

Technology Special!

precision update



ISSUE 2/2009

THE NEWSLETTER OF THE PETER WOLTERS GROUP



EDITORIAL



Dear Customers and Business Partners,

For the machine tool industry, EMO is the world's leading exhibition for metalworking and the climax of the 2009 exhibition year. At this years show in Milan, we are pleased to be presenting functionally and technologically superior solutions for high precision surface processing, with which you can reliably achieve your quality, quantity and cost targets.

Over the years, our reputation for innovation and technological leadership has been our hallmark and the key to our market success. At no other time have these traits been more prevalent than during the current turbulent economic times, when we use these technological strengths, such as in those applied mechatronics, and continue to expand them.

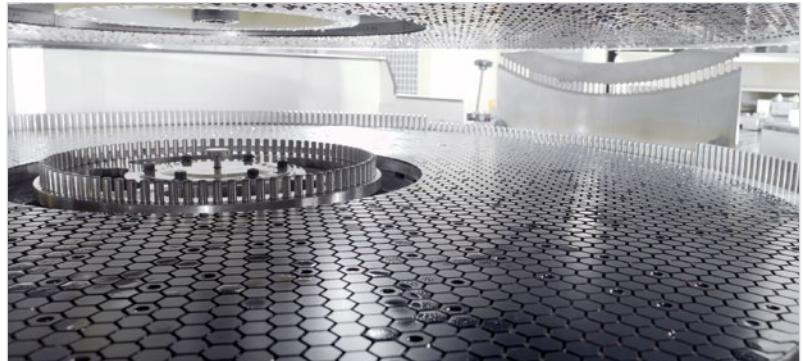
Through the integration of modern sensors and control algorithms, we have further increased our capabilities to offer more precise control of the production process and therefore offer better results with closer tolerances. Furthermore, we are currently creating pioneering innovations on the road to intelligent machines that will control themselves unassisted.

With each innovation which we produce we aim to provide a definite and sustainable increase of your productivity and competitiveness, together we will find the solution to give you a head start in precision. Please contact us.

Yours sincerely

Kay Petersen
 Manager, PETER WOLTERS GmbH

NEW PROCESS



Working area of the PETER WOLTERS AC 1000-F double-sided fine grinding machine

Sensors: Grinding process optimisation with the "sensitive grinding wheel"

Thanks to the combination of the innovative "sensitive grinding wheel" with the PDR system DataCare® and modern control loop concepts, PETER WOLTERS grinding, polishing and lapping machines set completely new standards in process quality, productivity and efficiency.

With fine grinding, polishing and lapping by means of a planetary motion, workpieces are produced to the highest specifications of flatness, plane parallelism and thickness tolerances in batch processing. To achieve optimum productivity and efficiency in addition to the required quality of the workpieces, it is necessary to dynamically and automatically adjust the grinding, polishing and lapping machines to changes in process conditions.

With the development of the "sensitive grinding wheel" for AC-series machines, PETER WOLTERS has taken an important step towards the achievement of this goal. For the first time ever, the central parameters of force and temperature distribution can now be

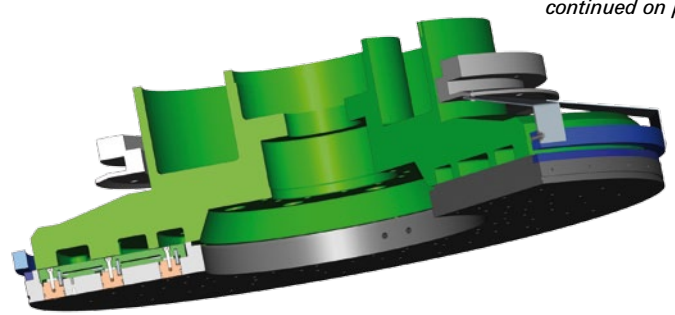


PETER WOLTERS AC-1000-F

recorded immediately and without error directly from the process by means of sensors integrated into the "sensitive grinding wheel".

