NON-DESTRUCTIVE TESTING FOR THE RAILWAY INDUSTRIES

Wheels, Wheelsets and Wheelset Axles

KARL DEUTSCH

ECHOGRAPH AXLEAUTO Inspection of Wheelset Axles (Hollow Shaft)

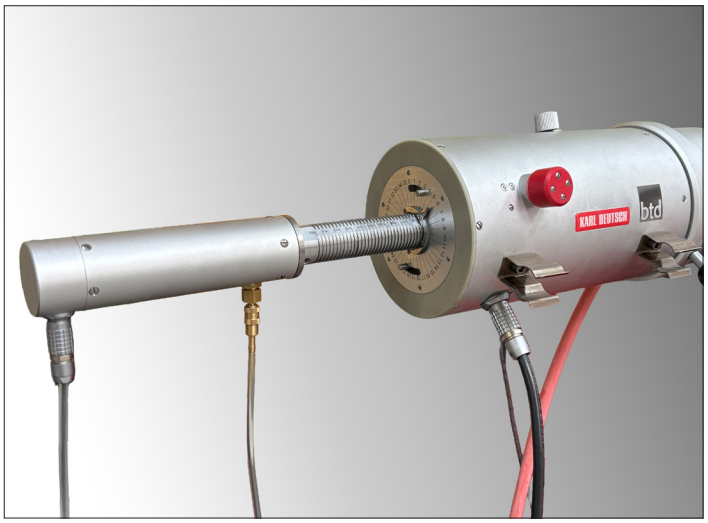
ECHOGRAPH AXLEAUTO

The ECHOGRAPH AXLEAUTO is a portable, modular testing system for wheelset axles with hollow shaft. The inspection of the axles is conducted mostly automated. The main components of the setup are a special testing unit with the necessary ultrasonic testing probes according to ISB 04 (DGZfP), a scaled inspection rod with the required elements for signal transmission, coupling agent supply, and a drive unit. The inspection rod can be halved in length so that the entire testing system can easily be stored in a case for protection and transport due to its small pack size. Mounting or dismounting the unit only takes a few minutes, depending on the required adapter. Including assembly of the axle adapter, the complete inspection of one side of the axle is finished in 15 minutes at most. The modular concept enables testing of wheelset axles with different hollow shaft diameters. Only a small amount of ultrasonic coupling agent is required due to the special construction of the probe.

This system is a more cost-effective, alternative solution to fully automated testing systems and offers smaller railway workshops and service providers an automated solution for inspections with a high flaw detection probability.

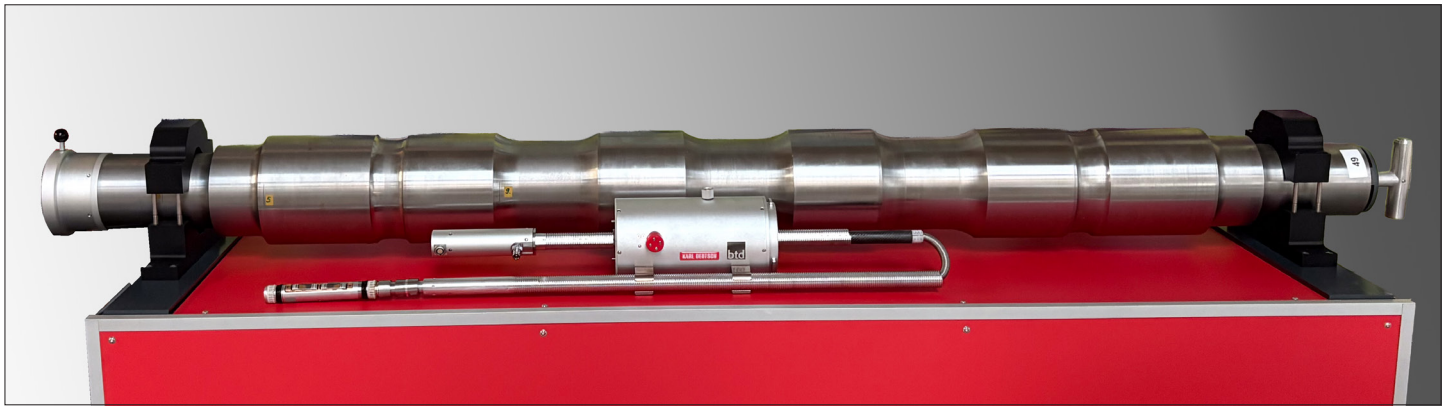
Performance characteristics:

