


FZ100
Portal Milling Machine



THE PORT  L TO SUCCESS



WITH 6 AXES INTO A NEW DIMENSION

With the new FZ 100 portal milling machine Zimmermann has managed to achieve 6-axis machining using the newly developed M3 ABC 3-axis milling head. This concept sets new standards in the volume machining of aluminium, composite and model making materials as well as in the High Speed Cutting of steel and cast iron, where conventional 2-axis fork heads with A- and C-axis have long reached their limits in the 5-axis simultaneous machining.

Performance: Machining four times faster is possible

The machining time for typical operations such as the milling of pockets with sloping sides, for example in structural components for aircraft manufacture, can be drastically reduced by the additional B-axis. But also, in almost every other case, simultaneous machining using the M3 ABC becomes much more productive.

Surface: Perfect quality thanks to the six axes

The 3-axis head avoids the pole position of the traditional 2-axis A-/C-head at $A = 0^\circ$. Thus for the first time, particularly in mould and pattern making, optimal 5-axis simultaneous machining with the highest possible surface finish is available in practice. A real revolution!

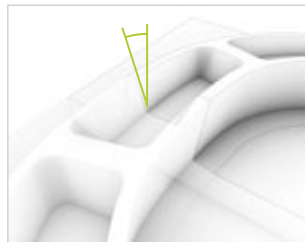
Compensation: Highest accuracy possible

For the first time the geometric errors of the milling machine can be fully compensated. Besides the overall improvement in quality, machine accuracy can now be easily recalibrated at regular intervals over a period of many years without loss of production.

Taking all these advantages together we can clearly speak of a new dimension in portal milling technology. In the following pages you can learn more about this highly productive technology.



The unique third axis is clearly visible. This B-axis can be moved simultaneously by $\pm 15^\circ$.



Typical structural components for aircraft manufacture have inner sloping sides with a setting angle of three to five degrees. With the M3 ABC milling head the machining of pockets in combination with an ideal feed rate is perfect.



Materials

- Steel and cast iron (HSC-finishing)
- Light alloys
- Composite materials such as CRP and GRP

The world's first 3-axis milling head: M3 ABC

Up to now 2-axis fork heads with A- and C-axis have been used for 5-axes machining in portal milling machines. This method has the disadvantage that there is a pole at the zero position of the A-axis, where the C-axis of the milling head is ineffective. The C-axis cannot swivel the milling spindle when the milling spindle is in the vertical position. Even the slightest change in orientation requires large rotation of the C-axis. This leads to the following disadvantages:

- Considerably reduced productivity and surface finish in simultaneous machining (thus mould makers often only use an oriented tool in so-called 3+2-axis machining).
- No compensation for errors in the machine geometry is possible. This results in steps on the surface when milling with oriented tools.

A completely new dimension in productivity

The revolutionary, design-related increase in speed can be especially clearly demonstrated based on the example of a structural component with sloping side walls of 3° to 5° as is common in the aircraft industry.

- Even in the corners of the pockets, where an A-/C-head is almost stationary, the M3 ABC achieves a constantly high feed rate, thus leading to a significantly less tool wear.
- Only minimum rotation is needed to achieve any angle of orientation with the three axes available – thus saving a lot of time.
- The pirouette-like retraction of the C-axis after each cycle is no longer necessary.



3-axis simultaneous milling without pole situation and still large swivel ranges – this is only possible with the M3 ABC.



The key to the innovation is the specially developed, very rigid and precise curved guideways of the B-axis.



In spite of the three axes, the M3 ABC is amazingly compact.

Machining time ¹			
100%	25%	50%	25%
A-/C-head with limited C-axis	A-/B-head on gimbals	A-/C-head with infinite C-axis	M3 ABC

¹ Typical structural component from the aircraft industry with sloping pocket sides. Comparison of different types of milling head for 5-axis machining. It must be emphasized that the M3 ABC has a significantly larger swiveling angle in comparison to the A-/B-head and subsequent machining with additional angle heads is not necessary.

Great flexibility

Similar machining speeds to the M3ABC can be achieved, in certain cases, using a parallel kinematic milling head or an A-/B-head on gimbals. However, these solutions have a restricted swivel angle and thus often require subsequent machining with additional angle heads. This does not apply to the M3ABC: It has three degrees of freedom and large swivel angles, thus offering complete flexibility in the way it is used.

