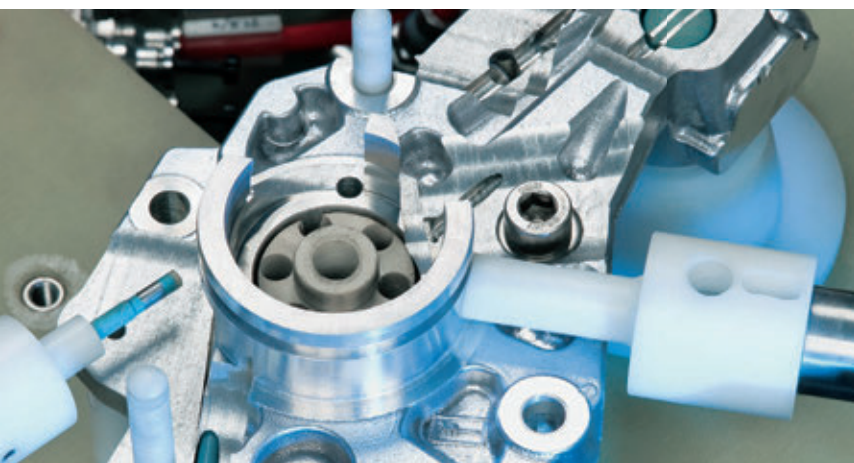


# ELECTRO-CHEMICAL MACHINING (ECM)



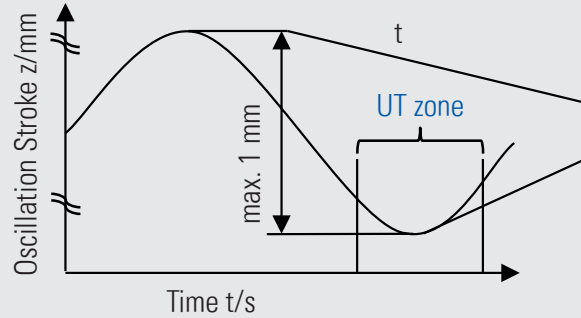
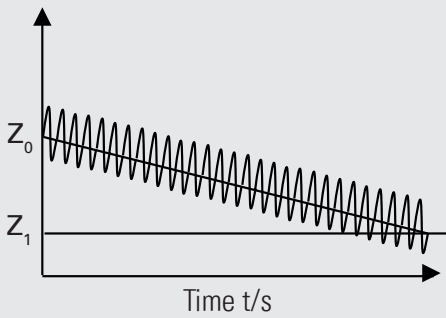
think  
VERTICAL



# ECM – The Process

## THE PECM PROCESS

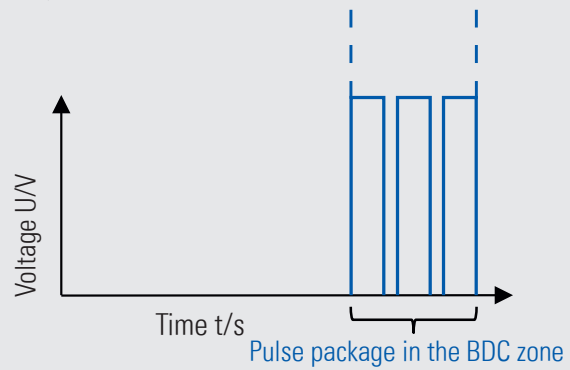
- » Precision electro-chemical machining
- » Pulsed direct voltage and an oscillating cathode



- » BDC: Bottom dead center
- »  $Z_0$ : Start of the die-sinking process
- »  $Z_1$ : End of the die-sinking process

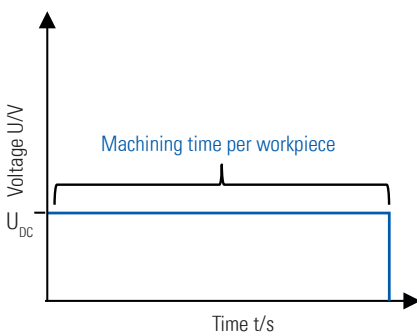


Contour accuracy = high



## THE ECM PROCESS

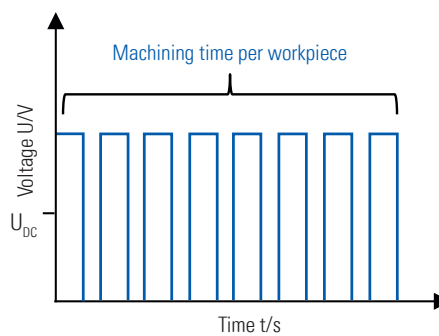
- » Non-pulsed direct voltage



Contour accuracy = lower

## THE PULSE ECM PROCESS

- » Pulsed direct voltage



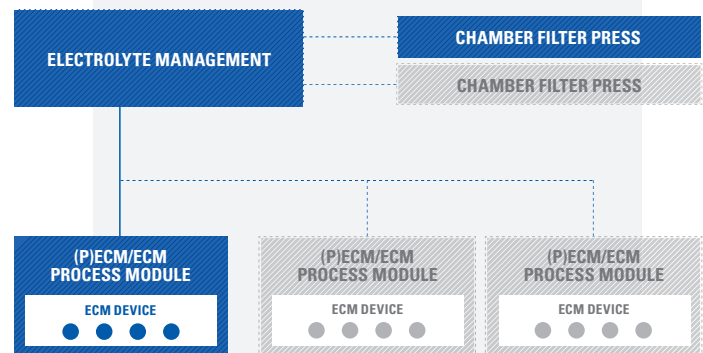
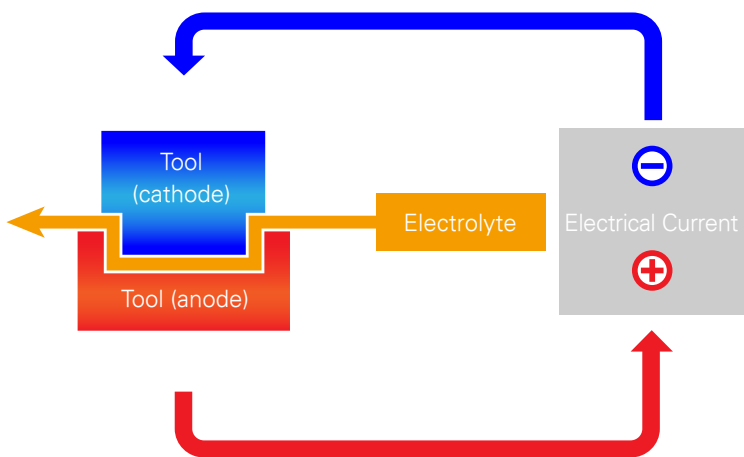


## ELECTRO-CHEMICAL MACHINING BASED ON THE PRINCIPLE OF ELECTROLYSIS

The tool is connected as the cathode to a direct 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 tool with no contact, but very high precision.

