passion
for precision

fraisa

High-performance milling cutter ZX

NEW

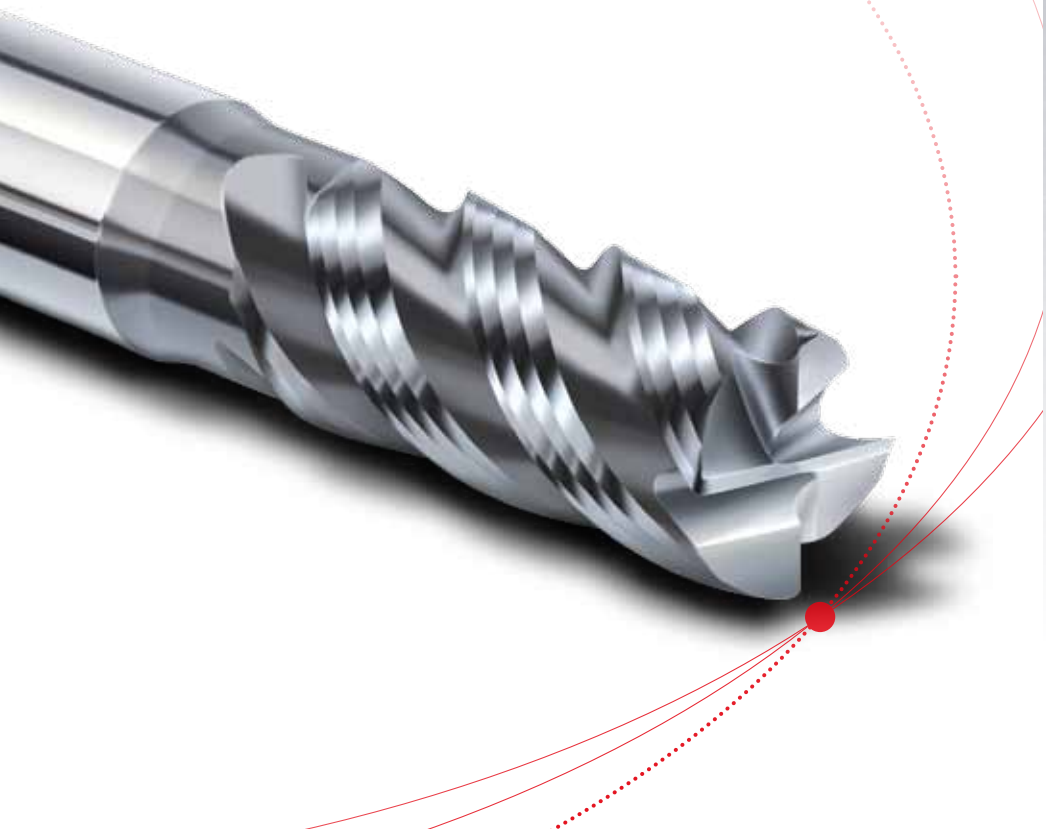
High-performance milling
in difficult-to-cut materials
with the new ZX tools

The new milling tools **ZX** made of solid carbide were developed specifically for the efficient machining of difficult-to-cut materials.

Thanks to the innovative **ZX** overall concept, outstanding results with regards to productivity, quality and process safety can be achieved.

FRAISA thereby creates a new performance benchmark for the machining of difficult-to-cut materials. Cost reduction is guaranteed with **ZX**.

The range consisting of **ZX-NV**, **ZX-RNV** (corner radius) and **ZX-NV5** with five cutting edges, offers the potential for optimising all work processes.



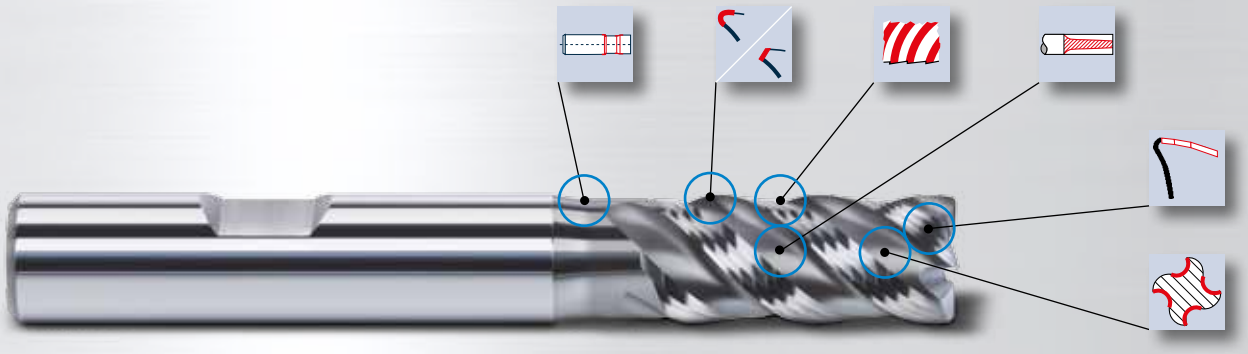
The advantages:

- **Highest degree of productivity:** through maximum metal removal
- **Higher process safety:** thanks to less vibrations and a smooth operation
- **Improved component quality:** through better tool rigidity and process-safe operation
- **Longer service life:** thanks to more wear resistance and repeatable operating time
- **Higher degree of optimisation:** reduced control intervals and very stable operating behaviour
- **Less energy consumption:** through smooth cutting and reduced friction
- **Extensive range:** for a wide component and application spectrum

Innovation and technology in the X-Generation class

Geometry, carbide and coating – all elements of the **ZX** concept are matched for the highest performance!

FRAISA has a **patent pending** for the **ZX** milling concept.



Smooth transitions
- The shaft-neck-cutting edge transitions are made with smooth gradients and radii
- Improved tool rigidity and therefore less lateral deflection
- Minimal step formation with several infeed depths
- Higher mechanical load and therefore improved performance

Increased core diameter
- Improvement of the tool rigidity and therefore less tool deflection
- Higher performance in the infeed area ap, ae and the feed rate fz
- Better component precision through less tool deflection

Edge conditioning and protective chamfer
- More cutting edge stability due to rounded and strengthened main cutting edge
- Increased mechanical and thermal load capacity on the cutting edge
- More performance through the increase of tooth feed
- More service life and process safety – thus higher degree of optimisation

Special open space design
- Significant reinforcement of the cutting wedge
- Higher performance, less vibrations and improved component quality
- More service life and process safety – thus higher degree of optimisation

Uneven and variable helix angle
- Axial as well as radial vibration damping and also smooth and calm cutting
- Better component surfaces and less noise emission
- Lower spindle load and energy consumption, despite high metal removal volume

Optimised flute geometry
- Tuned to the swarf formation process of difficult-to-cut materials
- Better component surface due to less friction and therefore less heat generation
- More process safety at high metal removal volumes

High-performance coating POLYCHROM
- Large application range on different materials with dry and wet machining
- High thermal and mechanical resistance – thus high process safety
- Outstanding coating adhesion – thus longer service life and performance

Carbide HM X10
- Outstanding combination of hardness and toughness – thus highest performance
- Fine grain carbide with particularly homogenous structure – thus more performance and safety

The new ZX range
Facts that speak for themselves

Scope of application "Difficult-to-cut materials"

Difficult-to-cut materials have special chemical, mechanical and thermal properties, which differ from normal and stainless steel as well as from titanium alloys. Often distinguishable due to a high fracture toughness, hot hardness and abrasiveness, they are the ultimate chipping challenge in mechanical machining.

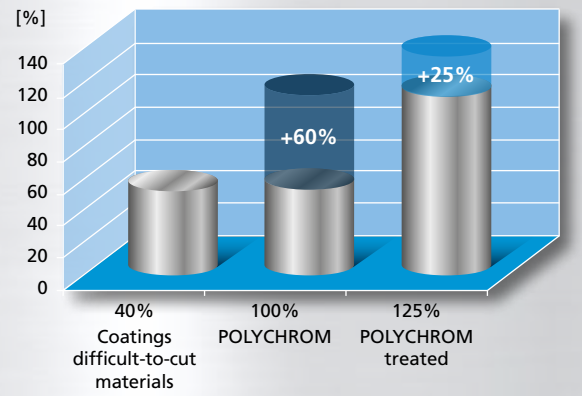
The "Classics" include Inconel, Nimonic, Rene, Hardox, manganese steel, submarine steel, Nimocast, Udimet, and also annealed high-speed steel. Here, for example, the aged state of Inconel is a big influencing factor on the chipping ability. While an annealed state can be processed quite easily, current tool concepts reach their performance limits when facing aged types (Rm >1200N/mm²). Wear-resistant steel also really puts tools to the test. This is particularly due to the high fracture toughness (high strength at the same time as high fracture elongation).

