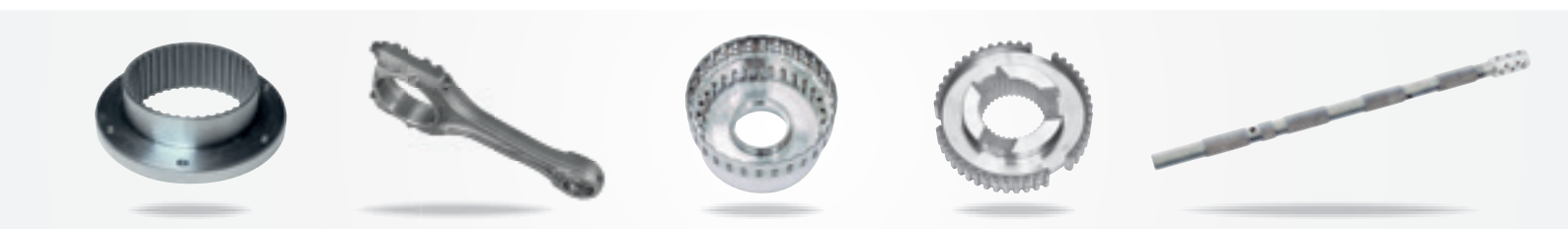
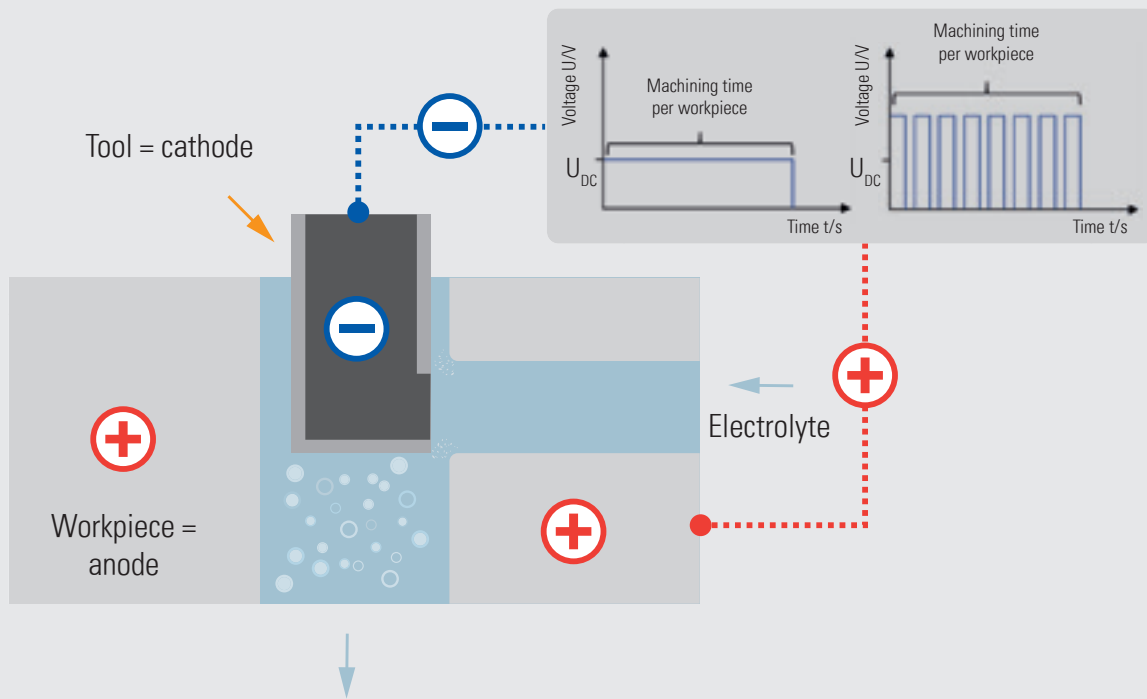


