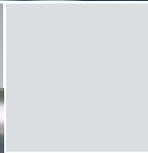
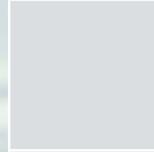




■ Made  
■ in  
■ Germany



## Aerospace

Taking Risk and Cost out of your Business  
Tooling Solutions from EMUGE-FRANKEN



### Engine Components and Accessories

- Blades / Blisks
- Disks / Shafts / Hubs
- Casings

### Landing Gear Components

- Main landing gear beam
- Landing gear components

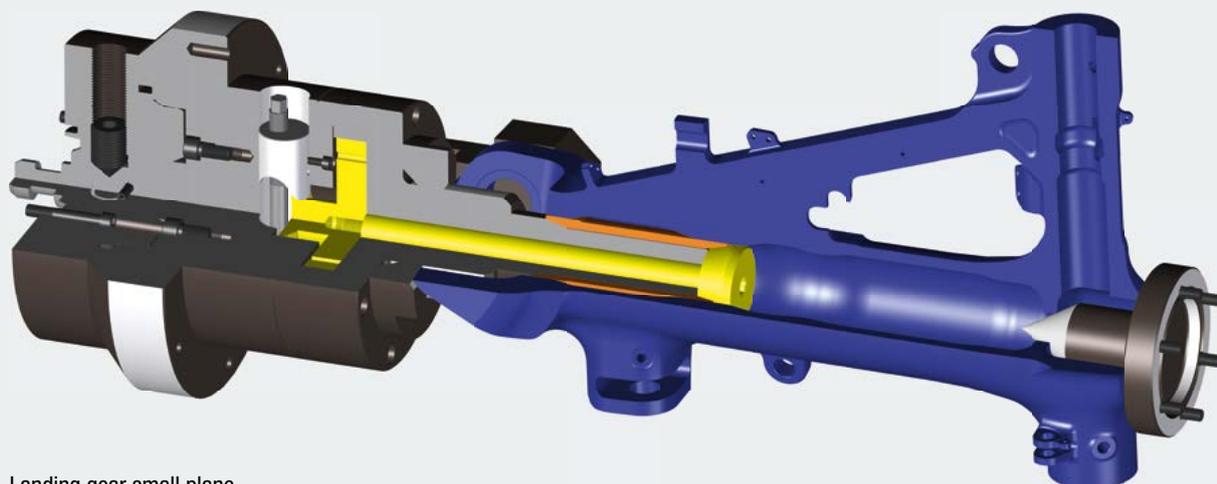
### Structural Components

- Spars / Skins / Ribs / Frames
- Pylons
- Flap tracks
- Other components

From light weight structure composite materials to advanced super alloys, EMUGE-FRANKEN has the know-how, the engineers, the application expertise and last but not least the tools to reduce risks and costs in the manufacture of aerospace programmes.

We partner with our customers to develop machining strategies and to implement standard and customised solutions with minimum cost per part and high repeatability in mind.

	Material	Typical components	Clamping tools
<b>M</b>	Stainless steels and high alloy steels	<ul style="list-style-type: none"> <li>• Flap tracks</li> <li>• Main fittings</li> <li>• Slat tracks</li> <li>• Shafts</li> </ul>	<b>myTEC</b>  <b>EMUGE</b>
<b>N</b>	Aluminium	<ul style="list-style-type: none"> <li>• Wing ribs</li> <li>• Frame components</li> <li>• Interior components</li> </ul>	
<b>N</b>	Composite	<ul style="list-style-type: none"> <li>• Central wing boxes</li> <li>• Vertical tails</li> <li>• Wings</li> <li>• Interior components</li> </ul>	
<b>S</b>	Titanium	<ul style="list-style-type: none"> <li>• Engine mounts</li> <li>• Impellers</li> <li>• Landing gear beams</li> <li>• Main fittings</li> <li>• Pylon brackets</li> <li>• Thrust fittings</li> <li>• Blisks</li> <li>• Fan casings</li> <li>• Fan disks</li> </ul>	<b>myTEC</b>  <b>EMUGE</b>
	Heat resistant super alloys	<ul style="list-style-type: none"> <li>• Shafts</li> <li>• Spools</li> <li>• Combustion casings</li> <li>• Turbine disks</li> </ul>	<b>myTEC</b>  <b>EMUGE</b>



