

EiMa Maschinenbau GmbH

The first 5-axis milling center for large series production of carbon fiber laminates worldwide

EiMa Beta S

In collaboration with BMW, EiMa has developed the first machine for machining carbon fiber laminates, which is also capable of going into large series production. EiMa's extensive experience with machining carbon fiber laminates in single and small series production was incorporated in this development.

Beta S is a very stiff 5-axis, traveling column machine with short compensation paths – for high productivity with minimum miller tool wear. Its swiveling table separates the machining area from the equipping and removal area. Loading and equipping is realized in a quiet environment that is free of dust, at an ergonomically favorable work height, running completely in parallel with the main machining time.

Innovative holding mechanisms with suction holders and additional clamps hold the workpieces – a design that is suitable for large series production. An aerodynamic suction system, optimized from the energy perspective, extracts fine carbon fiber laminate dust, which is potentially explosive. This means that workpieces are almost completely free of any dust.

In the meantime, BMW has integrated eleven Beta-S machines in its production lines (status: September 2015).

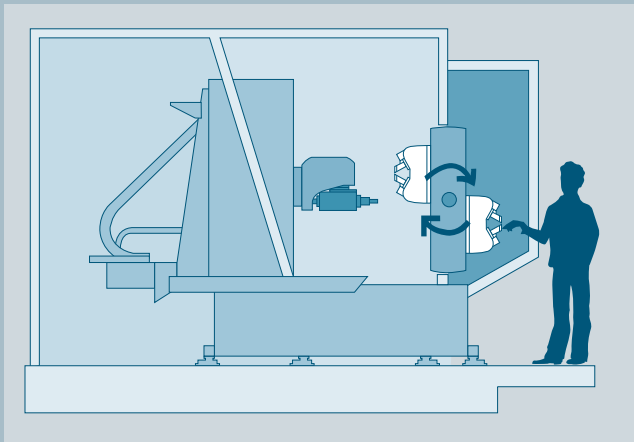
EiMa – responsible for the complete process

- Clarifications and experiments in the preliminary phase (together with users)
- Clamping technology and machine concept

- Holding mechanisms for large series production
- Energy efficiency and tool utilization
- Fine dust handling, explosion protection, removal of chips and residual material
- Ergonomics, noise along with safety and health at work
- Operating equipment regulations of the operating company (automotive)
- IT and line integration, OK check, quality data, interface to track & trace systems

Highlights of the Beta S

- Worldwide the first machine series suitable for large series production of carbon fiber laminate parts
- Completely separate removal area:
 - Work in a dust-free and quiet environment
 - Precleaned, almost dust-free parts
 - Loading in parallel with the main machining time, removal, setup, replacing equipment
- Mechanical design and tool holding system extremely stiff, minimized tool wear
- Milling tools and drills are completely utilized, lower total costs:
 - Wear calculation (effective machining distance/ cutting performance)
 - Automatic milling tool offset: even wear of the complete cutting edge
 - Automatic changeover to replacement tool



Equipping in parallel with the main machining time, loading and unloading – dust-free and quiet

The swiveling table separates the machining space of the machine from the equipping and removal area. The tool magazine is also equipped with inner and outer locations that can be swiveled for loading in parallel with the main machining time.

Technical data

- Materials: Aluminum and carbon fiber laminates
- Traversing distance:
X: 3600 mm, Y: 960 mm (up/down), Z: 600 mm
- Feed X/Y/Z axis: 70/40/60 m/min
- Positioning accuracy $P = 25 + 7 * (\text{total stroke in mm} - 1000) / 1000$ mm for each linear axis (after compensation)
- Repeat accuracy for each axis: ± 0.012 mm
- 5-axis milling head with 15 kW motor spindle (with encoder), max 24,000 rpm, 12 Nm (S1)
- Tool holder/adapter HSK 63F
- Swivel tool changer for 2 x 8 tools
- NC-controlled rotary indexing table with two fixed end positions (0°, 180°)
- Holding mechanism identification

Control technology from Siemens

- CNC: SINUMERIK 840D sl with NCU 720.3PN and PCU 50.5-P
- System software: SINUMERIK Operate with HMI Pro
- Touch panel: SINUMERIK TP 015A
- Energy data acquisition: SENTRON PAC4200
- SINUMERIK Operate with intuitive shopfloor programming ShopMill
- Synchronized actions to sense tool wear (active spindle power, milling and drilling distance)
- Complete process control and monitoring
- PROFIBUS and PROFINET validation at all machines
- Electrical cabinets are built in WKC Chemnitz, Germany

Competent partner for machining carbon fiber laminates

Carbon fiber laminates are becoming increasingly important in many industrial sectors – and are presenting new challenges for production companies. The material is harder than aluminum with the same strength, there is a risk that the electrically conductive fine dust can explode, the tool wear is comparatively high, and for the holding mechanism, material-specific special issues have to be taken into account. EiMa is a competent and experienced partner when it comes to machining carbon fiber laminates – from individual part production up to large series production.

EiMa Maschinenbau GmbH

Gutenbergstraße 11

72636 Frickenhausen

www.eima-maschinenbau.de

Siemens AG
Digital Factory
P.O. Box 31 80
91050 Erlangen
GERMANY

Subject to change without prior notice
Article No. E20001-A1870-P610-X-7600
SCHÖ/1000022620 V1.MKALLG.WES
SB 09150.5
Printed in Germany
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