- Probe and drive unit weight (combined): < 5 kg
- Transport length: < 900 mm
- Inspection time (net): < 8 minutes
- Assembly time: < 5 minutes
- All probe diameters available from 30 mm



Drive unit of the ECHOGRAPH AXLEAUTO with emergency-stop button and potentiometer

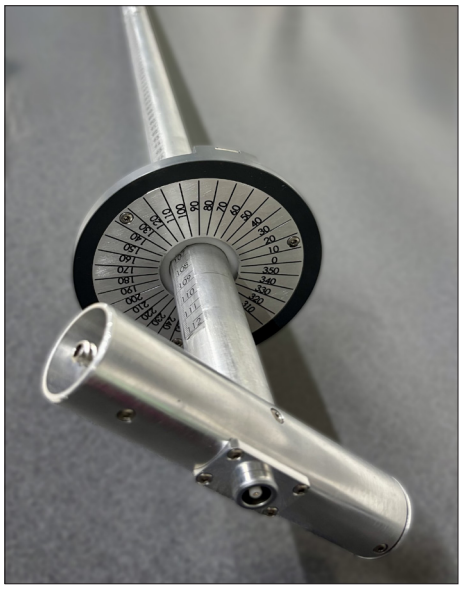
Probe for the modular testing concept – example for a bore hole diameter of 30 mm



ECHOGRAPH AXLEAUTO: The compact and handy solution for inspections of wheelset axles with hollow shaft.

ECHOGRAPH AXLEMANU Inspection of Wheelset Axles (Hollow Shaft)
CRACKVIEW AI Crack Detection System

ECHOGRAPH AXLEMANU



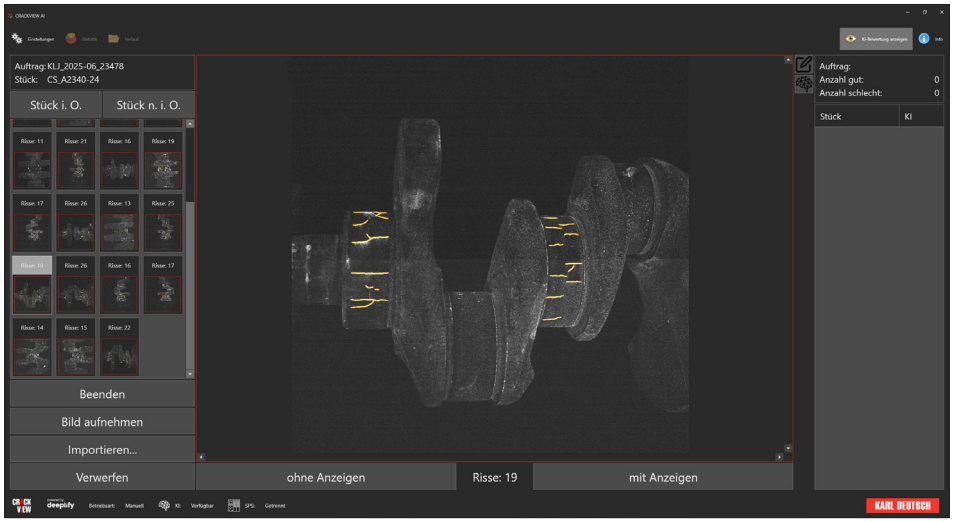
ECHOGRAPH AXLEMANU: Mobile inspection of wheelset axles with two spring-loaded ultrasonic probes