Landing gear small plane

End mills	Taps	Thread milling cutters	Twist drills	PCD tools
<b>FRANKEN</b> <i>TiNox-Cut</i> <b>FRANKEN</b> <i>Turbine</i> <b>FRANKEN</b> <i>Expert</i>	<b>EMUGE</b> <b>—VA—</b>	<b>EMUGE</b> <ul style="list-style-type: none"> <li>• GSF-Z</li> <li>• GF-Vario-Z</li> <li>• ZGF</li> <li>• ZGF-S-Cut</li> </ul>	<b>EMUGE</b> <ul style="list-style-type: none"> <li>• EF-Drill-VA</li> <li>• EF-Drill-NI</li> <li>• Special solutions</li> </ul>	
<b>FRANKEN</b> <i>TiNox-Cut</i> <b>FRANKEN</b> <i>Turbine</i> <b>FRANKEN</b> <i>Expert</i>	<b>EMUGE</b> <b>—AL—</b>	<b>EMUGE</b> <ul style="list-style-type: none"> <li>• GSF-Z</li> <li>• GF-Vario-Z</li> <li>• ZGF</li> <li>• ZGF-S-Cut</li> </ul>	<b>EMUGE</b> <ul style="list-style-type: none"> <li>• EF-Drill-AL</li> </ul>	<b>NAWA</b> <i>blueCUT</i>
<b>FRANKEN</b> <i>Fiber-Cut</i>	Custom solutions	Custom solutions	<b>FRANKEN</b> <i>Fiber-Cut</i>	<b>NAWA</b> <i>blueCUT</i>
<b>FRANKEN</b> <i>TiNox-Cut</i> <b>FRANKEN</b> <i>Turbine</i> <b>FRANKEN</b> <i>Expert</i>	<b>EMUGE</b> <b>—TI—</b>  <b>EMUGE</b> <b>—TILEG—</b>	<b>EMUGE</b> <ul style="list-style-type: none"> <li>• GSF-Z</li> <li>• GF-Vario-Z</li> <li>• ZGF</li> <li>• ZGF-S-Cut</li> </ul>	<b>EMUGE</b> <ul style="list-style-type: none"> <li>• EF-Drill-VA</li> <li>• EF-Drill-NI</li> <li>• Special solutions</li> </ul>	
<b>FRANKEN</b> <i>TiNox-Cut</i> <b>FRANKEN</b> <i>Turbine</i> <b>FRANKEN</b> <i>Expert</i>	<b>EMUGE</b> <b>—NI—</b>	<b>EMUGE</b> <ul style="list-style-type: none"> <li>• GSF-Z</li> <li>• GF-Vario-Z</li> <li>• ZGF</li> <li>• ZGF-S-Cut</li> </ul>	<b>EMUGE</b> <ul style="list-style-type: none"> <li>• EF-Drill-VA</li> <li>• EF-Drill-NI</li> <li>• Special solutions</li> </ul>	

