 | 3.7 | 25.0 | 60.0 | 4.0 | 2 | 30 | 16 |
| 2,5X30 | 2.5 | 2.41 | 3.7 | 30.0 | 70.0 | 4.0 | 2 | 30 | 16 |



EXN1-M15-0003 | EXN1 PERFORMMAKER MICRO Z2 ASR

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| | | | Dimension | Ø 0.2x0.5 | | Ø 0.2x1.5 | | Ø 0.3x1 | | Ø 0.3x2 | | Ø 0.4x2 | | Ø 0.4x3 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD ap= 0.2xD | ae= 0.25xD ap= L2 max | ae= 1xD ap= 0.18xD | ae= 0.2xD ap= L2 max | ae= 1xD ap= 0.2xD | ae= 0.25xD ap= L2 max | ae= 1xD ap= 0.18xD | ae= 0.23xD ap= L2 max | ae= 1xD ap= 0.2xD | ae= 0.25xD ap= L2 max | ae= 1xD ap= 0.18xD | ae= 0.23xD ap= L2 max |
| | | | Application | | | | | | | | | | | | |
| | Material | Strength (N/mm²) | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.008 | 0.012 | 0.007 | 0.011 | 0.012 | 0.016 | 0.011 | 0.015 | 0.012 | 0.016 | 0.011 | 0.015 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.008 | 0.012 | 0.007 | 0.011 | 0.012 | 0.016 | 0.011 | 0.015 | 0.012 | 0.016 | 0.011 | 0.015 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.007 | 0.011 | 0.006 | 0.01 | 0.011 | 0.015 | 0.01 | 0.014 | 0.011 | 0.015 | 0.01 | 0.014 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.006 | 0.01 | 0.005 | 0.009 | 0.01 | 0.014 | 0.009 | 0.013 | 0.01 | 0.014 | 0.009 | 0.013 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.008 | 0.012 | 0.007 | 0.011 | 0.012 | 0.016 | 0.011 | 0.015 | 0.012 | 0.016 | 0.011 | 0.015 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.007 | 0.011 | 0.006 | 0.01 | 0.011 | 0.015 | 0.01 | 0.014 | 0.011 | 0.015 | 0.01 | 0.014 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.006 | 0.01 | 0.005 | 0.009 | 0.01 | 0.014 | 0.009 | 0.013 | 0.01 | 0.014 | 0.009 | 0.013 |

| | | | Dimension | Ø 0.5x2 | | Ø 0.5x6 | | Ø 0.6x2 | | Ø 0.6x6 | | Ø 0.7x2 | | Ø 0.7x4 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD ap= 0.2xD | ae= 0.25xD ap= L2 max | ae= 1xD ap= 0.1xD | ae= 0.12xD ap= L2 max | ae= 1xD ap= 0.2xD | ae= 0.25xD ap= L2 max | ae= 1xD ap= 0.1xD | ae= 0.12xD ap= L2 max | ae= 1xD ap= 0.2xD | ae= 0.25xD ap= L2 max | ae= 1xD ap= 0.18xD | ae= 0.23xD ap= L2 max |
| | | | Application | | | | | | | | | | | | |
| | | | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.016 | 0.02 | 0.013 | 0.017 | 0.016 | 0.02 | 0.013 | 0.017 | 0.016 | 0.02 | 0.015 | 0.018 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.016 | 0.02 | 0.013 | 0.017 | 0.016 | 0.02 | 0.013 | 0.017 | 0.016 | 0.02 | 0.015 | 0.018 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.015 | 0.018 | 0.012 | 0.015 | 0.015 | 0.018 | 0.012 | 0.015 | 0.015 | 0.018 | 0.014 | 0.016 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.014 | 0.016 | 0.011 | 0.013 | 0.014 | 0.016 | 0.011 | 0.013 | 0.014 | 0.016 | 0.013 | 0.014 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.016 | 0.02 | 0.013 | 0.017 | 0.016 | 0.02 | 0.013 | 0.017 | 0.016 | 0.02 | 0.015 | 0.018 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.015 | 0.018 | 0.012 | 0.015 | 0.015 | 0.018 | 0.012 | 0.015 | 0.015 | 0.018 | 0.014 | 0.016 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.014 | 0.016 | 0.011 | 0.013 | 0.014 | 0.016 | 0.011 | 0.013 | 0.014 | 0.016 | 0.013 | 0.014 |

| | | | Dimension | Ø 0.8x4 | | Ø 0.8x8 | | Ø 1x4 | | Ø 1x25 | | Ø 1.2x6 | | Ø 1.2x10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD ap= 0.2xD | ae= 0.25xD ap= L2 max | ae= 1xD ap= 0.16xD | ae= 0.2xD ap= L2 max | ae= 1xD ap= 0.2xD | ae= 0.25xD ap= L2 max | ae= 1xD ap= 0.02xD | ae= 0.25xD ap= L2 max | ae= 1xD ap= 0.2xD | ae= 0.25xD ap= L2 max | ae= 1xD ap= 0.16xD | ae= 0.2xD ap= L2 max |
| | | | Application | | | | | | | | | | | | |
| | | | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.018 | 0.022 | 0.016 | 0.02 | 0.025 | 0.03 | 0.015 | 0.02 | 0.025 | 0.03 | 0.023 | 0.028 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.018 | 0.022 | 0.016 | 0.02 | 0.025 | 0.03 | 0.015 | 0.02 | 0.025 | 0.03 | 0.023 | 0.028 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.016 | 0.02 | 0.014 | 0.018 | 0.022 | 0.027 | 0.013 | 0.018 | 0.022 | 0.027 | 0.02 | 0.025 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.014 | 0.018 | 0.012 | 0.016 | 0.019 | 0.024 | 0.011 | 0.016 | 0.019 | 0.024 | 0.017 | 0.022 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.018 | 0.022 | 0.016 | 0.02 | 0.025 | 0.03 | 0.015 | 0.02 | 0.025 | 0.03 | 0.023 | 0.028 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.016 | 0.02 | 0.014 | 0.018 | 0.022 | 0.027 | 0.013 | 0.018 | 0.022 | 0.027 | 0.02 | 0.025 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.014 | 0.018 | 0.012 | 0.016 | 0.019 | 0.024 | 0.011 | 0.016 | 0.019 | 0.024 | 0.017 | 0.022 |

**ADVICE |** Values in the table are the shortest and the longest overhang length (L3) of each dimension; please calculate fz, ap and ae depending on the given values.

| | | | Dimension | Ø 1.4x6 | | Ø 1.4x8 | | Ø 1.5x6 | | Ø 1.5x25 | | Ø 1.6x6 | | Ø 1.6x10 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 1xD | ae= 0.23xD | ae= 1xD | ae= 0.25xD | ae= 1xD | ae= 0.04xD | ae= 1xD | ae= 0.25xD | ae= 1xD | ae= 0.23xD |
| | | | | ap= 0.2xD | ap= L2 max | ap= 0.18xD | ap= L2 max | ap= 0.2xD | ap= L2 max | ap= 0.03xD | ap= L2 max | ap= 0.2xD | ap= L2 max | ap= 0.18xD | ap= L2 max |
| | | | Application | | | | | | | | | | | | |
| | Material | Strength (N/mm²) | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.025 | 0.03 | 0.024 | 0.028 | 0.025 | 0.03 | 0.018 | 0.023 | 0.03 | 0.035 | 0.028 | 0.033 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.025 | 0.03 | 0.024 | 0.028 | 0.025 | 0.03 | 0.018 | 0.023 | 0.03 | 0.035 | 0.028 | 0.033 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.022 | 0.027 | 0.021 | 0.025 | 0.022 | 0.027 | 0.015 | 0.02 | 0.027 | 0.031 | 0.025 | 0.03 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.019 | 0.024 | 0.018 | 0.022 | 0.019 | 0.024 | 0.012 | 0.017 | 0.024 | 0.027 | 0.022 | 0.027 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.025 | 0.03 | 0.024 | 0.028 | 0.025 | 0.03 | 0.018 | 0.023 | 0.03 | 0.035 | 0.028 | 0.033 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.022 | 0.027 | 0.021 | 0.025 | 0.022 | 0.027 | 0.015 | 0.02 | 0.027 | 0.031 | 0.025 | 0.03 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.019 | 0.024 | 0.018 | 0.022 | 0.019 | 0.024 | 0.012 | 0.017 | 0.024 | 0.027 | 0.022 | 0.027 |

| | | | Dimension | Ø 1.8x6 | | Ø 1.8x10 | | Ø 2x6 | | Ø 2x35 | | Ø 2.5x8 | | Ø 2.5x30 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 1xD | ae= 0.23xD | ae= 1xD | ae= 0.25xD | ae= 1xD | ae= 0.025xD | ae= 1xD | ae= 0.25xD | ae= 1xD | ae= 0.08xD |
| | | | | ap= 0.2xD | ap= L2 max | ap= 0.18xD | ap= L2 max | ap= 0.2xD | ap= L2 max | ap= 0.02xD | ap= L2 max | ap= 0.2xD | ap= L2 max | ap= 0.06xD | ap= L2 max |
| | | | Application | | | | | | | | | | | | |
| | | | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.03 | 0.035 | 0.028 | 0.033 | 0.03 | 0.035 | 0.018 | 0.023 | 0.035 | 0.04 | 0.023 | 0.028 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.03 | 0.035 | 0.028 | 0.033 | 0.03 | 0.035 | 0.018 | 0.023 | 0.035 | 0.04 | 0.023 | 0.028 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.027 | 0.031 | 0.025 | 0.03 | 0.027 | 0.031 | 0.015 | 0.02 | 0.03 | 0.035 | 0.02 | 0.025 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.024 | 0.027 | 0.022 | 0.027 | 0.024 | 0.027 | 0.012 | 0.017 | 0.025 | 0.03 | 0.017 | 0.022 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.03 | 0.035 | 0.028 | 0.033 | 0.03 | 0.035 | 0.018 | 0.023 | 0.035 | 0.04 | 0.023 | 0.028 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.027 | 0.031 | 0.025 | 0.03 | 0.027 | 0.031 | 0.015 | 0.02 | 0.03 | 0.035 | 0.02 | 0.025 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.024 | 0.027 | 0.022 | 0.027 | 0.024 | 0.027 | 0.012 | 0.017 | 0.025 | 0.03 | 0.017 | 0.022 |

**ADVICE |** Values in the table are the shortest and the longest overhang length (L3) of each dimension; please calculate fz, ap and ae depending on the given values.

## STILL CAN'T FIND A SUITABLE MILLING CUTTER?

**No problem** – simply customize an existing tool. Using our configurator for special milling cutters, you can customize existing tools to your needs in an instant or create your own tools based on predefined types.

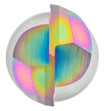
WE WILL RESPOND TO ALL REQUESTS SUBMITTED VIA THE CONFIGURATOR WITHIN ONE WORKING DAY AT THE LATEST

| | |
|---|---|
| Cooling | |
| Tolerance | d04 |
| Coating | AlphaSlide Rainbow |

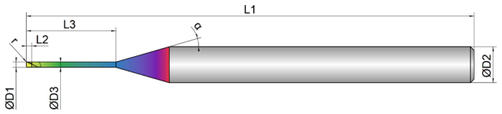
| | |
|---|---|
| Strategy | HSC HPC |
| Application | |
| Features | HA R |

Expert

- Optimized face geometry for excellent surfaces and highest dimensional accuracy
- Defined microbevel for support and stabilization
- Polished chip space for ideal chip evacuation



- Multipass milling of 3D contours




- Tolerance D1: -0.001/-0.006 mm
- Tolerance D3: 0/-0.02 mm
- Radius tolerance r: 0/-0.003 mm (measured from 0-90°)

**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M16-0023 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 0,2X0,5 | 0.2 | 0.18 | 0.2 | 0.5 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,2X1 | 0.2 | 0.18 | 0.2 | 1.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,2X2 | 0.2 | 0.18 | 0.2 | 2.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,2X3 | 0.2 | 0.18 | 0.2 | 3.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,3X1 | 0.3 | 0.28 | 0.3 | 1.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,3X2 | 0.3 | 0.28 | 0.3 | 2.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,3X3 | 0.3 | 0.28 | 0.3 | 3.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,3X4 | 0.3 | 0.28 | 0.3 | 4.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,3X6 | 0.3 | 0.28 | 0.3 | 6.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,4X1 | 0.4 | 0.38 | 0.4 | 1.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,4X2 | 0.4 | 0.38 | 0.4 | 2.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |



EXN1-M16-0023 | EXN1 FORMMAKER MICRO Z2 R0.05 ASR

| EXN1-M16-0023 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 0,4X3 | 0.4 | 0.38 | 0.4 | 3.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,4X4 | 0.4 | 0.38 | 0.4 | 4.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,4X6 | 0.4 | 0.38 | 0.4 | 6.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,4X8 | 0.4 | 0.38 | 0.4 | 8.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,5X1 | 0.5 | 0.48 | 0.5 | 1.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,5X2 | 0.5 | 0.48 | 0.5 | 2.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,5X3 | 0.5 | 0.48 | 0.5 | 3.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,5X4 | 0.5 | 0.48 | 0.5 | 4.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,5X6 | 0.5 | 0.48 | 0.5 | 6.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,5X8 | 0.5 | 0.48 | 0.5 | 8.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,5X10 | 0.5 | 0.48 | 0.5 | 10.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,6X3 | 0.6 | 0.58 | 0.6 | 3.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,6X4 | 0.6 | 0.58 | 0.6 | 4.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,6X6 | 0.6 | 0.58 | 0.6 | 6.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,6X8 | 0.6 | 0.58 | 0.6 | 8.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,6X10 | 0.6 | 0.58 | 0.6 | 10.0 | 50.0 | 4.0 | 2 | 0.05 | 30 | 16 |

Download Catalog Pages (PDF)

| | Material | Strength (N/mm²) | Dimension | Ø 0.2x0.5 | | | Ø 0.2x3 | | | Ø 0.3x1 | | | Ø 0.3x6 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.05xD | ae= 0.05xD | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.03xD | ae= 0.01xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.06xD | ap= L2 max | ae= 0.05xD | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.02xD | ap= L2 max | ae= 0.01xD |
| | | | Application | | | | | | | | | | | | |
| | | | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.008 | 0.012 | 0.014 | 0.005 | 0.007 | 0.009 | 0.008 | 0.012 | 0.014 | 0.005 | 0.007 | 0.009 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.008 | 0.012 | 0.014 | 0.005 | 0.007 | 0.009 | 0.008 | 0.012 | 0.014 | 0.005 | 0.007 | 0.009 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.007 | 0.011 | 0.013 | 0.004 | 0.006 | 0.008 | 0.007 | 0.011 | 0.013 | 0.004 | 0.006 | 0.008 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.006 | 0.01 | 0.012 | 0.003 | 0.005 | 0.007 | 0.006 | 0.01 | 0.012 | 0.003 | 0.005 | 0.007 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.008 | 0.012 | 0.014 | 0.005 | 0.007 | 0.009 | 0.008 | 0.012 | 0.014 | 0.005 | 0.007 | 0.009 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.007 | 0.011 | 0.013 | 0.004 | 0.006 | 0.008 | 0.007 | 0.011 | 0.013 | 0.004 | 0.006 | 0.008 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.006 | 0.01 | 0.012 | 0.003 | 0.005 | 0.007 | 0.006 | 0.01 | 0.012 | 0.003 | 0.005 | 0.007 |

| | Material | Strength (N/mm²) | Dimension | Ø 0.4x1 | | | Ø 0.4x8 | | | Ø 0.5x1 | | | Ø 0.5x10 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.03xD | ae= 0.01xD | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.03xD | ae= 0.01xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.02xD | ap= L2 max | ae= 0.01xD | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.02xD | ap= L2 max | ae= 0.01xD |
| | | | Application | | | | | | | | | | | | |
| | | | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.012 | 0.016 | 0.018 | 0.005 | 0.007 | 0.009 | 0.016 | 0.02 | 0.022 | 0.009 | 0.013 | 0.015 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.012 | 0.016 | 0.018 | 0.005 | 0.007 | 0.009 | 0.016 | 0.02 | 0.022 | 0.009 | 0.013 | 0.015 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.011 | 0.015 | 0.017 | 0.004 | 0.006 | 0.008 | 0.015 | 0.018 | 0.021 | 0.008 | 0.012 | 0.014 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.01 | 0.014 | 0.016 | 0.003 | 0.005 | 0.007 | 0.014 | 0.016 | 0.02 | 0.007 | 0.011 | 0.013 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.012 | 0.016 | 0.018 | 0.005 | 0.007 | 0.009 | 0.016 | 0.02 | 0.022 | 0.009 | 0.013 | 0.015 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.011 | 0.015 | 0.017 | 0.004 | 0.006 | 0.008 | 0.015 | 0.018 | 0.021 | 0.008 | 0.012 | 0.014 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.01 | 0.014 | 0.016 | 0.003 | 0.005 | 0.007 | 0.014 | 0.016 | 0.02 | 0.007 | 0.011 | 0.013 |

| | Material | Strength (N/mm²) | Dimension | Ø 0.6x3 | | | Ø 0.6x10 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.04xD | ae= 0.015xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.03xD | ap= L2 max | ae= 0.015xD |
| | | | Application | | | | | | |
| | | | Feed (mm/Z) | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.016 | 0.02 | 0.022 | 0.012 | 0.015 | 0.017 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.016 | 0.02 | 0.022 | 0.012 | 0.015 | 0.017 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.015 | 0.018 | 0.021 | 0.011 | 0.014 | 0.016 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.014 | 0.016 | 0.02 | 0.01 | 0.013 | 0.015 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.016 | 0.02 | 0.022 | 0.012 | 0.015 | 0.017 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.015 | 0.018 | 0.021 | 0.011 | 0.014 | 0.016 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.014 | 0.016 | 0.02 | 0.01 | 0.013 | 0.015 |