The ECHOGRAPH AXLEMANU is the smallest tool in the product family for inspections of wheelset axles with hollow shaft. The modular construction is compatible with the ECHOGRAPH AXLEAUTO and allows for using the same probes for both testing systems. A magnetic degree disc mounted to the outside of the wheelset axle helps with optimal guidance of the inspection rod and precise localisation of flaw indications. Due to the inspection rod being divisible, the ECHOGRAPH AXLEMANU has a small pack size and is easily portable. Connecting the system to an ECHOGRAPH 1095 enables working with up-to-date manual ultrasonic technology.

- Modular concept, compatible with ECHOGRAPH AXLEAUTO
- Small pack size due to divisible inspection rod
- Magnetic degree disc on the outside of the wheelset axle for optimal guidance and reproducible inspections
- Up-to-date ultrasonic technology for all applications with ECHOGRAPH 1095
- Optionally, other ultrasonic flaw detectors can be used

CRACKVIEW AI

The CRACKVIEW AI system digitises magnetic particle testing. The surfaces of the test parts prepared with magnetic particles are photographed using industrial cameras. CRACKVIEW AI uses a neural network (artificial intelligence / AI) to analyse the images in real time and determines the shape, position and number of possible crack indications with the associated evaluation result. The training of the AI is based on a KARL DEUTSCH data set consisting of thousands of images of crack indications, so that only a limited amount of customer-specific training data is required to specialise the system for a new task. Thus, the components can be sorted to OK / NOT OK without a human inspector having to view them. The inspection accuracy is constant regardless of work duration or time of day and is not subject to human influence. In addition, traceability of the test results is possible for the first time, as the individual test results of the components can be documented and archived together with the order and test piece data.



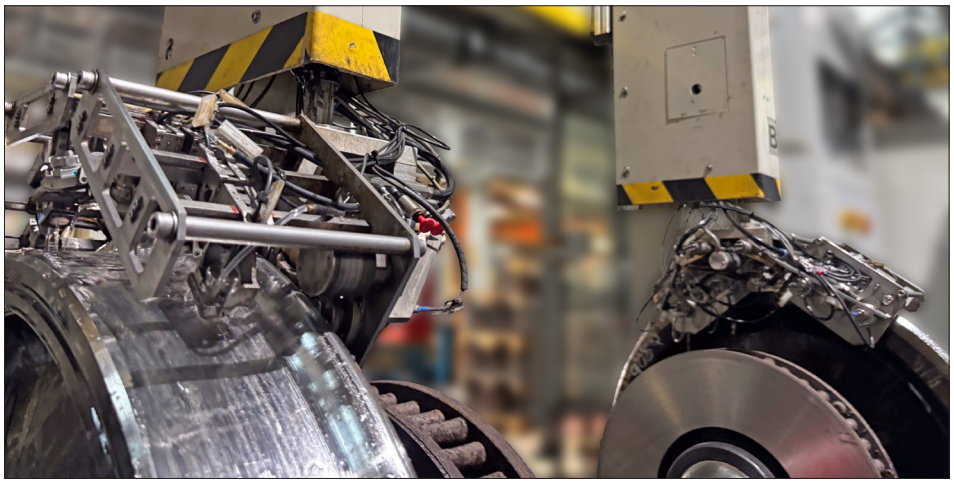
CRACKVIEW AI: Automated AI-based evaluation of magnetic particle crack indications

- Interface between neural network, PLC and cameras
- Neural network for semantic segmentation
- 3 modes: Adjustment/Manual/Automatic
- Database for order/part-related test results
- Crack evaluation in milliseconds

ECHOGRAPH WHEELSET V Inspection of Wheelsets (Disassembled Condition)