Product lines that drive your productivity



**FRANKEN**  
*TiNox-Cut*

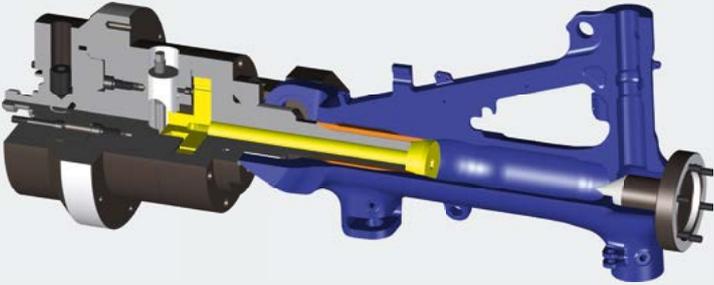
**EMUGE**  
**—TI—**

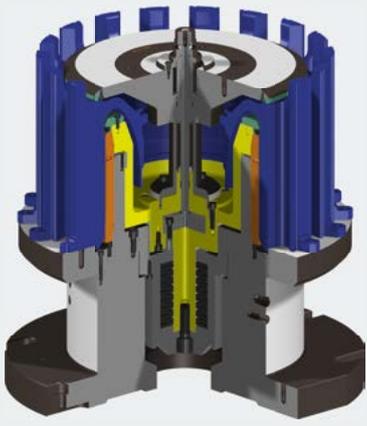
**EMUGE**  
**—TILEG—**

**EMUGE**  
 GSF-Z

**EMUGE**  
 EF-Drill-VA

**NAWA**  
*blueCUT*

<b>Workpiece</b>	Landing gear small plane		
<b>Machining operations</b>	<ul style="list-style-type: none"> <li>• Turning</li> <li>• Drilling</li> <li>• Milling 80%</li> </ul>		
<b>Considerations</b>	<ul style="list-style-type: none"> <li>• Size of clamping tool</li> <li>• Mechanical clamping</li> <li>• Complex and asymmetrical component</li> </ul>		
<b>Solution</b>	<b>Clamping System SZ</b>	<p><b>Features:</b></p> <ul style="list-style-type: none"> <li>• Outer dimensions: Dia. 490 mm, length 980 mm</li> <li>• Clamping force: 10 t</li> <li>• Transmittable torque: 3400 Nm</li> <li>• Clamping diameter: 1118 mm and 119 mm</li> <li>• Weight: 600 kg</li> </ul>	

<b>Workpiece</b>	Turbine hub		
<b>Machining operations</b>	<ul style="list-style-type: none"> <li>• Milling</li> </ul>		
<b>Considerations</b>	<ul style="list-style-type: none"> <li>• Spring tension</li> <li>• Additional face clamping</li> </ul>		
<b>Solution</b>	<b>Clamping System SZ</b>	<p><b>Features:</b></p> <ul style="list-style-type: none"> <li>• Outer dimensions: Dia. 580 mm, length 580 mm</li> <li>• Clamping force: 2.25 t</li> <li>• Transmittable torque: 1200 Nm</li> <li>• Clamping diameter: 337.5 mm</li> <li>• Weight: 400 kg</li> </ul>	



**Whatever thread milling solution you are looking for, we have it!**

Huge portfolio of standard tooling

- All thread systems
- Huge variety of construction sizes
- Applicable in all materials

### **GF-Vario-Z**



**Solid carbide thread milling cutters, variable**

- With corrected thread profile  
(for different thread sizes, but for one pitch only)
- Increased number of flutes
- Optimised cutting geometry

### **ZGF-S-CUT**



**Solid carbide circular thread milling cutters**

- With corrected thread profile  
(for one single thread size only)

### **GSF-Z**



**Solid carbide thread milling cutters  
with countersinking step**

- For the machining of countersunk edge and thread in one work process
- With corrected thread profile  
(for one single thread size only)
- Increased number of flutes
- Optimised cutting geometry



**The best tap only works properly, when using it with the right holder.**

EMUGE-FRANKEN is a globally leading supplier of high precision, high performance taps with nearly 100 years of knowledge in designing, manufacturing and applying the tools.

- Huge standard portfolio for all thread systems
- Wide range of product lines for all kind of materials
- Innovative and optimised geometries for various applications
- Advanced in-house coating technology
- Design and manufacturing of corresponding holders

EMUGE-FRANKEN develops and manufactures holders for any kind of application. We truly understand the needs of the tap and have designed outstanding, tool life extending tool holding systems such as the Softsynchro® mechanism.

Softsynchro® holders are designed for application on machines with synchronous spindle. The threading tool is pitch-controlled by the synchronous spindle; eventually arising axial forces caused by synchronisation faults are minimised by a patent-protected minimum length compensation on tension and on compression.

- Reduces axial forces
- Extending tool life
- For wet, dry and MQL machining



Product lines for all common aerospace materials – overview of our standard geometries with brief description

<b>M</b>	<b>EMUGE</b> —VA—	<p><b>For stainless steel materials and steel materials</b></p> <p>With tough and long-chipping materials, the chips must be transported in an axial direction in order to avoid chip jams. An increased profile relief angle reduces friction and with it, the danger of cold welding.</p>
<b>N</b>	<b>EMUGE</b> —AL—	<p><b>For aluminium wrought alloys</b></p> <p>In the machining of long-chipping aluminium, it is absolutely necessary to provide chip transport in an axial direction. In addition to the large rake angle, these tools are made with a reduced number of flutes so that there is even more room for the swarf. This helps to avoid clogging of the flutes.</p>
<b>S</b>	<b>EMUGE</b> —TI—	<p><b>For titanium</b></p> <p>These alloys are usually very strong, long-chipping and clamping. Small rake angles and very high relief angles are necessary. Often, it is necessary also to specially adjust the tool to the individual alloy and the specific work conditions.</p>
	<b>EMUGE</b> —TILEG—	<p><b>For titanium alloys</b></p> <p>Titanium alloys are becoming more and more popular in modern industry. The geometry of this tool has been specially adjusted to the machining of these materials. Cold welding is prevented by the extra high relief angle values. A helix correction provides short chips.</p>
	<b>EMUGE</b> —NI—	<p><b>For nickel alloys</b></p> <p>Nickel alloys are usually very tough, clamping and of high tensile strength, e.g. Inconel 718. Negative rake angles, very high relief angles and a hard surface coating are an unconditional necessity. Lubrication with paste or oil is necessary in most cases.</p>



**We provide reliability**

Besides taps and holders, we also manufacture corresponding gauges. Our cooperation partner DECOM UGK located on the EMUGE premises is available for the calibration of your gauging and measuring equipment.