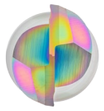
**ADVICE** | Values in the table are the shortest and the longest overhang length (L3) of each dimension; please calculate fz, ap and ae depending on the given values.
ae/ap(max) = 0.5x corner radius!

| | |
|---|---|
| Cooling | |
| Tolerance | d04 |
| Coating | AlphaSlide Rainbow |

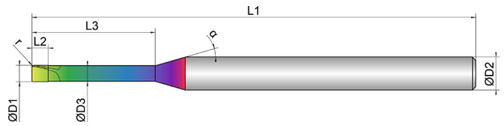
| | |
|---|---|
| Strategy | HSC HPC |
| Application | |
| Features | HA R |

Expert

- Optimized face geometry for excellent surfaces and highest dimensional accuracy
- Defined microbevel for support and stabilization
- Polished chip space for ideal chip evacuation



- Multipass milling of 3D contours




- Tolerance D1: -0.001/-0.006 mm
- Tolerance D3: 0/-0.02 mm
- Radius tolerance r: 0/-0.003 mm (measured from 0-90°)

**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M16-0063 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 0,4X1 | 0.4 | 0.38 | 0.4 | 1.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,4X2 | 0.4 | 0.38 | 0.4 | 2.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,4X3 | 0.4 | 0.38 | 0.4 | 3.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,4X4 | 0.4 | 0.38 | 0.4 | 4.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,4X6 | 0.4 | 0.38 | 0.4 | 6.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,4X8 | 0.4 | 0.38 | 0.4 | 8.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,5X1 | 0.5 | 0.48 | 0.5 | 1.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,5X2 | 0.5 | 0.48 | 0.5 | 2.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,5X3 | 0.5 | 0.48 | 0.5 | 3.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,5X4 | 0.5 | 0.48 | 0.5 | 4.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,5X6 | 0.5 | 0.48 | 0.5 | 6.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,5X8 | 0.5 | 0.48 | 0.5 | 8.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,5X10 | 0.5 | 0.48 | 0.5 | 10.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |



EXN1-M16-0063 | EXN1 FORMMAKER MICRO Z2 R0.1 ASR

| EXN1-M16-0063 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 0,6X3 | 0.6 | 0.58 | 0.6 | 3.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,6X4 | 0.6 | 0.58 | 0.6 | 4.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,6X6 | 0.6 | 0.58 | 0.6 | 6.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,6X8 | 0.6 | 0.58 | 0.6 | 8.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,6X10 | 0.6 | 0.58 | 0.6 | 10.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,8X2 | 0.8 | 0.78 | 0.8 | 2.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,8X4 | 0.8 | 0.78 | 0.8 | 4.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,8X6 | 0.8 | 0.78 | 0.8 | 6.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,8X8 | 0.8 | 0.78 | 0.8 | 8.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,8X10 | 0.8 | 0.78 | 0.8 | 10.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,8X12 | 0.8 | 0.78 | 0.8 | 12.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1X2 | 1.0 | 0.95 | 1.0 | 2.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1X3 | 1.0 | 0.95 | 1.0 | 3.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1X4 | 1.0 | 0.95 | 1.0 | 4.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1X5 | 1.0 | 0.95 | 1.0 | 5.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1X6 | 1.0 | 0.95 | 1.0 | 6.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1X8 | 1.0 | 0.95 | 1.0 | 8.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1X10 | 1.0 | 0.95 | 1.0 | 10.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1X12 | 1.0 | 0.95 | 1.0 | 12.0 | 55.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1X15 | 1.0 | 0.95 | 1.0 | 15.0 | 60.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1X20 | 1.0 | 0.95 | 1.0 | 20.0 | 60.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1X25 | 1.0 | 0.95 | 1.0 | 25.0 | 70.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1X30 | 1.0 | 0.95 | 1.0 | 30.0 | 70.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1,2X5 | 1.2 | 1.14 | 1.2 | 5.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1,2X10 | 1.2 | 1.14 | 1.2 | 10.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1,2X15 | 1.2 | 1.14 | 1.2 | 15.0 | 55.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1,2X20 | 1.2 | 1.14 | 1.2 | 20.0 | 60.0 | 4.0 | 2 | 0.10 | 30 | 16 |

| EXN1-M16-0063 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,5X4 | 1.5 | 1.44 | 1.5 | 4.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1,5X6 | 1.5 | 1.44 | 1.5 | 6.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1,5X8 | 1.5 | 1.44 | 1.5 | 8.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1,5X10 | 1.5 | 1.44 | 1.5 | 10.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1,5X12 | 1.5 | 1.44 | 1.5 | 12.0 | 55.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1,5X15 | 1.5 | 1.44 | 1.5 | 15.0 | 55.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1,5X20 | 1.5 | 1.44 | 1.5 | 20.0 | 60.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1,5X25 | 1.5 | 1.44 | 1.5 | 25.0 | 60.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1,5X30 | 1.5 | 1.44 | 1.5 | 30.0 | 70.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1,8X8 | 1.8 | 1.74 | 1.8 | 8.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1,8X10 | 1.8 | 1.74 | 1.8 | 10.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1,8X15 | 1.8 | 1.74 | 1.8 | 15.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 1,8X20 | 1.8 | 1.74 | 1.8 | 20.0 | 55.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 2X4 | 2.0 | 1.91 | 2.0 | 4.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 2X6 | 2.0 | 1.91 | 2.0 | 6.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 2X8 | 2.0 | 1.91 | 2.0 | 8.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 2X10 | 2.0 | 1.91 | 2.0 | 10.0 | 50.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 2X12 | 2.0 | 1.91 | 2.0 | 12.0 | 55.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 2X15 | 2.0 | 1.91 | 2.0 | 15.0 | 55.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 2X20 | 2.0 | 1.91 | 2.0 | 20.0 | 60.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 2X25 | 2.0 | 1.91 | 2.0 | 25.0 | 70.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 2X30 | 2.0 | 1.91 | 2.0 | 30.0 | 70.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 2X35 | 2.0 | 1.91 | 2.0 | 35.0 | 80.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 2X40 | 2.0 | 1.91 | 2.0 | 40.0 | 80.0 | 4.0 | 2 | 0.10 | 30 | 16 |



EXN1-M16-0063 | EXN1 FORMMAKER MICRO Z2 R0.1 ASR

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| | | | Dimension | Ø 0.4x1 | | | Ø 0.4x8 | | | Ø 0.5x1 | | | Ø 0.5x10 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.03xD | ae= 0.01xD | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.03xD | ae= 0.01xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.02xD | ap= L2 max | ae= 0.01xD | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.02xD | ap= L2 max | ae= 0.01xD |
| | | | Application | | | | | | | | | | | | |
| | Material | Strength (N/mm²) | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.012 | 0.016 | 0.018 | 0.005 | 0.007 | 0.009 | 0.016 | 0.02 | 0.022 | 0.009 | 0.013 | 0.015 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.012 | 0.016 | 0.018 | 0.005 | 0.007 | 0.009 | 0.016 | 0.02 | 0.022 | 0.009 | 0.013 | 0.015 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.011 | 0.015 | 0.017 | 0.004 | 0.006 | 0.008 | 0.015 | 0.018 | 0.021 | 0.008 | 0.012 | 0.014 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.01 | 0.014 | 0.016 | 0.003 | 0.005 | 0.007 | 0.014 | 0.016 | 0.02 | 0.007 | 0.011 | 0.013 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.012 | 0.016 | 0.018 | 0.005 | 0.007 | 0.009 | 0.016 | 0.02 | 0.022 | 0.009 | 0.013 | 0.015 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.011 | 0.015 | 0.017 | 0.004 | 0.006 | 0.008 | 0.015 | 0.018 | 0.021 | 0.008 | 0.012 | 0.014 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.01 | 0.014 | 0.016 | 0.003 | 0.005 | 0.007 | 0.014 | 0.016 | 0.02 | 0.007 | 0.011 | 0.013 |

| | | | Dimension | Ø 0.6x3 | | | Ø 0.6x10 | | | Ø 0.8x2 | | | Ø 0.8x12 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.04xD | ae= 0.015xD | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.06xD | ae= 0.03xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.03xD | ap= L2 max | ae= 0.015xD | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.05xD | ap= L2 max | ae= 0.03xD |
| | | | Application | | | | | | | | | | | | |
| | Material | Strength (N/mm²) | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.016 | 0.02 | 0.022 | 0.012 | 0.015 | 0.017 | 0.016 | 0.02 | 0.022 | 0.012 | 0.015 | 0.017 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.016 | 0.02 | 0.022 | 0.012 | 0.015 | 0.017 | 0.016 | 0.02 | 0.022 | 0.012 | 0.015 | 0.017 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.015 | 0.018 | 0.021 | 0.011 | 0.014 | 0.016 | 0.015 | 0.018 | 0.021 | 0.011 | 0.014 | 0.016 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.014 | 0.016 | 0.02 | 0.01 | 0.013 | 0.015 | 0.014 | 0.016 | 0.02 | 0.01 | 0.013 | 0.015 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.016 | 0.02 | 0.022 | 0.012 | 0.015 | 0.017 | 0.016 | 0.02 | 0.022 | 0.012 | 0.015 | 0.017 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.015 | 0.018 | 0.021 | 0.011 | 0.014 | 0.016 | 0.015 | 0.018 | 0.021 | 0.011 | 0.014 | 0.016 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.014 | 0.016 | 0.02 | 0.01 | 0.013 | 0.015 | 0.014 | 0.016 | 0.02 | 0.01 | 0.013 | 0.015 |

| | | | Dimension | Ø 1x2 | | | Ø 1x30 | | | Ø 1.2x5 | | | Ø 1.2x20 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.015xD | ae= 0.01xD | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.04xD | ae= 0.015xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.01xD | ap= L2 max | ae= 0.01xD | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.03xD | ap= L2 max | ae= 0.015xD |
| | | | Application | | | | | | | | | | | | |
| | Material | Strength (N/mm²) | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.025 | 0.03 | 0.035 | 0.01 | 0.015 | 0.02 | 0.025 | 0.03 | 0.035 | 0.02 | 0.025 | 0.03 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.025 | 0.03 | 0.035 | 0.01 | 0.015 | 0.02 | 0.025 | 0.03 | 0.035 | 0.02 | 0.025 | 0.03 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.022 | 0.027 | 0.032 | 0.008 | 0.013 | 0.017 | 0.022 | 0.027 | 0.032 | 0.017 | 0.022 | 0.027 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.019 | 0.024 | 0.029 | 0.006 | 0.011 | 0.014 | 0.019 | 0.024 | 0.029 | 0.014 | 0.019 | 0.024 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.025 | 0.03 | 0.035 | 0.01 | 0.015 | 0.02 | 0.025 | 0.03 | 0.035 | 0.02 | 0.025 | 0.03 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.022 | 0.027 | 0.032 | 0.008 | 0.013 | 0.017 | 0.022 | 0.027 | 0.032 | 0.017 | 0.022 | 0.027 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.019 | 0.024 | 0.029 | 0.006 | 0.011 | 0.014 | 0.019 | 0.024 | 0.029 | 0.014 | 0.019 | 0.024 |

**ADVICE |** Values in the table are the shortest and the longest overhang length (L3) of each dimension; please calculate fz, ap and ae depending on the given values.
ae/ap(max) = 0.5x corner radius!

| | | | Dimension | Ø 1.5x4 | | | Ø 1.5x30 | | | Ø 1.8x8 | | | Ø 1.8x20 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.03xD | ae= 0.01xD | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.13xD | ae= 0.05xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.02xD | ap= L2 max | ae= 0.01xD | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.1xD | ap= L2 max | ae= 0.05xD |
| | | | Application | | | | | | | | | | | | |
| | Material | Strength (N/mm²) | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.025 | 0.03 | 0.035 | 0.015 | 0.02 | 0.025 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.025 | 0.03 | 0.035 | 0.015 | 0.02 | 0.025 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.022 | 0.027 | 0.032 | 0.013 | 0.017 | 0.022 | 0.027 | 0.031 | 0.035 | 0.022 | 0.026 | 0.03 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.019 | 0.024 | 0.029 | 0.011 | 0.014 | 0.019 | 0.024 | 0.027 | 0.03 | 0.019 | 0.022 | 0.025 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.025 | 0.03 | 0.035 | 0.015 | 0.02 | 0.025 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.022 | 0.027 | 0.032 | 0.013 | 0.017 | 0.022 | 0.027 | 0.031 | 0.035 | 0.022 | 0.026 | 0.03 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.019 | 0.024 | 0.029 | 0.011 | 0.014 | 0.019 | 0.024 | 0.027 | 0.03 | 0.019 | 0.022 | 0.025 |

| | | | Dimension | Ø 2x4 | | | Ø 2x40 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.015xD | ae= 0.01xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.01xD | ap= L2 max | ae= 0.010xD |
| | | | Application | | | | | | |
| | Material | Strength (N/mm²) | Feed (mm/Z) | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.03 | 0.035 | 0.04 | 0.02 | 0.025 | 0.03 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.03 | 0.035 | 0.04 | 0.02 | 0.025 | 0.03 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.027 | 0.031 | 0.035 | 0.017 | 0.021 | 0.025 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.024 | 0.027 | 0.03 | 0.014 | 0.017 | 0.02 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.03 | 0.035 | 0.04 | 0.02 | 0.025 | 0.03 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.027 | 0.031 | 0.035 | 0.017 | 0.021 | 0.025 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.024 | 0.027 | 0.03 | 0.014 | 0.017 | 0.02 |

**ADVICE** | Values in the table are the shortest and the longest overhang length (L3) of each dimension; please calculate fz, ap and ae depending on the given values.
ae/ap(max) = 0.5x corner radius!

## STILL CAN'T FIND A SUITABLE MILLING CUTTER?

**No problem** – simply customize an existing tool. Using our configurator for special milling cutters, you can customize existing tools to your needs in an instant or create your own tools based on predefined types.

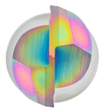
WE WILL RESPOND TO ALL REQUESTS SUBMITTED VIA THE CONFIGURATOR WITHIN ONE WORKING DAY AT THE LATEST

| | |
|---|---|
| Cooling | |
| Tolerance | d04 |
| Coating | AlphaSlide Rainbow |

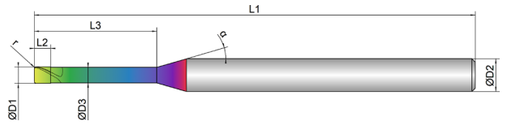
| | |
|---|---|
| Strategy | HSC HPC |
| Application | |
| Features | HA R |

Expert

- Optimized face geometry for excellent surfaces and highest dimensional accuracy
- Defined microbevel for support and stabilization
- Polished chip space for ideal chip evacuation



- Multipass milling of 3D contours




- Tolerance D1: -0.001/-0.006 mm
- Tolerance D3: 0/-0.02 mm
- Radius tolerance r: 0/-0.003 mm (measured from 0-90°)

**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M16-0103 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 0,8X2 | 0.8 | 0.78 | 0.8 | 2.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 0,8X4 | 0.8 | 0.78 | 0.8 | 4.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 0,8X6 | 0.8 | 0.78 | 0.8 | 6.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 0,8X8 | 0.8 | 0.78 | 0.8 | 8.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 0,8X10 | 0.8 | 0.78 | 0.8 | 10.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 0,8X12 | 0.8 | 0.78 | 0.8 | 12.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1X2 | 1.0 | 0.95 | 1.0 | 2.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1X3 | 1.0 | 0.95 | 1.0 | 3.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1X4 | 1.0 | 0.95 | 1.0 | 4.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1X5 | 1.0 | 0.95 | 1.0 | 5.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1X6 | 1.0 | 0.95 | 1.0 | 6.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1X8 | 1.0 | 0.95 | 1.0 | 8.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1X10 | 1.0 | 0.95 | 1.0 | 10.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |



EXN1-M16-0103 | EXN1 FORMMAKER MICRO Z2 R0.2 ASR

| EXN1-M16-0103 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 1X12 | 1.0 | 0.95 | 1.0 | 12.0 | 55.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1X15 | 1.0 | 0.95 | 1.0 | 15.0 | 60.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1X20 | 1.0 | 0.95 | 1.0 | 20.0 | 60.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1X25 | 1.0 | 0.95 | 1.0 | 25.0 | 70.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1X30 | 1.0 | 0.95 | 1.0 | 30.0 | 70.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1,2X5 | 1.2 | 1.14 | 1.2 | 5.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1,2X10 | 1.2 | 1.14 | 1.2 | 10.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1,2X15 | 1.2 | 1.14 | 1.2 | 15.0 | 55.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1,2X20 | 1.2 | 1.14 | 1.2 | 20.0 | 60.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1,5X4 | 1.5 | 1.44 | 1.5 | 4.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1,5X6 | 1.5 | 1.44 | 1.5 | 6.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1,5X8 | 1.5 | 1.44 | 1.5 | 8.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1,5X10 | 1.5 | 1.44 | 1.5 | 10.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1,5X12 | 1.5 | 1.44 | 1.5 | 12.0 | 55.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1,5X15 | 1.5 | 1.44 | 1.5 | 15.0 | 55.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1,5X20 | 1.5 | 1.44 | 1.5 | 20.0 | 60.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1,5X25 | 1.5 | 1.44 | 1.5 | 25.0 | 60.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1,5X30 | 1.5 | 1.44 | 1.5 | 30.0 | 70.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1,8X8 | 1.8 | 1.74 | 1.8 | 8.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1,8X10 | 1.8 | 1.74 | 1.8 | 10.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1,8X15 | 1.8 | 1.74 | 1.8 | 15.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 1,8X20 | 1.8 | 1.74 | 1.8 | 20.0 | 55.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 2X4 | 2.0 | 1.91 | 2.0 | 4.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 2X6 | 2.0 | 1.91 | 2.0 | 6.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 2X8 | 2.0 | 1.91 | 2.0 | 8.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |

| EXN1-M16-0103 | D1 mm ⌀ | D3 mm ⌀ | L2 mm | L3 mm | L1 mm | D2 mm ⌀ | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 2X10 | 2.0 | 1.91 | 2.0 | 10.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 2X12 | 2.0 | 1.91 | 2.0 | 12.0 | 55.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 2X15 | 2.0 | 1.91 | 2.0 | 15.0 | 55.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 2X20 | 2.0 | 1.91 | 2.0 | 20.0 | 60.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 2X25 | 2.0 | 1.91 | 2.0 | 25.0 | 70.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 2X30 | 2.0 | 1.91 | 2.0 | 30.0 | 70.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 2X35 | 2.0 | 1.91 | 2.0 | 35.0 | 80.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 2X40 | 2.0 | 1.91 | 2.0 | 40.0 | 80.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 2,5X15 | 2.5 | 2.41 | 2.5 | 15.0 | 55.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 2,5X20 | 2.5 | 2.41 | 2.5 | 20.0 | 55.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 2,5X25 | 2.5 | 2.41 | 2.5 | 25.0 | 60.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 2,5X30 | 2.5 | 2.41 | 2.5 | 30.0 | 70.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 3X6 | 3.0 | 2.91 | 4.5 | 6.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 3X8 | 3.0 | 2.91 | 4.5 | 8.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 3X10 | 3.0 | 2.91 | 4.5 | 10.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 3X12 | 3.0 | 2.91 | 4.5 | 12.0 | 50.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 3X15 | 3.0 | 2.91 | 4.5 | 15.0 | 55.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 3X20 | 3.0 | 2.91 | 4.5 | 20.0 | 55.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 3X25 | 3.0 | 2.91 | 4.5 | 25.0 | 60.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 3X30 | 3.0 | 2.91 | 4.5 | 30.0 | 70.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 3X35 | 3.0 | 2.91 | 4.5 | 35.0 | 80.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 3X40 | 3.0 | 2.91 | 4.5 | 40.0 | 80.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 3X45 | 3.0 | 2.91 | 4.5 | 45.0 | 90.0 | 4.0 | 2 | 0.20 | 30 | 16 |



EXN1-M16-0103 | EXN1 FORMMAKER MICRO Z2 R0.2 ASR

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| | Material | Strength (N/mm²) | Dimension | Ø 0.8x2 | | | Ø 0.8x12 | | | Ø 1x2 | | | Ø 1x30 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.06xD | ae= 0.03xD | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.015xD | ae= 0.01xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.05xD | ap= L2 max | ae= 0.03xD | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.01xD | ap= L2 max | ae= 0.01xD |
| | | | Application | | | | | | | | | | | | |
| | | | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.016 | 0.02 | 0.022 | 0.012 | 0.015 | 0.017 | 0.025 | 0.03 | 0.035 | 0.01 | 0.015 | 0.02 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.016 | 0.02 | 0.022 | 0.012 | 0.015 | 0.017 | 0.025 | 0.03 | 0.035 | 0.01 | 0.015 | 0.02 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.015 | 0.018 | 0.021 | 0.011 | 0.014 | 0.016 | 0.022 | 0.027 | 0.032 | 0.008 | 0.013 | 0.017 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.014 | 0.016 | 0.02 | 0.01 | 0.013 | 0.015 | 0.019 | 0.024 | 0.029 | 0.006 | 0.011 | 0.014 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.016 | 0.02 | 0.022 | 0.012 | 0.015 | 0.017 | 0.025 | 0.03 | 0.035 | 0.01 | 0.015 | 0.02 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.015 | 0.018 | 0.021 | 0.011 | 0.014 | 0.016 | 0.022 | 0.027 | 0.032 | 0.008 | 0.013 | 0.017 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.014 | 0.016 | 0.02 | 0.01 | 0.013 | 0.015 | 0.019 | 0.024 | 0.029 | 0.006 | 0.011 | 0.014 |

| | Material | Strength (N/mm²) | Dimension | Ø 1.2x5 | | | Ø 1.2x20 | | | Ø 1.5x4 | | | Ø 1.5x30 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.04xD | ae= 0.015xD | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.03xD | ae= 0.01xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.03xD | ap= L2 max | ae= 0.015xD | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.02xD | ap= L2 max | ae= 0.01xD |
| | | | Application | | | | | | | | | | | | |
| | | | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.025 | 0.03 | 0.035 | 0.02 | 0.025 | 0.03 | 0.025 | 0.03 | 0.035 | 0.015 | 0.02 | 0.025 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.025 | 0.03 | 0.035 | 0.02 | 0.025 | 0.03 | 0.025 | 0.03 | 0.035 | 0.015 | 0.02 | 0.025 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.022 | 0.027 | 0.032 | 0.017 | 0.022 | 0.027 | 0.022 | 0.027 | 0.032 | 0.013 | 0.017 | 0.022 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.019 | 0.024 | 0.029 | 0.014 | 0.019 | 0.024 | 0.019 | 0.024 | 0.029 | 0.011 | 0.014 | 0.019 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.025 | 0.03 | 0.035 | 0.02 | 0.025 | 0.03 | 0.025 | 0.03 | 0.035 | 0.015 | 0.02 | 0.025 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.022 | 0.027 | 0.032 | 0.017 | 0.022 | 0.027 | 0.022 | 0.027 | 0.032 | 0.013 | 0.017 | 0.022 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.019 | 0.024 | 0.029 | 0.014 | 0.019 | 0.024 | 0.019 | 0.024 | 0.029 | 0.011 | 0.014 | 0.019 |

| | Material | Strength (N/mm²) | Dimension | Ø 1.8x8 | | | Ø 1.8x20 | | | Ø 2x4 | | | Ø 2x40 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.13xD | ae= 0.05xD | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.015xD | ae= 0.01xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.1xD | ap= L2 max | ae= 0.05xD | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.01xD | ap= L2 max | ae= 0.01xD |
| | | | Application | | | | | | | | | | | | |
| | | | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 | 0.03 | 0.035 | 0.04 | 0.02 | 0.025 | 0.03 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 | 0.03 | 0.035 | 0.04 | 0.02 | 0.025 | 0.03 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.027 | 0.031 | 0.035 | 0.022 | 0.026 | 0.03 | 0.027 | 0.031 | 0.035 | 0.017 | 0.021 | 0.025 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.024 | 0.027 | 0.03 | 0.019 | 0.022 | 0.025 | 0.024 | 0.027 | 0.03 | 0.014 | 0.017 | 0.02 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 | 0.03 | 0.035 | 0.04 | 0.02 | 0.025 | 0.03 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.027 | 0.031 | 0.035 | 0.022 | 0.026 | 0.03 | 0.027 | 0.031 | 0.035 | 0.017 | 0.021 | 0.025 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.024 | 0.027 | 0.03 | 0.019 | 0.022 | 0.025 | 0.024 | 0.027 | 0.03 | 0.014 | 0.017 | 0.02 |

**ADVICE |** Values in the table are the shortest and the longest overhang length (L3) of each dimension; please calculate fz, ap and ae depending on the given values.
ae/ap(max) = 0.5x corner radius!

| | | | Dimension | Ø 2.5x15 | | | Ø 2.5x30 | | | Ø 3x6 | | | Ø 3x45 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.09xD | ae= 0.04xD | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.05xD | ae= 0.02xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.07xD | ap= L2 max | ae= 0.04xD | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.04xD | ap= L2 max | ae= 0.02xD |
| | | | Application | | | | | | | | | | | | |
| | Material | Strength (N/mm²) | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 | 0.033 | 0.038 | 0.043 | 0.025 | 0.03 | 0.035 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 | 0.033 | 0.038 | 0.043 | 0.025 | 0.03 | 0.035 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.027 | 0.031 | 0.035 | 0.022 | 0.026 | 0.03 | 0.03 | 0.034 | 0.038 | 0.022 | 0.026 | 0.03 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.024 | 0.027 | 0.03 | 0.019 | 0.022 | 0.025 | 0.027 | 0.03 | 0.033 | 0.019 | 0.022 | 0.025 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 | 0.033 | 0.038 | 0.043 | 0.025 | 0.03 | 0.035 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.027 | 0.031 | 0.035 | 0.022 | 0.026 | 0.03 | 0.03 | 0.034 | 0.038 | 0.022 | 0.026 | 0.03 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.024 | 0.027 | 0.03 | 0.019 | 0.022 | 0.025 | 0.027 | 0.03 | 0.033 | 0.019 | 0.022 | 0.025 |

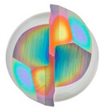
**ADVICE** | Values in the table are the shortest and the longest overhang length (L3) of each dimension; please calculate fz, ap and ae depending on the given values.
ae/ap(max) = 0.5x corner radius!

| | |
|---|---|
| Cooling | |
| Tolerance | d04 |
| Coating | AlphaSlide Rainbow |

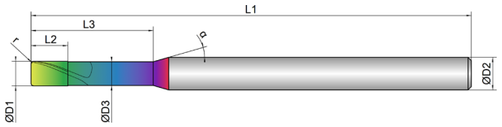
| | |
|---|---|
| Strategy | HSC HPC |
| Application | |
| Features | HA R |

Expert

- Optimized face geometry for excellent surfaces and highest dimensional accuracy
- Defined microbevel for support and stabilization
- Polished chip space for ideal chip evacuation



- Multipass milling of 3D contours




- Tolerance D1: -0.001/-0.006 mm
- Tolerance D3: 0/-0.02 mm
- Radius tolerance r: 0/-0.003 mm (measured from 0-90°)

**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M16-0143 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 1X2 | 1.0 | 0.95 | 1.0 | 2.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1X3 | 1.0 | 0.95 | 1.0 | 3.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1X4 | 1.0 | 0.95 | 1.0 | 4.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1X5 | 1.0 | 0.95 | 1.0 | 5.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1X6 | 1.0 | 0.95 | 1.0 | 6.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1X8 | 1.0 | 0.95 | 1.0 | 8.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1X10 | 1.0 | 0.95 | 1.0 | 10.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1X12 | 1.0 | 0.95 | 1.0 | 12.0 | 55.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1X15 | 1.0 | 0.95 | 1.0 | 15.0 | 60.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1X20 | 1.0 | 0.95 | 1.0 | 20.0 | 60.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1X25 | 1.0 | 0.95 | 1.0 | 25.0 | 70.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1X30 | 1.0 | 0.95 | 1.0 | 30.0 | 70.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1,2X5 | 1.2 | 1.14 | 1.2 | 5.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1,2X10 | 1.2 | 1.14 | 1.2 | 10.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1,2X15 | 1.2 | 1.14 | 1.2 | 15.0 | 55.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1,2X20 | 1.2 | 1.14 | 1.2 | 20.0 | 60.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1,5X4 | 1.5 | 1.44 | 1.5 | 4.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1,5X6 | 1.5 | 1.44 | 1.5 | 6.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1,5X8 | 1.5 | 1.44 | 1.5 | 8.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |



EXN1-M16-0143 | EXN1 FORMMAKER MICRO Z2 R0.3 ASR

| EXN1-M16-0143 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,5X10 | 1.5 | 1.44 | 1.5 | 10.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1,5X12 | 1.5 | 1.44 | 1.5 | 12.0 | 55.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1,5X15 | 1.5 | 1.44 | 1.5 | 15.0 | 55.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1,5X20 | 1.5 | 1.44 | 1.5 | 20.0 | 60.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1,5X25 | 1.5 | 1.44 | 1.5 | 25.0 | 60.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1,5X30 | 1.5 | 1.44 | 1.5 | 30.0 | 70.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1,8X8 | 1.8 | 1.74 | 1.8 | 8.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1,8X10 | 1.8 | 1.74 | 1.8 | 10.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1,8X15 | 1.8 | 1.74 | 1.8 | 15.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 1,8X20 | 1.8 | 1.74 | 1.8 | 20.0 | 55.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 2X4 | 2.0 | 1.91 | 2.0 | 4.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 2X6 | 2.0 | 1.91 | 2.0 | 6.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 2X8 | 2.0 | 1.91 | 2.0 | 8.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 2X10 | 2.0 | 1.91 | 2.0 | 10.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 2X12 | 2.0 | 1.91 | 2.0 | 12.0 | 55.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 2X15 | 2.0 | 1.91 | 2.0 | 15.0 | 55.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 2X20 | 2.0 | 1.91 | 2.0 | 20.0 | 60.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 2X25 | 2.0 | 1.91 | 2.0 | 25.0 | 70.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 2X30 | 2.0 | 1.91 | 2.0 | 30.0 | 70.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 2X35 | 2.0 | 1.91 | 2.0 | 35.0 | 80.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 2X40 | 2.0 | 1.91 | 2.0 | 40.0 | 80.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 2,5X15 | 2.5 | 2.41 | 2.5 | 15.0 | 55.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 2,5X20 | 2.5 | 2.41 | 2.5 | 20.0 | 55.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 2,5X25 | 2.5 | 2.41 | 2.5 | 25.0 | 60.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 2,5X30 | 2.5 | 2.41 | 2.5 | 30.0 | 70.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 3X6 | 3.0 | 2.91 | 4.5 | 6.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 3X8 | 3.0 | 2.91 | 4.5 | 8.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 3X10 | 3.0 | 2.91 | 4.5 | 10.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 3X12 | 3.0 | 2.91 | 4.5 | 12.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 3X15 | 3.0 | 2.91 | 4.5 | 15.0 | 55.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 3X20 | 3.0 | 2.91 | 4.5 | 20.0 | 55.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 3X25 | 3.0 | 2.91 | 4.5 | 25.0 | 60.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 3X30 | 3.0 | 2.91 | 4.5 | 30.0 | 70.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 3X35 | 3.0 | 2.91 | 4.5 | 35.0 | 80.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 3X40 | 3.0 | 2.91 | 4.5 | 40.0 | 80.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 3X45 | 3.0 | 2.91 | 4.5 | 45.0 | 90.0 | 4.0 | 2 | 0.30 | 30 | 16 |

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| | | | Dimension | Ø 1x2 | | | Ø 1x30 | | | Ø 1.2x5 | | | Ø 1.2x20 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.015xD | ae= 0.01xD | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.04xD | ae= 0.015xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.01xD | ap= L2 max | ae= 0.01xD | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.03xD | ap= L2 max | ae= 0.015xD |
| | | | Application | | | | | | | | | | | | |
| | Material | Strength (N/mm²) | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.025 | 0.03 | 0.035 | 0.01 | 0.015 | 0.02 | 0.025 | 0.03 | 0.035 | 0.02 | 0.025 | 0.03 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.025 | 0.03 | 0.035 | 0.01 | 0.015 | 0.02 | 0.025 | 0.03 | 0.035 | 0.02 | 0.025 | 0.03 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.022 | 0.027 | 0.032 | 0.008 | 0.013 | 0.017 | 0.022 | 0.027 | 0.032 | 0.017 | 0.022 | 0.027 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.019 | 0.024 | 0.029 | 0.006 | 0.011 | 0.014 | 0.019 | 0.024 | 0.029 | 0.014 | 0.019 | 0.024 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.025 | 0.03 | 0.035 | 0.01 | 0.015 | 0.02 | 0.025 | 0.03 | 0.035 | 0.02 | 0.025 | 0.03 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.022 | 0.027 | 0.032 | 0.008 | 0.013 | 0.017 | 0.022 | 0.027 | 0.032 | 0.017 | 0.022 | 0.027 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.019 | 0.024 | 0.029 | 0.006 | 0.011 | 0.014 | 0.019 | 0.024 | 0.029 | 0.014 | 0.019 | 0.024 |

| | | | Dimension | Ø 1.5x4 | | | Ø 1.5x30 | | | Ø 1.8x8 | | | Ø 1.8x20 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.03xD | ae= 0.01xD | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.13xD | ae= 0.05xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.02xD | ap= L2 max | ae= 0.01xD | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.1xD | ap= L2 max | ae= 0.05xD |
| | | | Application | | | | | | | | | | | | |
| | Material | Strength (N/mm²) | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.025 | 0.03 | 0.035 | 0.015 | 0.02 | 0.025 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.025 | 0.03 | 0.035 | 0.015 | 0.02 | 0.025 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.022 | 0.027 | 0.032 | 0.013 | 0.017 | 0.022 | 0.027 | 0.031 | 0.035 | 0.022 | 0.026 | 0.03 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.019 | 0.024 | 0.029 | 0.011 | 0.014 | 0.019 | 0.024 | 0.027 | 0.03 | 0.019 | 0.022 | 0.025 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.025 | 0.03 | 0.035 | 0.015 | 0.02 | 0.025 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.022 | 0.027 | 0.032 | 0.013 | 0.017 | 0.022 | 0.027 | 0.031 | 0.035 | 0.022 | 0.026 | 0.03 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.019 | 0.024 | 0.029 | 0.011 | 0.014 | 0.019 | 0.024 | 0.027 | 0.03 | 0.019 | 0.022 | 0.025 |

| | | | Dimension | Ø 2x4 | | | Ø 2x40 | | | Ø 2.5x15 | | | Ø 2.5x30 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.015xD | ae= 0.01xD | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.09xD | ae= 0.04xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.01xD | ap= L2 max | ae= 0.01xD | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.07xD | ap= L2 max | ae= 0.04xD |
| | | | Application | | | | | | | | | | | | |
| | Material | Strength (N/mm²) | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.03 | 0.035 | 0.04 | 0.02 | 0.025 | 0.03 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.03 | 0.035 | 0.04 | 0.02 | 0.025 | 0.03 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.027 | 0.031 | 0.035 | 0.017 | 0.021 | 0.025 | 0.027 | 0.031 | 0.035 | 0.022 | 0.026 | 0.03 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.024 | 0.027 | 0.03 | 0.014 | 0.017 | 0.02 | 0.024 | 0.027 | 0.03 | 0.019 | 0.022 | 0.025 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.03 | 0.035 | 0.04 | 0.02 | 0.025 | 0.03 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.027 | 0.031 | 0.035 | 0.017 | 0.021 | 0.025 | 0.027 | 0.031 | 0.035 | 0.022 | 0.026 | 0.03 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.024 | 0.027 | 0.03 | 0.014 | 0.017 | 0.02 | 0.024 | 0.027 | 0.03 | 0.019 | 0.022 | 0.025 |

**ADVICE |** Values in the table are the shortest and the longest overhang length (L3) of each dimension; please calculate fz, ap and ae depending on the given values.
ae/ap(max) = 0.5x corner radius!