ECHOGRAPH WHEELSET V

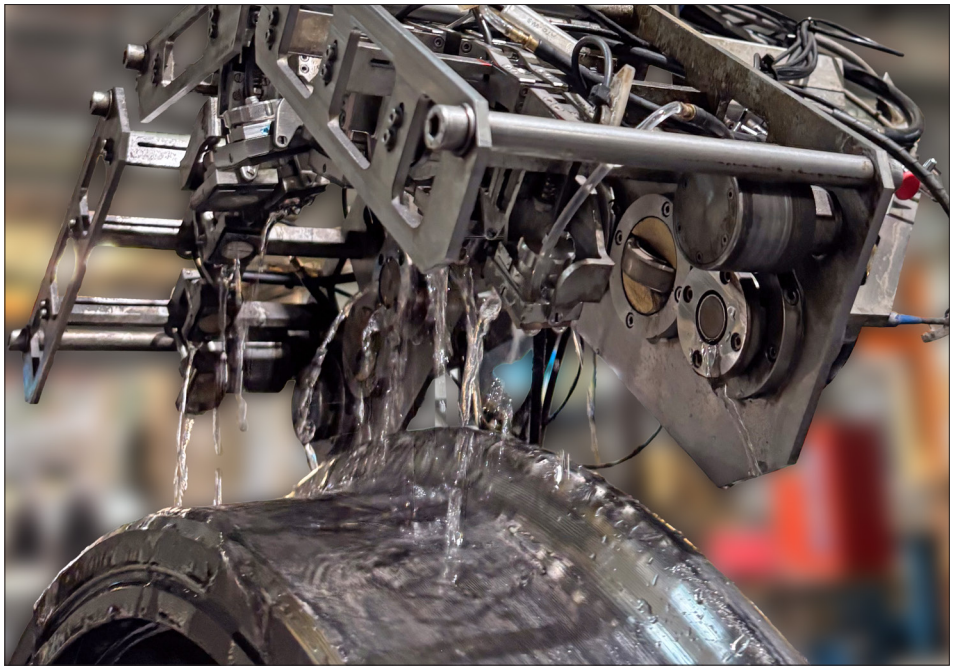
The complex automatic test bench ECHOGRAPH WHEELSET V was developed for the inspection of wheel rims and axles of different types. With ultrasonic and eddy current probes, the wheel rims are tested for longitudinal, transverse and volumetric defects. The wheel is inspected with six phased array probes simultaneously and fully automated after the wheelset data is entered. The probe holders automatically move into position at the wheel rims of the wheelsets. Testing is done on the wheel rim as well as on the front face of the flange. The wheelset is turned automatically during this process.



ECHOGRAPH WHEELSET V: Portal for testing wheelsets in disassembled condition

The ECHOGRAPH WHEELSET V is able to detect indications from a depth of 1 mm. After successful testing, the wheelset is automatically ejected from the wheel spinning stand. The test results are presented as bar diagrams with A-scans connected for every probe. The inspection of the axles is done via C-scan. Functions such as hiding form indications (without affecting the flaw indication) and zooming selected areas including their A-scans facilitate the work of the testing personnel. Recorded data is saved, logged and made available to higher-level systems via a database.

- Complete inspection of wheel rim and flange with UT and ET
- Inspection of wheelset axles with phased array technology
- Fully automated inspection of wheelsets (removed condition)
- Intuitive and comprehensive testing software



The ECHOGRAPH WHEELSET V tests with up to six phased array probes fully automatically for transverse and volumetric flaws from 1 mm depth.

