

# 701S

► YOUR ADVANCED  
MACHINING SOLUTIONS



**WWM**  
WILLEMIN-MACODEL

## MACHINING CENTRE WITH PARALLEL KINEMATICS

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THE 701S MACHINE IS THE FIRST MACHINING CENTRE TO TRULY MAKE FULL USE OF THE DYNAMIC CONTROL AND RIGIDITY OFFERED BY DELTA-TYPE KINEMATICS.

TRUE TO WILLEMIN-MACODEL'S REPUTATION, THIS MACHINE DELIVERS ULTRA-HIGH-PRECISION MACHINING CONDITIONS USING VERY-HIGH-SPEED MACHINING TECHNOLOGY. THE 701S MACHINING CENTRE, THE VERY ESSENCE OF INNOVATION, OFFERS UNRIVALLED PRECISION AND DYNAMIC CONTROL FOR MICRO-MACHINING APPLICATIONS.

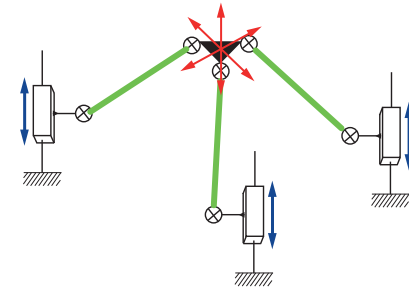
THE VERY-HIGH PERFORMANCE POWERED SPINDLE HAS BEEN SPECIALLY DEVELOPED TO FIT SEAMLESSLY WITH THE KINEMATICS ON THE 701S MACHINE. IT MEETS THE MOST STRINGENT REQUIREMENTS IN TERMS OF PRECISION AND QUALITY. THE TOOLS ARE DIRECTLY FIXED ON THE POWERED SPINDLE, WITH NO NEED OF A TOOL HOLDER. ITS MAXIMUM SPEED OF ROTATION IS 80,000 RPM.



## KINEMATICS

The concept is based on delta-type parallel kinematics actuating a basket connected to 3 arms. The major advantage of this type of kinematics lies in the fact that the weights in motion are minimised.

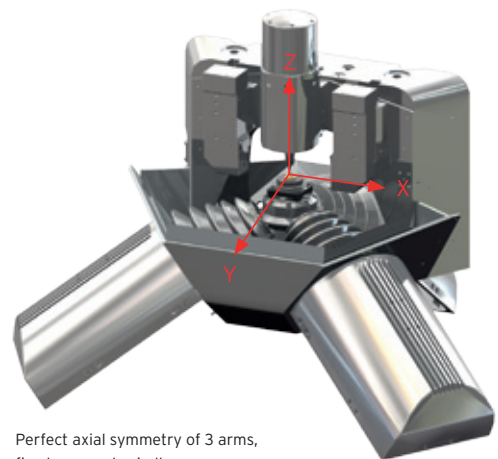
- Very rigid, reduced weight in motion
- Machining time 2 to 5 times quicker



Delta architecture parallel kinematics

## TRAVEL AND AXES DEFINITION

- X and Y =  $\varnothing$  52 mm
- Z = 32 mm
- Axes driven by linear motors
- Max. speed 72 m/min
- Acceleration 50 m/s<sup>2</sup> in machining (5g)
- Axes resolution of 10 nanometres (0.01  $\mu$ m) used optimally



Perfect axial symmetry of 3 arms, fixed powered spindle

## MACHINING STRATEGY

Dedicated to machining small workpieces ( $\varnothing$  52 x 32 mm), the entire machining strategy is oriented around «interpolation». This strategy is possible thanks to the extremely dynamic workpiece holder basket, which reduces the number of tools necessary compared with a conventional strategy.

- Excellent quality of circular interpolation
- Trajectory tracking, lower as 0.2  $\mu$ m
- Reduction in the number of cutting tools
- Uses standard tools
- Tool magazine with 36 positions
- Management of sister tools
- Ultra-high-precision and excellent repeatability
- Low sensitivity to variations in temperature



750 rpm x pitch of 0.1 mm => Fz = 75 mm/minute



## EXTREME PRECISION

The machine's dynamic control can achieve submicronic precision and very fine surface finishes thanks to the sensors' high level of accuracy and the ultra-fast calculation of the numerical control on PC base.