The material removed is then extracted from the electrolyte solution in the form of metal hydroxide. With this process, machining can be performed 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 stresses.**

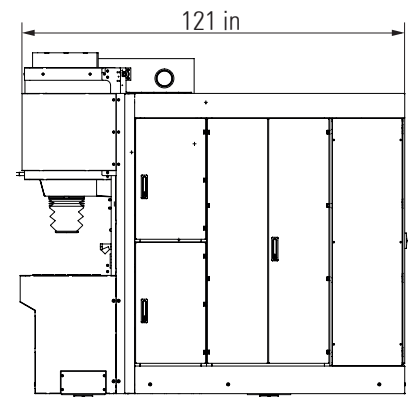


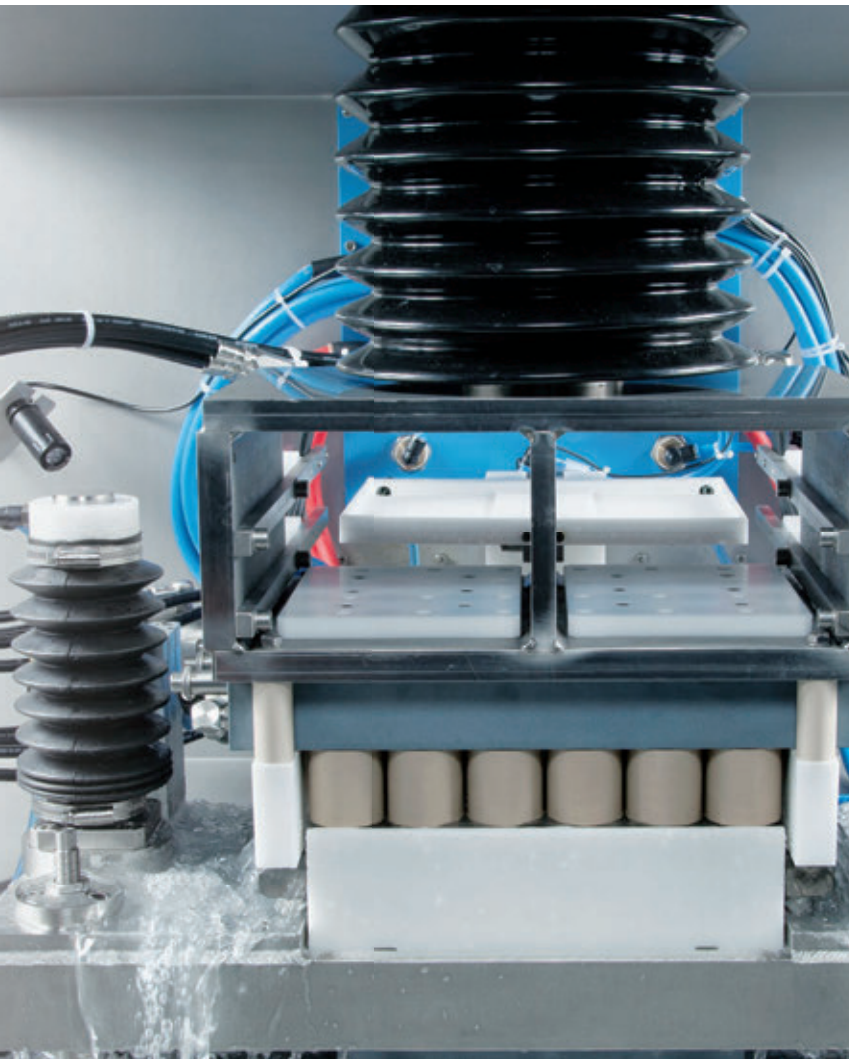
# PECM Machine – PTS

## PECM TECHNOLOGY FOR MACHINING COMPLEX 2D AND 3D GEOMETRIES

The EMAG PTS has a machine base made of MINERALIT®, a polymer concrete that is eight times more vibration resistant than gray cast iron. By minimizing vibration, the machines tool life is significantly improved.

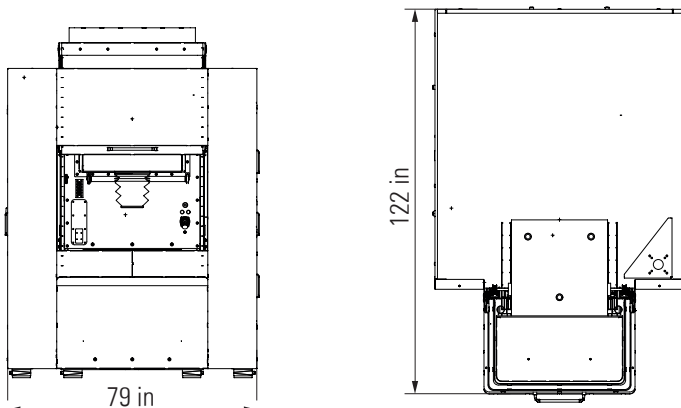
PECM technology is ideal for the precision machining of difficult to cut materials – jobs that require high accuracy and surface finishes are perfect for this completely new method for machining.





