State of the art MT and UT test stations in the German automotive industry

Michael Maaß, Wolfram A. Karl Deutsch, Frank Bartholomai
KARL DEUTSCH
Otto-Hausmann-Ring 101, 42115 Wuppertal, Germany
Phone (+49-202) 7192-185, Fax (+49-202) 714-932, info@karldeutsch.de, www.karldeutsch.de

Introduction

This presentation will show installations of MT and UT solutions in the German automotive production on safety relevant parts and critical engine components. The competitiveness of the German automotive industry and their component suppliers is based on a high quality standard. Contradictory requirements such as a higher degree of automation for cost efficiency and a high flexibility to support new technological advances have to be combined under the strict and rigorous precept of reliability.

MT – Magnetic particle testing technology of KARL DEUTSCH for automotive customers

Stationary testing machines for magnetic particle surface crack detection are widely in operation to check safety parts in automobile industry. The big advantage of MT is the flexibility to test different part geometries in one machine and the ability to offer cost efficient solutions for complex part geometries. KARL DEUTSCH MT machines are using the combination of 2 phase shifted AC magnetisations. This combined magnetisation reduces the MT cycle time strongly and it also guaranties sensitivity for all defect orientations in ONE test cycle, Figure 1.

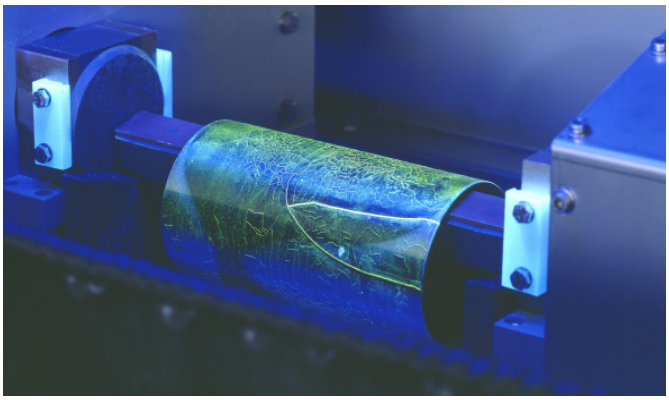


Figure 1: Hollow part tested in one test cycle with multi-directional AC magnetisation

An important positive side effect of AC magnetisation is the assurance to achieve a completely demagnetised test part after testing - a fact which became more and more important in recent years.
Various examples installed in the German automotive industry will show implemented applications with a further increase of the test speed. Figure 2 shows a turn-table solution with middle contact for simultaneous magnetisation of 2 con-rods in 1 test cycle and with loading, un-loading and evaluation in parallel to the test cycle.

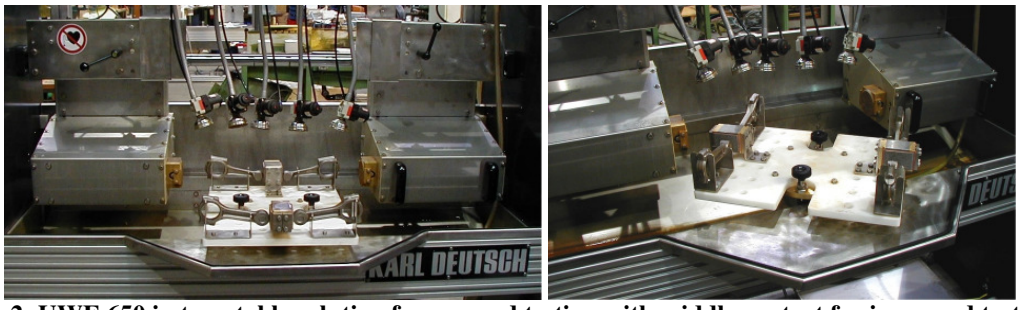


Figure 2: UWE 650 in turn table solution for con-rod testing with middle contact for increased test speed

A further increase of part throughput is linked with a higher degree of automation. This consequently leads to a conveyor system as presented in the following example of a DEUTROMAT machine for another German con-rod production line, Figure 3.

Figure 3: DEUTROMAT with conveyor and middle contact for fast and automatic magnetisation of con-rods

DEUTROMAT machines generally offer the highest degree of automation and also flexibility. If it comes to complex shaped geometries and consequently very demanding test tasks, the DEUTROMAT will deliver the solution. In this context the testing of steering knuckles has to be mentioned as typical example. Especially if the production line requests test cycle times of 10 s or even less, a multi-contact DEUTROMAT with a combination of 4 AC magnetisations in just ONE cycle is the solution, Figure 4. The contacts can be flexibly positioned and therefore allow the testing of many components with different geometries in the same testing machine. In addition, individual contacts can be switched off if not required for a component.

