

## **Willemin-Macodel revolutionises machine tools**

*In machining involving swarf removal, it is very rare that a new machine offers a new approach to well-established technologies; usually new developments are major or minor upgrades to known elements. With the 701S machine, which made its world première at EMO, Willemin-Macodel is rewriting the rulebook and is right on the front-line delivering a major technological leap which could well revolutionise the world of micro-technology.*

To get a quick idea of this new concept, imagine an inverted Delta robot supporting the workpiece to be machined on the basket connected to three arms. The machining spindle is attached to a fixed gantry overhanging the 3-axis table. This is a major advantage as the built-in weights are very light while still ensuring excellent rigidity.

### **Delta Structure**

The idea of producing a machine tool equipped with a parallel structure as opposed to a conventional serial kinematic structure is not new, but it has never been achieved with such a high degree of success until now. After several years of development work based on a concept by the EPFL (Swiss Federal Institute of Technology), Willemin-Macodel has developed one of the most innovative Delta machines for micro-machining with submicronic precision, and it has been entirely designed and produced in Switzerland.

### **A new machining strategy**

Dedicated to machining small workpieces ( $\varnothing$  50 x 30 mm), the entire machining strategy has been developed around 'interpolation'. In this way, machining operations can benefit from the highly dynamic control of the basket, while reducing the number of tools needed. The engineers have integrated a new numerical control on the PC base which is capable of executing control loops much more quickly than conventional controls, along with very high-resolution measuring scales (less than 10 nanometres). The combination of high-resolution measuring scales and ultra-fast control loop calculations guarantee submicronic contour tracking. The trajectory error is reduced by a factor of 10 compared with the conventional machines available on the market.

### **Powered spindle rotating at 80,000 rpm and no tool holder necessary**

A spindle shaft with no floating mechanical parts, and excellent balancing, results in top quality rotation. Removing the tool holder and mounting the tool directly in the spindle shaft means that this precision of rotation is maintained right up to the tip of the tool; it also delivers greater machining accuracy, improved surface finish quality and extends the life service of the tools.

### **Optical measuring system**

Each time the tool is changed, an optical measuring system checks the position and the geometry of the tools in rotation and makes any necessary correction to account for the real co-ordinates. This system directly corrects tool residual roundness errors. It is also used to detect and compensate for problems of wear or damage to cutting edges. Like every element of the machine, the system software has been developed by Willemin-Macodel so that it is perfectly suited to the 701S machine and its new technology.

### **Lighter, more dynamic, more rigid**

When we talk of high precision, machine manufacturers always associate weight and rigidity. Willemin-Macodel has created a paradigm shift. The parallel structure enables the weight in motion to be minimised while ensuring the feed control remains rigid. Combining these 2 elements guarantees a high natural frequency, highly dynamic control and great reliability in high-speed trajectory tracking. This machine structure is capable of withstanding accelerations of around 5G!

### **Consumption: no more than that of a hair-dryer!**

A direct consequence of this innovative machine concept is that the energy required to perform machining operations is minimal. So much so that the machine consumes around the same amount of power as a hair-dryer. The choice of high energy efficiency motors and actuators minimises heat loss and guarantees the dimensional stability of the assembly, therefore ensuring greater machining precision on the workpiece. Another consequence of the machine's low energy consumption is that it is not necessary to develop power-hungry peripherals to handle the heat which has already dissipated. In terms of energy, this machine is the first to delivery such efficiency. It is, in fact, a case of a virtuous circle.

### **Setting new standards in precision and productivity**

The new 701S clearly pushes the boundaries of conventional machining: on parts produced for customers working in partnership with us in the development of the machine, cycle times were significantly reduced as it is 2 to 5 times quicker than with a conventional process, depending on the type of application. In terms of precision, the machine can achieve submicronic accuracy and surface finishes close to resurfacing processes. If necessary, subsequent superfinishing operations will be greatly simplified.

### **Customers won over**

The operating costs of the 701S are minimal compared with a conventional process, but that argument alone is not enough; the parts produced must also be manufactured to an exceptionally high standard, and that is where our company has delivered results. Not only are parts machined more quickly, but they are also produced with greater accuracy and an improved surface finish. Willemin-Macodel engineers have been testing the machine for several months and most recently in collaboration with the company's partners. The results achieved have surpassed the targets set. The company reports that customers have been impressed by the quality of the parts produced and won over by this new technology.

### **The proof is in the....swarf!**

To convince professionals of the new process, the company has produced many parts using the 701S. The main advantages according to our customers are:

- very short machining time
- exceptional accuracy and surface finish
- low machine operating costs
- low energy consumption
- very compact size
- ergonomic and simple to program

### **Technological revolution**

We have only mentioned the main new developments; it is also worth detailing the new powered spindle which rotates at 80,000 rpm, the new palletization system and the machine's fully integrated tool changer, or even the innovations in the articulation systems and the arms supporting the workpiece holder basket. With a footprint of 1 m<sup>2</sup>, the compact size and efficiency of Willemin-Macodel's new 701S is impressive.

Constantly looking for ways to produce parts with greater accuracy and with ever finer surface finishes, the company is certainly taking it to the next level.

With the 701S, the Swiss Jura-based company has created a new category of machine which is set to revolutionise the 3-axis machining market. The machine would be perfectly suited to watchmaking or micro-moulding, for example.

### **Launch at EMO**

The machine will make its world première at EMO. The first deliveries are planned for the first quarter of 2014.

Willemin-Macodel is also presenting its high performance machining range which also includes developments that are new to EMO: the new compact and economical 308B machining centre – a world première at a machine tools exhibition – offers exceptional accuracy and flexibility for a machine of its size, given that it can machine from bar stock or in one-piece mode, always with simultaneous 5-axis machining.

The 408S2 machining centre presented with its new high precision direct drive dual divider offers highly dynamic control and also incorporates machining functions up to 4000 rpm.

The 408MTT multi-process machining centre working from bar stock and equipped with a machining turret will also be on show at the Swiss manufacturer's stand. This machine can be used for machining using two tools simultaneously on the material. With its capacity to remove swarf during machining, the 408MTT machining centre significantly reduces machining time.

The 508MT machine, renowned globally for its milling/bar turning functions, will also be making the journey to EMO. Presented with its secondary operation turret with 3 positions and its handling system, this machine integrates seamlessly into the production flow, whether this be on a small, medium or large scale. This machine is characterised by the high level of precision and quality it offers.

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**Images and captions**

**View of the machine**

With a footprint of 1 m<sup>2</sup>, the compact size and efficiency of Willemin-Macodel's new 701S is impressive.

**View of the machining area**

Workpiece holder basket mounted on 3 axes offering perfect point symmetry.

**View of a typical workpiece**

Dedicated to producing parts for the micro-technology industry, the machine challenges certain established assumptions.

**View of tool magazine**

With 36 tools in a very compact space, the 701S offers a very high level of autonomy.