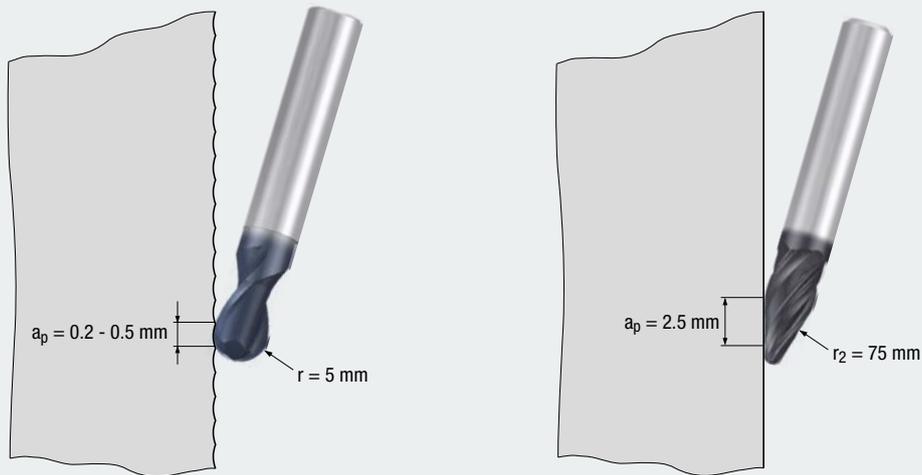
DECOM UGK is a DAkkS-accredited test laboratory for length and other geometrical measuring parameters.

**Machining time reduction in finishing by up to 90% with circle segment end mills.**

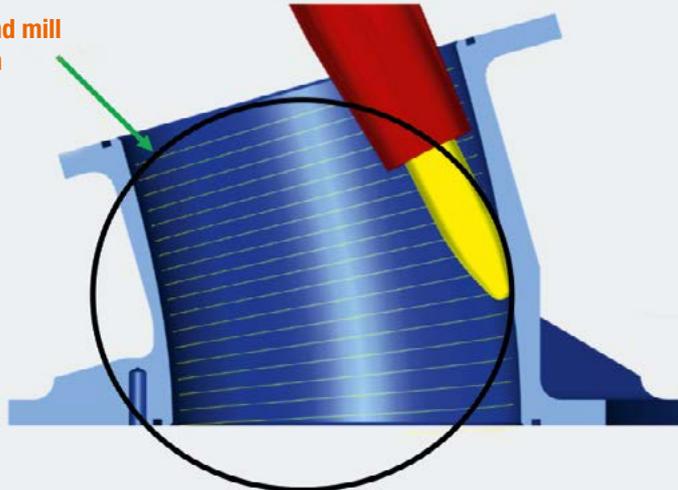
Circle segment end mills can work with considerably larger axial feeds compared to traditional ball-nose cutters. Due to the large radius on the circumferential cutting edge of the barrel cutter, it theoretically equals a ball-nose cutter with a diameter of 150-500 mm or even larger.

Because of the larger radius, the machining times can be strongly reduced due to the higher axial feeds. In cases in which a ball-nose cutter uses an

axial feed of 0.2 to 0.5 mm during the finishing process, the barrel cutter provides five-times these axial feeds while still achieving the desired surface quality. In theory you use a carbide ball-nose cutter with a diameter of 150 mm.