Industries and applications with difficult-to-cut materials
Aerospace (gears and structural components)
Energy industry (generators, turbines, heat exchangers, fuel cells)
Environmental protection and waste industry (flue gas desulphurisation plants)
Chemical industry (cauldrons, heat exchangers, pumps and valves)
Medical engineering (screens)
Petrochemistry
Tool and mould construction (HSS tools or wear components)
Wear parts (crushers, vehicle loading surfaces, excavators, knives)

FRAISA POLYCHROM – The best performing coating for difficult-to-cut materials

The high-performance coating POLYCHROM has been verified as the best performing and most universal coating for difficult-to-cut materials. Special processing improves the coating adhesion and increases productivity by a further 25% – both for dry and wet machining!

Productivity

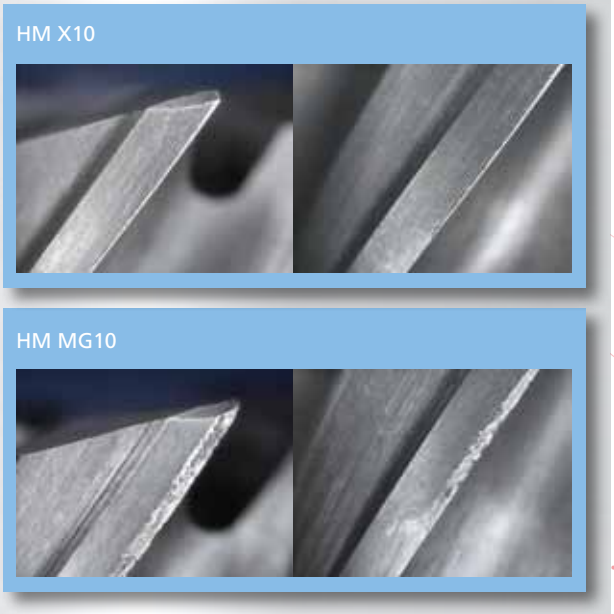


Carbide HM X10 for high wear resistance

The carbide quality as basis for a high-performance tool is crucial.

With the carbide HM X10, FRAISA has created a new carbide group with 10 % cobalt for the **ZX** end mills. This fine grain carbide is characterised by a particularly high toughness, wear resistance and homogeneity. The wear patterns show the HM X10 substrate, in comparison to a MG10 substrate.

Substrate comparison (after 17 minutes operating time)



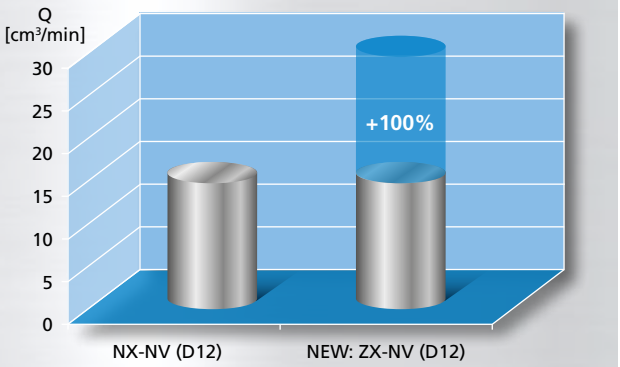
Inconel 718, aged, Rm = 1,400 N/mm2
v_c = 30 m/min; fz = 0.045 mm; ap = 10 mm; ae = 1.5 mm;
Emulsion 9% ; Q = 3.8 cm3/min

Highest productivity per workpiece

The high performance level of the **ZX** end mill results from a whole range of technological innovations. When machining difficult-to-cut materials the metal removal capacity Q is the main aspect.

As current tools can only achieve low volume rates, the machining time is accordingly long. In comparison, the new **ZX** end mill can achieve double the metal removal rate. The more difficult the machining of a material is, the more the performance of the **ZX** end mill comes into play.

Productivity increase



Process safety in a new dimension

The process safety decreases with difficult machining. Even small deviations from the known condition of material, environment or strategy may cause tool breakage.

The particularly robust and technologically optimised implementation of the **ZX** concept increases the process safety and repeatability.