# ELECTROCHEMICAL MACHINING (ECM)

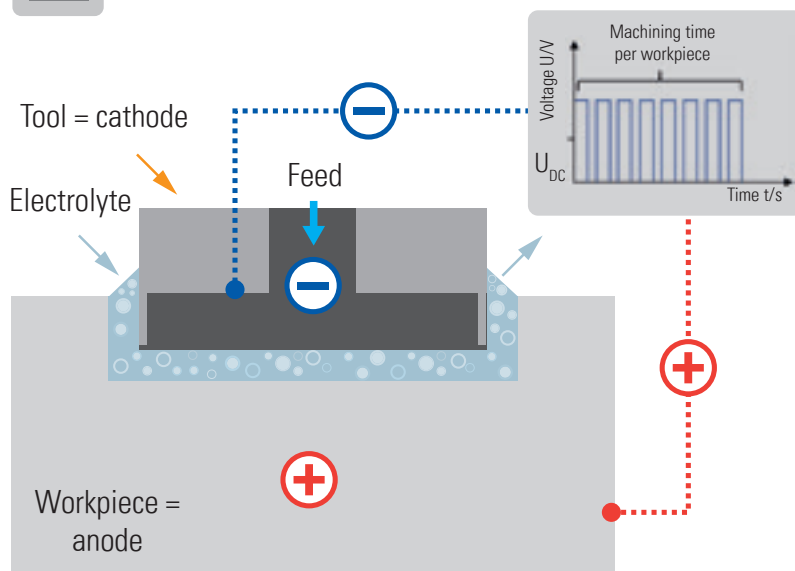


# ECM – The Process

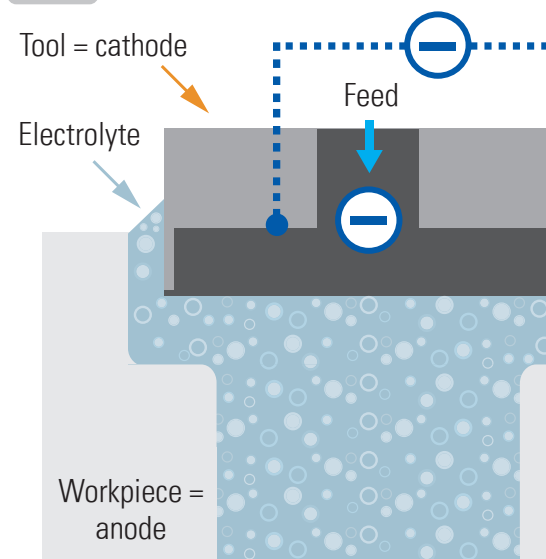
## STATIONARY CATHODE



## MOVING CATHODE



## ELECTROCHEMICAL MACHINING (ECM)



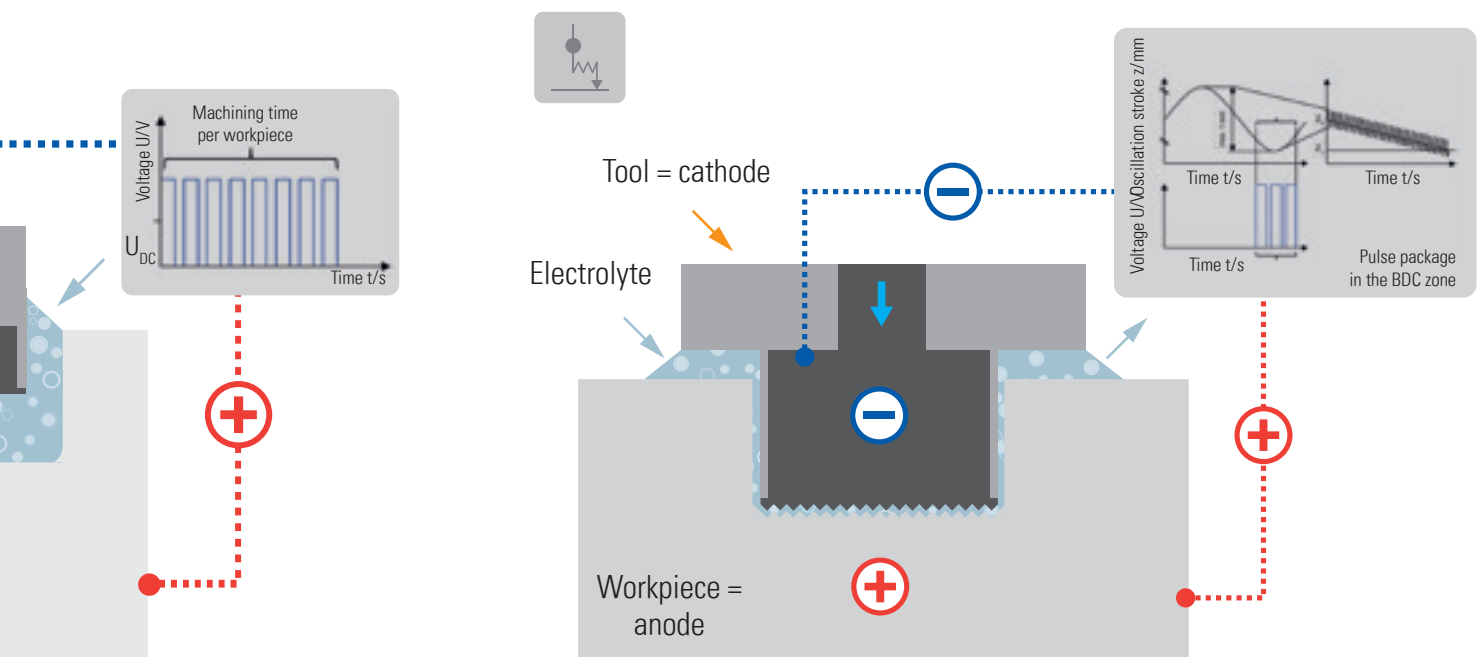
## ELECTROCHEMICAL MACHINING IS BASED ON THE PRINCIPLE OF ELECTROLYSIS.