Surface finish

Machining is performed at all times with the optimal high feedrate and always with an optimally oriented tool. For the first time in 5-axis simultaneous machining the sixth axis ensures a perfect surface finish.

Design

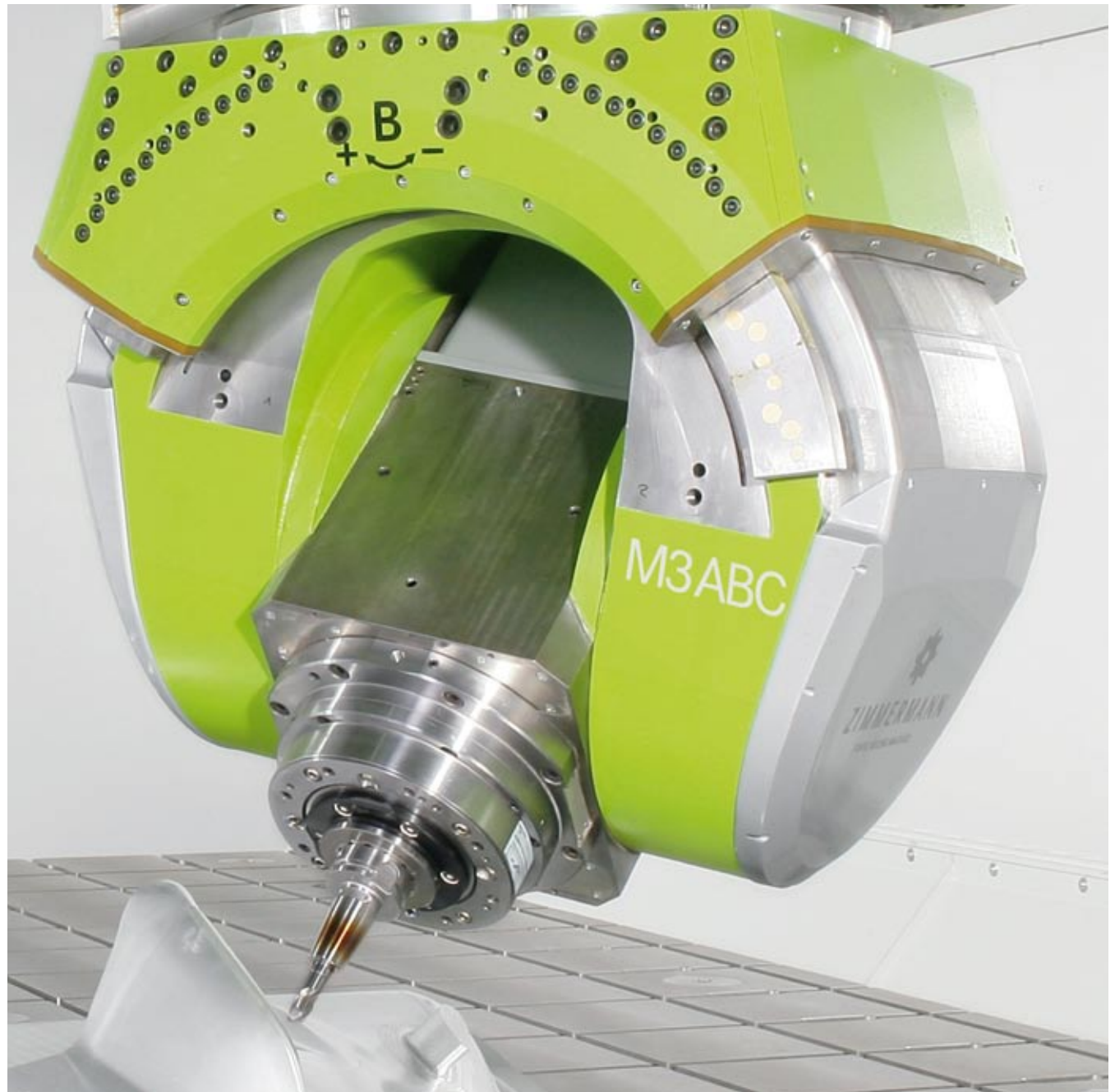
At first sight the patent pending M3ABC milling head looks like a normal fork head. It is equipped with a C-axis with a swivel range of $\pm 360^\circ$ and an A-axis which can rotate the milling spindle $\pm 110^\circ$. The design innovation is the additional B-axis between these two axes with a swiveling range of $\pm 15^\circ$. To achieve this axis, an extremely rigid and accurately curved guideway has been specially developed. Thanks to the third axis, a C-axis with infinite rotation is now no longer required.