EXN1-M16-0143 | EXN1 FORMMAKER MICRO Z2 R0.3 ASR

| | | | Dimension | Ø 3x6 | | | Ø 3x45 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.05xD | ae= 0.02xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.04xD | ap= L2 max | ae= 0.02xD |
| | | | Application | | | | | | |
| | Material | Strength (N/mm²) | Feed (mm/Z) | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.033 | 0.038 | 0.043 | 0.025 | 0.03 | 0.035 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.033 | 0.038 | 0.043 | 0.025 | 0.03 | 0.035 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.03 | 0.034 | 0.038 | 0.022 | 0.026 | 0.03 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.027 | 0.03 | 0.033 | 0.019 | 0.022 | 0.025 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.033 | 0.038 | 0.043 | 0.025 | 0.03 | 0.035 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.03 | 0.034 | 0.038 | 0.022 | 0.026 | 0.03 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.027 | 0.03 | 0.033 | 0.019 | 0.022 | 0.025 |

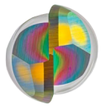
**ADVICE |** Values in the table are the shortest and the longest overhang length (L3) of each dimension; please calculate fz, ap and ae depending on the given values.
ae/ap(max) = 0.5x corner radius!

| | |
|---|---|
| Cooling | |
| Tolerance | d04 |
| Coating | AlphaSlide Rainbow |

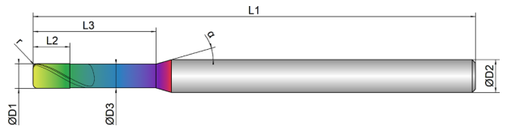
| | |
|---|---|
| Strategy | HSC HPC |
| Application | |
| Features | HA R |

Expert

- Optimized face geometry for excellent surfaces and highest dimensional accuracy
- Defined microbevel for support and stabilization
- Polished chip space for ideal chip evacuation



- Multipass milling of 3D contours




- Tolerance D1: -0.001/-0.006 mm
- Tolerance D3: 0/-0.02 mm
- Radius tolerance r: 0/-0.003 mm (measured from 0-90°)

**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M16-0183 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,5X4 | 1.5 | 1.44 | 1.5 | 4.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1,5X6 | 1.5 | 1.44 | 1.5 | 6.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1,5X8 | 1.5 | 1.44 | 1.5 | 8.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1,5X10 | 1.5 | 1.44 | 1.5 | 10.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1,5X12 | 1.5 | 1.44 | 1.5 | 12.0 | 54.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1,5X15 | 1.5 | 1.44 | 1.5 | 15.0 | 54.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1,5X20 | 1.5 | 1.44 | 1.5 | 20.0 | 60.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1,5X25 | 1.5 | 1.44 | 1.5 | 25.0 | 60.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1,5X30 | 1.5 | 1.44 | 1.5 | 30.0 | 70.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1,8X8 | 1.8 | 1.74 | 1.8 | 8.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1,8X10 | 1.8 | 1.74 | 1.8 | 10.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1,8X15 | 1.8 | 1.74 | 1.8 | 15.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1,8X20 | 1.8 | 1.74 | 1.8 | 20.0 | 54.0 | 4.0 | 2 | 0.50 | 30 | 16 |



EXN1-M16-0183 | EXN1 FORMMAKER MICRO Z2 R0.5 ASR

| EXN1-M16-0183 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 2X4 | 2.0 | 1.91 | 2.0 | 4.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 2X6 | 2.0 | 1.91 | 2.0 | 6.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 2X8 | 2.0 | 1.91 | 2.0 | 8.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 2X10 | 2.0 | 1.91 | 2.0 | 10.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 2X12 | 2.0 | 1.91 | 2.0 | 12.0 | 54.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 2X15 | 2.0 | 1.91 | 2.0 | 15.0 | 54.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 2X20 | 2.0 | 1.91 | 2.0 | 20.0 | 60.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 2X25 | 2.0 | 1.91 | 2.0 | 25.0 | 70.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 2X30 | 2.0 | 1.91 | 2.0 | 30.0 | 70.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 2X35 | 2.0 | 1.91 | 2.0 | 35.0 | 80.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 2X40 | 2.0 | 1.91 | 2.0 | 40.0 | 80.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 2,5X12 | 2.5 | 2.41 | 2.5 | 12.0 | 54.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 2,5X15 | 2.5 | 2.41 | 2.5 | 15.0 | 54.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 2,5X20 | 2.5 | 2.41 | 2.5 | 20.0 | 54.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 2,5X25 | 2.5 | 2.41 | 2.5 | 25.0 | 60.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 2,5X30 | 2.5 | 2.41 | 2.5 | 30.0 | 70.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 3X6 | 3.0 | 2.91 | 4.5 | 6.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 3X8 | 3.0 | 2.91 | 4.5 | 8.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 3X10 | 3.0 | 2.91 | 4.5 | 10.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 3X12 | 3.0 | 2.91 | 4.5 | 12.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 3X15 | 3.0 | 2.91 | 4.5 | 15.0 | 54.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 3X20 | 3.0 | 2.91 | 4.5 | 20.0 | 54.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 3X25 | 3.0 | 2.91 | 4.5 | 25.0 | 60.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 3X30 | 3.0 | 2.91 | 4.5 | 30.0 | 70.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 3X35 | 3.0 | 2.91 | 4.5 | 35.0 | 80.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 3X40 | 3.0 | 2.91 | 4.5 | 40.0 | 80.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 3X45 | 3.0 | 2.91 | 4.5 | 45.0 | 90.0 | 4.0 | 2 | 0.50 | 30 | 16 |

Download Catalog Pages (PDF)

| | | | Dimension | Ø 1.5x4 | | | Ø 1.5x30 | | | Ø 1.8x8 | | | Ø 1.8x20 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.03xD | ae= 0.01xD | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.13xD | ae= 0.05xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.02xD | ap= L2 max | ae= 0.01xD | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.1xD | ap= L2 max | ae= 0.05xD |
| | | | Application | | | | | | | | | | | | |
| | Material | Strength (N/mm²) | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.025 | 0.03 | 0.035 | 0.015 | 0.02 | 0.025 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.025 | 0.03 | 0.035 | 0.015 | 0.02 | 0.025 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.022 | 0.027 | 0.032 | 0.013 | 0.017 | 0.022 | 0.027 | 0.031 | 0.035 | 0.022 | 0.026 | 0.03 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.019 | 0.024 | 0.029 | 0.011 | 0.014 | 0.019 | 0.024 | 0.027 | 0.03 | 0.019 | 0.022 | 0.025 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.025 | 0.03 | 0.035 | 0.015 | 0.02 | 0.025 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.022 | 0.027 | 0.032 | 0.013 | 0.017 | 0.022 | 0.027 | 0.031 | 0.035 | 0.022 | 0.026 | 0.03 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.019 | 0.024 | 0.029 | 0.011 | 0.014 | 0.019 | 0.024 | 0.027 | 0.03 | 0.019 | 0.022 | 0.025 |

| | | | Dimension | Ø 2x4 | | | Ø 2x40 | | | Ø 2.5x12 | | | Ø 2.5x30 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.015xD | ae= 0.01xD | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.09xD | ae= 0.04xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.01xD | ap= L2 max | ae= 0.01xD | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.07xD | ap= L2 max | ae= 0.04xD |
| | | | Application | | | | | | | | | | | | |
| | Material | Strength (N/mm²) | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.03 | 0.035 | 0.04 | 0.02 | 0.025 | 0.03 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.03 | 0.035 | 0.04 | 0.02 | 0.025 | 0.03 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.027 | 0.031 | 0.035 | 0.017 | 0.021 | 0.025 | 0.027 | 0.031 | 0.035 | 0.022 | 0.026 | 0.03 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.024 | 0.027 | 0.03 | 0.014 | 0.017 | 0.02 | 0.024 | 0.027 | 0.03 | 0.019 | 0.022 | 0.025 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.03 | 0.035 | 0.04 | 0.02 | 0.025 | 0.03 | 0.03 | 0.035 | 0.04 | 0.025 | 0.03 | 0.035 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.027 | 0.031 | 0.035 | 0.017 | 0.021 | 0.025 | 0.027 | 0.031 | 0.035 | 0.022 | 0.026 | 0.03 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.024 | 0.027 | 0.03 | 0.014 | 0.017 | 0.02 | 0.024 | 0.027 | 0.03 | 0.019 | 0.022 | 0.025 |

| | | | Dimension | Ø 3x6 | | | Ø 3x45 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 1xD | ae= 0.25xD | ae= 0.1xD | ae= 1xD | ae= 0.05xD | ae= 0.02xD |
| | | | | ap= 0.2xD | ap= L2 max | ae= 0.1xD | ap= 0.04xD | ap= L2 max | ae= 0.02xD |
| | | | Application | | | | | | |
| | Material | Strength (N/mm²) | Feed (mm/Z) | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.033 | 0.038 | 0.043 | 0.025 | 0.03 | 0.035 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.033 | 0.038 | 0.043 | 0.025 | 0.03 | 0.035 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.03 | 0.034 | 0.038 | 0.022 | 0.026 | 0.03 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.027 | 0.03 | 0.033 | 0.019 | 0.022 | 0.025 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.033 | 0.038 | 0.043 | 0.025 | 0.03 | 0.035 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.03 | 0.034 | 0.038 | 0.022 | 0.026 | 0.03 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.027 | 0.03 | 0.033 | 0.019 | 0.022 | 0.025 |

**ADVICE |** Values in the table are the shortest and the longest overhang length (L3) of each dimension; please calculate fz, ap and ae depending on the given values.
ae/ap(max) = 0.5x corner radius!

## STILL CAN'T FIND A SUITABLE MILLING CUTTER?

**No problem** – simply customize an existing tool. Using our configurator for special milling cutters, you can customize existing tools to your needs in an instant or create your own tools based on predefined types.

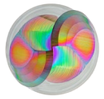
WE WILL RESPOND TO ALL REQUESTS SUBMITTED VIA THE CONFIGURATOR WITHIN ONE WORKING DAY AT THE LATEST

| | |
|---|---|
| Cooling | |
| Tolerance | d04 |
| Coating | AlphaSlide Rainbow |

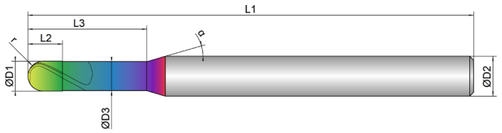
| | |
|---|---|
| Strategy | HSC |
| Application | |
| Features | HA |

Expert

- Optimized face geometry for excellent surfaces and highest dimensional accuracy
- Defined microbevel for support and stabilization
- Polished chip space for ideal chip evacuation



- Tolerance D1: -0.001/-0.006 mm
- Tolerance D3: 0/-0.02 mm
- Radius tolerance r: 0/-0.003 mm (measured from 0-90°)




**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M17-0003 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 0,1X0,3 | 0.1 | 0.08 | 0.08 | 0.3 | 45.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,1X0,5 | 0.1 | 0.08 | 0.08 | 0.5 | 45.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,1X1 | 0.1 | 0.08 | 0.08 | 1.0 | 45.0 | 4.0 | 2 | 0.05 | 30 | 16 |
| 0,2X0,5 | 0.2 | 0.17 | 0.16 | 0.5 | 45.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,2X1 | 0.2 | 0.17 | 0.16 | 1.0 | 45.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,2X2 | 0.24 | 0.17 | 0.16 | 2.0 | 45.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,2X3 | 0.2 | 0.17 | 0.16 | 3.0 | 45.0 | 4.0 | 2 | 0.10 | 30 | 16 |
| 0,3X0,5 | 0.3 | 0.27 | 0.24 | 0.5 | 45.0 | 4.0 | 2 | 0.15 | 30 | 16 |
| 0,3X1 | 0.3 | 0.27 | 0.24 | 1.0 | 45.0 | 4.0 | 2 | 0.15 | 30 | 16 |
| 0,3X2 | 0.3 | 0.27 | 0.24 | 2.0 | 45.0 | 4.0 | 2 | 0.15 | 30 | 16 |
| 0,3X3 | 0.3 | 0.27 | 0.24 | 3.0 | 45.0 | 4.0 | 2 | 0.15 | 30 | 16 |
| 0,3X4 | 0.3 | 0.27 | 0.24 | 4.0 | 45.0 | 4.0 | 2 | 0.15 | 30 | 16 |
| 0,3X6 | 0.3 | 0.27 | 0.24 | 6.0 | 45.0 | 4.0 | 2 | 0.15 | 30 | 16 |
| 0,4X1 | 0.4 | 0.37 | 0.32 | 1.0 | 45.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 0,4X2 | 0.4 | 0.37 | 0.32 | 2.0 | 45.0 | 4.0 | 2 | 0.20 | 30 | 16 |





| EXN1-M17-0003 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 0,4X3 | 0.4 | 0.37 | 0.32 | 3.0 | 45.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 0,4X4 | 0.4 | 0.37 | 0.32 | 4.0 | 45.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 0,4X6 | 0.4 | 0.37 | 0.32 | 6.0 | 45.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 0,4X8 | 0.4 | 0.37 | 0.32 | 8.0 | 45.0 | 4.0 | 2 | 0.20 | 30 | 16 |
| 0,5X1 | 0.5 | 0.47 | 0.4 | 1.0 | 45.0 | 4.0 | 2 | 0.25 | 30 | 16 |
| 0,5X1,5 | 0.5 | 0.47 | 0.4 | 1.5 | 45.0 | 4.0 | 2 | 0.25 | 30 | 16 |
| 0,5X2 | 0.5 | 0.47 | 0.4 | 2.0 | 45.0 | 4.0 | 2 | 0.25 | 30 | 16 |
| 0,5X3 | 0.5 | 0.47 | 0.4 | 3.0 | 45.0 | 4.0 | 2 | 0.25 | 30 | 16 |
| 0,5X4 | 0.5 | 0.47 | 0.4 | 4.0 | 45.0 | 4.0 | 2 | 0.25 | 30 | 16 |
| 0,5X6 | 0.5 | 0.47 | 0.4 | 6.0 | 45.0 | 4.0 | 2 | 0.25 | 30 | 16 |
| 0,5X8 | 0.5 | 0.47 | 0.4 | 8.0 | 45.0 | 4.0 | 2 | 0.25 | 30 | 16 |
| 0,6X2 | 0.6 | 0.57 | 0.48 | 2.0 | 45.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 0,6X3 | 0.6 | 0.57 | 0.48 | 3.0 | 45.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 0,6X4 | 0.6 | 0.57 | 0.48 | 4.0 | 45.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 0,6X6 | 0.6 | 0.57 | 0.48 | 6.0 | 45.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 0,6X8 | 0.6 | 0.57 | 0.48 | 8.0 | 45.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 0,8X2 | 0.8 | 0.77 | 0.64 | 2.0 | 45.0 | 4.0 | 2 | 0.40 | 30 | 16 |
| 0,8X3 | 0.8 | 0.77 | 0.64 | 3.0 | 45.0 | 4.0 | 2 | 0.40 | 30 | 16 |
| 0,8X4 | 0.8 | 0.77 | 0.64 | 4.0 | 45.0 | 4.0 | 2 | 0.40 | 30 | 16 |
| 0,8X6 | 0.8 | 0.77 | 0.64 | 6.0 | 45.0 | 4.0 | 2 | 0.40 | 30 | 16 |
| 0,8X8 | 0.8 | 0.77 | 0.64 | 8.0 | 45.0 | 4.0 | 2 | 0.40 | 30 | 16 |
| 1X2 | 1.0 | 0.96 | 0.8 | 2.0 | 45.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1X3 | 1.0 | 0.96 | 0.8 | 3.0 | 45.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1X4 | 1.0 | 0.96 | 0.8 | 4.0 | 45.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1X5 | 1.0 | 0.96 | 0.8 | 5.0 | 45.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1X6 | 1.0 | 0.96 | 0.8 | 6.0 | 45.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1X8 | 1.0 | 0.96 | 0.8 | 8.0 | 45.0 | 4.0 | 2 | 0.50 | 30 | 16 |