The tool is connected as the cathode to a DC voltage source with the workpiece acting as the anode. A charge exchange takes place between the cathode and anode in an aqueous electrolyte solution, which targets specific areas of the workpiece. This can be used to create contours, ring ducts, grooves, or bell hollows with no contact but very high precision.

The removed material is precipitated from the electrolyte solution in the form of metal hydroxide. The machining can be carried out regardless of the structural condition of the metal. Both soft and hard material can be machined.

**The components are not subjected to either thermal or mechanical stress.**

## PRECISION ELECTROCHEMICAL MACHINING (PECM)



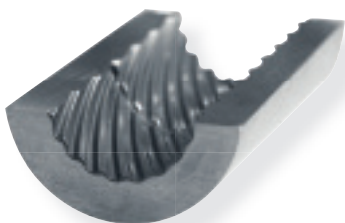
# (P)ECM machine – PI

## PI – PREMIUM INTEGRATED

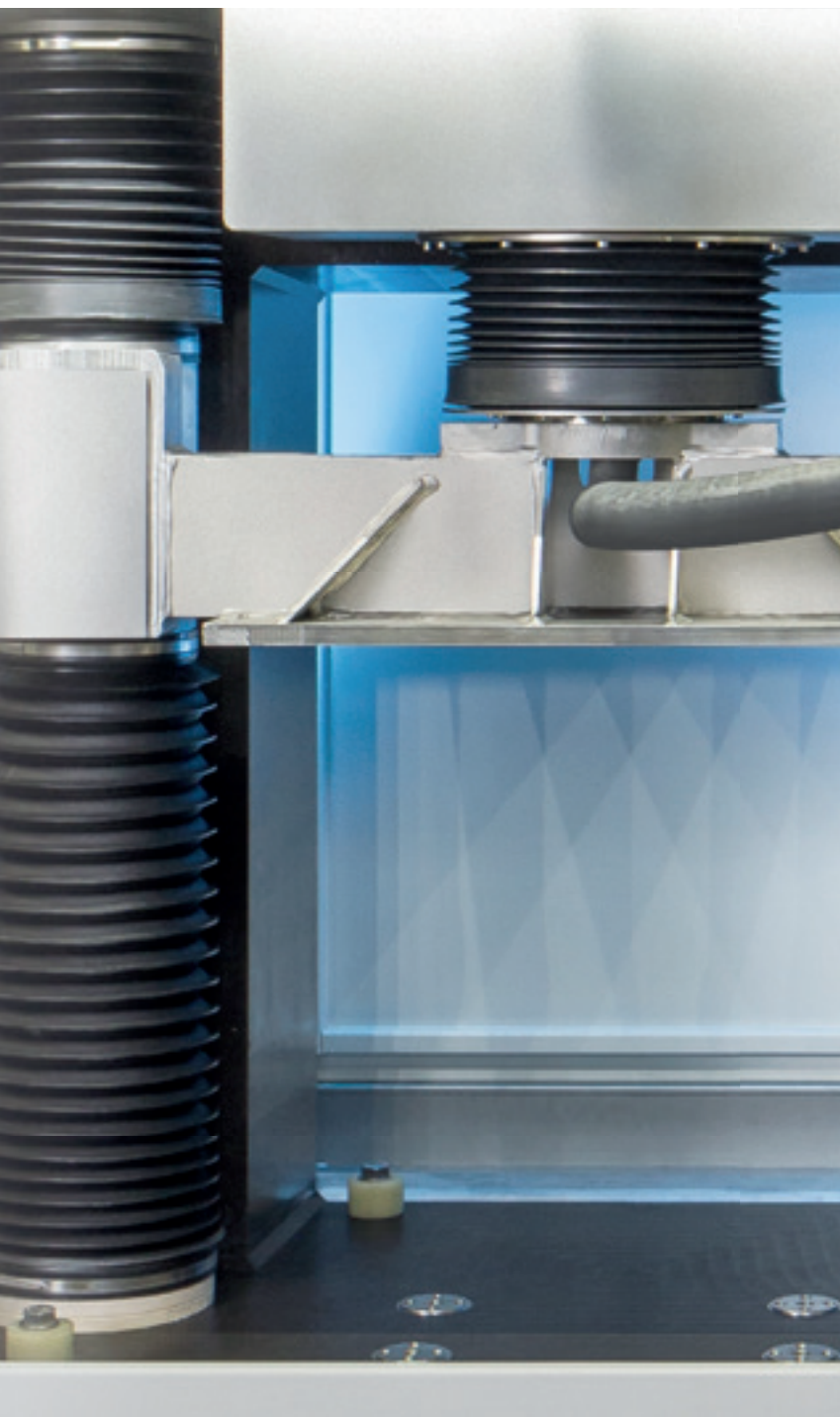
The PI machine with its integral electrolyte management system is a compact entry-level machine to the (P)ECM precision machining process. The (P)ECM machining area, control cabinet with control system, and electrolyte management system are all mounted on one machine frame (single frame). This means that the PI has a small footprint, is compact, and can be transported with a forklift truck!