Through the combination of locally measured values for force and temperature, conclusions can be drawn about

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The PETER WOLTERS "sensitive grinding wheel" with integrated force and temperature sensors enable automatic readjustment of the process to provide optimum grinding results

Visit us at EMO 2009,
 5-10 October
 Milano/Italy
 Hall 6, Booth P15/N16

MICRON NEWS

At PETER WOLTERS, the name MICRON represents a unique range of high-precision 4, 5 or 6 axis grinding machines for deep grinding (Creep Feed Grinding) and high-performance grinding (HEDG Grinding)

High-precision grinding of guide vanes for aircraft engines

In August this year, a further MICRON machine was delivered to a leading American aircraft engine manufacturer. The very highest precision was required, as aircraft engines and their components are subject to extremely high safety requirements. The high-performance Macro-series machine will be used for the optimum grinding of guide vanes. The faces of the heads and feet, which will later



Guide Vane

form an inner and outer ring in the housing, are ground; these are made from a highly heat-resistant nickel alloy, which is used in the hot zone of the engine. The form tolerance required by the engine manufacturer is < 0.25 mm with a parallelism of $< 75 \mu$, a tolerance easily achieved by the Macro-Series Machine.

Tooling

In October this year a MICRON Macro-S machine will be delivered to a US-American producer of special tools for the global market. The task is to grind precise profiles in the jaws of wire stripping pliers. The profiled grinding wheel of the Macro-S produces a profile with a depth of up to 4 mm in a single pass. The maximum permissible profile displacement is $\pm 25 \mu$ and the required tolerance for the radius is $< 100 \mu$.

The Macro-S is equipped with an indexing table, which enables parallel loading and unloading thus creating a potential throughput



MICRON Macro

of 720 components per hour. In order to ensure cool grinding and high profile precision, the Macro-S is equipped with an overhead dressing system and a diamond dressing roller.

MICRON soon to be "Made in Germany"

From the middle of October, the first MICRON machine will be built at the PETER WOLTERS headquarters in Rendsburg, Germany. In preparation for this, a PETER WOLTERS assembly team spent a long period in West-Springfield, Massachusetts/USA, where they received special training in the production of MICRON machines.

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NEW PROCESS

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the condition of the grinding wheel (e.g. the current geometry) and changes in the grinding characteristics, which could lead to negative process results. The control of the machine can then be optimised on the basis of the data obtained from the "sensitive grinding wheel". In practice, this optimisation is still performed manually. In combination with the process data recording system DataCare®, PETER WOLTERS has now for the very first time provided the possibility for the development of complex automated control strategies for planetary motion grinding, polishing and lapping machines. With this, AC-series machines can now be operated even closer to the optimum process. The advantages for users are obvious: assur-

ance and increase of quality, productivity and efficiency of processes.

PETER WOLTERS engineers are now working at full speed to develop the next generation of "sensitive grinding wheels". By the integration of additional sensors to measure wear and tangential forces (drag forces) the qualitative assessment of the grinding tool and the associated possibilities for process optimisation will be increased to a previously unattained level.

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Front view of the VOUMARD VM 360

The pioneering VM 360, for Internal & External Grinding of large Workpieces without retooling

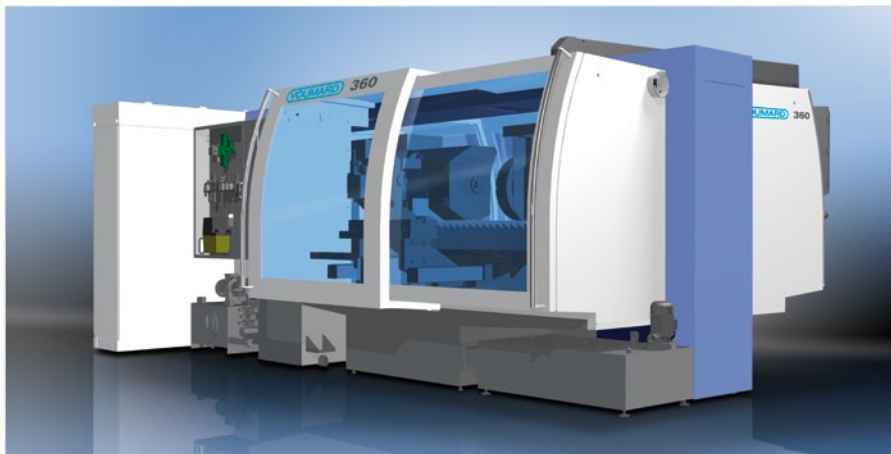
The new VOUMARD VM 360 ID/OD grinding machine for high-precision, productive single-pass processing of large workpieces