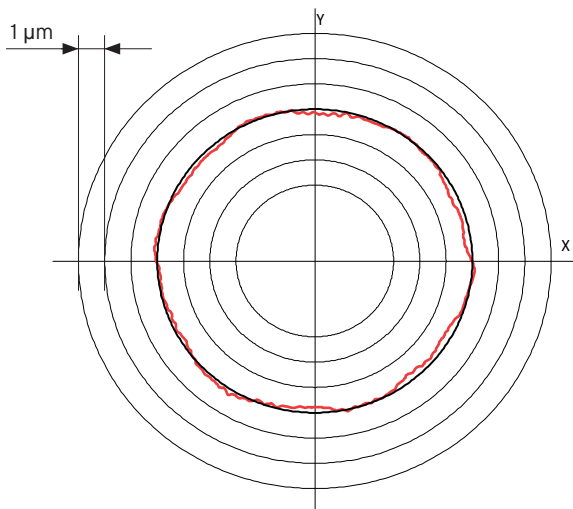
- Ultra-high-speed fixed spindle (80,000 rpm)
- Temperature variations of structures minimised
- Perfect point symmetry
- Mathematical model used to transform articular co-ordinates into cartesian co-ordinates
- Precision of joints eliminates play
- Uniform rigidity across the entire structure, guiding guaranteed without energy loss and without friction
- The centre of action of the forces is projected into the centre of the mass to be machined
- The measurement system is aligned with the machining point
- Control loop sampling frequency is very high (100 kHz)

## STATIC AND DYNAMIC

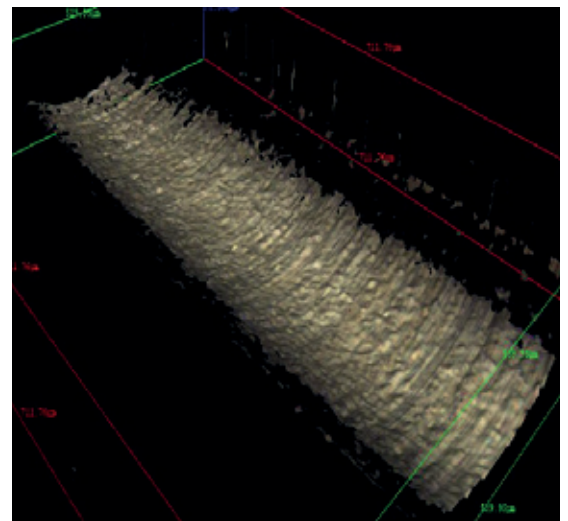
The low weight of the moving components enables great accelerations and high speeds. Trajectory tracking is improved by a factor of 10 compared with conventional machines.

- High static and dynamic rigidity
- Highly dynamic control
- Reduced payload
- Perfect uniformity of the drive chain
- High repeatability 0,1  $\mu\text{m}$
- Structure with high natural frequency
- Excellent trajectory tracking