Compact structure

The curved guideway has the advantage that the milling head is extremely compact despite the additional axis, thus further increasing the flexibility and performance.

Spindle

The M3ABC uses high-performance, well proven spindles from Weiss company. Other spindles are available as an option.





Overhead, weight-optimized and structurally rigid portal moving in the X-direction, for high dynamic performance and precision.

Weight-optimized vertical slide with high bending strength for large Z-ranges.


Backlash-free portal drives on both sides with rack and pinion mechanism well away from the dirt zone, guided on both sides.

Compound-filled side columns.

3-axis M3ABC milling head. The heart of the machine makes this the world's first 6-axis portal milling machine.

Worktable made of cast iron with T-slots, permanently anchored to the foundations.

Completely enclosed protective housing through closed side walls, back wall and a front sliding door with large inspection windows.



A strong portal design for perfect 6-axis machining

Portal milling machines are very versatile, making them an ideal basis for the new 6-axis machining. The construction with fixed side walls and an overhead portal moving in the X-direction results in very low and constantly moved masses. Thus the machine has a consistent dynamic performance leading to excellent surface finish, even with very large components. The large degrees of freedom in all axes are greatly enhanced by the 3-axis milling head, permitting optimal finish machining in a single set-up.

Design of the side columns

The side columns are manufactured in one piece up to a length of eight meters. To achieve an extremely rigid structure, they are made of welded and heat-treated steel, and filled with fiber-reinforced special compound (DemTec). In this way, our long standing system supplier ensures easy assembly, high long-term stability and practically no need for maintenance. The design also ensures the highest possible temperature stability, oscillation and vibration damping so that high dimensional accuracy and surface quality can be achieved. The especially rigid structure ensures extremely good dynamic performance and excellent contour accuracy and is thus clearly superior to conventional cast iron or welded steel constructions.

The portal

The overhead dynamically driven gantry portal enables 6-axis simultaneous machining and 5-sided machining with the highest precision and speed. The low moving masses ensure excellent dynamic performance.

Mechanical construction

To achieve the ideal machine structure, the dynamically rigid design was optimized in multi-level series of FEM calculations. Separate FEM calculations are carried out for each type of machine and each individual size. Analysis of the design is carried out using the latest mechatronic overall closed-loop simulation approach, taking into account the motors, drives and control system parameters.


Modular concept

From the start, the basic construction of the new FZ 100 was designed to make it as easy as possible to adapt all the basic parameters to the customer's specific demands. Travels, work areas, options and much more can thus be configured flexibly.

The result of this design is a unique combination of performance, short machining times, flexibility, highest quality surface finish, excellent rigidity over a long period of time and thus all-in-all extremely cost-effective.

The intelligence is in the detail

Drive system



The FZ 100 is equipped with very generously dimensioned mechanical components in the drive system (double guides in X, up to 8 carriages, reinforcing the dimensioning of drive system to Module 5). It is a simultaneous 6-axis machine with a portal driven on both sides. The X-, Y- and Z-axes are equipped with highly precise, pre-loaded circulating roller bearings in the X-axis as standard, ensuring excellent linear movement of the portal.



All axes have feed rates up to 60 m/min and an acceleration of up to 4 m/s² for the highest dynamic performance during the HSC machining.

The FZ 100 is as a standard equipped with powerful rack and pinion drives in all three axes with each two electronically preloaded servo motors in x- and y- and one in the z-axis.



Compensation

The complete work area of the machine can be fully measured using a new, cost-effective laser measurement system with all 24 possible errors within a day. With very little effort the machine can be recalibrated once a year to compensate for errors and thus to restore the original accuracy both quickly and reliably. Thanks to the six degrees of freedom, for the first time all errors of the machine can be fully compensated.

Measuring systems

The three linear axes X, Y and Z are equipped with Heidenhain direct linear measuring systems. The measuring systems are pressurized to protect them against contamination. As an option the rotary axes A, B and C are equipped with high-resolution angular measuring systems.



Control systems

In general control systems made by all the well known manufacturers can be used for 6-axis machining. Functions such as »look ahead«, »stick-slip« limitation and spline interpolation are now available as standard. The Volumetric Compensation System VCS-5ax from Siemens in the latest version of the 840D control system also provides optimal compensation possibilities. An almost unlimited number of options such as measuring probes, tool measurement and measuring software are available on request.