The PI is ideal for ...

- » ECM deburring
- » (P)ECM internal profiling (rifling)
- » (P)ECM machining
- » (P)ECM sinking







## EMAG ECM – PI

- + Scalable generator technology up to 2,500 A
- + DC, pulse, and PECM technology
- + Flexibly configurable pulse technology
- + Individual cathodes can be selected/deselected
- + Single cathode monitoring
- + Process control using by time, distance, or Idt
- + Small footprint
- + Modular design
  - Machining area: sinking module, oscillation module, rifling module, deburring module
  - Electrolyte management system (EMS)
  - Microfiltration
  - Cr6+ reduction
- + Touch panel and S7-1500 controller from Siemens
- + Conductivity monitoring
- + Temperature control
- + pH value control with metering
- + Transportable by a forklift truck

### Options:

- » Fast short-circuit shutdown
- » Automatic cathode cleaning
- » Oscillation at up to 100 Hz and stroke from 0 to 0.6 mm
- » C-axis for interpolated multiple sinking movement
- » IoT Ready
- » Automation interface
- » Single nest pressure control
- » Single nest flow monitoring
- » Automatic machining area door

## TECHNICAL DATA

Generator capacity	A (DC)	400 – 2,500
Generator capacity	A (pulse)	400 – 8,000

# EMAG PI – Modular design

## BASIC MODULE

Modules in the machining area are equipped with a basic module made of Mineralit, can be selected according to the ECM application.

### 1. DEBURRING MODULE

The machining area is prepared for an ECM deburring tool.



### 2. SINKING MODULE

The machining area with a Z-axis to carry out accurate sinking applications.



### 3. OSCILLATION MODULE

The machining area with a Z-axis and superimposed oscillation to carry out high-precision PECM applications.



### 4. RIFLING MODULE

The machining area with a Z-axis and a C-axis to produce internal profiles.





EMS & machining area



**Microfiltration (for higher electrolyte quality)**



**Cr6+ reduction (depending on material)**



**Chamber filter press**

## OPTIONS FOR THE BASIC MODULE



# (P)ECM machine – PS

## PS – PREMIUM STANDARD

The PS machine with a deburring, sinking, or oscillation module is the flexible machine platform for the (P)ECM process:

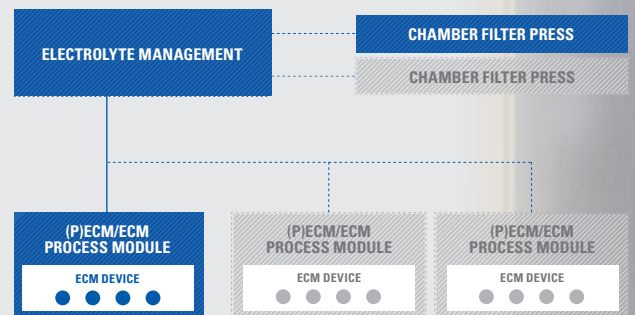
- » Modular machine concept
- » Manual or semi-automatic starter systems
- » Suitable for automation using robots or gantry loaders
- » Smart software and hardware interfaces

The PS single machine provides the basis for a modular system. This reduces investment costs because customers only have to invest in linking several processes (e.g., pre-washing, (P)ECM station 1, (P)ECM station 2, final treatment, and automation) once production increases.

The PS is ideal for ...

- » ECM deburring
- » (P)ECM internal profiling
- » (P)ECM machining
- » (P)ECM sinking

on a wide range of components.



## BASIC MODULE

Modules in the machining area are equipped with a basic module made of Mineralit, can be selected according to the ECM application.