| EXN1-M17-0003 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 1X10 | 1.0 | 0.96 | 0.8 | 10.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1X12 | 1.0 | 0.96 | 0.8 | 12.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1,2X3 | 1.2 | 1.16 | 0.96 | 3.0 | 45.0 | 4.0 | 2 | 0.60 | 30 | 16 |
| 1,2X4 | 1.2 | 1.16 | 0.96 | 4.0 | 45.0 | 4.0 | 2 | 0.60 | 30 | 16 |
| 1,2X6 | 1.2 | 1.16 | 0.96 | 6.0 | 45.0 | 4.0 | 2 | 0.60 | 30 | 16 |
| 1,2X8 | 1.2 | 1.16 | 0.96 | 8.0 | 45.0 | 4.0 | 2 | 0.60 | 30 | 16 |
| 1,2X10 | 1.2 | 1.16 | 0.96 | 10.0 | 45.0 | 4.0 | 2 | 0.60 | 30 | 16 |
| 1,2X12 | 1.2 | 1.16 | 0.96 | 12.0 | 50.0 | 4.0 | 2 | 0.60 | 30 | 16 |
| 1,2X20 | 1.2 | 1.16 | 0.96 | 20.0 | 55.0 | 4.0 | 2 | 0.60 | 30 | 16 |
| 1,5X3 | 1.5 | 1.44 | 1.2 | 3.0 | 45.0 | 4.0 | 2 | 0.75 | 30 | 16 |
| 1,5X4 | 1.5 | 1.44 | 1.2 | 4.0 | 45.0 | 4.0 | 2 | 0.75 | 30 | 16 |
| 1,5X6 | 1.5 | 1.44 | 1.2 | 6.0 | 45.0 | 4.0 | 2 | 0.75 | 30 | 16 |
| 1,5X8 | 1.5 | 1.44 | 1.2 | 8.0 | 45.0 | 4.0 | 2 | 0.75 | 30 | 16 |
| 1,5X10 | 1.5 | 1.44 | 1.2 | 10.0 | 45.0 | 4.0 | 2 | 0.75 | 30 | 16 |
| 1,5X12 | 1.5 | 1.44 | 1.2 | 12.0 | 50.0 | 4.0 | 2 | 0.75 | 30 | 16 |
| 1,8X8 | 1.8 | 1.74 | 1.44 | 8.0 | 45.0 | 4.0 | 2 | 0.90 | 30 | 16 |
| 1,8X10 | 1.8 | 1.74 | 1.44 | 10.0 | 45.0 | 4.0 | 2 | 0.90 | 30 | 16 |
| 1,8X12 | 1.8 | 1.74 | 1.44 | 12.0 | 50.0 | 4.0 | 2 | 0.90 | 30 | 16 |
| 2X4 | 2.0 | 1.94 | 1.6 | 4.0 | 45.0 | 4.0 | 2 | 1.00 | 30 | 16 |
| 2X6 | 2.0 | 1.94 | 1.6 | 6.0 | 45.0 | 4.0 | 2 | 1.00 | 30 | 16 |
| 2X8 | 2.0 | 1.94 | 1.6 | 8.0 | 45.0 | 4.0 | 2 | 1.00 | 30 | 16 |
| 2X10 | 2.0 | 1.94 | 1.6 | 10.0 | 45.0 | 4.0 | 2 | 1.00 | 30 | 16 |
| 2X12 | 2.0 | 1.94 | 1.6 | 12.0 | 45.0 | 4.0 | 2 | 1.00 | 30 | 16 |
| 3X6 | 3.0 | 2.92 | 3.5 | 6.0 | 45.0 | 4.0 | 2 | 1.50 | 30 | 16 |
| 3X8 | 3.0 | 2.92 | 3.5 | 8.0 | 45.0 | 4.0 | 2 | 1.50 | 30 | 16 |
| 3X10 | 3.0 | 2.92 | 3.5 | 10.0 | 45.0 | 4.0 | 2 | 1.50 | 30 | 16 |
| 3X12 | 3.0 | 2.92 | 3.5 | 12.0 | 45.0 | 4.0 | 2 | 1.50 | 30 | 16 |



EXN1-M17-0003 | EXN1 ROWMAKER MICRO Z2 ASR

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| | | | Dimension | Ø0.1x0.3 | Ø0.1x1 | Ø0.2x0.5 | Ø0.2x3 | Ø0.3x0.5 | Ø0.3x6 | Ø0.4x1 | Ø0.4x8 | Ø0.5x1 | Ø0.5x8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 0.1xD ap= 0.1xD | ae= 0.05xD ap= 0.05xD | ae= 0.1xD ap= 0.1xD | ae= 0.02xD ap= 0.02xD | ae= 0.1xD ap= 0.1xD | ae= 0.01xD ap= 0.01xD | ae= 0.1xD ap= 0.1xD | ae= 0.01xD ap= 0.01xD | ae= 0.1xD ap= 0.1xD | ae= 0.015xD ap= 0.015xD |
| | | | Application | | | | | | | | | | |
| | Material | Strength (N/mm²) | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.012 | 0.007 | 0.014 | 0.008 | 0.014 | 0.008 | 0.018 | 0.009 | 0.016 | 0.012 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.012 | 0.007 | 0.014 | 0.008 | 0.014 | 0.008 | 0.018 | 0.009 | 0.016 | 0.012 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.011 | 0.006 | 0.013 | 0.007 | 0.013 | 0.007 | 0.017 | 0.008 | 0.015 | 0.011 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.01 | 0.005 | 0.012 | 0.006 | 0.012 | 0.006 | 0.016 | 0.007 | 0.014 | 0.01 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.012 | 0.007 | 0.014 | 0.008 | 0.014 | 0.008 | 0.018 | 0.009 | 0.016 | 0.012 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.011 | 0.006 | 0.013 | 0.007 | 0.013 | 0.007 | 0.017 | 0.008 | 0.015 | 0.011 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.01 | 0.005 | 0.012 | 0.006 | 0.012 | 0.006 | 0.016 | 0.007 | 0.014 | 0.01 |

| | | | Dimension | Ø0.6x2 | Ø0.6x8 | Ø0.8x2 | Ø0.8x8 | Ø1x2 | Ø1x12 | Ø1.2x3 | Ø1.2x20 | Ø1.5x3 | Ø1.5x12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 0.1xD ap= 0.1xD | ae= 0.025xD ap= 0.025xD | ae= 0.1xD ap= 0.1xD | ae= 0.05xD ap= 0.05xD | ae= 0.1xD ap= 0.1xD | ae= 0.03xD ap= 0.03xD | ae= 0.1xD ap= 0.1xD | ae= 0.015xD ap= 0.015xD | ae= 0.1xD ap= 0.1xD | ae= 0.07xD ap= 0.07xD |
| | | | Application | | | | | | | | | | |
| | Material | | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.022 | 0.017 | 0.022 | 0.017 | 0.035 | 0.028 | 0.035 | 0.025 | 0.035 | 0.03 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.022 | 0.017 | 0.022 | 0.017 | 0.035 | 0.028 | 0.035 | 0.025 | 0.035 | 0.03 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.021 | 0.016 | 0.021 | 0.016 | 0.032 | 0.026 | 0.032 | 0.023 | 0.032 | 0.027 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.02 | 0.015 | 0.02 | 0.015 | 0.029 | 0.024 | 0.029 | 0.021 | 0.029 | 0.024 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.022 | 0.017 | 0.022 | 0.017 | 0.035 | 0.028 | 0.035 | 0.025 | 0.035 | 0.03 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.021 | 0.016 | 0.021 | 0.016 | 0.032 | 0.026 | 0.032 | 0.023 | 0.032 | 0.027 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.02 | 0.015 | 0.02 | 0.015 | 0.029 | 0.024 | 0.029 | 0.021 | 0.029 | 0.024 |

| | | | Dimension | Ø1.8x8 | Ø1.8x12 | Ø2x4 | Ø2x12 | Ø3x6 | Ø3x12 |
|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 0.1xD ap= 0.1xD | ae= 0.09xD ap= 0.09xD | ae= 0.1xD ap= 0.1xD | ae= 0.09xD ap= 0.09xD | ae= 0.1xD ap= 0.1xD | ae= 0.1xD ap= 0.1xD |
| | | | Application | | | | | | |
| | Material | | Feed (mm/Z) | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.04 | 0.035 | 0.04 | 0.035 | 0.043 | 0.04 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.04 | 0.035 | 0.04 | 0.035 | 0.043 | 0.04 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.035 | 0.032 | 0.035 | 0.032 | 0.038 | 0.035 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.03 | 0.029 | 0.03 | 0.029 | 0.033 | 0.03 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.04 | 0.035 | 0.04 | 0.035 | 0.043 | 0.04 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.035 | 0.032 | 0.035 | 0.032 | 0.038 | 0.035 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.03 | 0.029 | 0.03 | 0.029 | 0.033 | 0.03 |

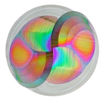
**ADVICE |** Values in the table are the shortest and the longest overhang length (L3) of each dimension; please calculate fz, ap and ae depending on the given values.

| | |
|---|---|
| Cooling | |
| Tolerance | d04 |
| Coating | AlphaSlide Rainbow |

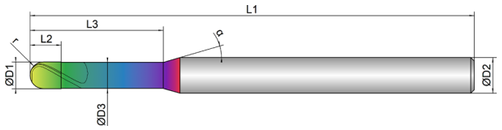
| | |
|---|---|
| Strategy | HSC |
| Application | |
| Features | HA |

Expert

- Optimized face geometry for excellent surfaces and highest dimensional accuracy
- Defined microbevel for support and stabilization
- Polished chip space for ideal chip evacuation



- Tolerance D1: -0.001/-0.006 mm
- Tolerance D3: 0/-0.02 mm
- Radius tolerance r: 0/-0.003 mm (measured from 0-90°)




**Roughing**

inappropriate — optimal

**Finishing**

inappropriate — optimal

| EXN1-M17-0013 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 0,5X10 | 0.5 | 0.47 | 0.4 | 10.0 | 50.0 | 4.0 | 2 | 0.25 | 30 | 16 |
| 0,6X10 | 0.6 | 0.57 | 0.48 | 10.0 | 50.0 | 4.0 | 2 | 0.30 | 30 | 16 |
| 0,8X10 | 0.8 | 0.77 | 0.64 | 10.0 | 50.0 | 4.0 | 2 | 0.40 | 30 | 16 |
| 0,8X12 | 0.8 | 0.77 | 0.64 | 12.0 | 50.0 | 4.0 | 2 | 0.40 | 30 | 16 |
| 1X15 | 1.0 | 0.96 | 0.8 | 15.0 | 50.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1X20 | 1.0 | 0.96 | 0.8 | 20.0 | 60.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1X25 | 1.0 | 0.96 | 0.8 | 25.0 | 60.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1X30 | 1.0 | 0.96 | 0.8 | 30.0 | 70.0 | 4.0 | 2 | 0.50 | 30 | 16 |
| 1,2X15 | 1.2 | 1.16 | 0.96 | 15.0 | 55.0 | 4.0 | 2 | 0.60 | 30 | 16 |
| 1,5X15 | 1.5 | 1.44 | 1.2 | 15.0 | 50.0 | 4.0 | 2 | 0.75 | 30 | 16 |
| 1,5X20 | 1.5 | 1.44 | 1.2 | 20.0 | 60.0 | 4.0 | 2 | 0.75 | 30 | 16 |
| 1,5X25 | 1.5 | 1.44 | 1.2 | 25.0 | 60.0 | 4.0 | 2 | 0.75 | 30 | 16 |
| 1,5X30 | 1.5 | 1.44 | 1.2 | 30.0 | 70.0 | 4.0 | 2 | 0.75 | 30 | 16 |
| 1,8X15 | 1.8 | 1.74 | 1.44 | 15.0 | 50.0 | 4.0 | 2 | 0.90 | 30 | 16 |



EXN1-M17-0013 | EXN1 ROWMAKER MICRO LONG Z2 ASR

| EXN1-M17-0013 | D1 mm ø | D3 mm ø | L2 mm | L3 mm | L1 mm | D2 mm ø | z # | r mm | ° | α ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,8X20 | 1.8 | 1.74 | 1.44 | 20.0 | 55.0 | 4.0 | 2 | 0.90 | 30 | 16 |
| 2X12 | 2.0 | 1.94 | 1.6 | 12.0 | 50.0 | 4.0 | 2 | 1.00 | 30 | 16 |
| 2X15 | 2.0 | 1.94 | 1.6 | 15.0 | 50.0 | 4.0 | 2 | 1.00 | 30 | 16 |
| 2X20 | 2.0 | 1.94 | 1.6 | 20.0 | 60.0 | 4.0 | 2 | 1.00 | 30 | 16 |
| 2X25 | 2.0 | 1.94 | 1.6 | 25.0 | 60.0 | 4.0 | 2 | 1.00 | 30 | 16 |
| 2X30 | 2.0 | 1.94 | 1.6 | 30.0 | 70.0 | 4.0 | 2 | 1.00 | 30 | 16 |
| 2X35 | 2.0 | 1.94 | 1.6 | 35.0 | 80.0 | 4.0 | 2 | 1.00 | 30 | 16 |
| 2X40 | 2.0 | 1.94 | 1.6 | 40.0 | 80.0 | 4.0 | 2 | 1.00 | 30 | 16 |
| 2,5X15 | 2.5 | 2.41 | 2.0 | 15.0 | 50.0 | 4.0 | 2 | 1.25 | 30 | 16 |
| 2,5X20 | 2.5 | 2.41 | 2.0 | 20.0 | 55.0 | 4.0 | 2 | 1.25 | 30 | 16 |
| 2,5X25 | 2.5 | 2.41 | 2.0 | 25.0 | 60.0 | 4.0 | 2 | 1.25 | 30 | 16 |
| 2,5X30 | 2.5 | 2.41 | 2.0 | 30.0 | 70.0 | 4.0 | 2 | 1.25 | 30 | 16 |
| 3X15 | 3.0 | 2.92 | 3.5 | 15.0 | 50.0 | 4.0 | 2 | 1.50 | 30 | 16 |
| 3X20 | 3.0 | 2.92 | 3.5 | 20.0 | 55.0 | 4.0 | 2 | 1.50 | 30 | 16 |
| 3X25 | 3.0 | 2.92 | 3.5 | 25.0 | 60.0 | 4.0 | 2 | 1.50 | 30 | 16 |
| 3X30 | 3.0 | 2.92 | 3.5 | 30.0 | 70.0 | 4.0 | 2 | 1.50 | 30 | 16 |
| 3X35 | 3.0 | 2.92 | 3.5 | 35.0 | 70.0 | 4.0 | 2 | 1.50 | 30 | 16 |
| 3X40 | 3.0 | 2.92 | 3.5 | 40.0 | 80.0 | 4.0 | 2 | 1.50 | 30 | 16 |
| 3X45 | 3.0 | 2.92 | 3.5 | 45.0 | 80.0 | 4.0 | 2 | 1.50 | 30 | 16 |

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| | | | Dimension | Ø 0.5x10 | Ø 0.6 10 | Ø 0.8x10 | Ø 0.8x12 | Ø 1x15 | Ø 1x30 | Ø 1.2x15 | Ø 1.5x15 | Ø 1.5x30 | Ø 1.8x15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 0.01xD ap= 0.01xD | ae= 0.015xD ap= 0.015xD | ae= 0.035xD ap= 0.035xD | ae= 0.02xD ap= 0.02xD | ae= 0.02xD ap= 0.02xD | ae= 0.01xD ap= 0.01xD | ae= 0.035xD ap= 0.035xD | ae= 0.05xD ap= 0.05xD | ae= 0.01xD ap= 0.01xD | ae= 0.07xD ap= 0.07xD |
| | | | Application | | | | | | | | | | |
| | Material | Strength (N/mm²) | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.012 | 0.017 | 0.017 | 0.017 | 0.028 | 0.017 | 0.028 | 0.03 | 0.025 | 0.035 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.012 | 0.017 | 0.017 | 0.017 | 0.028 | 0.017 | 0.028 | 0.03 | 0.025 | 0.035 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.011 | 0.016 | 0.016 | 0.016 | 0.026 | 0.016 | 0.026 | 0.027 | 0.022 | 0.032 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.01 | 0.015 | 0.015 | 0.015 | 0.024 | 0.015 | 0.024 | 0.024 | 0.019 | 0.029 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.012 | 0.017 | 0.017 | 0.017 | 0.028 | 0.017 | 0.028 | 0.03 | 0.025 | 0.035 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.011 | 0.016 | 0.016 | 0.016 | 0.026 | 0.016 | 0.026 | 0.027 | 0.022 | 0.032 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.01 | 0.015 | 0.015 | 0.015 | 0.024 | 0.015 | 0.024 | 0.024 | 0.019 | 0.029 |

| | | | Dimension | Ø 1.8x20 | Ø 2x12 | Ø 2x40 | Ø 2.5x15 | Ø 2.5x30 | Ø 3x15 | Ø 3x45 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infeed in mm | ae= 0.05xD ap= 0.05xD | ae= 0.09xD ap= 0.09xD | ae= 0.01xD ap= 0.01xD | ae= 0.09xD ap= 0.09xD | ae= 0.035xD ap= 0.035xD | ae= 0.09xD ap= 0.09xD | ae= 0.02xD ap= 0.02xD |
| | | | Application | | | | | | | |
| | Material | | Feed (mm/Z) | fz | fz | fz | fz | fz | fz | fz |
| N | NON-FERROUS | | Vc (m/min) | | | | | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | 500 | 0.03 | 0.035 | 0.025 | 0.035 | 0.03 | 0.04 | 0.03 |
| 1.2 | ALUMINIUM \| alloyed | <600 | 480 | 0.03 | 0.035 | 0.025 | 0.035 | 0.03 | 0.04 | 0.03 |
| 2.1-2.3 | ALUMINIUM \| cast | <600 | 450 | 0.027 | 0.032 | 0.022 | 0.032 | 0.027 | 0.035 | 0.025 |
| 3.1-3.3 | COPPER \| alloyed | <650 | 220 | 0.024 | 0.029 | 0.019 | 0.029 | 0.024 | 0.03 | 0.02 |
| 4.1 | MAGNESIUM \| alloyed | <250 | 500 | 0.03 | 0.035 | 0.025 | 0.035 | 0.03 | 0.04 | 0.03 |
| 5.1 | PLASTICS \| Thermoplastic | <100 | 400 | 0.027 | 0.032 | 0.022 | 0.032 | 0.027 | 0.035 | 0.025 |
| 5.2 | PLASTICS \| Duroplastic | <150 | 350 | 0.024 | 0.029 | 0.019 | 0.029 | 0.024 | 0.03 | 0.02 |

**ADVICE |** Values in the table are the shortest and the longest overhang length (L3) of each dimension; please calculate fz, ap and ae depending on the given values.