Clamping table

The machine bed made of gray cast iron is permanently fixed to the foundation, so that the clamped workpiece does not have to be moved. Machining is independent of the workpiece weight and thus highly accurate. The generous dimensioning – for loads of up to 20 t/m² – makes it possible to machine all kinds of workpieces.

Protection against dirt

The portal has been designed from the start to be resistant to dirt, since all the key components are positioned well away from the area where dirt can accumulate. Guides, drive and measuring systems are covered with dust-proof bellows to protect them from external influences. A wide range of systems for providing a compressed-air barrier, protective covers and extraction devices and systems are available.



Individual system solutions for every application

As well as the standard machine, Zimmermann offers turn-key system solutions to satisfy all additional technical demands.

We apply our technical expertise and tailor-made project management to the task: from the first idea to the very end of the project. Zimmermann supplies everything from a single source.

Dust and swarf

Whether to do with the health aspects of fine dust or questions of contamination with chips, from chip conveyors to full enclosure of the FZ 100, there are a wide range of solutions.

Clamping tables

Logistical considerations, size, weight, part geometry, etc. – there are aspects to consider when choosing the right clamping table and the appropriate loading systems.

Tool changer

As the link between the workpiece and the machine, tool changers of different designs can be supplied.

Clamping technology

The FZ 100 can be equipped with a variety of holding fixtures devices, depending on batch sizes, the range of components or the change-over times required.



FZ 100

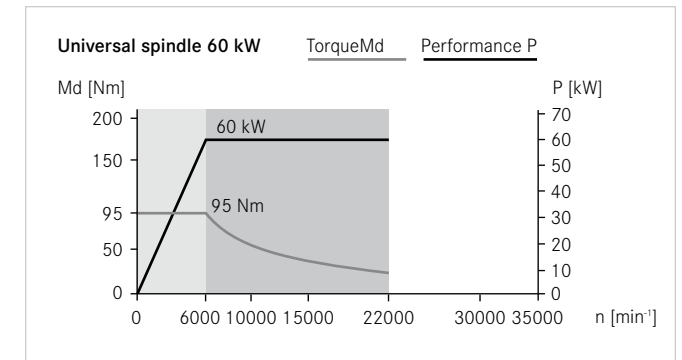
Technical data

Machine	FZ 100
Working ranges	
X-axis	2 800, 3 800, 4 800, 5 800, 7 800 mm ¹
Y-axis	2 900, 3 400, 3 900 mm ¹
Z-axis	1 250, 1 500, 2 000 mm ¹
Table size	
Length	3 800 – 8 800 mm
Width	3 000 – 4 000 mm
Height	220 mm
Table load	max. 20 000 kg/m ²
T-slots (longitudinal)	18 ^{H12} (optional 22 ^{H12})
Distance between T-slots	250 mm
Feed drives	
Feed X-, Y-, Z-axis	up to 60 000 mm/min.
Acceleration of linear axes	up to 4 m/s ²
Accuracies²	
Positioning accuracy X-axis	0,030 mm
Positioning accuracy Y-, Z-axis	0,020 mm
Repeatability X-axis	0,015 mm
Repeatability Y-, Z-axis	0,010 mm

Milling head	M3 ABC
Swiveling range	
A-, B-, C-axis	± 110, ± 15, ± 360°
Performance	
A-axis torque	825 Nm (opt. 1 050 Nm)
B-, C-axis torque	1 200 Nm
A-, B-axis clamping	2 000 Nm
C-axis clamping	3 000 Nm
Feed rate A-, B-/C-axis	180, 120°/s
Accuracies²	
Positioning accuracy A-, B-, C-axis	15"
Repeatability A-, B-, C-axis	10"

Milling spindle	M3 ABC
Performance S1 max. (100% ED)	
Torque S1 max. (100% ED)	95 Nm
Max. speed	22 000 rpm
Constant performance	as from 6 000 rp
Tool holder	
Swiveling axis – spindle nose	HSK 63 A
Tool clamping	321 mm
Tool release	spring clamp
Lubrication	hydraulic
	Permanent lubrication with automatic replenishment system

M3 ABC Milling spindle performance diagram



¹ Other dimensions on request

² According to VDI230-2 / DGQ.3441, based on basic machine, depending on the length
We reserve the rights to make technical changes

