

Case study

## Full throttle on the brake test stand



BMW AG reduces the measuring time needed for brake disc production in its Berlin-Spandau plant by more than 50 per cent. The introduction of high-speed coordinate measuring machines (CMMs) from Mitutoyo's MACH series, which will successively replace the existing measuring equipment, was key to this dramatic improvement.

*“Measuring technology by Mitutoyo has been used in the Berlin BMW plant since the beginning of the nineteen-eighties.”*

The Berlin production site is important for maintaining BMW's passenger vehicle production. The so-called 'assembled' brake discs are produced here. These are weight-optimised lightweight brake discs which – in contrast to discs cast as a single piece – are assembled from a friction ring and an aluminium cup. An extremely sophisticated piece of engineering and, incidentally, a technology that contributes significantly to the low fuel consumption of BMW's vehicles, while at the same time maintaining the highest safety levels.

Complex production methods involving potentially fundamental impact on the safety of the vehicle are inevitably subject to the most stringent testing requirements. Random inspections at close intervals account for these requirements in the production of the assembled brake disks. Here, important features are checked that cannot be tested at subsequent assembly stages.

➤ This includes, for example, the fit between the friction ring and the cup. Once these two components are riveted together they can no longer be subjected to measurement.

Up until now, these complex metrological tasks have been carried out using measuring instruments located within the production environment. These are positioned in the immediate vicinity of the production machines and provided with high-performance test benches as well as measuring devices and computerised equipment. Just as for the measuring instruments, hand-held measuring tools can also be accommodated in the extremely compact measuring stations that are tailor-made to take into account ergonomic as well as industrial safety aspects.

These were developed and supplied by the measurement instrument manufacturer Mitutoyo. Measuring technology by Mitutoyo has been used in the Berlin BMW plant since the beginning of the nineteen-eighties.

As the quantity and diversity of discs produced in Berlin increased, it became clear that the capacity of the existing measuring equipment would reach its limit sooner rather than later. There was also a financial aspect: every new model and every new brake disc variant introduced into the production program entailed considerable modification costs with respect to the measuring devices.

*“The test run only took a short time – it was instantly convincing.”*

In the long run, given a total of six measuring stations and currently 40 different disc types, this is a substantial item of expenditure difficult to calculate. Moreover, the time factor played an ever increasing role in view of the fact that the three-shift operation was now producing two million brake discs per annum. It was imperative that the entire measurement workflow as well as the testing process itself be accelerated.



At the beginning of 2012, Mitutoyo provided the measuring laboratory at the Spandau plant with a measuring machine for testing a newly developed brake disc – the perforated disc – as a loan that was supposed to tide over a supply shortage from another provider. This was the high-speed CMM known as the MACH-3A 653.

It quickly became clear that this measuring system would also be ideally suited for use in brake disc production. After all, Mitutoyo had designed the MACH-3A 653 especially for inline high-speed measurements, to a high level of accuracy, in the face of demanding operational conditions. Thanks to its completely enclosed design, this coordinate measuring machine is extremely resistant to the effects of rough production environments. And it is designed to operate over the very wide temperature range of 5 to 40 degrees Celsius. Good reasons for BMW to incorporate this system into its production. The test run only took a short time – it was instantly convincing.

Compared to current performance it was found possible to reduce measuring times by more than 50 percent with the MACH-3A 653 – full throttle on the ‘brake test stand’!

➤ Actually, this is not surprising if one takes into account the performance specification of Mitutoyo's measuring machine: with a traverse speed of up to 1.2 m/s and an acceleration of nearly 12 m/s<sup>2</sup>, which is ten-times faster than most other coordinate measuring machines, this high-speed CMM reaches its target extremely quickly. These virtues are complemented by impressive accuracy: the length measurement uncertainty specification of the MACH-3A 653 starts at 2.5 µm.

Other highlights of this impressive machine include integrated thermal-error compensation for CMM and workpiece in the temperature range 5° to 40°C; an optional indexing table capable of 5-degree increments; an integrated operating mode display with traffic light indicator (automatic/joystick operation, malfunction) and a compact build with a small footprint.

As an essential precondition, any measuring instrument used in a production environment at BMW must feature

maximum user friendliness. It has to be ensured that workers tasked with random testing are able to operate the system in an uncomplicated and safe manner. Sensors for recognising the devices in use provide for a safe process. In addition, Mitutoyo supports its customers in preparing an individual safety concept pursuant to the Machinery Directive.

The sum of all these advantages led to an order of several MACH-3A 653 high-speed machines from Mitutoyo, all at once. A total of six units, to be exact.

Mitutoyo supplied the MACH-3A 653 CMMs installed at the Berlin plant inclusive of all peripherals, including a made-to-measure loading system and support devices, as well as implementing integration of the software into the BMW-specific statistical evaluation system. Full throttle, then, in all regards.

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