ECHOGRAPH WHEELSET A Inspection of Wheelsets (Assembled Condition)

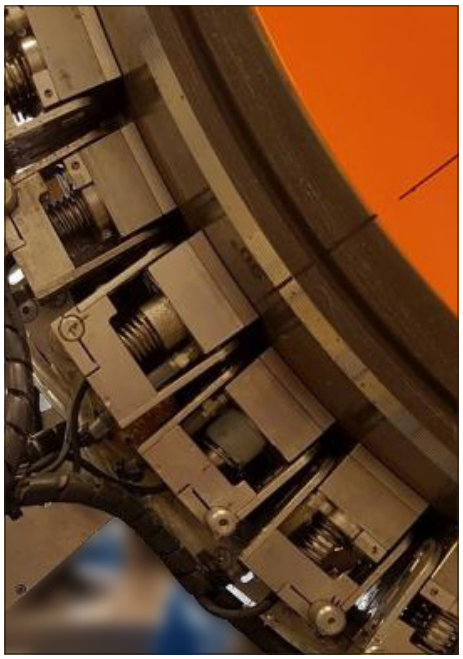
ECHOGRAPH WHEELSET A

The underfloor unit ECHOGRAPH WHEELSET A is an inspection system for fully automated ultrasonic and eddy current testing of wheel rims in assembled condition. The wheels can be tested both in profiled and non-profiled condition. It is suitable for wheelsets with a diameter range of 640 to 1200 mm with a maximum axial load of 30 tons. The tread testing system is installed four times (two systems from each side for every wheel disc) to allow testing regardless of different types of mounted parts such as brake disks, linkages, and gearboxes.

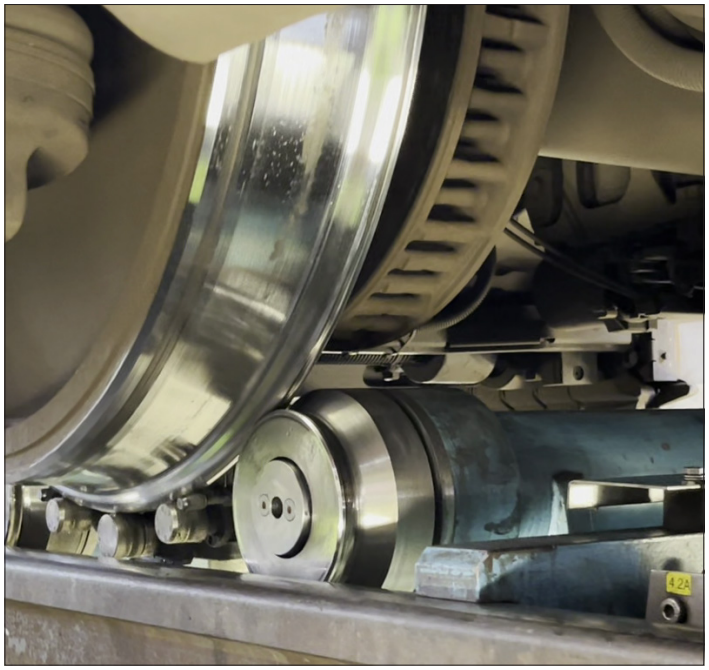
The system is adjusted in advance using a calibration wheelset with standardised flaws. Afterwards, the wheelset to be inspected is positioned above the test bed with the train. Fine adjustment is done automatically by the ECHOGRAPH WHEELSET A. With ultrasonic and eddy current testing, even the smallest hairline cracks and surface defects can be detected. For every wheel disc, 14 ultrasonic and 4 eddy current probes are used. A track of 360° is allocated to each probe.