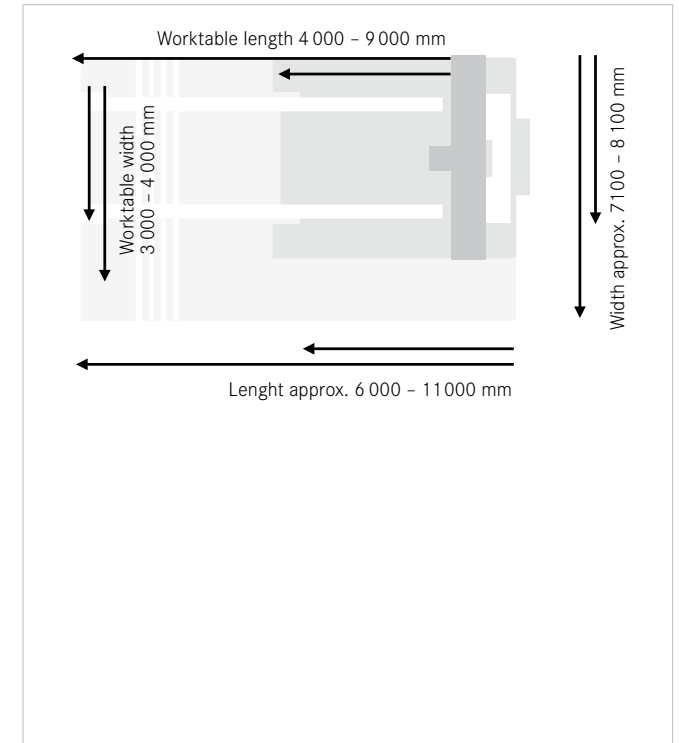
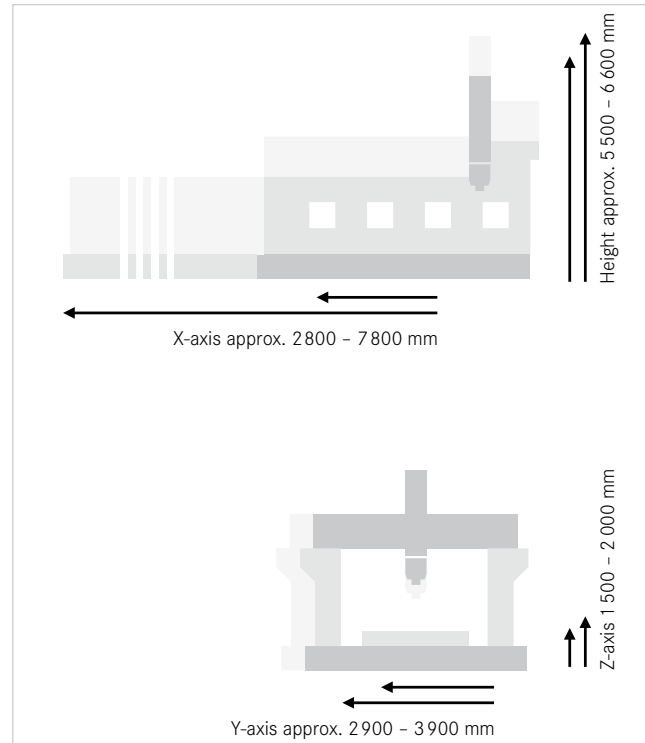
Equipment options

FZ 100

Simultaneous A-axis	■
Simultaneous C-axis	■
Simultaneous B-axis	■
A-, C-, B-axis clamping	■
Control cabinet air-conditioning	■
Housings	■
Minimum quantity lubrication	■
Coolant system (internal, external)	■
Toolchanger 30, 50, 100 positions or more	■
Measuring probe	■
Tool measurement	■
Special clamping	■
Special painting	■
Chip conveyors	■
Dust extraction	■
Clamping fixtures	■
Clamping table variants	■
Partitioned work area	■

■ Standard ■ Optional

Dimensions



All dimensions shown are examples for the FZ 100 in minimum or maximum design configurations. Special sizes deviating from this are also possible.



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PORTAL MILLING MACHINES



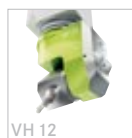
FZ 100



FZ 35



M3 ABC



VH 12



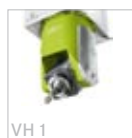
FZ 42



FZ 32



VH 6



VH 1



FZ 38



FZ 30 / FZ 35



VH 30



FZ 37



FZ 25



VH 20

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