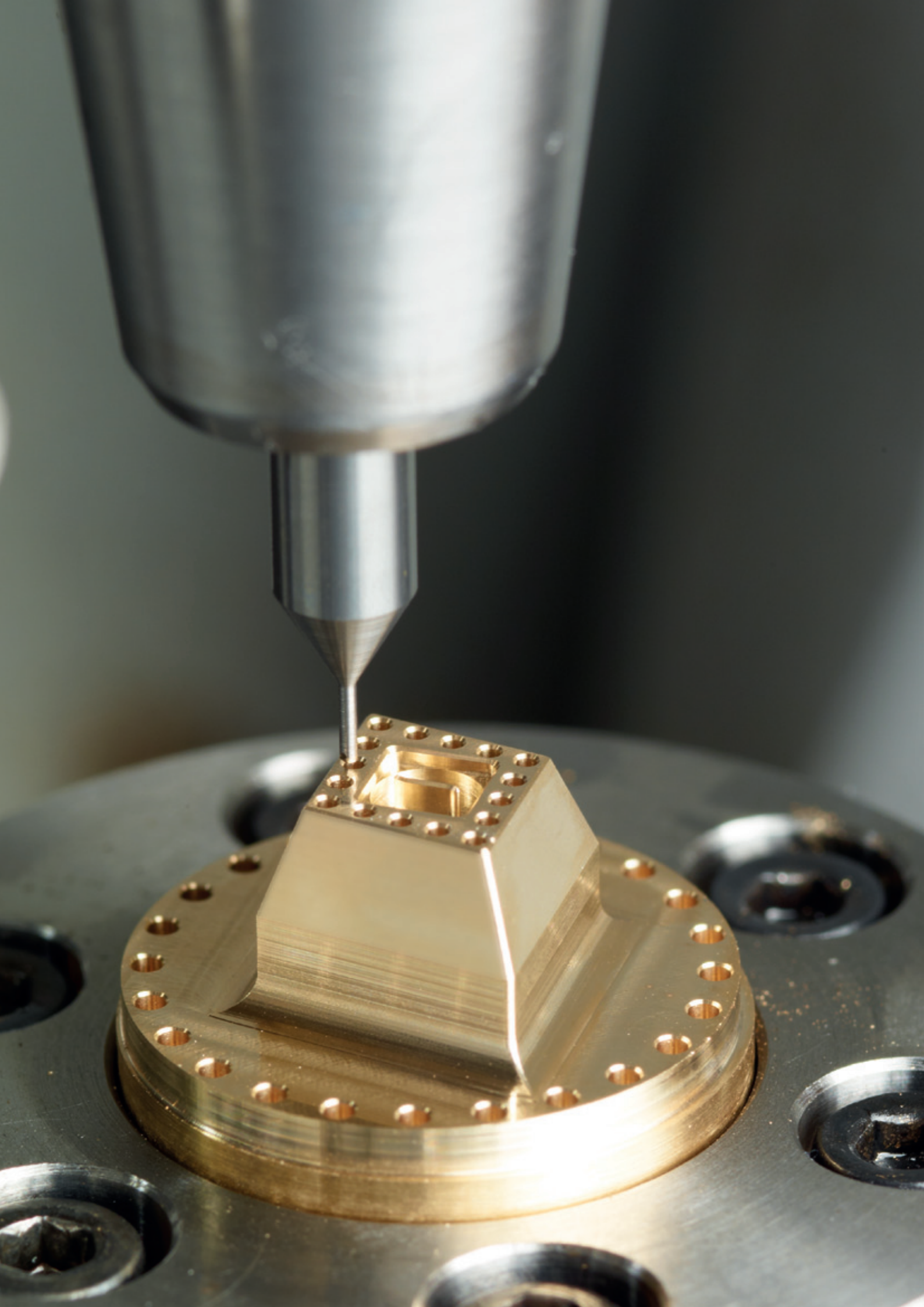
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Feed rate = 1200 mm / hmin  
 Programmed circle radius = 0.2000 mm  
 Reference circle radius = 0.1994 mm



Ra 0.35  $\mu\text{m}$  = n5. Surface finish inside a bore

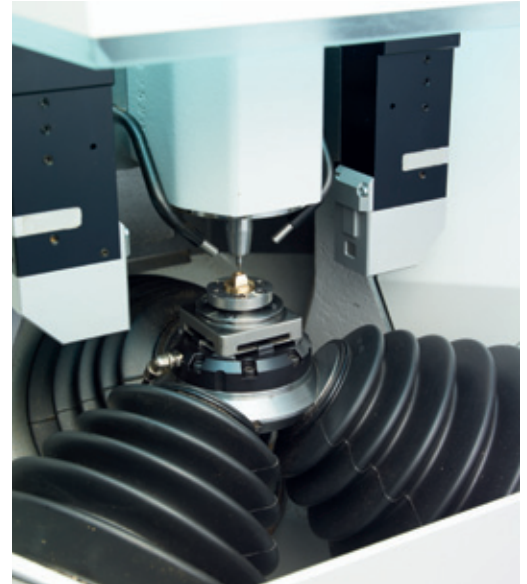


### POWERED SPINDLE

- Ultra-high-speed 80,000 rpm
- Ultra-high-precision ceramic ball bearings
- No floating mechanical parts
- Very high balancing quality
- Tool fixed directly on the spindle shaft
- Cylindrical interface  $\varnothing$  6 mm