## EMAG ECM – PTS:

- + Flexible generator technology
  - » DC / Pulse / PECM technology
  - » Pulse options suitable for flexible use
  - » Single cathode control
  - » Single cathode monitoring
  - » Automatic cathode cleaning during the process
  - » Fast short circuit shutdown to minimize tool costs
  - » Top-quality surface finish
  - » Process control using LDT monitoring
- + MINERALIT® polymer machine base
- + Clamping surface: 31 x 22 x 20 in (W x D x H)
- + Machining area size 42 x 28 in (W x D)
- + Space requirement 42 x 28 in (W x D x H)
- + Oscillator with play-free precision drive
- + Z-axis with max. 25 kN axial load
- + Hydraulic zero point clamping system
- + SIEMENS SINUMERIK 840D sl machine control unit
- + Electrolyte management system tailored to the machining task
- + Optional: XY working table
- + Optional: C-axis as a rotary table



## TECHNICAL DATA

Machining area	mm inch	1,070 x 700 42 x 28
Clamping surface	mm inch	800 x 550 x 515 32 x 22 x 21
Generator capacity	A (DC)	2,500 – 5,000
Generator capacity	A (pulse)	6,000 – 12,000

- + Enclosed machining area with lifting door

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

# ECM Machine – CI

## CI – COMFORT INTEGRATED

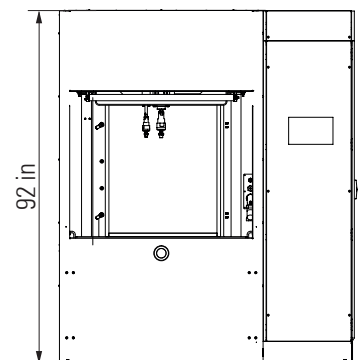
The Comfort Integrated (CI) model is the perfect entry level system into the ECM process.

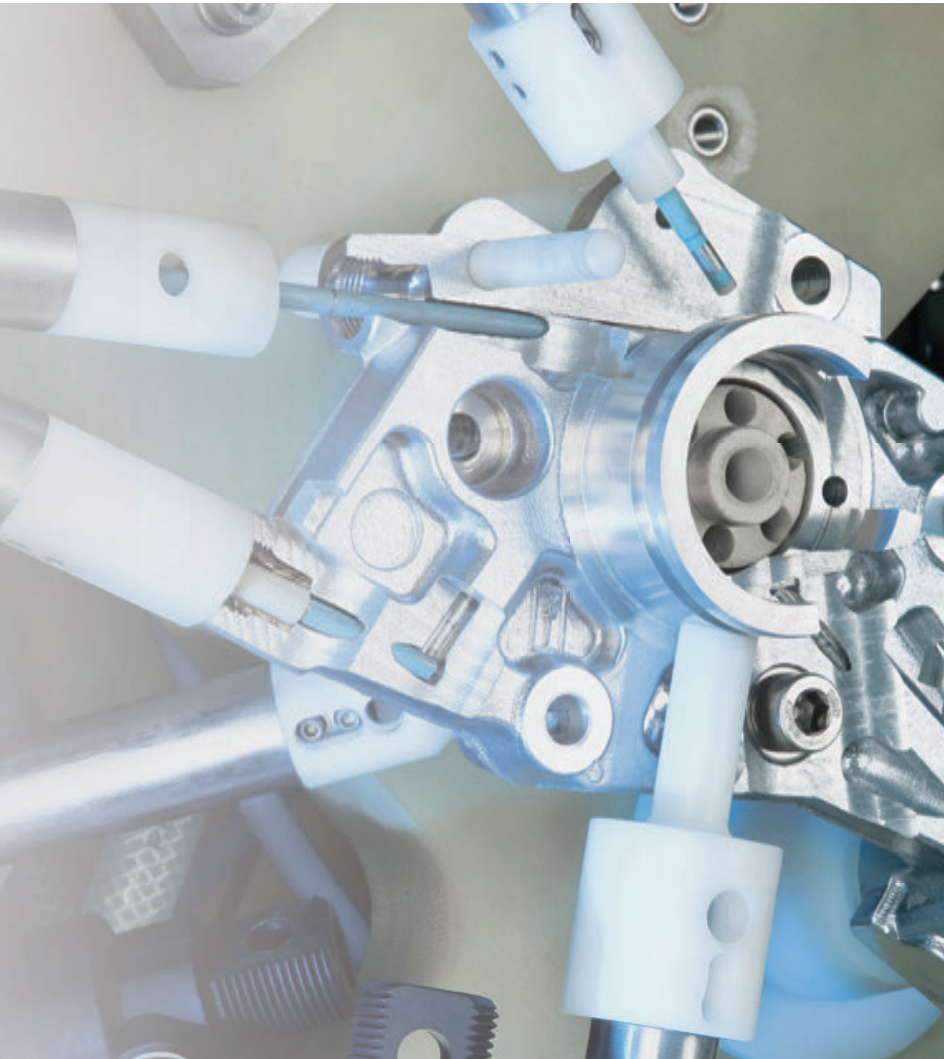
- » Manual or semi-automatic version available as starter system
- » Fast upgrade to fully automatic
- » Smart software and hardware interfaces

The 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 CI has a small footprint, is compact and can be transported with a forklift.

The CI is ideal for the following:

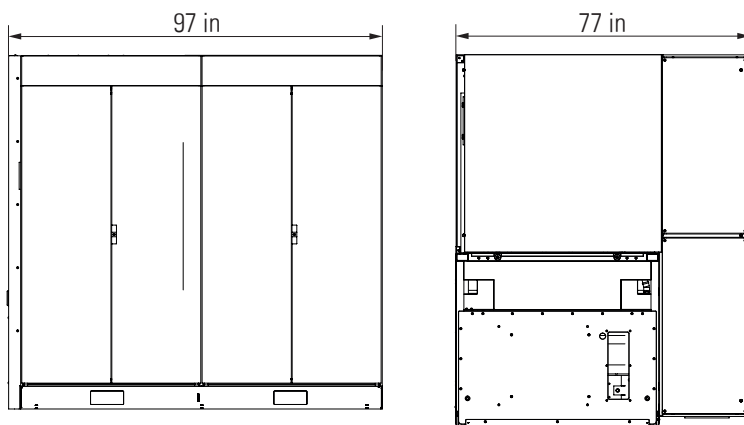
- » ECM machining
  - » ECM drilling
  - » ECM broaching
  - » ECM deburring
- on a wide range of components.