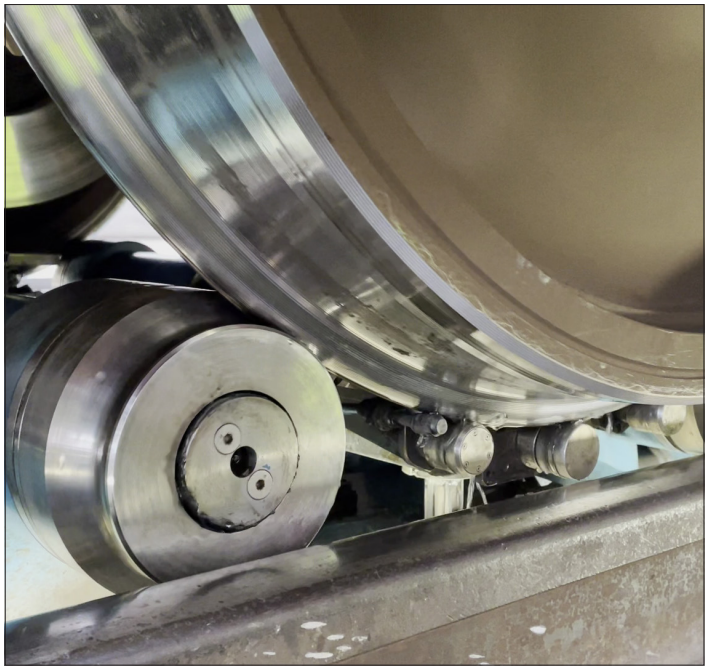
Optionally, the ECHOGRAPH WHEELSET A can be expanded with phased array technology, leading to improved imaging and inspection results. The entire test procedure is conducted automatically and takes less than 10 minutes for a flawless wheelset. The results are saved to the corresponding wheelset number with additional information regarding the inspection.

- Complete inspection of wheel rim and flange with UT and ET in built-in condition
- Fully automatic detection of standardised flaws, smallest hairline cracks and damages to the surface
- Parallel inspection of both wheels possible
- Intuitive and comprehensive testing software
- Expandable with phased array technology



ECHOGRAPH WHEELSET A: Inspection of wheelsets in assembled condition



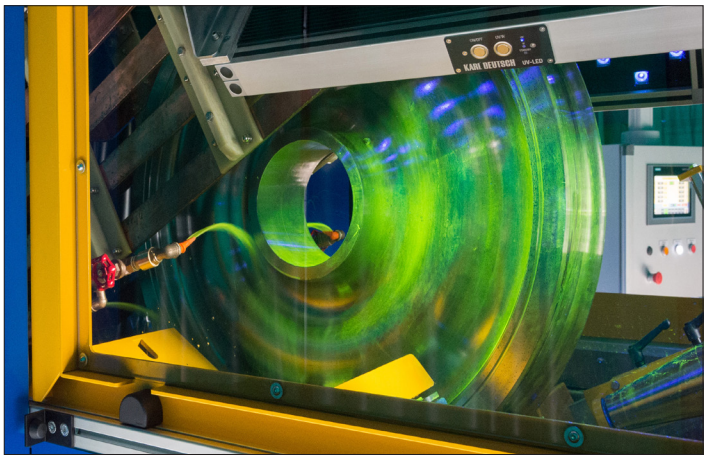


The tread inspection system approaches the wheelset from below and tests regardless of mounted parts due to the quadruple design.

DEUTROMAT, DEUTROFLUX UWS, and FLUXA
Magnetic Particle Testing of Railway Components

DEUTROMAT

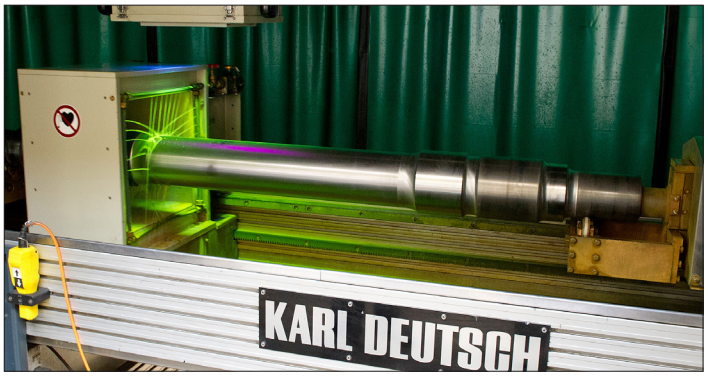
For magnetic particle testing of railroad wheels or steel tyres, a DEUTROMAT system is preferably used. A high current coil is used to magnetise the wheels. A combination of coil and yoke pair enables detection of cracks in all orientations on steel tyres. In both cases, the test piece is rotated 360° to cover the entire surface. Loading and unloading is done from top by means of a portal.