## STILL CAN'T FIND A SUITABLE MILLING CUTTER?

**No problem** – simply customize an existing tool. Using our configurator for special milling cutters, you can customize existing tools to your needs in an instant or create your own tools based on predefined types.

WE WILL RESPOND TO ALL REQUESTS SUBMITTED VIA THE CONFIGURATOR WITHIN ONE WORKING DAY AT THE LATEST

# EXPLANATION

## APPLICATIONS

| | | | |
|---|---|---|---|
| Multipass milling | Trimming | Deburring | Engraving |
| Corner rounding | Full slot milling | Forward and backward deburring | |

## COOLINGS

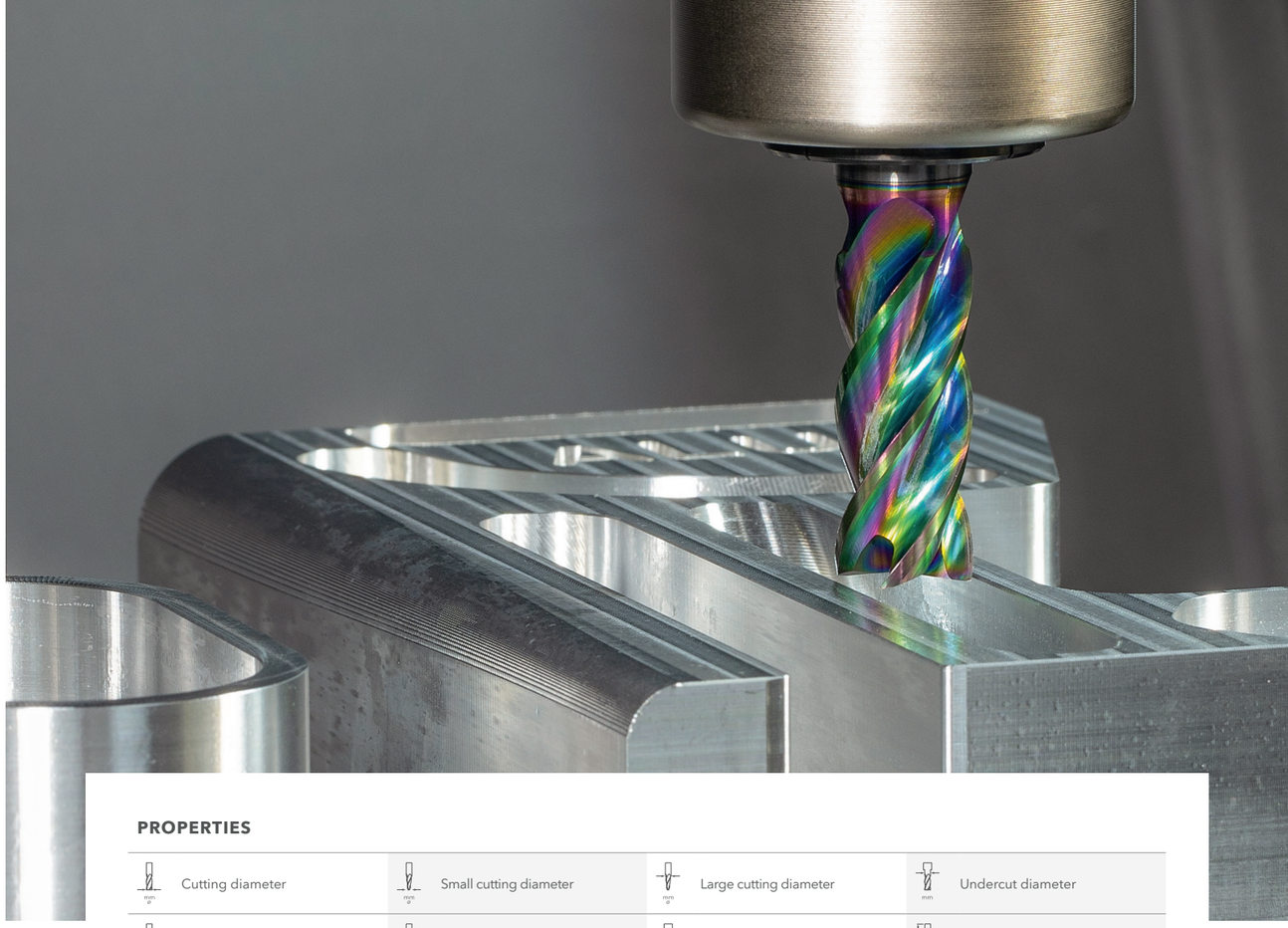
| | | | |
|---|---|---|---|
| Air-cooling | Dry machining | Oil cooling | Cooling Lubricant |
| Minimum quantity lubrication | | | |

## FEATURES

| | | | |
|---|---|---|---|
| 0,5xD 0,5xD | 1xD 1xD | 1,5xD 1,5xD | 2xD 2xD |
| 2,5xD 2,5xD | 3xD 3xD | 3,5xD 3,5xD | 4xD 4xD |
| 5xD 5xD | Center cutting | Non-center cutting | HA Without Weldon |
| HB With Weldon | Internal cooling | Dynamic helical pitch | Chip breaker |
| ≠ Unequal tooth pitch | Roughing teeth | Helical immersion | Feed directions x,y |
| Feed directions x, y, z | Feed directions x, y, (z) | R Corner radius | 45° Corner bevel |
| 90° Sharp edged | | | |

## STRATEGY

| | | | |
|---|---|---|---|
| ETC Extended Trochoidal Cutting | HPC High Performance Cutting | HSC High Speed Cutting | MTC Multi Task Cutting |
| UNI Universal Machining | | | |



## PROPERTIES

| | | | |
|---|---|---|---|
| mm Cutting diameter | mm Small cutting diameter | mm Large cutting diameter | mm Undercut diameter |
| mm Cutting length | mm Total bevel length | mm Undercut length | mm Total length |
| mm Shank diameter | # Number of teeth | mm Corner radius | mm Corner bevel |
| mm Programming radius | mm max Maximum cutting depth | ° Helical angle | ° Alpha angle |

## APPLICATION TABLE

**The** values given in the application table are only guidelines. These values are largely dependent on the machining situation and application.

## FIGURES

**All** technical drawings and photographs are given as an example. The product may deviate from the original in terms of colour and dimensions.

## N 1.1 ALUMINIUM | alloyed <500 N/mm²

| Materialnumber | Germany \| DIN | Europe \| EN | France \| AFNOR | Great Britain \| BS | Italy \| UNI | Sweden \| SIS | Spain \| UNE | Japan \| JIS | USA \| AISI |
|---|---|---|---|---|---|---|---|---|---|
| **3.0205** | Al99 | AW-1200 | A 4 | 1 C | P-Al99.0 | 4010 | L-3001 | A1200 | AA1200 |
| **3.0250** | Al99.5H | | A 59050 C | L 31 | | | | | AA1000 |
| **3.0255** | Al99.5 | AW-1050 A | A 5 | L 31 | P-AlP99.5 | 4007 | L-3051 | A1050 | AA1050 A |
| **3.0275** | Al99.7 | AW-1070 A | A 7 | 2L 48 | P-AlP99.7 | 4005 | L-3071 | A1070 | AA1070 A |
| **3.0280** | Al99.8 | | | | | | | | |
| **3.0285** | Al99.8 | AW-1080 A | A 8 | 1A | P-Al99.8 | 4004 | L-3081 | A1080 | AA1080 A |
| **3.0305** | Al99.9 | AW-1090 | | | | | | | |
| **3.0505** | AlMn 0.5 Mg 0.5 | AW-3105 | | N 31 | | | | A3105 | AA3105 |
| **3.0506** | AlMn 0.6 | AW-3207 | | | | | | | |
| **3.0515** | AlMn 1 | AW-3103 | | N 3 | P-AlMn 1.2 | 4067 | L-3811 | A3103 | AA3103 |
| **3.0517** | AlMn 1 Cu | AW-3003 | A-M1 | | P-AlMn 1.2 Cu | | L-3810 | A3003 | AA3003 |
| **3.0525** | AlMn 1 Mg 0.5 | AW-3005 | A-MG0,5 | | | | | A3005 | AA3005 |
| **3.0526** | AlMn 1 Mg 1 | AW-3004 | A-M1G | | P-AlMn 1.2 Mg | GA/6511 | L-3820 | A3004 | AA3004 |
| **3.0915** | AlFeSi | AW-8011A | | | | | | | |
| **3.1255** | AlCu 4 SiMg | AW-2014 | A-U4SG | H 15 | P-AlCu 4.4 SiMnMg | | L-3130 | A2014 | AA2014 |
| **3.1305** | AlCu 2.5 Mg | AW-2117 | A-U2G | L 86 | P-AlCu 2.5 MgSi | | L-3180 | A2117 | AA2117 |
| **3.1324** | AlCu 4 MgSi | AW-2017 A | | | | | | | |
| **3.1325** | AlCuMg1 | AW-2017 A | A-U4G | H 14 | P-AlCu 4.5 MgMn | GA631 | L-3120 | A2017 | AA2017 A |
| **3.1355** | AlCuMg2 | AW-2024 | A-U4G1 | L 97 / L 98 | P-AlCu 4.5 MgMn | 5 | L-3140 | A2024 | AA2024 |
| **3.1371** | G-AlCu 4 TiMg | AC-21000 | | | | | | | |
| **3.1841** | G-AlCu 4 Ti | AC-21100 | | | | | | | |
| **3.2134** | G-AlSi 5 Cu 1,3 Mg | AC-45300 | | | | | | | |
| **3.2307** | Al99.85 MgSi | | | | | | | | |
| **3.2315** | AlMgSi 1 | AW-6082 | A-SGM0,7 | H 30 | P-AlMgSi | 4212 | L-3453 | | AA6082 |
| **3.3206** | AlMgSi 0.5 | AW-6060 | A-GS | H 9 | P-AlMgSi | 4140 | L-3442 | | AA6060 |
| **3.3208** | Al99.9 MgSi | AW-6401 | | | | | | | |
| **3.3210** | AlMgSi 0.7 | AW-6005 A | | | | | | | |
| **3.3211** | AlMg 1 SiCu | AW-6061 | A-GSUC | H 20 | P-AlMg 1 SiCu | | L-3420 | A6061 | AA6061 |
| **3.3241** | G-AlMg 3 Si | | | | | | | | |
| **3.3261** | G-AlMg 5 Si | AC-51400 | | | | | | | |
| **3.3292** | GD-AlMg 9 | AC-51200 | | | | | | | |
| **3.3307** | Al99.85 Mg 0.5 | AW-5110 | | | | | | | |
| **3.3308** | Al99.9 Mg 0.5 | AW-5210 | | | | | | | |
| **3.3315** | AlMg1 | AW-5005 A | A-G0,6 | N 41 | P-AlMg 0.9 | 4106 | L-3350 | A5005 | AA5005 A |
| **3.3316** | AlMg 1.5 | AW-5050 | A-G1,5 | 3L 44 | P-AlMg 1.5 | | L-3380 | | AA5050 B |
| **3.3317** | Al99.85 Mg 1 | AW-5305 | | | | | | | |
| **3.3318** | Al99.9 Mg 1 | AW-5505 | | | | | | | |
| **3.3326** | AlMg 1.8 | AW-5051 A | | | | | | | |
| **3.3345** | AlMg 4.5 | AW-5082 | A-G4,5 | | P-AlMg 4.4 | | | A5082 | AA5082 |
| **3.3523** | AlMg 2.5 | AW-5052 | A-G2,5C | L 80 / L 81 | P-AlMg 2.5 | 4120 | L-3360 | A5052 | AA5052 |
| **3.3525** | AlMg 2 Mn 0.3 | AW-5251 | A-G2M | N4 | P-AlMg 2 Mn | | L-3361 | | AA5251 |
| **3.3527** | AlMg 2 Mn 0.8 | AW-5049 | A-G2,5MC | | | | | A5049 | AA5049 |
| **3.3535** | AlMg 3 | AW-5754 | A-G3M | | P-AlMg 3.5 | 4130 | L-3390 | | AA5754 |
| **3.3537** | AlMg 2.7 Mn | AW-5454 | A-G2,5MC | | P-AlMg 2.7 Mn | 4130 | L-3391 | | AA5454 |
| **3.3541** | G-AlMg 3 | AC-51100 | | | | | | | |
| **3.3545** | AlMg 4 Mn | AW-5086 | A-G4MC | | P-AlMg 4.4 | | L-3382 | | AA5086 |
| **3.3547** | AlMg 4,5 Mn | AW-5083 | A-G4,5MC | N 8 | P-AlMg 4.5 | 4140 | L-3321 | A5083 | AA5083 |
| **3.3549** | AlMg 5 Mn | AW-5182 | | | | | | | |
| **3.3555** | AlMg 5 | AW-5019 | | | | | | | |
| **3.3561** | G-AlMg 5 | AC-51300 | | | | | | | |

## N 1.2 ALUMINIUM | alloyed <600 N/mm²

| Materialnumber | Germany \| DIN | Europe \| EN | France \| AFNOR | Great Britain \| BS | Italy \| UNI | Sweden \| SIS | Spain \| UNE | Japan \| JIS | USA \| AISI |
|---|---|---|---|---|---|---|---|---|---|
| **3.0615** | AlMgSiPb | AW-6012 | A-SGPb | | P-AlSiMgMn | | L-3452 | | AA6012 |
| **3.1645** | AlCu 4 PbMgMn | AW-2007 | | | | 4355 | L-3121 | A2007 | AA2007 |
| **3.1655** | AlCu 6 BiPb | AW-2011 | A-U5PbBi | FC 1 | P-AlCu 5.5 PbBi | 4338 | L-3192 | A2011 | AA2011 |
| **3.4335** | AlZn 4.5 Mg 1 | AW-7020 | A-Z5G | H 17 | | 4425 | L-3741 | | AA7020 |
| **3.4345** | AlZnMgCu 0.5 | AW-7022 | A-Z4GU | | | | | | AA7022 |
| **3.4365** | AlZnMgCu 1.5 | AW-7075 | A-Z5GU | 2L 95 | P-AlZn 5.8 MgCu | | L-3710 | A7075 | AA7075 |





## N 2.1 – N 2.3 ALUMINIUM | cast <600 N/mm²

| Materialnumber | Germany \| DIN | Europe \| EN | France \| AFNOR | Great Britain \| BS | Italy \| UNI | Sweden \| SIS | Spain \| UNE | Japan \| JIS | USA \| AISI |
|---|---|---|---|---|---|---|---|---|---|
| **3.1841** | G-AlCu 4 Ti | | | | | | | AC1A | A 295.0 |
| **3.1871** | G-AlCu 4 TiMg | | | | | | | | |
| **3.2131** | G-AlSiCu1 | | | | | | | | |
| **3.2151** | G-AlSi 6 Cu 4 | AC-45000 | A-S5UZ | LM 4 | | | | AC4B | A 319.0 |
| **3.2161** | G-AlSi 8 Cu 3 | AC-46200 | A-S9U3A-Y4 | LM 24 | 5075 | | | AC4D | A 328.0 |
| **3.2163** | GD-AlSi 9 Cu 3 | | | | | | | | |
| **3.2211** | G-AlSi 11 | | | | | | | | |
| **3.2341** | G-AlSi 5 Mg | | | | | | | | |
| **3.2371** | G-AlSi 7 Mg 0,3 | AC-42100 | | | | | | AC4CH | A 356.0 |
| **3.2373** | G-AlSi 9 Mg | AC-43300 | | | | | | | |
| **3.2381** | G-AlSi 10 Mg | AC-43100 | | | | | | | |
| **3.2382** | GD-AlSi 10 Mg | | | | | | | | |
| **3.2383** | G-AlSi 10 Mg(Cu) | AC-43400 | A-S10G | LM 9 | 3049 | 4253 | | ADC3 | A 360.2 |
| **3.2581** | G-AlSi 12 | AC-47100 | A-S13 | LM 6 | 4514 | 4261 | | AC3A | A 413.2 |
| **3.2582** | GD-AlSi 12 | | | | | 4247 | | ADC1 | A 413.0 |
| **3.2583** | G-AlSi 12 Cu | AC-44300 | A-S12-Y4 | LM 20 | 5079 | 4260 | | ADC1 | A 413.1 |
| **3.2585** | SG-AlSi12 | | | | | | | | |
| **3.2982** | GD-AlSi 12 Cu | | | | | | | | |
| **3.3241** | G-AlMg 3 Si | | | | | | | | |
| **3.3261** | G-AlMg 5 Si | | | | | | | | |
| **3.3561** | G-AlMg 5 | | | | | | | AC7A | A 514.0 |