## EMAG ECM – CI:

- + Flexible generator technology
  - » DC / Pulse / ECM technology
  - » Pulse options provide flexibility
  - » Single cathode control
  - » Single cathode monitoring
  - » Automatic cathode cleaning during the process
  - » Fast short-circuit shutdown to minimize tool costs
  - » Top-quality surface finishes
- + SIEMENS touchscreen control panel
- + Conductivity monitoring
- + Temperature control
- + pH value control with acid metering system
- + Machining area 45 x 37 in (W x D)
- + Quill stroke with safety interlock
- + Compact design with integrated electrolyte filtration system
- + SIEMENS S7-300 machine control unit
- + All parameters are monitored by a control unit
- + Manual or semi-automatic versions available
- + Fast upgrade to full automation
- + Add technology for process and productivity improvement
- + DUO option available with two machining areas



## TECHNICAL DATA

Machining area	mm inch	1,150 x 950 42 x 28
Clamping surface	mm inch	1,300 x 800 x 900 32 x 22 x 21
Generator capacity	A (DC)	400 – 2,500
Generator capacity	A (pulse)	400 – 1,600

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

# ECM Machine – MPM

## MPM – MULTI-PROCESS MODULE

The EMAG Multi-Process Modular (MPM) is a single machine that can perform a variety of tasks simultaneously.

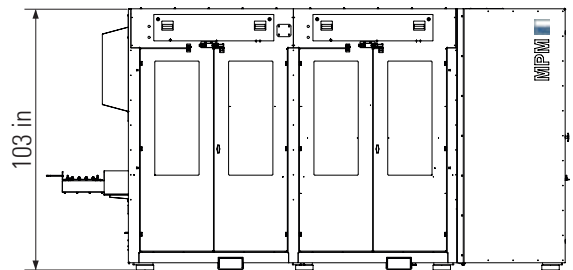
The ECM stations, cleaning system and two portals are all mounted on one single machine frame – giving the MPM a small, compact footprint that makes it easy to move with only a forklift.

Fully automatic, integrated process:

1. Supply
2. Preliminary cleaning (optional)
3. ECM machining
4. Final cleaning
5. Removal

Designed for large-scale production, the MPM is ideal for the following:

- » ECM machining
  - » ECM drilling
  - » ECM broaching
  - » ECM deburring
- on a wide range of components.

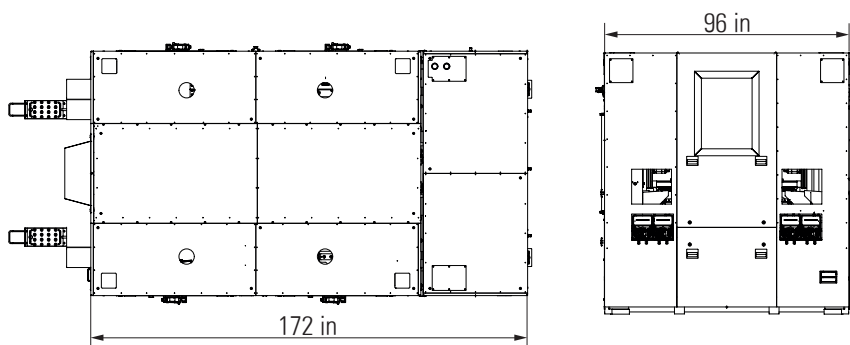






## EMAG ECM – MPM

- + Test station optional
- + Cycle times optimized for large-scale production
- + SIEMENS SINUMERIK 840 D sl machine control unit
- + ECM, automation and cleaning included
- + Complete process and system components provided by a single source
- + Retooling and maintenance of individual ECM stations possible while the system is operating
- + Fast recommissioning without dismantling due to the compact system layout
- + Hardware interfaces (power, water, waste water) are minimized during installation
- + Electrolyte management system customized to fit the machining task



## TECHNICAL DATA

Machining area per station	mm inch	800 x 600 32 x 24
Number of ECM stations		4 – 6
Generator capacity	A (DC)	400 – 2,500
Generator capacity	A (pulse)	400 – 6,000