### TEMPERATURE MANAGEMENT

- Optimisation of air-oil lubrication to minimise power consumption
- Effective thermostabilisation of the stator and spindle bearings
- Device guaranteeing constant preloading of bearings
- Perfect point symmetry in machine design

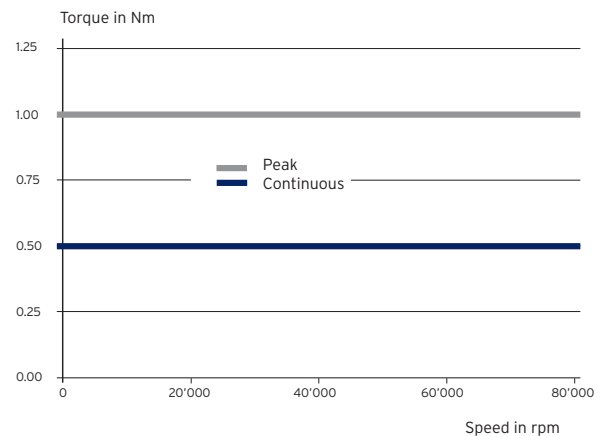
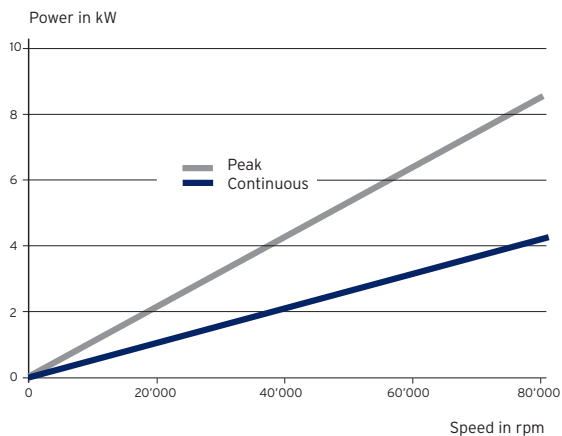


### SOUND LEVEL OF THE 701S MACHINE

- Spindle sound output at 30,000 rpm : 72 db
- Spindle sound output at 80,000 rpm : 65 db

### SERVO CONTROL

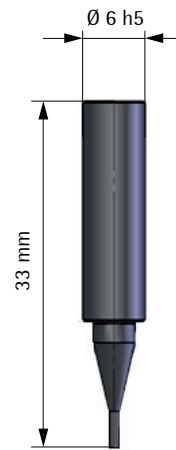
- Servo control rigidity according to speed of spindle
- Can use the spindle on the W-axis



## SECURING THE TOOLS ON THE POWERED SPINDLE

Our engineers have developed a system to «cold shrink» tools directly onto the powered spindle. Without a tool holder, the balancing, stability and roundness error are greatly improved, the machining quality and lifespan of tools are also significantly increased.

- $\varnothing 6 \text{ h5}$  mm tools
- Tooling economy







Easy access to the tool magazine, quick manual tool changes using the disc with 36 positions