### 1. DEBURRING MODULE

The machining area is prepared for an ECM deburring tool.



### 2. SINKING MODULE

The machining area with a Z-axis to carry out accurate sinking applications.







## EMAG ECM – PS

- + Machining area: sinking module, oscillation module or deburring module
- + Scalable generator technology up to 2,500 A
- + DC, pulse, and PECM technology
- + Flexibly configurable pulse technology
- + Individual cathodes can be selected/deselected
- + Single cathode monitoring
- + Process control using by time, distance, or ldt
- + In the form of a sinking module: 400 mm Z stroke
- + In the form of an oscillation module: 200 mm Z stroke
- + Touch panel and S7-1500 controller from Siemens
- + Conductivity monitoring
- + Temperature control
- + pH value control with metering

### Options:

- » Fast short-circuit shutdown
- » Automatic cathode cleaning
- » Oscillation at up to 100 Hz and stroke from 0 to 0.6 mm
- » C-axis for interpolated multiple sinking movement
- » IoT Ready
- » Automation interface
- » Can be combined with all electrolyte management systems from 20 to 600 l/min
- » Automatic machining area door

### 3. OSCILLATION MODULE

The machining area with a Z-axis and superimposed oscillation to carry out high-precision PECM applications.



## TECHNICAL DATA

Generator capacity	A (DC)	400 – 2,500
Generator capacity	A (pulse)	2,000 – 8,000



Subject to changes. The layout may change to suit technical requirements. All systems are built to current CE standards.