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

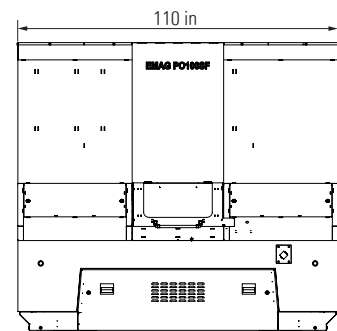
# PECM Machine – PO 100 SF

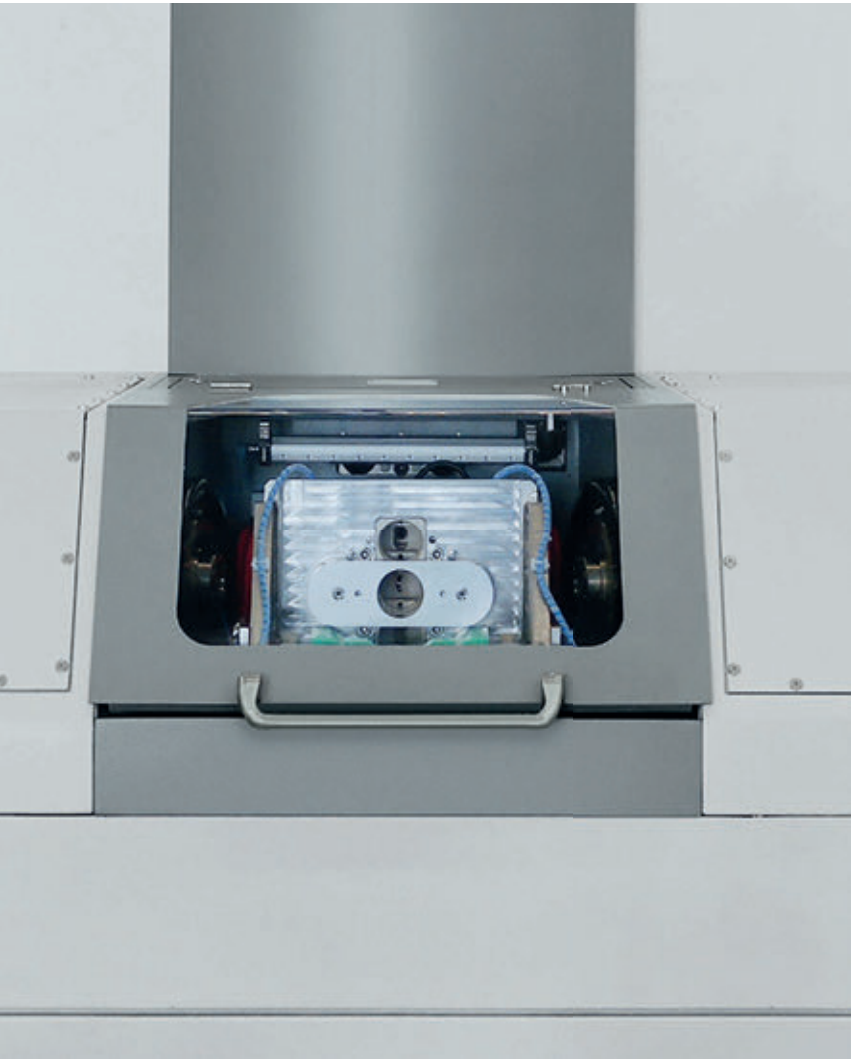
## PO 100 SF – SINGLE FOIL

The PO 100 SF is perfect for the efficient and precise production of turbine blades.

The machine's base is made out of MINERALIT®, a polymer concrete that is eight times more vibration resistant than gray cast iron. By minimizing vibration, the machine's tool life is significantly improved.

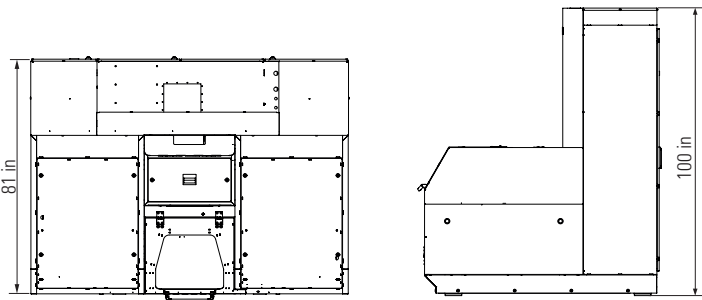
Using two opposite axes, individual turbine blades can be machined with high accuracy, meeting necessary surface requirements





## EMAG ECM – PO 100 SF

- + Flexible generator technology
  - » DC / Pulse / PECM technology
  - » Pulse options provide flexibility
  - » Automatic cathode cleaning during the process
  - » Fast short-circuit shutdown to minimize tool costs
  - » Process control using LDT monitoring
  - » Top-quality surface finish
- + MINERALIT® polymer concrete machine base
- + Clamping surface: 15 x 18 x 14 in (W x D x H)
- + Machining area size: 30 x 24 in (W x D)
- + Space requirement: 110 x 91 x 102 in (W x D x H)
- + Two oscillators with play-free precision drive
- + X1- and X2-axes, each with max. 25 kN axial force
- + Y-axis available
- + Hydraulic zero point clamping system
- + SIEMENS SINUMERIK 840D sl machine control unit
- + Customized electrolyte management system



## TECHNICAL DATA

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

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

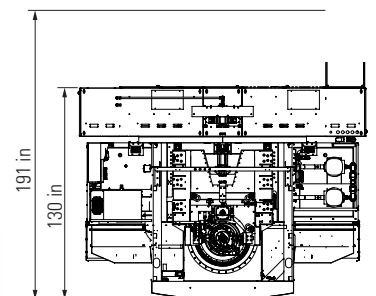
# PECM Machine – PO 900 BF

## PO 900 BF – BLISK

The PO 900 BF is the perfect solution for the complete manufacturing of blisks for airplane engine and turbine production.

The base of the machine is made out of MINERALIT®, a polymer concrete that is eight times more vibration resistant than grey cast iron. By minimizing the vibration the machine experiences, the tool life on the machine is dramatically improved.

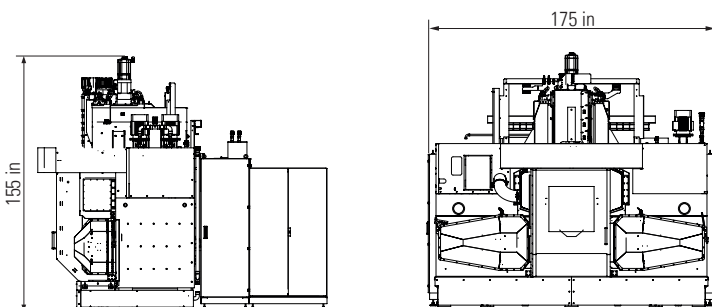
Multiple axes are used during production, which means that blisks with 3D shapes that have high accuracy and surface requirements can be produced using this completely new approach.





## EMAG ECM – PO 900 BF

- + Flexible generator technology
- + DC / Pulse / PECM technology
- + Pulse options provide flexibility
- + Automatic cathode cleaning during the process
- + Fast short-circuit shutdown to minimize tool costs
- + Process control using LDT monitoring
- + Top-quality surface finish
- + MINERALIT® polymer concrete machine base
- + Clamping surface: 15 x 18 x 14 in (W x D x H)
- + Machining area size: 30 x 24 in (W x D)
- + Space requirement: 110 x 91 x 102 in (W x D x H)
- + Two oscillators with play-free precision drive
- + X1- and X2-axes, each with max. 25 kN axial force
- + Y-axis available
- + Hydraulic zero point clamping system
- + SIEMENS SINUMERIK 840D sl machine control unit
- + Customized electrolyte management system



## TECHNICAL DATA

Component diameter up to	mm inch	900 36
Workpiece weight up to	kg lbs	300 661
Generator capacity	A (DC)	2 x 2,500 – 5,000
Generator capacity	A (pulse)	2 x 6,000 – 12,000