Increasing the process safety by means of:
Robust tools with above-average reserve for process deviations
Linear wear increase even under unfavourable conditions
Cutting edge preparation and protective chamfer for cutting wedge reinforcement
Tough hard carbide substrate for highest breakage resistance
Universal and high-performance hard material coating POLYCHROM
Cutting corner reinforcement for cylindrical end mills through protection radius

Reduction of costs – increase of competitiveness

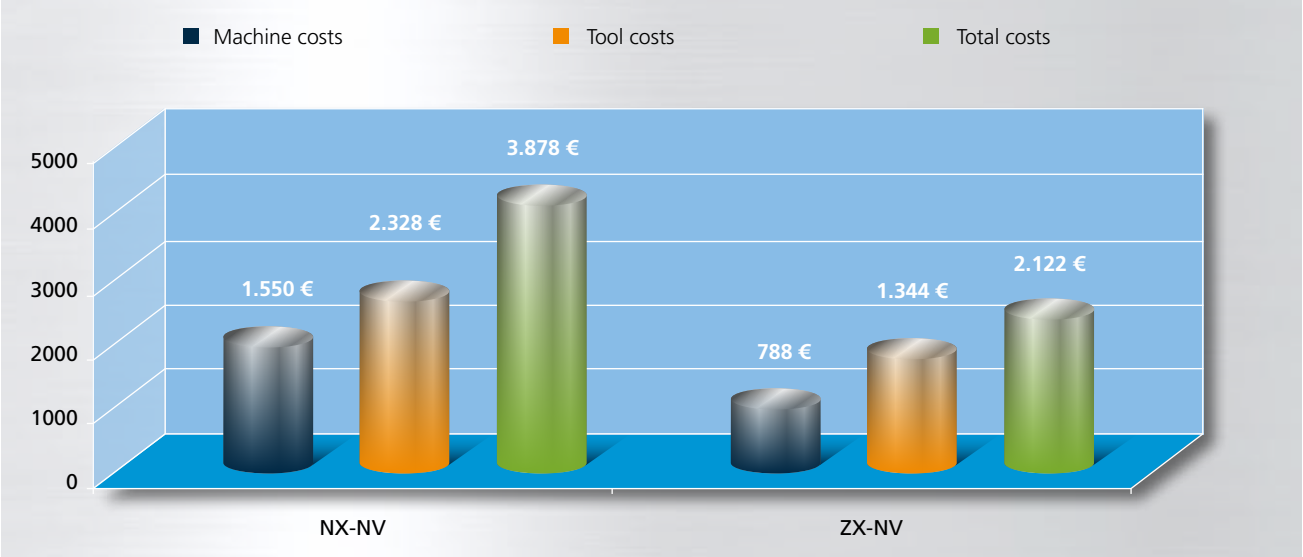
The **ZX** end mill is one of the most demanding tools in its manufacturing. Accordingly, it is important to assess the economic efficiency of the end mill concept. Does the procurement of the tool really pay off?

The practical example shows clearly: machine costs as well as tool costs can be almost halved through the use of the **ZX** end mill.

This is because using the **ZX** end mill can reduce both the number of required milling tools and therefore the tool costs, and also the machining time and consequently the machine costs. And at the same time safe working is also ensured.

Component made of Inconel 718, annealed, Rm = 800 N/mm²		
Tool type for Inconel 718	**NX-NV P5327**	**ZX-NV P8800**
Tool diameter	12 mm	12 mm
Production run	10 pcs	10 pcs
Volume / part to be removed	1.200 cm³	1.200 cm³
Total volume to be removed	12.000 cm³	12.000 cm³
Medium metal removal rate	12.9 cm³/min	25.7 cm³/min
Main machining time	930 min	467 min
Machine hourly rate	100 € / h	100 € / h
Machine costs	**1.550 €**	**778 €**
Service life of the end mill	40 min	40 min
Tool requirement	24 pcs	12 pcs
Costs per end mill	97 €	112 €
Tool costs	**2.328 €**	**1.344 €**
Total costs	**3.878 €**	**2.122 €**

Costs (comparison NX-NV and ZX-NV)



Extremely high tool rigidity

The technological features of the new **ZX** end mill also lead to an extremely high tool rigidity. This is required to support high mechanical loads when milling difficult-to-cut materials.

Combined with a very strong and yet smooth cutting wedge, the **ZX** is an innovation with regard to supporting the highest mechanical loads.