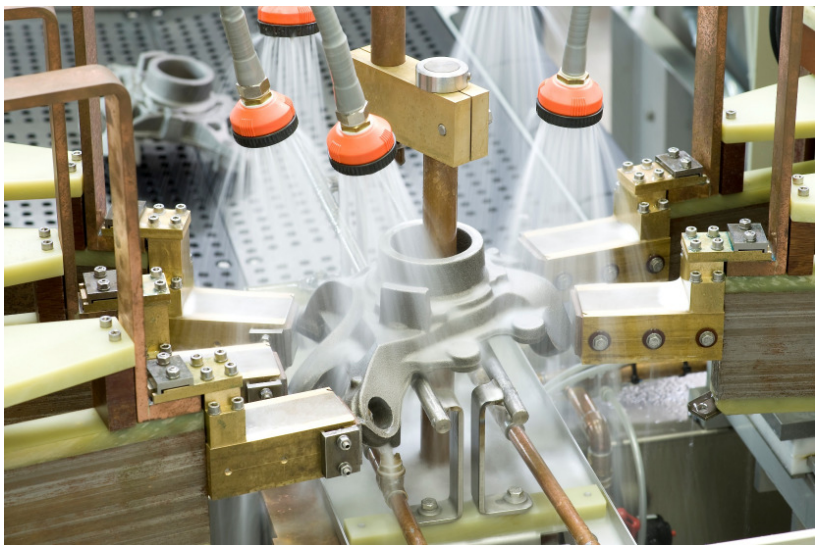


Figure 4: Multi-contact DEUTROMAT 4-fold combined magnetisation for steering knuckle tested in 1 cycle

To make a complex test machine easy to operate, the machine set-up is supported by the DEUTROFLUX MEMORY, Figure 5. All parameters are accessible by a touch panel. After the component-specific parameter settings are once defined by a supervisor, the operator just has to select the component to be tested from a menu to do a type change-over. Thus, false set-up and wrong operation are ruled out.

Figure 5: DEUTROFLUX MEMORY touch panel

The activation or disabling of contacts is also accomplished via the control mask as shown in Figure 6. The electric current values are accessible for all four contacts. Each contact can be activated or disabled separately (buttons K1 to K4). Further menus are provided to control field strength and clamping time for each contact. Deviations from the set-points are automatically monitored.

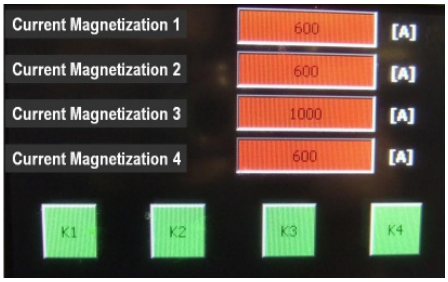


Figure 6: DEUTROFLUX MEMORY with multiple contact control

More and more automotive customers request the reproducibility and repeatability of NDT systems to be confirmed by Gauge R&R studies. To assure reproducible indication sensitivity in MT applications KARL DEUTSCH invented the new so called "Fluxa Control", which regularly and automatically controls the quality of the testing liquid; Figure 7 shows the measurement principle.

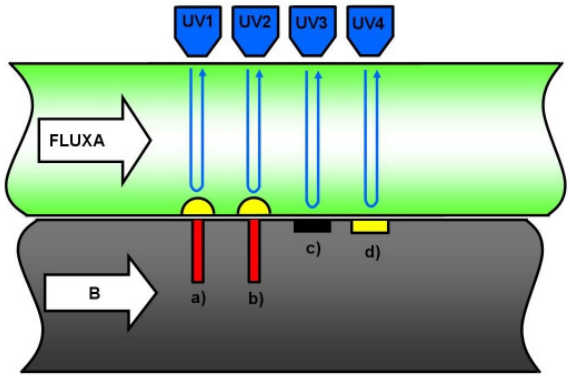


Figure 7: Measurement principle of FLUXA CONTROL (German Patent 100 39 725)

The FLUXA CONTROL is a supplementary option which can be also implemented in old, already existing MT benches. Figure 8 shows the implementation in a MT machine UWE 350 of KARL DEUTSCH.