## N 3.1 - N. 3.3 COPPER | alloyed <600 N/mm²

| Materialnumber | Germany \| DIN | Europe \| EN | France \| AFNOR | Great Britain \| BS | Italy \| UNI | Sweden \| SIS | Spain \| UNE | Japan \| JIS | USA \| AISI |
|---|---|---|---|---|---|---|---|---|---|
| **2.0060** | E-Cu 57 | CW-004A | | | | | | | B-120 |
| **2.0065** | E-Cu 58 | CW-004A | Sn-a2 | C 101 | | | | | C 11000 |
| **2.0070** | SE-Cu | CW-020A | Cu-c1 | C 101 | | | | | C 10300 |
| **2.0082** | G-Cu L 45 | | | HCC 1 | | | | | C 81100 |
| **2.0085** | G-Cu L 50 | CC-040A | | HCC 1 | | | | | C 81100 |
| **2.0240** | CuZn 15 | CW-502L | CuZn 15 | CZ 102 | | | | C 2300 | C 23000 |
| **2.0265** | CuZn 30 | CW-505L | CuZn 30 | CZ 102 | | | | C 2600 | C 26000 |
| **2.0321** | CuZn 37 | CW-508L | CuZn 37 | CZ 180 | C 2720 | | | | C 27200 |
| **2.0340** | G-CuZn 37 Pb | CC-754S-GM | | | | | | | |
| **2.0492** | G-CuZn 15 Si 4 | CC-761S-GS | | | | | | | B-198 |
| **2.0592** | G-CuZn 35 Al 1 | CC-765S | U-Z 36 N 3 | HTB 1 | | | | | C 86500 |
| **2.0595** | G-KCuZn 37 Al 1 | CC-766S | | | | | | | |
| **2.0596** | G-CuZn 34 Al 2 | CC-764S | U-Z 36 N 3 | | | | | | |
| **2.0857** | CuNi 3 Si | CW-112C | | | | | | | |
| **2.0916** | CuAl 5 | | | | | | | | |
| **2.0927** | SG-CuAl 9 Ni 5 Fe | | | | | | | | |
| **2.0936** | CuAl 10 Fe 3 Mn 2 | CW-306G | U-A 10 Fe | CA 103 | | | | | |
| **2.0966** | CuAl 10 Ni 5 Fe 4 | CW-307G | U-A 10 N | CA 104 | | | | | C 63000 |
| **2.1006** | SG-CuSn | | | | | | | | |
| **2.1050** | G-CuSn 10 | CC-480K-GS | | CT 1 | | | | | C 90700 |
| **2.1052** | G-CuSn 12 | CC-483K-GS | UE 12 P | Pb 2 | | | | | C 91700 |
| **2.1060** | G-CuSn 12 Ni 2 | CC-484K-GS | | | | | | | C 91700 |
| **2.1090** | G-CuSn 7 ZnPb | | UE 7 Z5 Pb 4 | | | | | | C 93200 |
| **2.1093** | G-CuSn 6 ZnNi | | | LG 4 | | | | | |
| **2.1096** | G-CuSn 5 ZnPb | | UE 5 Pb 5 Z 5 | LG 2 | | | | | C 83600 |
| **2.1176** | G-CuPb 10 Sn | CC-495K-GS | UE 10 Pb 10 | LB 2 | | | | | C 93700 |
| **2.1182** | G-CuPb 15 Sn | CC-496K-GS | U-Pb 15 E 8 | LB 1 | | | | | C 93800 |
| **2.1188** | G-CuPb 20 Sn | CC-497K-GS | U-Pb 20 | LB 5 | | | | | C 94100 |
| **2.1266** | CuCd 1 | | | | | | | | |
| **2.1292** | G-CuCrF 35 | CC-140C | | CC1-FF | | | | | C 81500 |
| **2.1293** | CuCrZr | CW-106C | U-Cr 0.8 Zr | CC 102 | | | | | C 81500 |
| **2.1322** | CuMg 0.4 | | | | | | | | |
| **2.1355** | CuMn 2 | | | | | | | | |
| **2.1461** | SG-CuSi 3 | CW-116C | | | | | | | |

## N 4.1 MAGNESIUM | alloyed <200 N/mm²

| Materialnumber | Germany \| DIN | Europe \| EN | France \| AFNOR | Great Britain \| BS | Italy \| UNI | Sweden \| SIS | Spain \| UNE | Japan \| JIS | USA \| AISI |
|---|---|---|---|---|---|---|---|---|---|
| **3.5101** | G-MgZn 4 SE1 Zr 1 | MC-35110 | G-Z 4 Tr | MAG-5 | | | | | ZE 41 |
| **3.5102** | G-MgZn 5 Th2 Zr1 | | | | | | | | |
| **3.5103** | MgSE 3 Zn2 Zr1 | MC-65120 | G-Tr 3 Z 2 | MAG-6 | | | | | EZ 33 |
| **3.5105** | G-MgTh 3 Zn2 Zr1 | | | | | | | | QE 22 |
| **3.5106** | G-MgAg 3 SE2 Zr1 | MC-65210 | G-Ag 22.5 | MAG-12 | | | | | |
| **3.5200** | G-MgAl 8 Zn 1 | MA-40020 | | | | | | | |
| **3.5312** | MgAl 3 Zn | MA-21130 | | | | | | | |
| **3.5314** | MgAl 3 Zn | | G-A3 Z1 | MAG-E-111 | | | | | AZ 31 B |
| **3.5470** | GD-MgAl 4 Si 1 | MC-21320 | | | | | | | |
| **3.5612** | GD-MgAl 6 Zn 3 | MC-21140 | | | | | | | |
| **3.5614** | MgAl 6 Zn | | G-A6 Z1 | MAG-E-121 | | | | | AZ 61 A |
| **3.5662** | GD-MgAl 6 | | | | | | | | |
| **3.5812** | G-MgAl 8 Zn 1 | MC-21110 | G-A9 | | | | | | AZ 81 |
| **3.5912** | G-MgAl 9 Zn 1 | MC-21120 | G-A 9 Z 1 | | | | | | AZ 91 |

## N 5.1 PLASTICS | thermoplastics <100 N/mm²

| Materialnumber | Germany \| DIN | Europe \| EN | France \| AFNOR | Great Britain \| BS | Italy \| UNI | Sweden \| SIS | Spain \| UNE | Japan \| JIS | USA \| AISI |
|---|---|---|---|---|---|---|---|---|---|
| **PC** | Makralon | | Orgalan | Sinvet | | | | | Lexan |
| **PC** | Nuclon | | | | | | | | Merlon |
| **PC** | Plastocarbon | | | | | | | | |
| **PE** | Baylon | | | Fertene | Carlona | | | | Althon |
| **PE** | Dekalen | | | Eraclene | Escorene | | | | Bakellite |
| **PE** | Lupolen | | | | | | | | Chemplex |
| **PE** | Hostalen | | | | | | | | Dylan |
| **PF** | Alberit | | | Fenachem | | | | | Biralit |
| **PF** | Bakelit | | | Moldesile | | | | | Biratex |
| **PF** | Bulitol | | | | | | | | Birax |
| **PF** | Durax | | | | | | | | |
| **PF** | Harex | | | | | | | | |
| **PF** | Resinol | | | | | | | | |
| **PFTE** | Hostaflon | | Soreflon | | | | | | Halon; Teflon |
| **PP** | Vestolen PP | | Eitex P | Moplen | Carola P | | | | Profax |
| **PP** | Synalen PP | | Napryl | Kastilen | Procom | | | | Rexene |
| **PP** | Novolen | | | | | | | | Tenite |
| **PP** | Hostalen PP | | | | | | | | |
| **PS** | Hostylon | | | Sdistir | Lustrex | | | | Carinex |
| **PS** | Lorkalen | | | Lastinol | | | | | Dylene |
| **PS** | Polystyrol | | | | | | | | Toporex |
| **PS** | Styropor | | | | | | | | |
| **PVC** | Coroplast | | | | | | | | |
| **PVC** | Hostalit | | | | | | | | |
| **PVC** | Mipolam | | | | | | | | |
| **PVC** | Opalon | | | | | | | | |
| **PVC** | Solvec | | | | | | | | |
| **PVC** | Vinoflex | | | | | | | | |
| **PP-H** | Homopolymer | | | | | | | | |
| **PP-C** | Copolymer | | | | | | | | |
| **ABS** | Acrylnitrid Butadien Styrol | | | | | | | | |
| **PMMA** | Polymethyl metha Crylat | | | | | | | | |
| **PMMA** | Plexiglas; Resarit; Degluan | | | | | | | | |
| **POMC** | Polyoxymethylen | | | | | | | | |
| **POMC** | Hostaform; ultraform | | | | | | | | |
| **PI** | Polymid | | | | | | | | |
| **PEI** | Polytherimid | | | | | | | | |
| **PVC-H** | Polyvinylchlorid (hard) | | | | | | | | |
| **PA** | Polyamide | | | | | | | | |





## N 5.2 PLASTICS | duroplastics <150 N/mm²

| Materialnumber | Germany \| DIN | Europe \| EN | France \| AFNOR | Great Britain \| BS | Italy \| UNI | Sweden \| SIS | Spain \| UNE | Japan \| JIS | USA \| AISI |
|---|---|---|---|---|---|---|---|---|---|
| **PUR 5220** | | | | | | | | | |
| **PF 31** | | | | | | | | | |
| **MP 183** | | | | | | | | | |

## Technical formulas

**Calculate cutting speed (m/min)**

$$V_c = \frac{D * \pi * n}{1000}$$

**Calculate rotational speed (rpm)**

$$n = \frac{V_c * 1000}{D * \pi}$$

**Calculate feed rate (mm/min)**

$$V_f = n * z * f_z$$

**Calculate feed per tooth (mm/number of teeth)**

$$f_z = \frac{V_f}{n * z}$$

**Calculate chip removal rate (cm³/min)**

$$Q = \frac{a_p * a_e * V_f}{1000}$$

**Calculate average chip thickness (mm)**

$$h_m = f_z * \frac{\sqrt{a_e}}{D}$$

**Explanation of terms**

| | | |
|---|---|---|
| **Vc** | Cutting speed | in m/min |
| **n** | Rotational speed | in rpm |
| **Vf** | Feed rate | in mm/min |
| **Fz** | Feed per tooth | in mm/number of teeth |
| **z** | Number of teeth (cutting) | |
| **ap** | Depth of cut | in mm |
| **ae** | Width of cut | in mm |
| **hm** | Average chip thickness | in mm |
| **Q** | Chip removal rate | in cm³/min |
| **D** | Diameter of tool | in mm |

# CONVERSION TABLE STRENGTH HARDNESS

| Material | | Strength (N/mm²) | Hardness (HRC) | Hardness (HB) |
|---|---|---|---|---|
| **P** | **(Steel)** | | | |
| 1.1 | STEEL \| unalloyed | <500 | <15,2 | <147 |
| 1.2-1.5 | STEEL \| unalloyed | <1100 | <33,5 | <325 |
| 2.1-2.2 | STEEL \| low-alloyed | <950 | <28,8 | <280 |
| 2.3-2.4 | STEEL \| low-alloyed | <1300 | <40 | <385 |
| 3.1-3.2 | STEEL \| high-alloyed | <1100 | <33,5 | <325 |
| 3.3 | STEEL \| high-alloyed | <1400 | <44 | <410 |
| **K** | **(Castings)** | | | |
| 1.1-1.2 | CASTINGS \| Grey cast iron | <1000 | <30 | <295 |
| 2.1-2.2 | CASTINGS \| Modular cast iron | <850 | <25 | <250 |
| 3.1-3.2 | CASTINGS \| Malleable cast iron | <800 | <24 | <235 |
| **M** | **(Stainless Steel)** | | | |
| 1.1 | STAINLESS STEEL \| ferritic/martensitic | <850 | <25 | <250 |
| 2.1 | STAINLESS STEEL \| austenitic | <650 | <20 | <190 |
| 2.2 | STAINLESS STEEL \| austenitic | <750 | <22 | <220 |
| 3.1 | DUPLEX STEEL \| super austenitic | <1100 | <33,5 | <325 |
| **N** | **(Non-Ferrous Metal)** | | | |
| 1.1 | ALUMINIUM \| alloyed | <500 | <15,2 | <147 |
| 1.2 | ALUMINIUM \| alloyed | <600 | <18,2 | <177 |
| 2.1-2.3 | ALUMINIUM \| casted | <600 | <18,2 | <177 |
| 3.1-3.3 | COPPER \| alloyed | <650 | <20 | <190 |
| 4.1 | MAGNESIUM \| alloyed | <250 | <7,5 | <76 |
| 5.1 | PLASTICS \| thermoplastic | <100 | 0 | 0 |
| 5.2 | PLASTICS \| duroplastic | <150 | 0 | 0 |
| **S** | **(Superalloys)** | | | |
| 1.1 | IRON-BASED ALLOY \| HRSA | <1200 | <36 | <355 |
| 1.2 | NICKEL-BASED ALLOY \| HRSA | <1450 | <45 | <425 |
| 1.3 | COBALT-BASED ALLOY \| HRSA | <1450 | <45 | <425 |
| **T** | **(Titanium)** | | | |
| 2.1-2.2 | TITANIUM \| pure; alloyed | <1000 | <30 | <295 |
| 2.3 | TITANIUM \| alloyed | <1400 | <44 | <410 |





# GENERAL TERMS OF SALE

**§ 1 SCOPE**

1. These General Terms of Sale apply to all business relationships between Hofmann & Vratny OHG (hereinafter referred to as "Hofmann & Vratny") and its customers (hereinafter referred to individually as the "Ordering Party" and collectively as the "Ordering Parties").

2. These General Terms of Sale only apply to Ordering Parties that are entrepreneurs pursuant to §§ 14 and 310 para. 1 of the BGB (Civil Code of Germany), legal entities under public law, and/or special funds under public law.

3. The scope of application of these General Terms of Sale includes, but is not limited to, contracts regarding the sale and/or delivery of chattels (hereinafter referred to as "Goods") regardless of whether they are produced by Hofmann & Vratny or procured from suppliers (§§ 433 and 651 of the BGB). Unless agreed upon otherwise, the version of these General Terms of Sale applicable at the time the Ordering Party places an order and in any case the most recent version of these General Terms of Sale provided to the Ordering Party in writing in the form of a master agreement also shall apply to similar contracts made at a later date without Hofmann & Vratny being required to make reference to them in every individual case.

4. These General Terms of Sale shall apply exclusively. These General Terms of Sale also shall apply if and when Hofmann & Vratny executes a delivery without reservation despite having knowledge of the Ordering Party's terms of sale which contradict or deviate from these General Terms of Sale. Any of the Ordering Party's terms of sale which contradict or deviate from these General Terms of Sale shall become part of a contract only with Hofmann & Vratny's express prior consent. Such requirement to consent shall apply in any case even, for example, if the Ordering Party refers to its terms of sale as part of an order placement and Hofmann & Vratny does not object explicitly to such terms.

5. If Hofmann & Vratny and the Ordering Party have entered into any individual agreements, such individual agreements shall prevail over these General Terms of Sale. The content of such individual agreements only can be substantiated by a written contract or by written confirmation from Hofmann & Vratny. Individual agreements (e.g., outline delivery contracts, quality assurance agreements) and information provided in Hofmann & Vratny's order confirmation shall prevail over these General Terms of Sale. In case of doubt, commercial clauses shall be interpreted based on the Incoterms® issued by the International Chamber of Commerce in Paris (ICC) and applicable at the time the contract is entered into.

6. All of the Ordering Party's legal declarations and notifications made with regard to the contract (e.g., in connection with deadlines or notices of defects, rescission, or reduction) shall be made in writing to be effective. In the context of these General Terms of Sale, in writing shall include written and text forms (e.g., letters, e-mails, faxes). Legal requirements regarding form and other verifications including, but not limited to, cases of doubt regarding the legitimation of the notifying party shall remain unaffected.

7. All references to applicable laws shall be for the purpose of clarification only. Unless amended in or excluded expressly from these General Terms of Sale, laws shall apply even without express reference.

**§ 2 OFFERS AND ACCEPTANCE**

1. All offers made by Hofmann & Vratny shall be subject to change and shall be non-binding including if and when images, drawings, technical documentation, calculations, analyses, other documents or product descriptions of whatever nature (hereinafter referred to as "Documents") are provided to the Ordering Party if the proprietary rights and copyrights to those Documents are retained by Hofmann & Vratny.

2. All orders for Goods placed by the Ordering Party shall constitute binding offers. Unless stated otherwise in the respective order, Hofmann & Vratny shall be entitled to accept an offer within two weeks after receipt of said offer.

3. Hofmann & Vratny shall accept offers in writing (e.g., in the form of an order confirmation) or by delivering the respective Goods to the Ordering Party.

4. All proprietary rights and copyrights to Documents shall remain with Hofmann & Vratny. Documents marked as confidential shall be forwarded to third parties only with the express written consent of Hofmann & Vratny.

**§ 3 DELIVERY DEADLINES AND DEFAULT OF DELIVERY**

1. Delivery deadlines shall be agreed upon by Hofmann & Vratny and the individual Ordering Party or shall be specified by Hofmann & Vratny upon acceptance of the order or in the order confirmation.

2. Hofmann & Vratny's compliance with delivery obligations shall be conditional upon the Ordering Party's on-time and proper compliance with the Ordering Party's obligations including, but not limited to, the provision of the papers, permits and approvals required to be provided by the Ordering Party and the receipt by Hofmann & Vratny of the agreed-upon down payment, if any. In the event of delays, the delivery time shall be extended reasonably.