A further milestone in the consistent innovation programme of the PETER WOLTERS Group: With the new VM 360 internal and external cylindrical grinding machine, VOUMARD has extended its product range with an innovative complete grinding machine for large work-pieces. The standard version of this compact grinding machine, which was developed on the basis of the proven VM 300 grinding machine, operates with seven CNC axes, which can be optionally supplemented by another five CNC axes. The VM 360 was developed according to the requirements of our customers within the aircraft industry, the spindle industry as well as

general mechanical engineering and provides a genuine technical and economic alternative to the use of two separate machines. In a single pass, the VM 360 grinds work-pieces with a weight of up to 600 kg, a length of up to 1,300 mm and with an external diameter of up to 800 mm. One major feature is the stable and rigid grinding unit for external grinding. It carries two grinding wheels; each with diameters of 400 or 500 mm. The VM 360 can therefore be used as a fully fledged external cylindrical grinding machine. For internal grinding, four separate spindles on a revolving turret with grinding wheels or grinding rods can be

applied. The VM 360 grinds the most difficult geometries on complex work-pieces in a single pass. Automatic dressing of the external and internal grinding wheels in programmable cycles is undertaken by freely configurable dressing units. Combining the dressing capabilities with the vibration-damped, thermally stable machine base and the precision slide guides, the VM 360 guarantees the very highest precision of $< 1 \mu\text{m}$ at the work-piece.

With the VM 360, VOUMARD has opened up new opportunities for its customers for lucrative orders in many fields of application. In comparison with two separate machines, the considerably lower investment and the small footprint gives the VM 360 a strong position in the market. The combination of both internal and external grinding in a single clamping process ensures higher precision, considerably shorter throughput times and therefore a higher productivity, which soon pays for itself.



Rear view of the VOUMARD VM 360

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Integration of sensors and control algorithms as an enabling technology for Planetary Pad Grinding (PPG) of silicon wafers

The increasing demands regarding the dimensional accuracy of technical work pieces require new and optimized machining procedures. This is especially true in the field of electronic industries, where the ongoing miniaturization leads to even smaller tolerances allowed for the silicon wafers as a starting material for the electronic devices. In order to address these requirements, it is often necessary to develop not only a new manufacturing process on an existing machine tool but also to adapt the tool itself to the characteristics of the process. This can be achieved by the integration of advanced sensors and advanced control algorithms, which allow a closer control of the process and therefore better results within a smaller tolerance range.

As an example for this approach the usage of advanced sensors and control algorithms for the newly developed grinding process producing silicon wafers with very low nanotopography on a AC 2000-P³ can be described. The main challenge of the grinding process is the temperature balance during the process. The grinding of the wafers generates heat in the AC 2000-P³ which results, due to the thermal expansion of the polishing wheels, in a change of the angle between the upper and the lower polishing wheel. Since the alignment of the two wheels has an effect on the geometry of the wafer (figure 1), the alignment has to be controlled very precisely. This is achieved by means of 2 or more eddy current sensors, which are located in the upper polishing wheel and measure the distance between the two wheels during the process.