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

# EMS

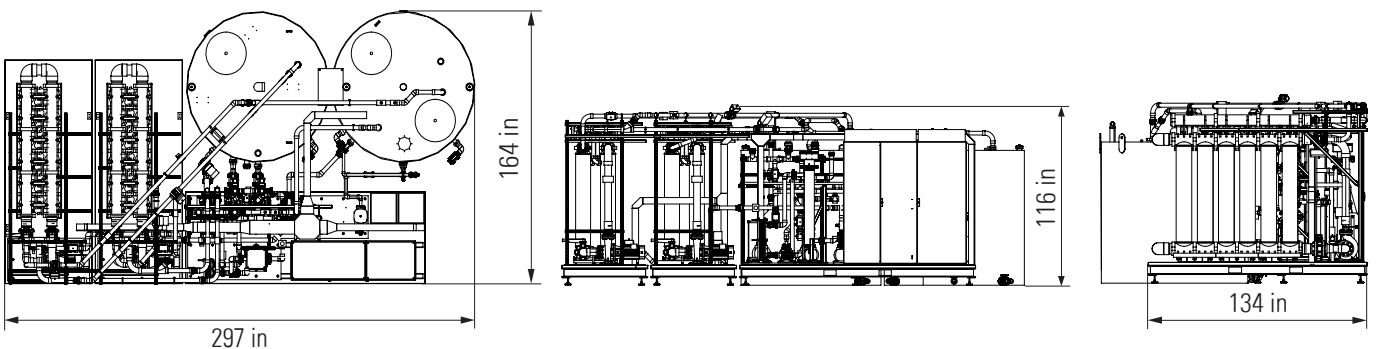
## EMS – ELECTROLYTE MANAGEMENT SYSTEM

This allows the filtrate quality and volume to be customized specifically to your requirements. Systems with a filtration capacity of between 40 and 600 l/min (10-158 gal) are available, standard. Monitoring conductivity, temperature, pressure, flow rate and pH value allow for high reproducibility of machining results.

Depending on the discharge volume, sludge can either be removed manually or automatically and will be designed to fit your production process perfectly. With the modular concept of the EMAG ECM machines, you are able to supply multiple ECM machines with electrolyte using a single EMS.



## EMS 150

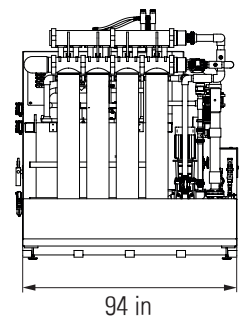
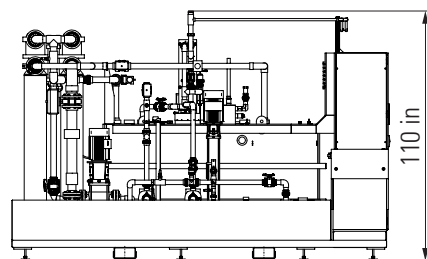
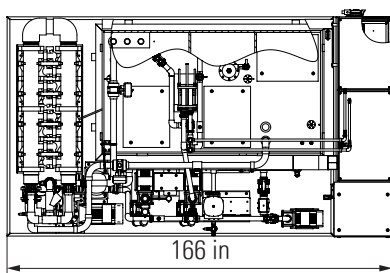




## EMAG ECM – EMS:

- + Electrolyte  $\text{NaNO}_3$  or  $\text{NaCl}$
- + Flow rates of up to 158 gpm
- + Electrolyte pressure of up to 20 bar
- + Temperature control
- + Flow rate or pressure control
- + pH value control using acid/alkaline addition
- + Conductivity monitoring
- + Particle size:  $< 0.5 \mu\text{m}$
- + Display and setting of all electrolyte parameters on a SIEMENS touchscreen panel

## EMS 35



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

# ECM Machine – CS

## CS – COMFORT STANDARD

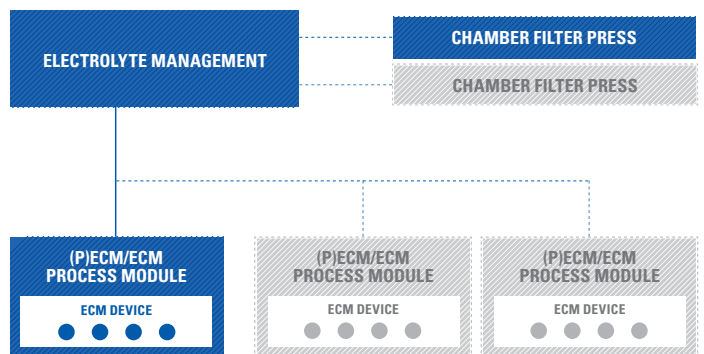
The Comfort Standard (CS) machine is the perfect system to start automating the ECM process.

- » Modular machine concept
- » Manual or semi-automatic version available
- » Quick and easy upgrade to full automation
- » Smart software and hardware interfaces

The single CS machine provides all the necessary components to incorporate a modular automation concept. The system is designed so that as production increases, additional processes can be added one at a time (for example pre-washing, ECM station 1, ECM station 2, final treatment and automation), reducing initial investment costs.

The CS is ideal for the following:

- » ECM machining
  - » ECM drilling
  - » ECM broaching
  - » ECM deburring
- on a wide range of components.





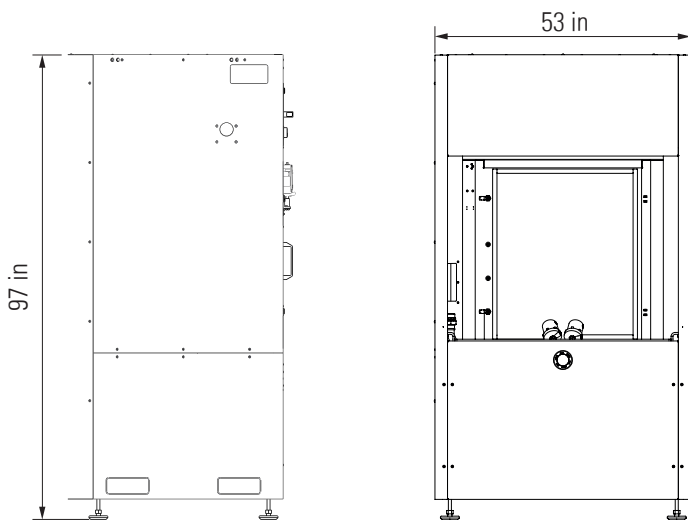
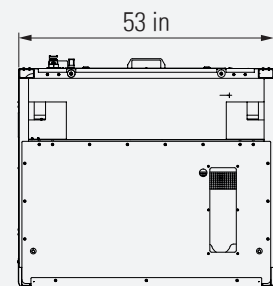