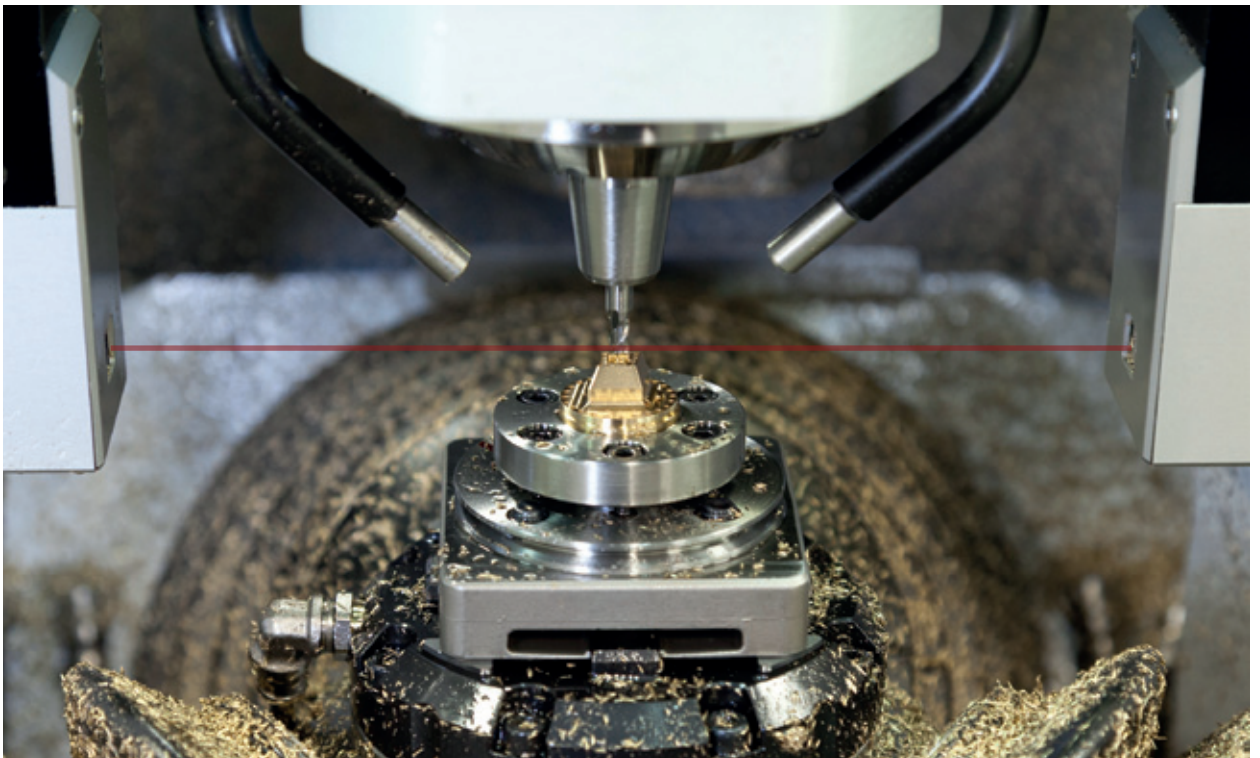
## TOOL MAGAZINE

With 36 tools in a very compact space and machining strategies that still use interpolation, meaning fewer tools are necessary, the 701S offers a very high level of autonomy.

- Magazine with 36 positions
- $\varnothing$  of plate 135 mm

## TOOLS MEASURED BY AN OPTICAL READER

Each time a tool is changed, a measuring device equipped with an optical reader checks the position and geometry of the tool, and applies the necessary adaptations to take into account the actual dimensions of the tool. This system directly corrects tool roundness errors. It is also used to detect wear or damage to tools.