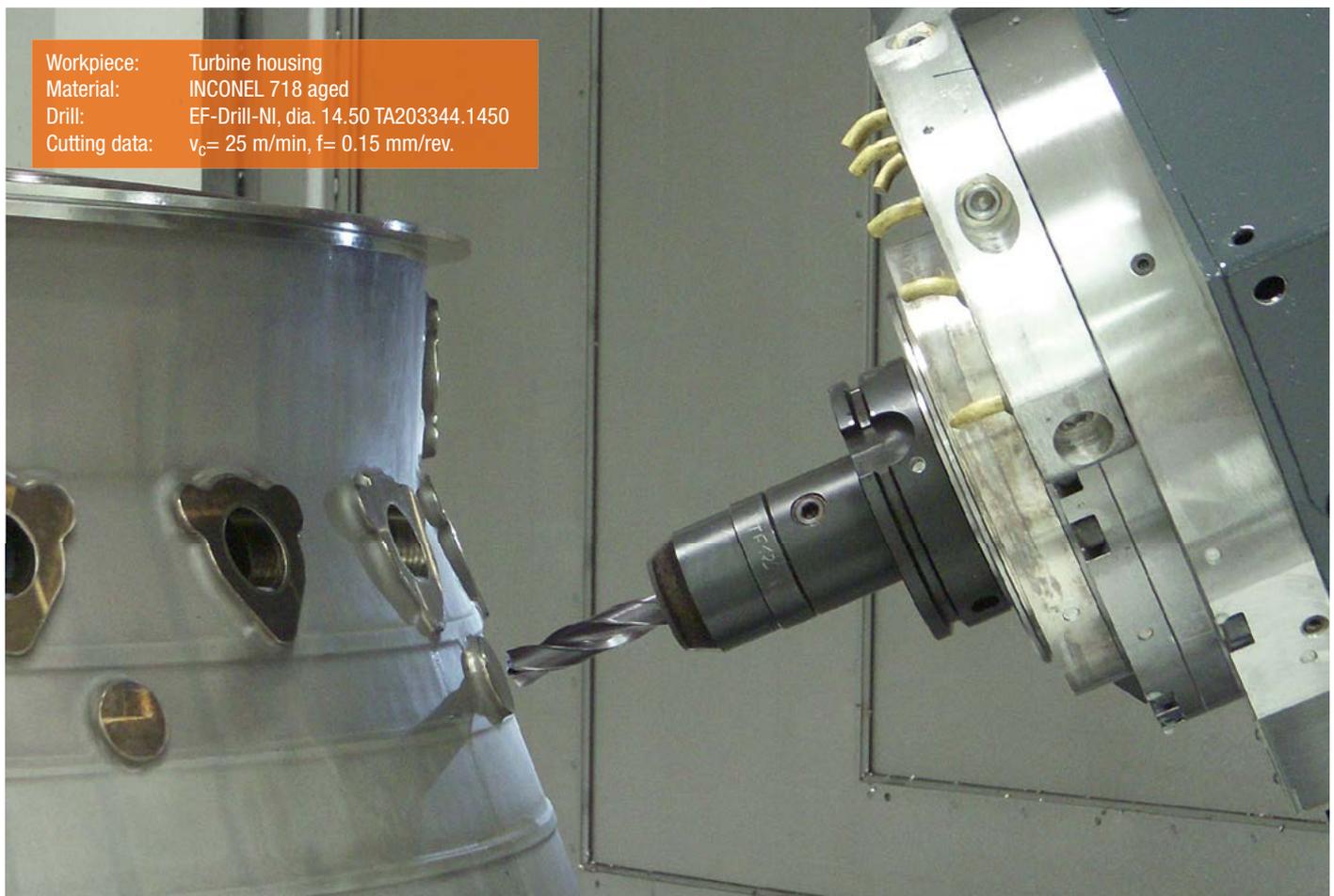
**Ball nose end mill  
dia. 150 mm**



**Standard Milling programme for difficult to cut materials (Titanium, Nickel-base alloys)**

M		<p>The TiNox-Cut series was especially developed for machining titanium alloys, nickel-base alloys and stainless steel materials.</p> <p>This product range consists of both solid carbide and HSS-PM end mills. Long finisher with a flute length/ diameter ratio of max. 5:1 are available for finishing of these difficult to cut materials.</p>	<p><b>Characteristics:</b></p> <ul style="list-style-type: none"> <li>• Variable spacing</li> <li>• Highly heat-resistant coating</li> <li>• Roughing and semi-finishing profiles are available</li> <li>• Optionally available with internal coolant supply, axial exit (ICA) or radial and axial exit (ICRA)</li> </ul>
S			
N		<p>The Alu-Cut series includes tools made from solid carbide and HSS particularly developed for the process-reliable volume machining of wrought aluminium alloys with up to 5% silicon content. Materials with higher silicon content should preferably be machined with coated tools.</p>	<p><b>Characteristics:</b></p> <ul style="list-style-type: none"> <li>• Variable spacing</li> <li>• Available with WR profile for roughing</li> <li>• Special geometry for machining aluminium</li> <li>• Optionally available with internal coolant supply, radial and axial exit (ICRA)</li> </ul>
N		<p>Under the product line Fiber-Cut we summarise all carbide tools for milling of fiber-reinforced plastics. These plastics are reinforced with carbon-, glass- and aramid fibers (CFRP / GFRK / AFRP) in different percentages. These very special materials require a specific end mill family.</p> <p>With newly developed end mill geometries and coatings, Fiber-Cut is a very economical solution. For the highest demands on wear resistance of the tools also diamond coated end mills are available.</p>	<p><b>Characteristics:</b></p> <ul style="list-style-type: none"> <li>• Various types of roughing profiles</li> <li>• Right-hand or left-hand spiral</li> <li>• With and without drill point</li> <li>• Optionally available with internal coolant supply, radial and axial exit (ICRA)</li> </ul>
		<p>Turbine tools with specially tailored geometry were developed for the requirements of materials and component designs in the aircraft and turbine industry.</p>	<p><b>Characteristics:</b></p> <ul style="list-style-type: none"> <li>• Stable design due to taper design</li> <li>• Newly developed geometry for machining aluminium</li> <li>• Highly heat-resistant coating</li> <li>• Roughing and semi-finishing profiles available</li> </ul>