## EMAG ECM – CS

- + Modular machine concept
- + Smart software and hardware interfaces
- + Manual or semi-automatic version available
- + Quick, easy upgrade to full automation
- + The latest filtration technology
- + SIEMENS S7-300 machine control unit
- + All parameters are monitored by a control unit
- + Quill stroke with safety interlock
- + Options available for improving processes and productivity
- + Customized electrolyte management system
- + CS-DUO version with two machining areas available
- + CL or CL-DUO, large versions are also available

## TECHNICAL DATA

Machining area	mm inch	1,150 x 950 45 x 38
Clamping surface	mm inch	1,300 x 800 x 900 51 x 32 x 36
Generator capacity	A (DC)	400 – 2,500
Generator capacity	A (pulse)	400 – 6,000



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

# (P)ECM Machine – PI

## PI – PREMIUM INTEGRATED

The Premium Integrated (PI) model is the perfect entry system for automating the (P)ECM process.

- » Manual or semi-automatic version as starter system
- » Fast upgrade to fully automatic
- » Smart software and hardware interfaces

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 the following:

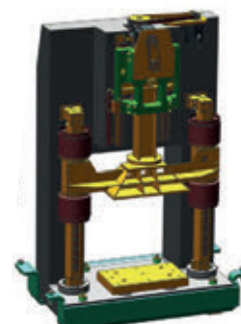
- » (P)ECM machining
- » (P)ECM countersinking
- » (P)ECM broaching

on a wide range of components.

The PI modules have a base made of MINERALIT®, a polymer concrete which is eight 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.



Countersinking module



Oscillation module



## EMAG ECM – PI

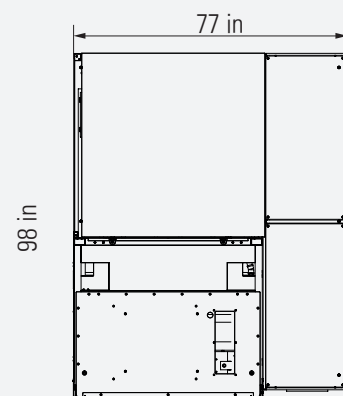
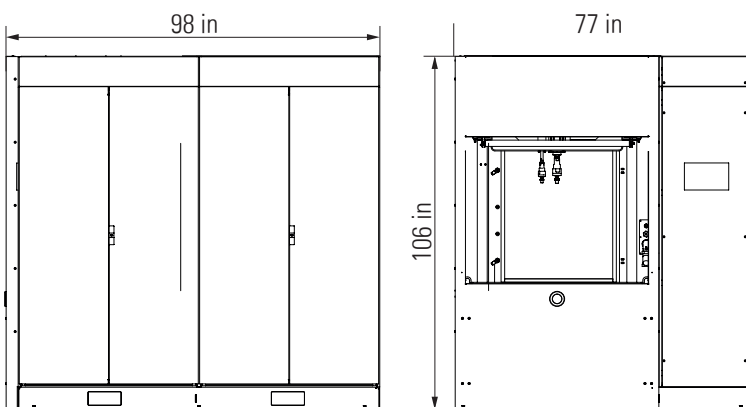
- + Compact design with integrated electrolyte filtration system
- + Oscillation module, 200 mm / 8 in stroke
- + Countersinking module, 400 mm / 16 in stroke
- + Scalable generator technology / pulse technology
- + SIEMENS S7-1500 machine control unit
- + All parameters are monitored by a control unit
- + Pulse duration from 50  $\mu$ s to DC (direct current)
- + Manual or semi-automatic version as starter system
- + Fast upgrade to full automation
- + Options available for improving processes and productivity

The following versions of PI machines are available:

- » PI 400 S (ECM)
- » PI 400 O (PECM)

## TECHNICAL DATA

Machining area	mm inch	1,150 x 950 45 x 38
Clamping surface	mm inch	600 x 400 24 x 16
Generator capacity	A (DC)	400 – 2,500
Generator capacity	A (pulse)	400 – 6,000



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

# (P)ECM Machine – PS

## PS – PREMIUM STANDARD

The Premium Standard (PS) model is the perfect entry system for automating the (P)ECM process.

- » Modular machine concept
- » Manual or semi-automatic version as starter system
- » Fast upgrade to full automation
- » Smart software and hardware interfaces

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

The PS is ideal for the following:

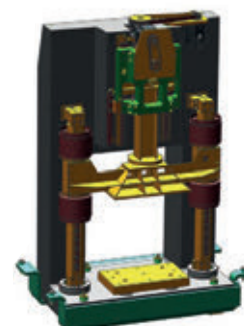
- » (P)ECM machining
- » (P)ECM countersinking
- » (P)ECM broaching

on a wide range of components.

The PS modules have a base made of MINERALIT®, a polymer concrete which is eight 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.



Countersinking module



Oscillation module

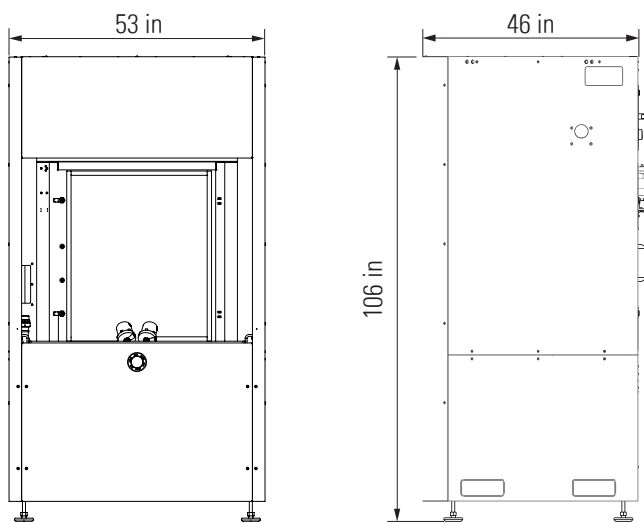


## EMAG ECM – PS

- + Modular design
- + Countersinking module, 400 mm / 16 in stroke
- + Oscillation module, 200 mm / 8 in stroke
- + Scalable generator / pulse technology
- + SIEMENS S7-1500 machine control unit
- + All parameters are monitored by a control unit
- + Pulse duration from 50  $\mu$ s to DC (direct current)
- + Manual or semi-automatic version as starter system
- + Fast upgrade to fully automated
- + Options available for improving processes and productivity
- + Electrolyte Management System, tailored to the machining task