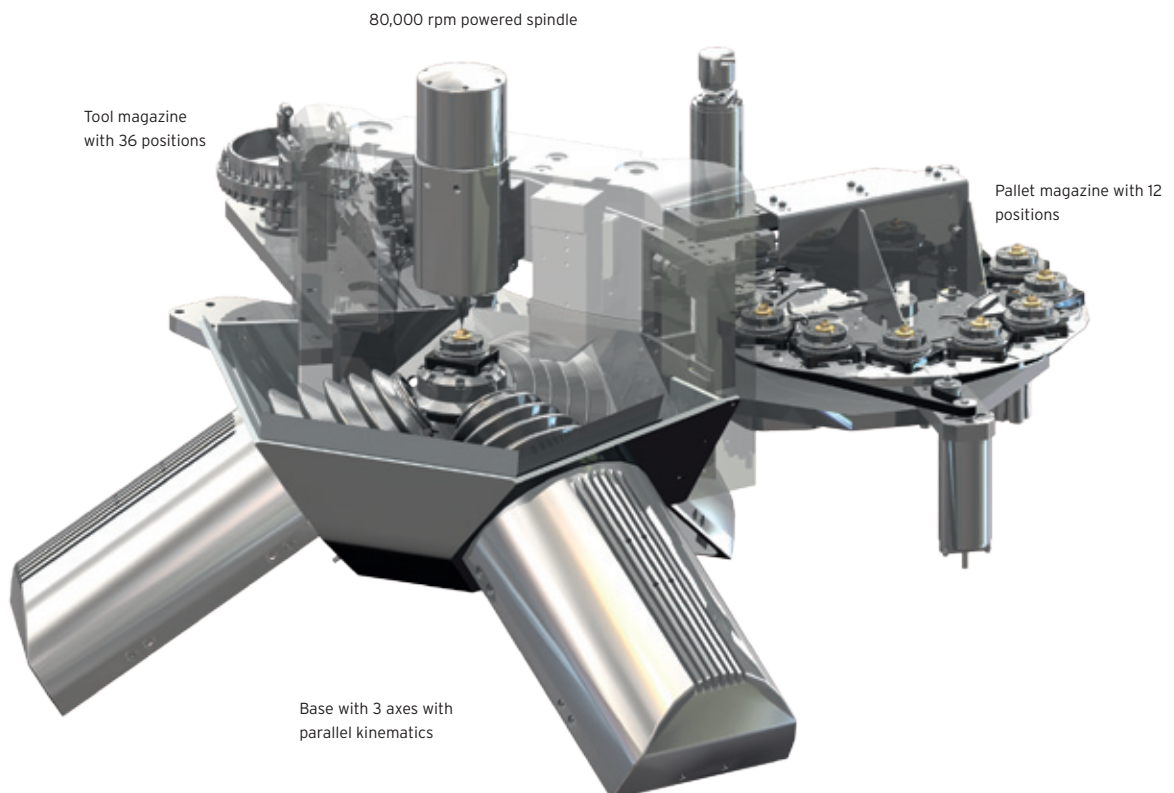
## PALLET MAGAZINE

The pallet magazine fitted on a rotating plate is used to automate production and thereby offers greater machining autonomy. Pallet feeding takes place in concurrent operation time.

- 12 pallets
- Payload 0.7 Kg
- 3R interface Macro 54 x 54 mm



Magazine of 12 pallets on a rotating plate perfectly integrated into the 701S machine

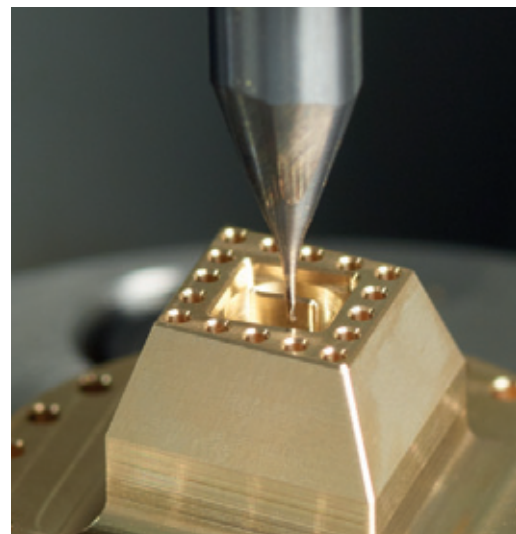
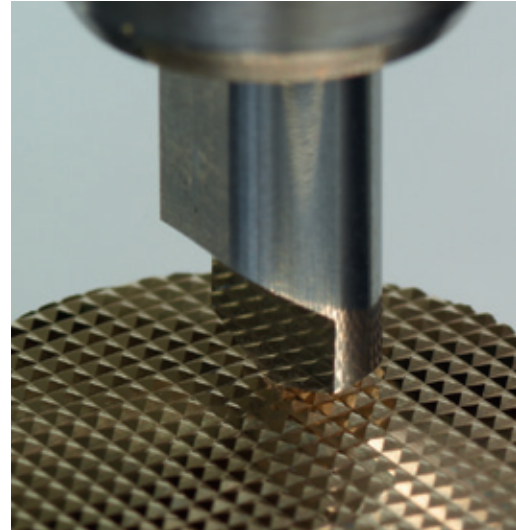