Advantages of high tool rigidity

Less tool deflection resulting in better component quality

Support of highest mechanical loads resulting in a higher metal removal rate

Less vibrations resulting in longer service life and less noise emission

Higher degree of efficiency

Due to the tool design in the area of the chip formation and chip removal, a smooth cut and chip flow is made possible. The tools run more smoothly and require less energy per removed volume.

ZX-NV5, number of teeth 5 for more feed rate per minute

If a small adjustment for the lateral infeeds is needed due to the component or for finishing, the use of the **ZX-NV5** is recommended. With the fifth cutting edge, the feed rate can be increased by 25 %. And there is no disadvantage with the component quality or contour accuracy.

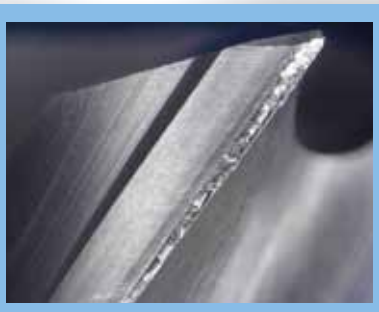
ZX-NV5

Service life or volume?

ZX end mills provide a better wear pattern at the same metal removal rate in comparison with other concepts (e.g. NX-NV). This leads to a longer operating time:

Identical metal removal rate:
Better wear pattern and longer operating time

Inconel 718, annealed, Rm = 800 N/mm²



NX-NV, Ø 10 mm
P5327.450
after 35 minutes operating time

v_c = 40 m/min
fz = 0.05 mm
ap = 10 mm
ae = 1.5 mm
Emulsion 9%
Q = 3.8 cm³/min

ZX-RNV, Ø 10 mm
P8820.448
after 35 minutes operating time. Can be used for longer.

v_c = 40 m/min
fz = 0.05 mm
ap = 10 mm
ae = 1.5 mm
Emulsion 9%
Q = 3.8 cm³/min

Or a higher metal removal rate with identical operating time:

Identical operating time with identical wear:
Higher metal removal rate

Inconel 718, aged, Rm = 1.400 N/mm²

NX-NV, Ø 10 mm
P5327.450
after 31 minutes
118 cm³ volume

v_c = 40 m/min
fz = 0.05 mm
ap = 10 mm
ae = 1.5 mm
Emulsion 9%
Q = 3.8 cm³/min

ZX-RNV, Ø 10 mm
P8820.448
after 31 minutes
428 cm³ volume

v_c = 40 m/min
fz = 0.05 mm
ap = 18 mm
ae = 3 mm
Emulsion 9%
Q = 13.8 cm³/min

Application technology – Information and influencing factors

For maximum economic efficiency, FRAISA recommends using the **ZX** end mill at the highest possible metal removal rate. The aim is to increase productivity and reduce the total machining costs.

If some additional information surrounding this are taken into account, the **ZX** concept can unleash its full potential.

Application technological information for high temperature or wear resistant alloys:

Concentricity and tool clamping

Ensure a good concentricity (approx. < 0.02 mm) and use good quality clamping devices.

Side lock holder (Weldon) with good concentricity is very suitable for heavy chipping.

▶ A good clamping quality improves the service life of the tool.

Cooling lubrication

The cooling lubrication is one of the most important factors.

The concentration of the emulsion should be 9-15% for good lubricating qualities.

Position the coolant flow directly onto the tool. There are also clamping devices with internal channels, that supply coolant to the cutting edge.

▶ A good alignment of the cooling lubricant and sufficient volume flow for the heat removal are important, in order to significantly increase the service life and process safety.

Stability/vibrations

It is often appropriate to use a relatively small tool diameter, in order to reduce the total load in the processing environment and benefit from the productivity of the ZX end mill.

In practice tool diameters too large are used in relation to the environment (machine/spindle/clamping).

▶ The smaller tool diameter allows the maximum performance of the tool to be achieved and the machine is under less load.

Tool radii

Corner radii smaller than 2 mm achieve more performance – especially with materials that have a high strain hardening (e.g. manganese steel)

The reason for this lies with the high mechanical deformation of the chip in the case of large corner radii.

Cutting data

The feed rate per tooth is the most influential parameter and must not be set too high. The cutting speed is also limited due to bad thermal conductivity of alloys.

Here, consult the catalogue or the ToolExpert for information when starting. If the lateral infeed (ae) is reduced, the cutting speed can be increased.