M	<p><b>EMUGE</b> EF-Drill-VA</p>	<p>Specially designed for machining austenitic, stainless steels. These twist drills are available in the designs according DIN 6537 short (3 x D) and long (5 x D) from stock.</p>	<p>They are also suitable for use in special materials like titanium alloys, nickel alloys, cobalt alloys and iron alloys.</p>
N	<p><b>FRANKEN</b> <i>Fiber-Cut</i></p>	<p>Fiber-Cut Drill is specially designed for drilling CFK.</p>	<p>Multiple layered or structural layered carbon fibres will be cut without delaminating the layers. The diamond coating slows down tool wear, increases the tool life and therefore cuts down tool cost per hole.</p>
N	<p><b>EMUGE</b> EF-Drill-AL EF-Drill-GAL</p>	<p>There are two different versions available for aluminium.</p>	<p>EF-Drill-AL is designed for soft aluminium. This design avoids aluminium buildup at the point thinning. EF-Drill-GAL is designed for harder aluminium with higher silicon percentage. Here the geometry and coating is adjusted for bigger wear resistance.</p>
S	<p><b>EMUGE</b> EF-Drill-NI</p>	<p>Specially designed for machining high temperature alloys.</p>	<p>The geometry is designed to minimise accordion chips and dissipate heat created during the cutting process very quickly from the cutting zone and bore hole.</p>





Company NAWA GmbH is the PCD milling expert within the EMUGE-FRANKEN group.

Besides a standard tool portfolio, NAWA is specialised in designing and manufacturing of custom solutions.

Thanks to a diverse machine tool outfit, NAWA is able to produce unique tooling in outstanding quality in a short period of time.

## blueCUT

The NAWA *blueCUT* end mill is a proven milling solution for machining of composite materials and aluminium:

- Durable PCD grade for long tool life
- Precise run out, to keep tight work piece tolerances
- Excellent edge preparation for a clean cut without fraying
- Standard portfolio with all common sized in stock and ready to ship
- Quick turn custom solutions programme, for fast shipment of our custom designed tool



Member of





Our application engineering specialists are at your disposal worldwide. On request we implement new concepts and offer support for the optimisation of your production processes. We test your materials in our test workshop and recommend the optimal tool.

We will develop and design special tools specifically for your needs. Our service also includes system solutions. The close cooperation of our OEM team with the manufacturers of machines provides us with a comprehensive insight into process parameters.

As a result we can develop and implement the most suitable and economically efficient production solutions.

In addition to our training workshops and seminars worldwide, our customers are always welcome to participate in our special workshops.