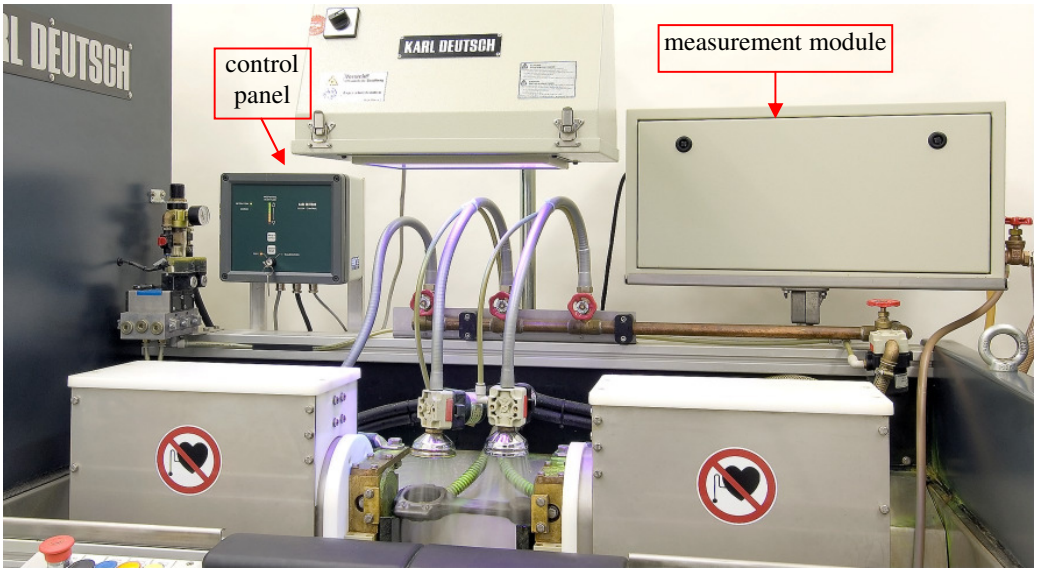
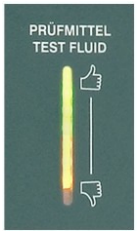


Figure 8: FLUXA CONTROL implemented in UWE 350

The FLUXA CONTROL PANEL is informing about the fluid quality with a simple and clear indication, Figure 9.



Good quality of magnetic test fluid

Warning: recommended to change test fluid
Exchange of magnetic test fluid mandatory

Figure 9: FLUXA CONTROL indication for quality of magnetic test fluid

UT – Ultrasonic testing technology of KARL DEUTSCH for automotive customers

Flexibility to component geometry and specific customer's production needs is a positive criterion for MT solutions in general, but quite demanding for automated UT test stations. Modular designed multi-channel UT electronic in combination with fast and open software interfaces are today requirements for UT installations in automotive production lines. Figure 10 shows the multi-channel ECHOGRAPH 1093, which can be equipped with up to 8 test channels.

Figure 10: ECHOGRAPH 1093 modular ultrasonic test electronic, here shown with 4 test channels

Figure 11 is a top down view into an immersion tank for weld seam testing of gear components. The component is tested from the bottom side by partial immersion. A point focussed probe with a broad bandwidth (6-20 MHz) is selected to achieve a high sensitivity for small defects in the weld seam. For automatic coupling control, the backwall echo is monitored.