## APPLICATIONS

The state-of-the-art 701S machining centre is mainly aimed at cutting-edge industries:

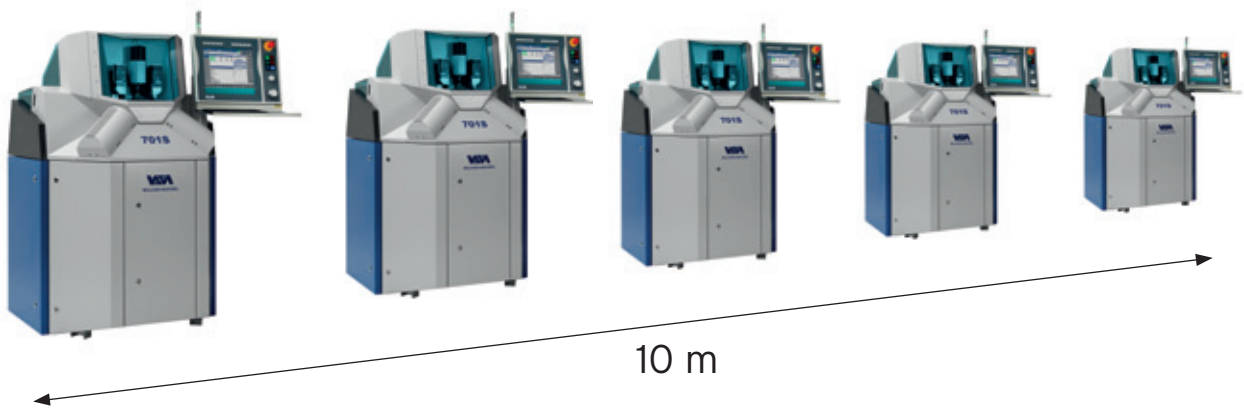
- Watchmaking / Movements
- Medical / Instrumentation
- Micro-mechanics
- Injection micro-moulding
- Optics and connectivity





## COMPACT SIZE

With a floor space of approximately 1 m<sup>2</sup>, the 701S machine is impressively compact and efficient.



## FINANCIAL SAVINGS

12

- Small footprint
- Minimal energy consumption
- Reduced cost of consumables (no need for tool holders, micro-lubrication)

## ENVIRONMENTALLY FRIENDLY

A direct consequence of this innovative machine concept is that the energy required to perform machining operations is minimal, generating less heat. The low level of heat loss also guarantees constant temperature levels are maintained.

Another consequence of the machine's low energy consumption is that it is not necessary to develop power-hungry peripherals to compensate for the heat which has already dissipated.

This virtuous circle is one of the 701S machining centre's real advantages in terms of the environment.