The axial infeed (ap) should be selected as high as possible, in order to benefit from the high rigidity of the ZX tool.

The lateral infeed (ae) can also be varied easily. However, the decision is dependent on the milling strategy.

Machining strategy

It is beneficial to spend more time on the programming in order to create as constant as possible the cutting conditions.

For this the feed rate should be reduced in the corners and the lateral infeed (ae) should be programmed as constant. If the lateral infeed (ae) is applied as constantly as possible, it can be set at a higher level. If quick changes in direction or large overlaps occur, ae must be reduced to prevent excessive load on the tool in adverse areas.

The ZX end mills were specifically developed for difficult-to-cut materials

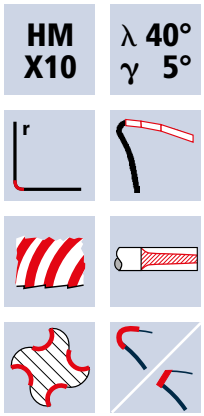
Exhaustive tests have also proven the functioning with stainless or hardened and tempered steels, however, not entirely.

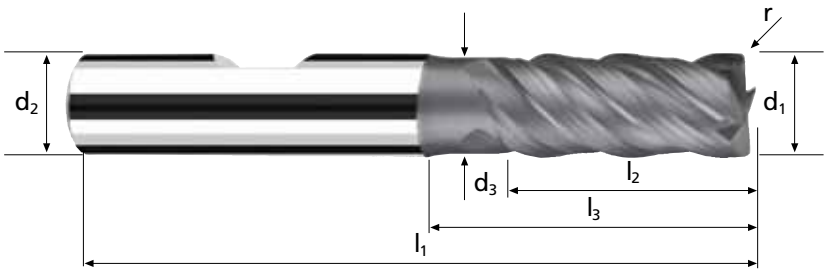
ZX works well in 1.4571, but only adequately in 1.4301. This is linked to the high fracture elongation and the low tensile strength of 1.4301.

▶ The **ZX** concept is therefore only partially suitable for very soft materials, which at the same time feature a high fracture elongation.

Cylindrical end mills ZX-NV

Smooth-edged, normal version with short neck





Roughing

Finishing

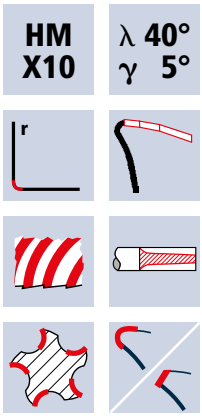
Inox Stainless | Ti Titanium | Nickel-Alloys Mangan-Steels HSS

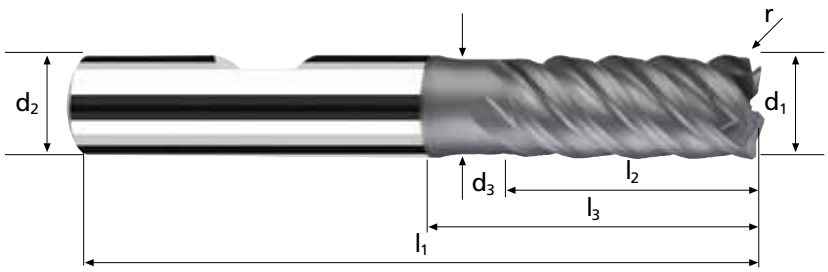
Example: **Order-N°.** Coating **P** | Article N° **8800** | Ø-Code **.180**

Ø Code	d_1 e8	d_2 h6	d_3	l_1	l_2	l_3	r	α	z		POLYCHROM
											P8800
											P8700
.180	3	6	2.8	57	8	14	0.10	4.5°	4		•
.220	4	6	3.7	57	11	16	0.10	3.0°	4		•
.260	5	6	4.6	57	13	18	0.15	1.5°	4		•
.300	6	6	5.5	57	13	20	0.15	0.0°	4		•
.391	8	8	7.4	63	19	26	0.15	0.0°	4		•
.450	10	10	9.2	72	22	31	0.20	0.0°	4		•
.501	12	12	11.0	83	26	37	0.20	0.0°	4		•
.610	16	16	15.0	92	32	43	0.30	0.0°	4		•
.682	20	20	19.0	104	38	53	0.30	0.0°	4		•