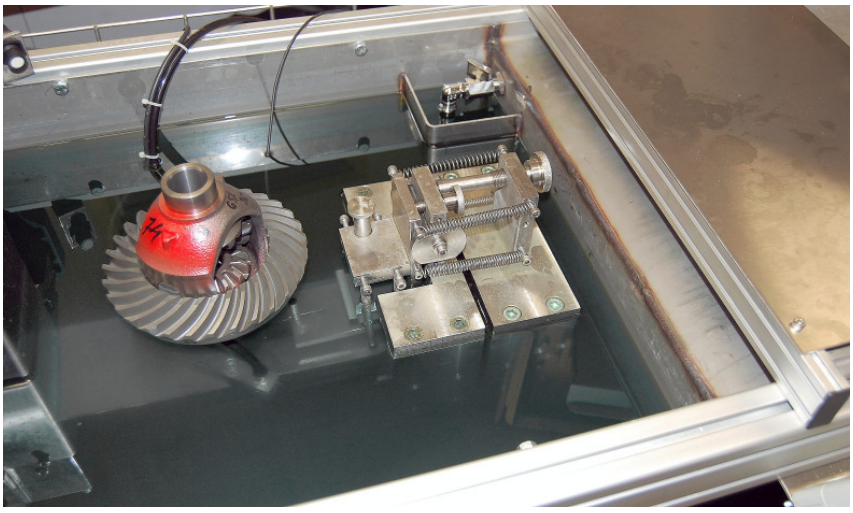


Figure 11: UT with immersion tank for weld seam testing of gear components

As another example, a UT machine for piston pin testing is presented, Figure 12. The components have a diameter range from 31 to 62 mm and a wall thickness between 8.2 and 17.5 mm. The input conveyor uses small V-rollers to transport the pins into the test station. Two rubber wheels produce a helical forward movement of the pins. Two broadband line focused probes are mounted above the specimens. Their position shows a lateral offset with respect to the 12 o'clock position of the pins, thus producing angle incidence in both circumferential directions to detect longitudinal defects. Helical test traces are achieved for full coverage of the pins. Coupling is done with partially free water jets. Position sensors enable and disable the probes. A sorting mechanics automatically separates faulty specimens into a tray.

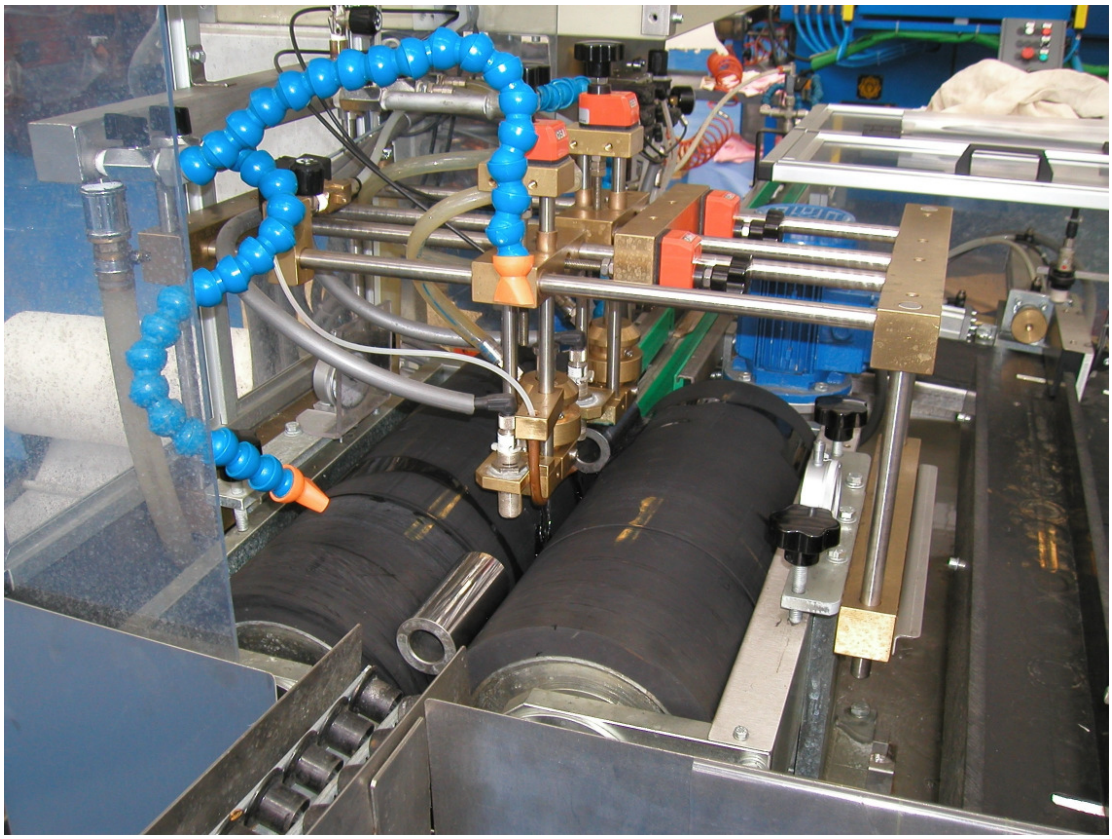


Figure 12: UT with water jet coupling for piston pin testing