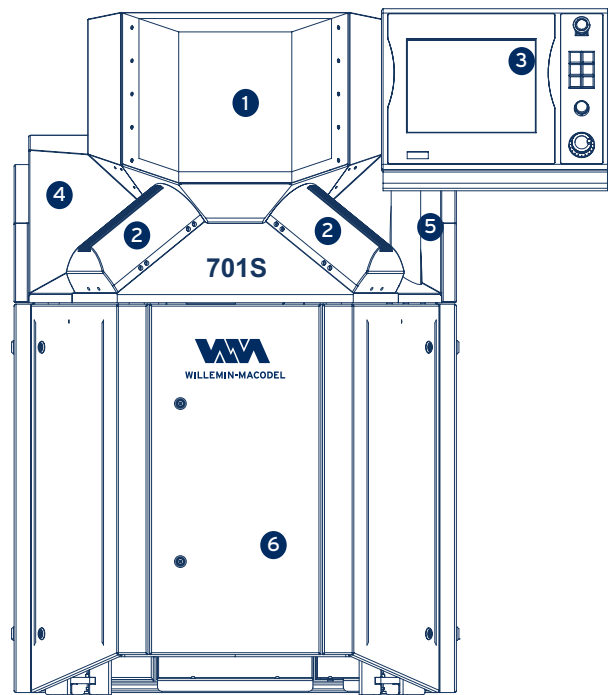
## CONSUMPTION

This revolutionary machining centre therefore offers a major advantage in terms of saving energy, as its consumption is approximately 2 kW - about the same as a hairdryer!



## CONCENTRATED TECHNOLOGY

- Parallel kinematics
- Delta architecture = reduced built-in weight
- Milling up to 80,000 rpm
- Tools checked by optical reader
- Machining using interpolation
- Micro-lubrication for high-speed machining
- No tool holder - tools are directly «cold shrunk» onto the tip of the spindle
- Constant temperature levels, minimal heat from bearings



- 1 Ultra-high-speed fixed spindle (80,000 rpm)
- 2 Delta architecture, 3 articulated arms without play and without friction
- 3 Ergonomically designed CNC with ISO programming and PC interface
- 4 Removable tool magazine with 36 positions
- 5 Pallet magazine with 12 positions
- 6 Swarf management with built-in filtration



## TECHNICAL SPECIFICATIONS

CAPACITIES	Travel	X - Y - Z	Ø 52 x 32 mm
FEEDS AND FORCES	Max. speed		72 m/min
	Acceleration		50 m/s <sup>2</sup> (5g)
	Motor feed force		65 N / 280 N max
	Resolution		< 0,01 µm (10 nm)
INTEGRATED POWERED SPINDLE	Tool connector		Ø 6 mm
	Power continuous/ peak		4,1/8,4 KW
	Torque continuous/ peak		0,5/1,0 Nm
	Speed		0 - 80,000 rpm
TOOL MAGAZINE	Number of tools		36
	Tool shank Ø		6 mm h5
	Max. tool length		33 mm
TOOL CHECK	Length / Ø / Geometry		Optical reader
PALLET MAGAZINE	12 pallets		54 x 54 mm
CLAMPING SYSTEM	Pallet		3R
COOLANT	Micro lubrication		0,3l/5 bar
	Oil		4l/min
NUMERICAL CONTROL			PC base

Voltage  
3 x 400 V / 50Hz

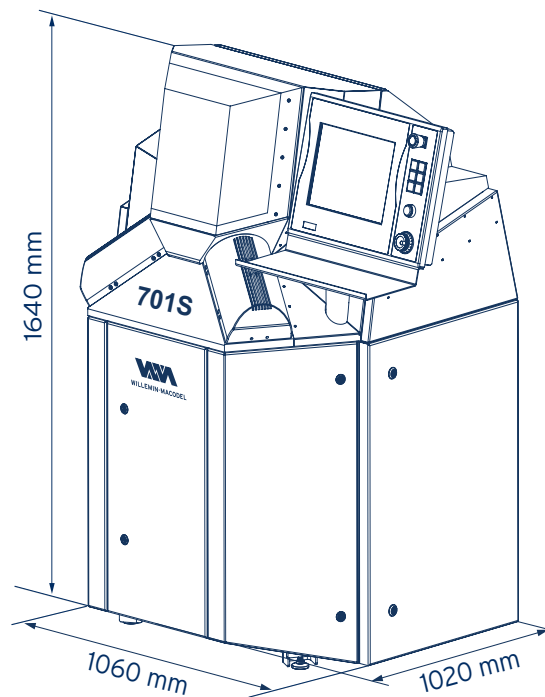
Installed power  
8 kVA/10A

Air pressure  
5 bar

Air consumption  
80 nl/min. 180 nl/min. with microlubrication

Floor space  
~ 1 m<sup>2</sup>

Net weight  
950 kg



## SIÈGE PRINCIPAL / HEADQUARTER / FIRMENSITZ

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