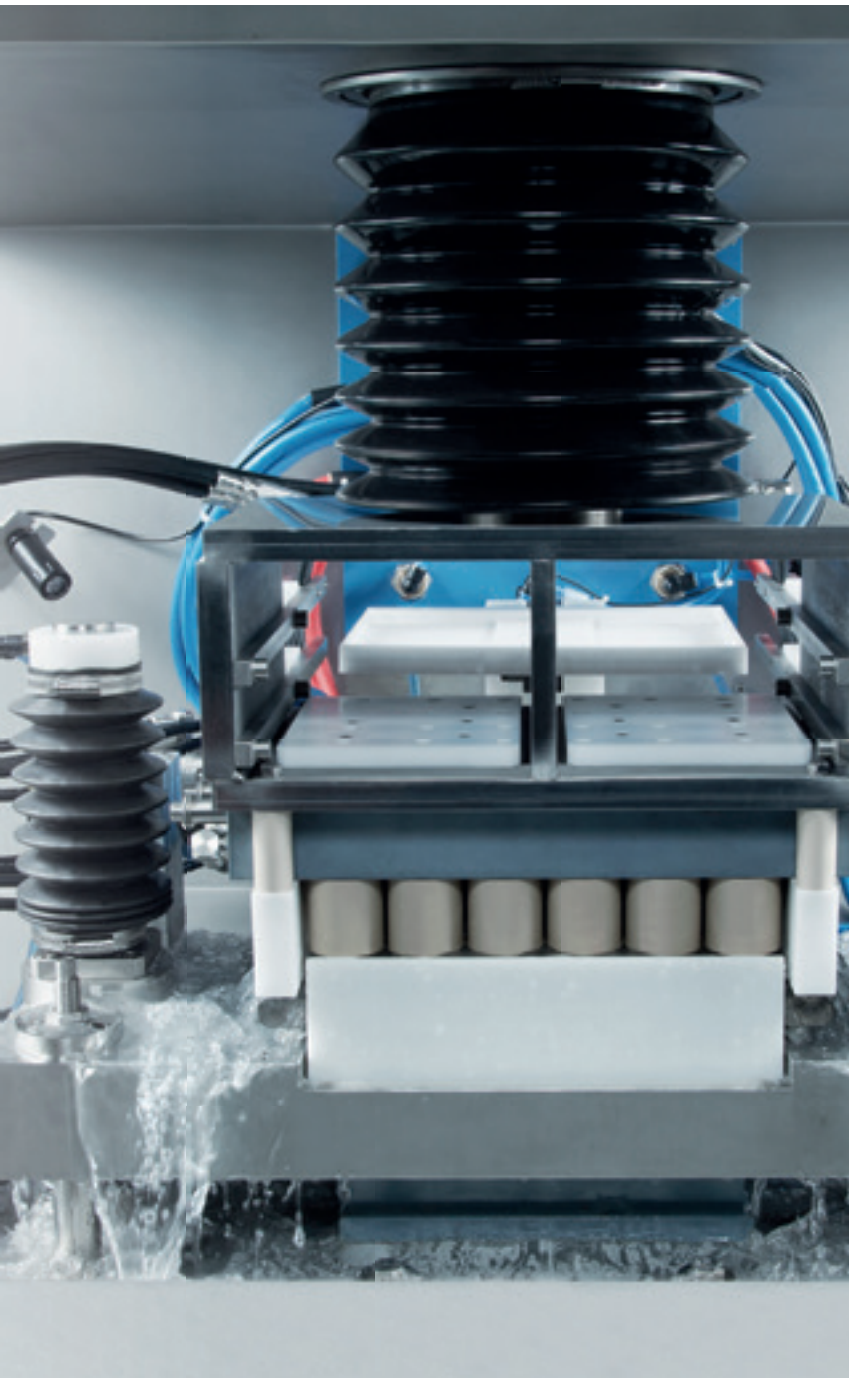
# PECM machine – PTS

The EMAG PTS has a base made of MINERALIT®, a polymer concrete which is 8 times more resistant to vibration than gray cast iron. The machine and the tools suffer from less vibration as a result of this outstanding feature.

PECM technology is ideal for the precision machining of materials which are difficult to cut. Tasks involving high accuracy and surface requirements can be carried out using a completely new approach.



Subject to changes. The layout may change to suit technical requirements.  
All systems are built to current CE standards.



## EMAG ECM – PTS:

- + Scalable generator technology up to 12,000 A
- + DC, pulse, and PECM technology
- + Flexibly configurable pulse technology
- + Fast short-circuit shutdown
- + Process control using time, distance, and Idt
- + Machine base made of Mineralit®
- + Footprint: 2,100 x 3,200 x 2,900 mm (W x D x H)
- + Oscillator with play-free precision drive
- + Z-axis with 200 mm stroke and max. 25 kN axial load
- + Hydraulic zero point clamping system
- + Siemens Sinumerik 840D sl controller

### Options:

- » Individual cathodes can be selected/deselected
- » Single cathode monitoring
- » Single nest pressure control
- » Single nest flow monitoring
- » Automatic machining area door
- » Cathode cleaning
- » XY worktable
- » C-axis
- » Scalable electrolyte management systems
- » IoT Ready
- » Automation interface
- » Oscillation at up to 100 Hz and stroke from 0.05 to 0.6 mm
- + Z-axis with 350 mm stroke and max. 25 kN axial load



## TECHNICAL DATA

Machining area	mm inch	1,070 x 700 x 515 42 x 27.5 x 20
Clamping table	mm inch	800 x 550 31.5 x 21.5
Generator capacity	A (DC)	2,500 – 5,000
Generator capacity	A (pulse)	6,000 – 12,000

- + Enclosed machining area with lifting door



# PECM machine – PO 100 SF

## PO 100 SF – SINGLE FOIL

The economical solution for the synchronous machining of both sides of turbine blades.

The PO 100 SF has a base made of MINERALIT®, a polymer concrete which is 8 times more resistant to vibration than gray cast iron. The machine and the tools suffer from less vibration as a result of this outstanding feature.

The machining process takes place using two opposite axes. This means that individual turbine blades with 3D shapes and high accuracy/surface requirements can be produced using a completely new approach.



Subject to changes. The layout may change to suit technical requirements.  
All systems are built to current CE standards.



## EMAG ECM – PO 100 SF

- + Scalable generator technology up to 24,000 A
- + DC, pulse, and PECM technology
- + Single cathode monitoring
- + Fast short-circuit shutdown
- + Process control using time, distance, and Idt
- + Machine base made of Mineralit®
- + Footprint: 2,800 x 2,300 x 2,600 mm (W x D x H)
- + Oscillator with play-free precision drive
- + X1-/X2-axis with 200 mm stroke and max. 25 kN axial load
- + Interpolating Y-axis with 100 mm stroke
- + Hydraulic zero point clamping system
- + Siemens Sinumerik 840D sl controller

### Options:

- » Parallel machining of blades
- » Cathode cleaning
- » Scalable electrolyte management systems
- » IoT Ready
- » Automation interface
- » Single nest pressure control
- » Single nest flow monitoring
- » Oscillation at up to 100 Hz and stroke from 0.05 to 0.6 mm

## TECHNICAL DATA

Machining area	mm inch	750 x 600 x 360 30 x 24 x 14
Clamping table	mm inch	370 x 450 15 x 18
Generator capacity	A (DC)	2 x 2,500 – 5,000
Generator capacity	A (pulse)	2 x 6,000 – 12,000

# PECM machine – PO 900 BF

## PO 900 BF – BLISK FOIL

The alternative to the traditional machining of blisks and IBRs.