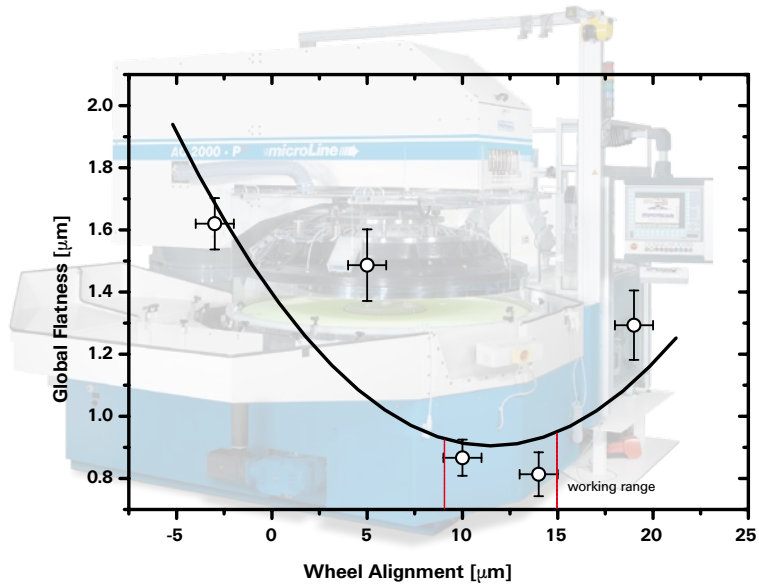


Figure 1: Achieved global flatness as a function of the wheel alignment. It is necessary to control the alignment within a range of 5 µm in order to grind very flat wafers

By comparing the distance measured by each sensor as well as monitoring the change of this distance in time it is possible to measure the alignment of the wheels very precisely. The high precision measurement is then used as input for the UPAC-system (Upper Platen Adaptive Control) which allows the angular movement of the upper wheel by means of a hydropneumatic system. A sophisticated control algorithm allows the closed loop control of the alignment within less than 45 seconds and with an accuracy of a few micron. The use of this fast control system during the rather short and rapid grinding process enables the manufacturing of silicon wafers with nearly perfect geometry.

For the subsequent manufacturing steps, not only the geometry but also the absolute thickness of the wafers after the grinding process has to be controlled in narrow limits, usually in a range of less than 3 µm. The endpoint detection algorithm has to be very fast, because the removal rate of the process is quite high. Additionally, it is difficult to measure the thickness of all wafers of the batch with sufficient accuracy, since the accuracy of the optical sensors usually used for direct measurement is also in the range of a few microns under processing conditions, limiting their usability for closed loop control.

Instead of implementing new sensors, PETER WOLTERS has addressed this challenge by further analyzing the data already obtained by the existing eddy current sensors. The distance between the upper and the lower wheel at the location of each sensor is, in fact, the remaining thickness of the wafer plus the alignment deviation of the wheels. By combining the data of 2 or more sensors it is possible to separate the thickness signal and use it as input for the closed loop control. Using this patent pending closed loop control system, it is possible to determine the end point of the process reproducible and precise (figure 2), so that the thickness of the ground wafers are all within the specified limit.

The implementation of the advanced sensors and the appropriate control system enables the implementation of new processes in the manufacturing chain of wafers and allows PETER WOLTERS' customers mass production of best quality silicon wafers.

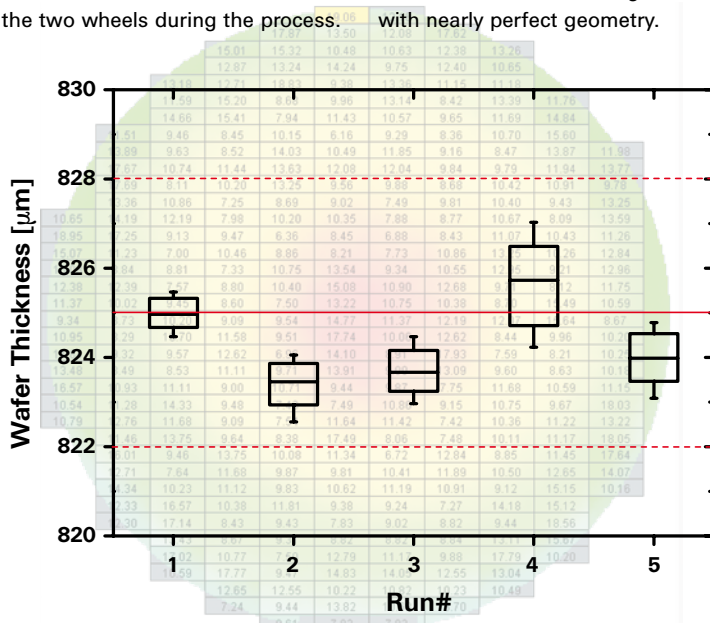


Figure 2: Statistical data on ground wafer thickness for different runs. All wafers are within the control limits.