Product lines that drive your productivity



**FRANKEN**  
*TiNox-Cut*



**FRANKEN**  
*Fiber-Cut*



**EMUGE**  
**TI**



**NAWA**  
*blueCUT*



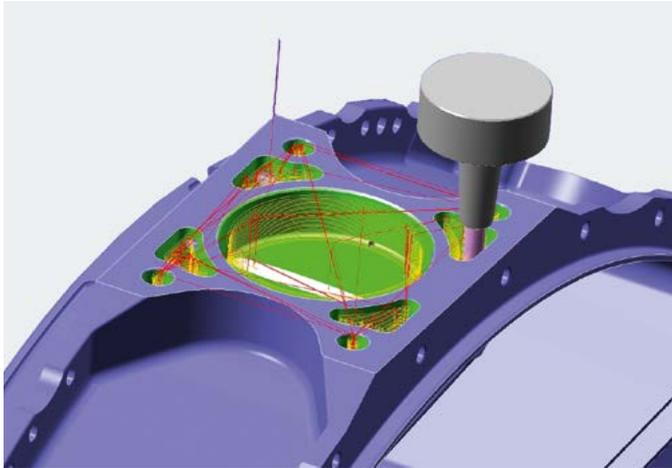
**EMUGE**  
**GSF-Z**



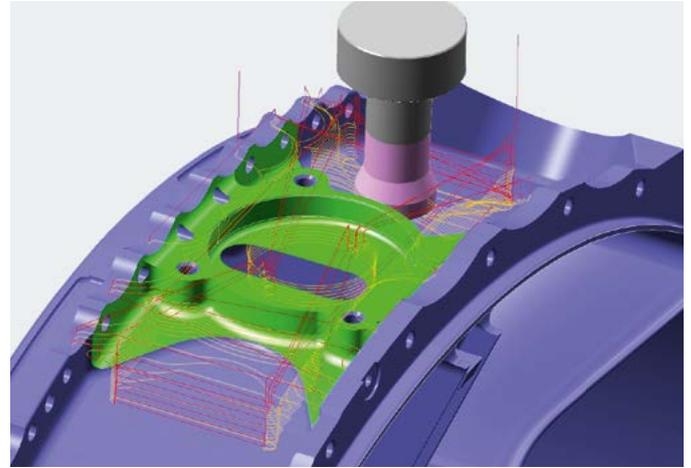
**EMUGE**  
**VA**

We do not only cooperate with machine tool manufacturers, but we also maintain close relationships with leading CAD-CAM suppliers to be able to set up the process to fully utilise the machine tool the CAM capabilities.

This way we are able to design and suggest the most efficient and reliable manufacturing concept for lowest cost per part and highest process reliability.



Example for process design for a manufacturer of aerospace components



Product lines that drive your productivity



**FRANKEN**  
*TiNax-Cut*



**FRANKEN**  
Custom solution



**EMUGE**  
**AL**



**FRANKEN**  
Custom solution



**FRANKEN**  
Deburring end mill



**FRANKEN**  
*Fiber-Cut*

Suck – Squeeze – Bang – Blow: These are the four stages that comprise the overall function of a jet engine. Generating more than 50 000 horse power of thrust force, jet engines are power plants in the air.

Besides high in service reliability, long life, low emissions, low noise and low fuel consumption are requirements to jet engines.

The over 18 000 components of an engine have to withstand temperatures from -60 °C at the fan and over 1 100 °C in the combustor.

To meet the safety requirements the parts must be manufactured reliably to tight tolerances repeatedly.

Product lines that drive your productivity



**FRANKEN**  
TiNox-Cut



**FRANKEN**  
Fiber-Cut



**EMUGE**  
EF-Drill



**EMUGE**  
ZGF-S-Cut



**EMUGE**  
NI

Titanium alloys, nickel-base alloys and advanced materials such as polymere matrix composites, metal matrix composites, metal ceramic composites,  $\gamma$ -titanium and carbon fibres are the materials modern jets are made of.

These materials are highly valuable and scrap must be avoided under all circumstances. EMUGE-FRANKEN has a wide range of tooling solutions, that provide high and reliable performance.

Product lines that drive your productivity



**FRANKEN**  
Turbine



**FRANKEN**  
Turbine



**FRANKEN**  
Expert



**FRANKEN**  
Expert



**FRANKEN**  
Custom solution



EMUGE-Werk in Lauf



EMUGE as part of the EMUGE-FRANKEN company association develops and manufactures precision tools for thread production and for the clamping of tools and workpieces. The diverse programme aims at offering a tool system solution from the machine spindle to the clamping of the workpiece.

Taps, cold-forming taps and thread milling cutters are available for a variety of dimensions and materials. Twist drills provide an excellent drill hole quality, which are also perfectly adapted to the threading tools. A selected range of dies and thread rolls enables the reliable production of external threads.

Numerous tool holders and thread gauges complete the system-based approach and their product features contribute to an increase in productivity.



FRANKEN in Rückersdorf



Ever since its foundation FRANKEN as part of the EMUGE-FRANKEN company association has been developing and manufacturing milling tools. The wide range of end mills of solid carbide and HSS as well as PCD and CBN inserts or milling cutters with indexable inserts is characterised by precision and innovation.