3. If Hofmann & Vratny is unable to meet any binding delivery deadlines for reasons beyond the control of Hofmann & Vratny (non-availability of services), the Ordering Party shall be notified without undue delay and shall be provided with an estimated new delivery deadline. If the agreed upon Goods do not become available before the new deadline expires, Hofmann & Vratny shall be entitled to rescind the contract in whole or in part and shall reimburse the Ordering Party without undue delay for any and all consideration paid up to that time. For the fulfillment of this clause, non-availability of services shall include, but shall not be limited to, delayed delivery from any of Hofmann & Vratny's suppliers for reasons beyond the control of Hofmann & Vratny or its suppliers, or if Hofmann & Vratny is not responsible for procuring the Goods.

4. If failure to comply with a delivery deadline is due to an act of God, industrial dispute or other event beyond the control of Hofmann & Vratny, the delivery time shall be extended reasonably. The same shall apply if and when any such act of God, industrial dispute or other event has arisen at any of Hofmann & Vratny's sub-suppliers which event can be demonstrated to have had an impact on compliance with the delivery deadline. Hofmann & Vratny shall notify the Ordering Party of such circumstances without undue delay. Events also shall be deemed to be beyond Hofmann & Vratny's control if and when they occur during a delay. In this case, the delay shall be deemed to be suspended for the duration of the respective event.

5. The beginning of a period of delivery default shall be in accordance with the law, but shall in any case require a reminder issued by the Ordering Party.

6.If a contract regarding stand-by delivery has been signed, Hofmann & Vratny shall deliver and invoice the Goods no later than 12 months after the date of such contract (hereinafter referred to as the "Recall Period"), even if the Ordering Party has failed to recall the Goods by that time. After the Recall Period has expired, Hofmann & Vratny can notify the Ordering Party of Hofmann & Vratny's readiness to deliver and can request that the Ordering Party recall the Goods within a reasonable period of time. If the Ordering Party fails to recall the Goods within such period, Hofmann & Vratny shall be entitled to demand an additional lumpsum compensation for warehousing costs (hereinafter referred to as the "Warehousing Allowance"). The Warehousing Allowance shall be 0.5% of the net value of the purchased Goods for every full week, but shall not exceed 5% of the net value of the purchased Goods in total. The Ordering Party shall be free to prove that Hofmann & Vratny did not incur any damages or that any damages incurred were lower than the Warehousing Allowance. If the Ordering Party fails to recall the Goods within the Recall Period determined by Hofmann & Vratny, Hofmann & Vratny shall be entitled to dispose of the Goods as Hofmann & Vratny sees fit. The statutory provisions regarding rescission shall remain unaffected.

## § 4 DELIVERY AND DEFAULT OF ACCEPTANCE

1. Unless agreed upon otherwise, all deliveries shall be ex works, that is, the place of performance for deliveries and for all subsequent actions. Unless agreed upon otherwise, upon request and at the expense of the Ordering Party the Goods shall be delivered to another destination (hereinafter referred to as "Sales Involving the Carriage of Goods"). Unless agreed upon otherwise, Hofmann & Vratny shall be entitled to determine the shipment method (including, but not limited to, the forwarder, the type of shipment and the packaging).

2. Partial deliveries shall be admissible, provided the Ordering Party reasonably can be expected to accept them.

3. Delivered Goods shall be accepted by the Ordering Party even if the delivered Goods have minor defects provided the Ordering Party reasonably can be expected to accept such Goods.

4. The risk of accidental destruction and/or deterioration of the Goods shall transfer to the Ordering Party no later than upon surrender of the Goods. In the case of Sales Involving the Carriage of Goods, the risk of accidental destruction and/or deterioration of the Goods and the risk of delay shall transfer to the Ordering Party no later than at the time of delivery of the Goods to the forwarder, carrier, or any other person designated to execute shipment of the Goods. Delivery shall be deemed to have been effected even if the Ordering Party is in default of acceptance.

5. If the Ordering Party is in default of acceptance or fails to cooperate or if delivery is delayed for other reasons for which the Ordering Party is responsible, Hofmann & Vratny shall be entitled to demand reimbursement for the damages incurred in connection therewith including additional expenses (e.g., warehousing costs).

## § 5 TERMS OF PAYMENT

1. Unless agreed upon otherwise in individual cases, Hofmann & Vratny's prices plus statutory sales tax valid at the time the contract is signed shall apply. The prices indicated in Hofmann & Vratny's catalogs are non-binding and subject to change and/ or correction.

2. Unless agreed upon otherwise, in the case of Sales Involving the Carriage of Goods the Ordering Party shall bear the costs of packaging and transportation ex works and the costs, if any, for transportation insurance if such insurance is requested by the Ordering Party. All customs and other fees, taxes and other public charges also shall be borne by the Ordering Party unless agreed upon otherwise. Ownership of the packaging for transportation and otherwise pursuant to the Verpackungsordnung (Packaging Ordinance of Germany) shall transfer to the Ordering Party and such packaging shall not be returned to Hofmann & Vratny. Pallets shall be exempt from this rule.

3. Unless agreed upon otherwise in the order confirmation, the purchase price plus statutory sales tax shall be due and payable without any deductions within 14 days after the date of invoicing and delivery or acceptance of the Goods. However, Hofmann & Vratny reserves the right to make full or partial deliveries against cash in advance at any time including during an ongoing business relationship. The assertion of such right shall be communicated no later than at the time the order confirmation is issued. The Ordering Party shall be deemed to be in default of payment upon the expiration of the aforementioned payment deadline. The applicable rate of interest on the purchase price of the Goods shall become payable during the default period. The right to assert claims for more substantial compensation shall be reserved. Hofmann & Vratny's right to claim commercial-rate default interest (§ 353 of the HGB) shall remain unaffected.

4. The Ordering Party's rights of set-off and retention shall be limited to the extent the Ordering Party's claim is determined in a court of law or is undisputed. The Ordering Party's rights based on defects in the purchased Goods (see § 7 hereof) shall remain unaffected.

5. After the contract has been signed, if there is evidence that Hofmann & Vratny's claim to the purchase price will be compromised due to lack of performance on the part of the Ordering Party, Hofmann & Vratny shall be entitled to refuse performance pursuant to the applicable laws and, after setting a deadline, if applicable, shall be entitled to rescind the contract. In the case of contracts regarding the production of customized items, Hofmann & Vratny shall be entitled to rescind the contract immediately and the laws regarding the expendability of setting deadlines shall remain unaffected.

## § 6 RETENTION OF TITLE

1. Until all pending and future receivables in connection with the business relationship between Hofmann & Vratny and the Ordering Party are paid in full, Hofmann & Vratny shall retain ownership of the Goods. If the Ordering Party violates the contract including, but not limited to, default of payment, Hofmann & Vratny shall be entitled to rescind the contract pursuant to the applicable laws and to demand the surrender of the Goods.

2. Goods subject to retention of title shall not be pledged or assigned as collateral before the Ordering Party has paid in full. The Ordering Party shall notify Hofmann & Vratny in writing without undue delay in the event of a fling for commencement of insolvency proceedings or if third parties gain access (e.g., seizures) to Goods belonging to Hofmann & Vratny.

3. If the Ordering Party violates the contract including, but not limited to, by failing to pay the purchase price when due, Hofmann & Vratny shall be entitled to rescind the contract pursuant to the applicable laws and to demand the surrender of the Goods due to the retention of title and the rescission.

4. Until further notice, the Ordering Party shall be entitled to resell/and or process in the ordinary course of business any Goods subject to retention of title. In this case, the provisions below also shall apply.

a) The retention of title shall include title to the full value of work products resulting from processing, mixing or combining the Goods, in which case Hofmann & Vratny shall be deemed to be the manufacturer. If and when third-party goods are processed, mixed or combined and such third parties retain ownership, Hofmann & Vratny shall acquire coownership pro rata of the invoiced value of work products so processed, mixed or combined. In all other cases, the creation of work products shall be subject to the same provisions as the delivered Goods subject to retention of title.

b) The Ordering Party hereby agrees to assign to Hofmann & Vratny as collateral any and all receivables against third parties resulting from the resale of the Goods or work results in full or in the amount of Hofmann & Vratny's estimated share of co-ownership pursuant to a) above, and Hofmann & Vratny hereby accepts such assignment. The Ordering Party's obligations under § 6 2) hereof also shall apply with respect to the receivables assigned.

c) In addition to Hofmann & Vratny, the Ordering Party shall remain authorized to collect receivables. Hofmann & Vratny undertakes to refrain from collecting receivables as long as the Ordering Party meets its payment obligations vis-à-vis Hofmann & Vratny and does not fail to perform and Hofmann & Vratny does not assert its retention of title by asserting a right under § 6 3) hereof. Otherwise, Hofmann & Vratny shall be entitled to demand that the Ordering Party inform Hofmann & Vratny of such receivables assigned and of the names of the debtors, provide Hofmann & Vratny with all the information required for collecting such receivables and the pertinent documents, and inform the debtors (third parties) of the assignment. In addition, in this case Hofmann & Vratny shall be entitled to revoke the Ordering Party's authorization to resell and/or process Goods which are subject to retention of title.

5. Upon request of the Ordering Party, Hofmann & Vratny shall release the collateral to which Hofmann & Vratny is entitled insofar as the realizable value of such collateral exceeds the receivables to be collateralized by more than 10 percent. Hofmann & Vratny shall be free in its decision regarding which collateral to release.

## § 7 LIABILITY FOR DEFECTS AND CLAIMS FOR DEFECTS

1. Unless otherwise agreed upon herein, the Ordering Party's rights based on defects in quality and/or in title (including delivery of the wrong Goods or insufficient amounts, improper assembly/installation, or incomplete instructions) shall be subject to the applicable laws. The special legal stipulations regarding reimbursement of expenses at the time of delivery of newly produced Goods (supplier's recourse as specified in §§ 478, 445a, 445b and §§ 445c, 327 para. 5, 327u of the BGB) shall remain unaffected in any case, unless equal-value compensation has been agreed upon, for example, as part of a quality assurance agreement.





2. Hofmann & Vratny's liability for defects shall be based first and foremost on the respective agreement entered into regarding the quality and the postulated use of the Goods (including fittings and instructions). In this context, an agreement regarding the quality of Goods shall be any and all product descriptions and manufacturer-provided information outlined in the individual agreement or made publicly known by Hofmann & Vratny (including, but not limited to, in catalogs or on Hofmann & Vratny's internet homepage) at the time the contract was signed. However, if and when no agreement regarding quality has been entered into, the presence or absence of a defect shall be determined based on the legal regulations (§ 434 para. 3 of the BGB). Statements made publicly by the manufacturer or on the manufacturer's behalf including, but not limited to, in advertising materials or on labels on the Goods shall prevail over other third parties' statements. In the case of Goods comprising digital elements or other digital content, Hofmann & Vratny shall be responsible for providing and, if required, updating the digital content only if defined expressly in an agreement regarding the quality of Goods, as stipulated above. Hofmann & Vratny shall not assume any liability for public statements made by the manufacturer or other third parties.

3. Hofmann & Vratny shall not assume liability for any defects of which the Ordering Party is aware, or for any defects of which the Ordering Party is grossly negligent if it is not aware (§ 442 of the BGB) at time the contract is signed. The assertion of claims by the Ordering Party regarding defects shall be conditional upon the Ordering Party's meeting of its statutory duty to inspect and to give notice of defects (§§ 377 and 381 of the HGB (Commercial Code of Germany)). If a defect in the Goods becomes apparent during or after inspection, the Ordering Party shall give written notice to Hofmann & Vratny without undue delay. Regardless of the Ordering Party's duty to inspect and to give notice of defects, the Ordering Party shall give written notice of obvious defects within two weeks after delivery, which notice shall be deemed to have been given in a timely manner if it is transmitted before the end of such period. If the Ordering Party fails to inspect the Goods properly and/or to give proper notice of any defects, Hofmann & Vratny shall not assume liability for any defects for which no notice was given.

4. If any of the Goods are defective, Hofmann & Vratny shall be free to offer supplementary action to remedy the defect or defects (supplementary remedy) or to deliver defect-free Goods (replacement) to the Ordering Party. In individual cases, the Ordering Party may refuse a supplementary action selected by Hofmann & Vratny that the Ordering Party considers to be unreasonable. It is Hofmann & Vratny's right to refuse to offer supplementary action under the applicable laws shall remain unaffected. The requirement for Hofmann & Vratny to provide any supplementary action owed shall be conditional upon the Ordering Party's paying of the purchase price when due. However, the Ordering Party shall be entitled to retain a reasonable portion of the purchase price pro rata in consideration of the defect. The Ordering Party shall give Hofmann & Vratny the time and the opportunity to provide the supplementary action owed including, but not limited to, providing Hofmann & Vratny the opportunity to inspect the Goods which are subject to complaint. If Hofmann & Vratny opts to replace the Goods, at Hofmann & Vratny's request the Ordering Party shall return the defective Goods to Hofmann & Vratny in accordance with the applicable laws; however, the Ordering Party shall not have the right to request to return the defective Goods. Supplementary action shall not include the disassembly, removal, or de-installation of defective Goods nor the assembly, mounting, or installation of defect-free Goods, provided Hofmann & Vratny was not originally obligated to provide such services; any rights the Ordering Party may have to be reimbursed for such costs (hereinafter referred to as "Disassembly and Assembly Costs") shall remain unaffected.

5. If in fact a defect is present, any and all expenses incurred in connection with inspections and supplementary action including, but not limited to, transportation, road, labor and material costs, and Disassembly and Assembly Costs shall be borne by Hofmann & Vratny in accordance with the laws and these General Terms of Sale. However, if the Ordering Party's demand for remedy of a defect is proven to be invalid because the Ordering Party was aware or was grossly negligent if it was not aware that no defect actually was present, Hofmann & Vratny can demand reimbursement from the Ordering Party for any costs incurred therewith. If the costs of supplementary remedy would be disproportionately high, the Ordering Party shall not be entitled to claim remedy of defects.

6. If and when a reasonable deadline for supplementary action set by the buyer has expired unsuccessfully or can be disregarded under the law, the Ordering Party can rescind the purchasing contract in accordance with the law or reduce the purchase price. However, no right to rescind shall apply in the case of insignificant defects.

7. The Ordering Party's claims for damages or reimbursement for wasted expenses shall be limited by the provisions of § 8 below and shall be excluded in all other cases.

8. The statute of limitations for claims for defects in quality and in title shall be one year after delivery of the Goods. The statute of limitations shall commence upon delivery of the Goods provided acceptance has been agreed upon. Other special legal stipulations regarding statutes of limitations (including, but not limited to, § 438 para. 1 no. 1, no. 2, para. 3, §§ 444, 445b of the BGB) shall remain unaffected. The aforementioned statutes of limitations specified in the purchasing laws also shall apply to any contractual and extra-contractual claims for reimbursement made by the Ordering Party based on a defect in the Goods, unless applying the regular statute of limitations stipulated by law (§§ 195, 199 of the BGB) would result in a reduced statute of limitations in individual cases. Any claims for reimbursement the Ordering Party may have pursuant to § 8 para. 2 p. 1 and p. 2 (a) and pursuant to the Produkthaftungsgesetz (Product Liability Act of Germany) shall be subject exclusively to the statutes of limitations stipulated by law.

## § 8 OTHER LIABILITIES

1. Unless agreed upon otherwise in these General Terms of Sale and in the provisions below, Hofmann & Vratny's liability for breach of contractual and non-contractual obligations shall be in accordance with the applicable laws.

2. Hofmann & Vratny's liability for damages, regardless of the legal reasons and of whether or not they are known, as part of Verschuldenshaftung (liability arising from damage caused by negligent act) shall include intent and gross negligence. Subject to the limitations of liability stipulated by law (e.g., diligence with its own affairs, insignificant breach of duty), in the event of minor negligence Hofmann & Vratny's liability shall be limited to (a) damages resulting from harm to life, body or health and/or (b) damages resulting from the not-insignificant breach of a material contractual obligation, that is, an obligation which must be met to make the proper fulfillment of the contract possible and the meeting of which the Ordering Party relies upon and can rely upon on a regular basis. In this case, however, Hofmann & Vratny's liability shall be limited to reimbursement of the foreseeable damages typical in such cases.

3. The limitation of liability specified above also shall apply vis-à-vis third parties and in the event of a breach of duty by any person (including to his/her own benefit) for which Hofmann & Vratny is responsible by law; however, it shall not apply if and when Hofmann & Vratny is found to have failed to disclose a defect maliciously or has assumed a guarantee for the quality of the Goods and for the Ordering Party's claims under the Produkthaftungsgesetz.

4. The Ordering Party can rescind or cancel a contract due to a breach of obligation other than a breach based on a defect only if and when Hofmann & Vratny is responsible for such breach of obligation. The Ordering Party shall not have an unrestricted right to terminate a contract. All other cases shall be subject to the applicable laws and legal consequences.

## § 9 APPLICABLE LAW AND JURISDICTION

1. These General Terms of Sale and all legal relationships between Hofmann & Vratny and the Ordering Party shall be subject to the laws of the Federal Republic of Germany under exclusion of the provisions of uniform international law. The CISG shall not apply.

2. Any and all disputes arising directly or indirectly from the contractual relationship shall be subject exclusively, including at an international level, to the jurisdiction of Aßling if the Ordering Party is a businessperson as defined in the Handelsgesetzbuch (Commercial Code of Germany), a legal entity under public law, or a special fund under public law. The same shall apply if the Ordering Party is an entrepreneur pursuant to §§ 14 of the BGB. However, in any case Hofmann & Vratny shall be entitled to sue the Ordering Party at the place of performance of the obligation to deliver under these General Terms of Sale and/or under a prevailing individual agreement or at the Ordering Party's general jurisdiction. Prevailing legal regulations including, but not limited to, regarding exclusive jurisdictions, shall remain unaffected.

Hofmann & Vratny OHG
June 2022

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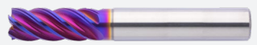

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