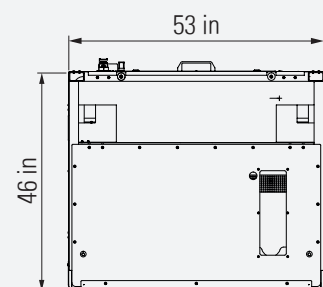
The following versions of PS machines are available:

- » PS 400 S (ECM)
- » PS 400 O (PECM)



## TECHNICAL DATA

Machining area	mm inch	1,150 x 950 45 x 38
Clamping surface	mm inch	600 x 400 24 x 16
Generator capacity	A (DC)	400 – 2,500
Generator capacity	A (pulse)	400 – 6,000



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



Turning

Milling

Grinding

Gear Hobbing

Power Skiving

# AT HOME, AROUND THE WORLD!

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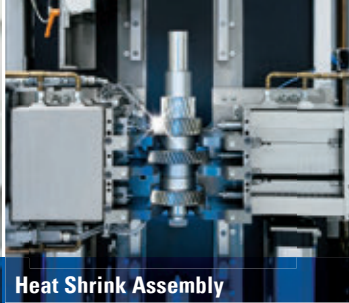
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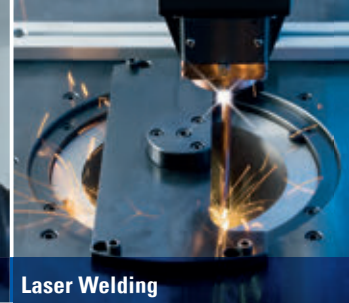
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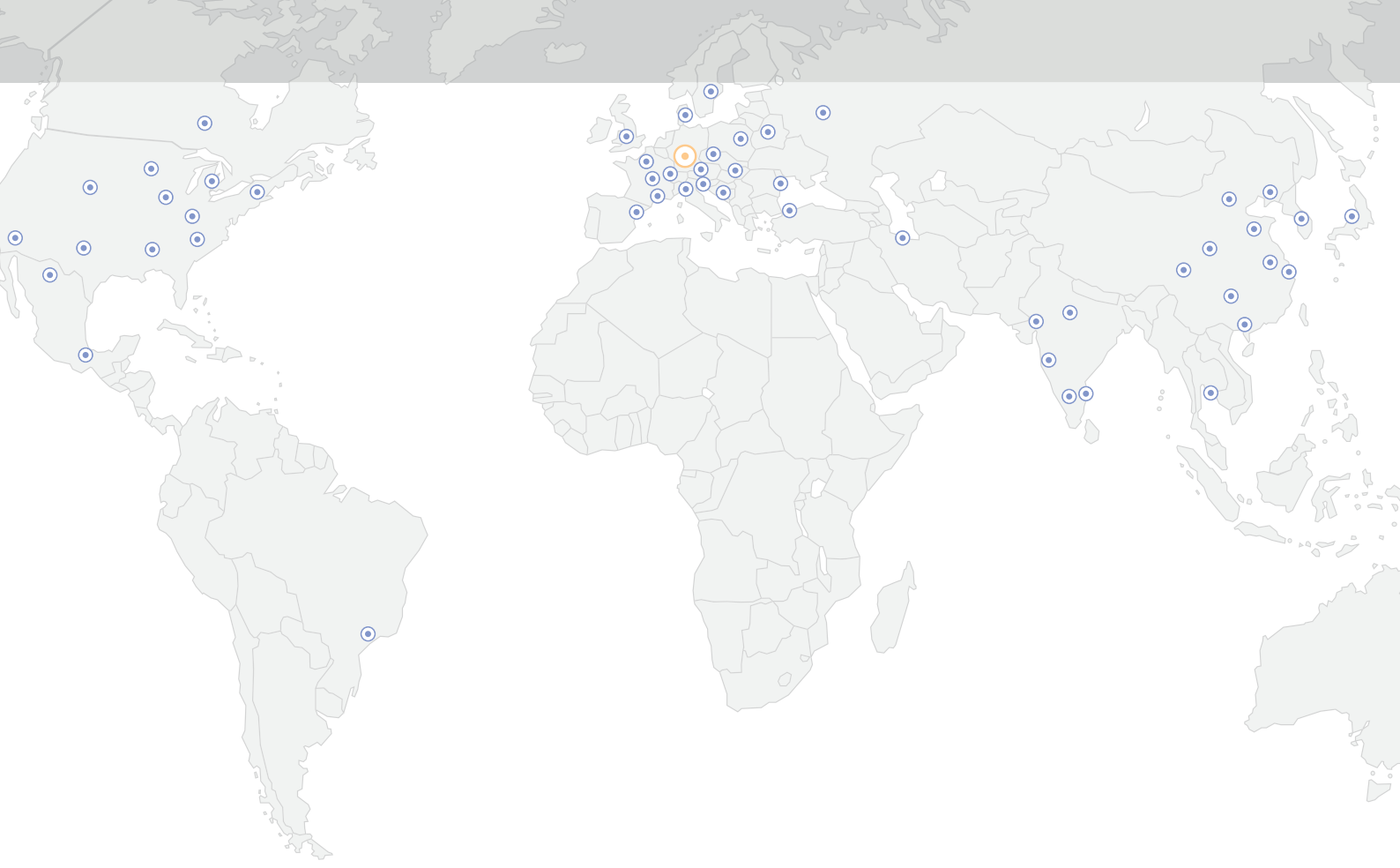
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