The production in our German manufacturing plant in Rückersdorf includes standard end mills and bore cutters as well as highly precise special form and profile milling tools. With its large variety of tool types and cutting materials, the consistently high standards and uncompromising precision, our product range of milling cutters meets even the highest quality requirements.

In addition to our selection of milling tools, we also offer a comprehensive range of clamping systems, tool holders and accessories.



NAWA in Veringendorf



NAWA Präzisionstechnik GmbH was founded in 1989 in Veringendorf, located in the south of Germany.

Since 2002, NAWA has been a member of the EMUGE-FRANKEN Group.

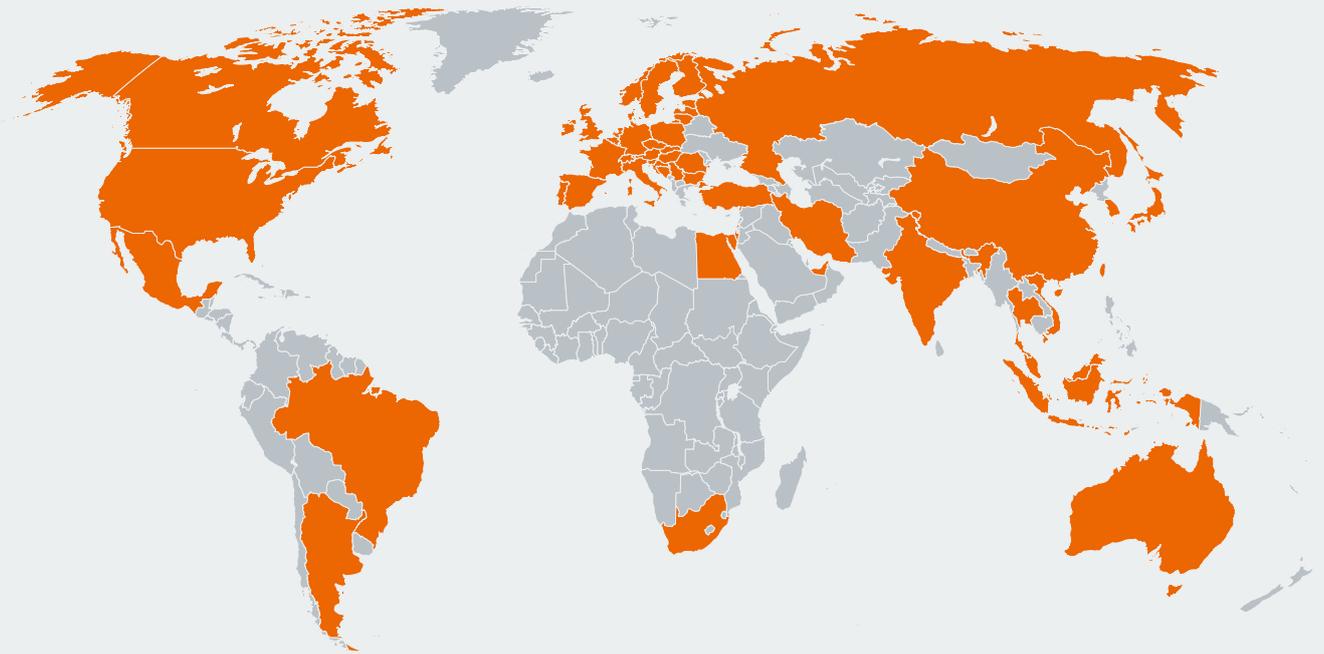
Within the EMUGE-FRANKEN Group, NAWA is specialized in design, manufacturing and servicing of tailor made PCD tooling, indexable insert tooling and solid tungsten carbide tooling.



myTEC in Marktheidenfeld



Since more than 30 years, myTEC® Präzisionswerkzeuge GmbH has been developing and manufacturing clamping tools for both workpiece- and tool-clamping. The pioneer of sealless connection technology for hydraulic expansion clamping tools became a member of EMUGE-FRANKEN Group in 2012. With its product range, myTEC® is focused on customers in the automotive and aerospace industry.



EMUGE-FRANKEN Vertriebspartner finden Sie auf [www.emuge-franken.com/vertrieb](http://www.emuge-franken.com/vertrieb)  
EMUGE-FRANKEN sales partners, please see [www.emuge-franken.com/sales](http://www.emuge-franken.com/sales)

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Fabrik für Präzisionswerkzeuge

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