Cylindrical end mills ZX-NV

Smooth-edged, normal version with short neck





Roughing

Finishing

Inox Stainless | Ti Titanium | Nickel-Alloys Mangan-Steels HSS

Example: **Order-N°.** Coating **P** | Article N° **8805** | Ø-Code **.300**

Ø Code	d_1 e8	d_2 h6	d_3	l_1	l_2	l_3	r	Z		POLYCHROM
										P8805
										P8705
.300	6	6	5.5	57	13	20	0.15	5		•
.391	8	8	7.4	63	19	26	0.15	5		•
.450	10	10	9.2	72	22	31	0.20	5		•
.501	12	12	11.0	83	26	37	0.20	5		•
.610	16	16	15.0	92	32	43	0.30	5		•
.682	20	20	19.0	104	38	53	0.30	5		•

Where is it possible to ask questions concerning the product?

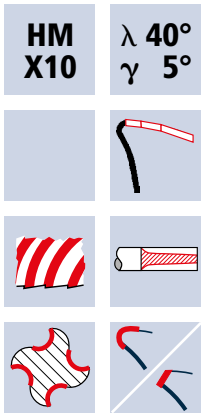
If you have any question, please send an email to **mail.ch@fraisa.com**. You may also directly contact our local customer consultant.

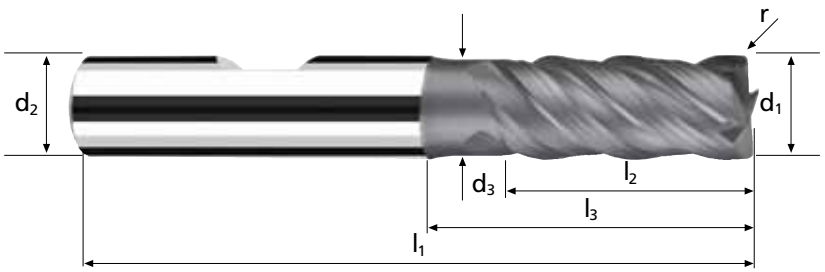
The FRAISA application engineers will be happy to advise you.

For further information, please refer to **www.fraisa.com**

Corner radius end mills ZX-RNV

Smooth-edged, normal version with short neck





Roughing

Finishing

Inox Stainless

Ti Titanium

Nickel-Alloys
Mangan-Steels
HSS

Example: **Order-N°.** Coating **P** Article N° **8820** Ø-Code **.299**

Ø Code	d_1 e8	d_2 h6	d_3	l_1	l_2	l_3	r 0/+0.03	α	z	POLYCHROM P8820	POLYCHROM P8720
.299	6	6	5.5	57	13	20	0.4	0.0°	4		•
.387	8	8	7.4	63	19	26	0.4	0.0°	4		•
.447	10	10	9.2	72	22	31	0.4	0.0°	4		•
.497	12	12	11.0	83	26	37	0.4	0.0°	4		•
.180	3	6	2.8	57	8	14	0.5	4.5°	4		•
.220	4	6	3.7	57	11	16	0.5	3.0°	4		•
.260	5	6	4.6	57	13	18	0.5	1.5°	4		•
.300	6	6	5.5	57	13	20	0.5	0.0°	4		•
.388	8	8	7.4	63	19	26	0.5	0.0°	4		•
.448	10	10	9.2	72	22	31	0.5	0.0°	4		•
.498	12	12	11.0	83	26	37	0.5	0.0°	4		•
.301	6	6	5.5	57	13	20	0.8	0.0°	4		•
.389	8	8	7.4	63	19	26	0.8	0.0°	4		•
.449	10	10	9.2	72	22	31	0.8	0.0°	4		•
.499	12	12	11.0	83	26	37	0.8	0.0°	4		•
.607	16	16	15.0	92	32	43	0.8	0.0°	4		•
.457	10	10	9.2	72	22	31.0	2.5	0.0°	4		•
.506	12	12	11.0	83	26	37.0	2.5	0.0°	4		•
.612	16	16	15.0	92	32	43.0	2.5	0.0°	4		•
.684	20	20	19.0	104	38	53.0	2.5	0.0°	4		•
.508	12	12	11.0	83	26	37.0	4.0	0.0°	4		•
.614	16	16	15.0	92	32	43.0	4.0	0.0°	4		•
.686	20	20	19.0	104	38	53.0	4.0	0.0°	4		•

Here, you will be provided with further information on the FRAISA Group.

The fastest way to our E-Shop can be found here.

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