The PO 900 BF has a base made of MINERALIT®, a polymer concrete which is 8 times more resistant to vibration than gray cast iron. The machine and the tools suffer from less vibration as a result of this outstanding feature.

The machining takes place using multiple axes. This means that complete blisks with 3D shapes and high accuracy/surface requirements can be produced using a completely new approach.



Subject to changes. The layout may change to suit technical requirements.  
All systems are built to current CE standards.





## EMAG ECM – PO 900 BF

- + Scalable generator technology up to 12,000 A
- + DC, pulse, and PECM technology
- + Flexible step technology and type management
- + Fast short-circuit shutdown
- + Process control using time, distance, and Idt
- + Machine base made of Mineralit®
- + Footprint: 4,400 x 6,600 x 4,500 mm (W x D x H)
- + Oscillation at up to 50 Hz and stroke from 0.05 to 0.9 mm
- + Oscillator with play-free precision drive
- + X1-/X2-axis with 250 mm stroke and max. 50 kN axial load
- + Compound slide for holding workpieces with Y-/Z-axis, C-axis, and B-axis
- + X-, Y-, Z-, and interpolating C-axes
- + Zero point clamping system for cathodes and work-piece
- + Siemens Sinumerik 840D sl controller

### Options:

- » Cathode cleaning
- » Scalable electrolyte management systems
- » IoT Ready
- » Automatic machining area door

## TECHNICAL DATA

Component diameter up to	mm inch	900 35.5
Workpiece weight up to	kg	300
Generator capacity	A (DC)	2 x 2,500 – 5,000
Generator capacity	A (pulse)	2 x 6,000 – 12,000

# EMS Electrolyte Management System

Both systems with chamber filter presses and with microfiltration are available for filtration purposes. The filtrate quality and volume can thus be tailored precisely to requirements. Systems from 40 to 900 l/min filtration capacity are available as standard.

High reproducibility of the machining result is assured by monitoring conductivity, temperature, pressure, flow rate, and pH value. The sludge can be discharged either manually or automatically, depending on cutting volume, and can be designed to operate without interrupting production on request. The economical solution for PECM process development and for the PECM machining of challenging 2D and 3D geometries.



## EMS 150

Subject to changes. The layout may change to suit technical requirements.  
All systems are built to current CE standards.



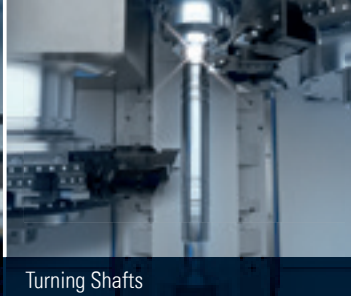
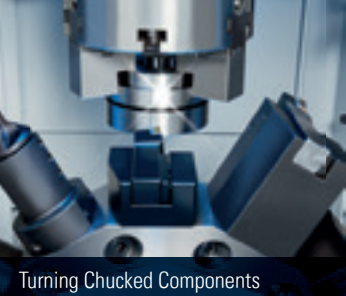
## EMAG ECM – EMS:

- + Electrolyte  $\text{NaNO}_3$  or  $\text{NaCl}$
- + Flow rates of up to 600 l/min
- + Electrolyte pressure of up to 20 bar
- + Temperature control
- + Flow rate or pressure control
- + pH value control by means of metered acid/alkaline addition
- + Conductivity monitoring
- + Particle size:  $< 0.5 \mu\text{m}$
- + Visualization and setting of all electrolyte parameters on a SIEMENS touch panel



**EMS 35**





Turning Chucked Components

Turning Shafts

Milling

Gear Hobbing

Gear Grinding

## AT HOME, AROUND THE WORLD

### EMAG EUROPE

#### **EMAG Salach GmbH**

Austrasse 24  
73084 Salach  
Germany  
Phone: +49 7162 17-0  
E-mail: [info@emag.com](mailto:info@emag.com)

#### **EMAG Salach GmbH – Sweden**

Glasgatan 19B  
73130 Köping  
Sweden  
Phone: +46 221 40305  
E-mail: [mkarlsson@emag.com](mailto:mkarlsson@emag.com)

#### **EMAG Salach GmbH – Czech Republic**

Lávová 1628/8  
104 00 Praha 10 – Uhřetěves  
Czech Republic  
Phone: +420 731 476070  
E-mail: [mdelis@emag.com](mailto:mdelis@emag.com)

#### **EMAG Salach GmbH – Austria**

Glaneckerweg 1  
5400 Hallein  
Austria  
Phone: +43 6245 76023-0  
E-mail: [info@austria.emag.com](mailto:info@austria.emag.com)

#### **EMAG Salach GmbH – Hungary**

Gerenda 10  
1163 Budapest  
Hungary  
Phone: +36 30 9362-416  
E-mail: [lbujaki@emag.com](mailto:lbujaki@emag.com)

#### **EMAG Salach GmbH – Poland**

Spółka z ograniczoną odpowiedzialnością  
Oddział we Wrocławiu  
ul. Krzycka 71A / 6  
53-020 Wrocław  
Poland  
Phone: +48 728 389 989  
E-mail: [arak@emag.com](mailto:arak@emag.com)

### EMAG ASIA

#### **EMAG (China) Machinery Co., Ltd.**

Sino-German Advanced Manufacturing  
Technology International Innovation park  
Building 2, No. 101, Chen Men Jing Road  
215400 Taicang  
Jiangsu, China  
Phone: +86 512 5357-4098  
E-mail: [info.china@emag.com](mailto:info.china@emag.com)

#### **TAKAMAZ EMAG Ltd.**

1-8 Asahigaoka Hakusan-City  
Ishikawa Japan, 924-0004  
Japan  
Phone: +81 76 274-1409  
E-mail: [info@takamaz.emag.com](mailto:info@takamaz.emag.com)

#### **EMAG KOREA Ltd.**

Rm204, Biz center, SKn Technopark  
124 Sagimakgol-ro, Sangdaewon-dong  
Jungwon-gu, Seongnam City  
Gyeonggi-do, 462-721  
South Korea  
Phone: +82 31 776-4415  
E-mail: [info@korea.emag.com](mailto:info@korea.emag.com)

#### **EMAG (Chongqing) Intelligent Technology Co., Ltd.**

24-7 Fangzheng Allee  
Beibei Stadtbezirk  
400700 Chongqing, China  
Phone: +86 23 6824 8000  
E-mail: [info.china@emag.com](mailto:info.china@emag.com)

#### **EMAG INDIA Pvt. Ltd.**

Technology Centre  
No. 17/G/46-3, Industrial Suburb  
2<sup>nd</sup> Stage, Yeshwantpur  
Bengaluru – 560 022  
India  
Phone: +91 80 50050163  
E-mail: [info@india.emag.com](mailto:info@india.emag.com)

#### **EMAG Systems GmbH (Thailand)**

Eastern Seaboard  
848/14 M.3, Bowin, Sriracha  
Chonburi 20230  
Thailand  
Phone: +66 (0) 38110485  
E-mail: [service.thailand@emag.com](mailto:service.thailand@emag.com)



Cylindrical Grinding

Out-of-round Grinding

ECM/PECM

Laser Processing

#### **EMAG Salach GmbH – France**

5 Avenue de l'Europe  
18150 La Guerche sur l'Aubois  
France  
Phone: +33 02 48 7711-00  
E-mail: [info.france@emag.com](mailto:info.france@emag.com)

#### **EMAG Salach GmbH – Spain**

Pasaje Arrahona, n° 18  
Polígono Industrial Santiga  
08210 Barberà del Vallès (Barcelona)  
Spain  
Phone: +34 93 7195080  
E-mail: [info.spain@emag.com](mailto:info.spain@emag.com)

#### **EMAG Salach GmbH Merkezi Almanya – Türkiye**

Istanbul Merkez Subesi  
Sanayi Cad. No.: 44  
Nish İstanbul Sitesi D Blok  
D:155 34196 Yenibosna – Istanbul  
Turkey  
Phone: +90 532 694 54 44  
E-mail: [ckoc@emag.com](mailto:ckoc@emag.com)

#### **EMAG Milano S.r.l.**

Via dei Mille 31  
20098 San Giuliano Milanese (Mi)  
Italy  
Phone: +39 02 905942-1  
E-mail: [info.milano@emag.com](mailto:info.milano@emag.com)

### **EMAG AMERICA**

#### **EMAG L.L.C. USA**

38800 Grand River Avenue  
Farmington Hills, MI 48335  
USA  
Phone: +1 248 477-7440  
E-mail: [info@usa.emag.com](mailto:info@usa.emag.com)

#### **EMAG MEXICO**

Maquinaria EMAG Mexico S de RL de CV  
Av. Hercules 301 Nave 1  
Polígono Empresarial Santa Rosa  
76220 Santa Rosa Jauregui, Querétaro  
Mexico  
Phone: +52 442 291 1552  
E-mail: [info@mexico.emag.com](mailto:info@mexico.emag.com)

#### **EMAG DO BRASIL**

Edifício Neo Corporate Offices, CJ 1503  
Rua Enxovia, 472  
04711-030 São Paulo SP  
Brazil  
Phone: +55 11 38370145  
E-mail: [info@brasil.emag.com](mailto:info@brasil.emag.com)