DEUTROMAT: Testing wheels for cracks in all orientations

DEUTROFLUX UWS

Both during production and revision inspection, magnetic particle testing is used in the workshops of railway companies. The inspection for longitudinal flaws (in axial direction) is done with a machine of the type DEUTROFLUX UWS, utilising ring field magnetisation induced by current flow. Inspection of transverse defects (in circumferential direction) is done with a motor-driven coil with a ring shower activated on the front. For reasons of cycle time, the coil can move in both directions, wetting and magnetising. An automatic clamping length adjustment is optionally available.



DEUTROFLUX UWS: Cabin ceiling enables crane loading from top.

FLUXA

FLUXA: Agents for magnetic particle testing

Besides systems, machines, and accessories for magnetic particle testing, KARL DEUTSCH also develops and manufactures crack inspection media. The product family FLUXA notably contains the UV-fluorescent magnetic powders, either as concentrates or ready-to-use, that are especially relevant for the railway sector. Furthermore, we also offer the test oils necessary for inspections as well as additives such as corrosive protection, wetting agent and system cleaner that allow customers to prepare their own test mixtures.

FLUXA testing agents ...

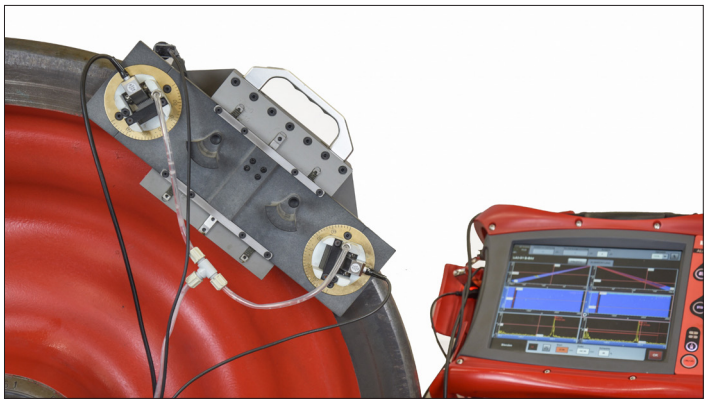
- are type-tested according to DIN EN ISO 9934-2
- fulfil multiple additional standards, such as ASME Code, Sec. V, Art.6, ASTM E1444 and E709 as well as SAE AMS3044, 3045 and 3046
- have long life times and deliver reproducible results even after over 100 hours in circulation
- are „Made in Germany“: developed and produced in Wuppertal

WS3 Wheelset Testing System
WS-RS Residual Stress Testing with Ultrasound

WS3

WERKSTOFFSERVICE Partner Products

In cooperation with W.S. Werkstoff Service GmbH, we offer a testing concept for semi-automatic ultrasonic testing of wheelsets. The WS3 (“Wheel Set Scan System”) consists of two scan appliances for axle inspection (customised for shaft and branch diameter) as well as two appliances for semi-automatic wheel rim inspection. The WS3 uses mechanical guides to accurately place the PAUT probes on the test surface. Encoders track the probe positions and end the scan automatically. The test data is connected to the probe positions for a locally precise evaluation. This system shortens inspection times, improves reliability, documents data reliably, creates electronic reports and ensures flexible configuration of the test procedures.



WS3: Semi-automatic inspection of wheelsets. First, the axle is tested, then the wheel flange with a second phased array probe holder.

WS-RS

WERKSTOFFSERVICE Partner Products

In cooperation with W.S. Werkstoff Service GmbH, we offer a testing concept as an alternative to x-ray diffractometry to test residual stress. The WS-RS system is able to conduct residual stress testing inside the wheel rim’s entire volume using ultrasonic technology. The polarised ultrasonic waves can detect both surface and internal stress of the test piece without damaging it. Wheels of good waggons are a practical application example, as they have to exhibit tangential residual compressive stress in the wheel rim after manufacturing (acc. to DIN EN 13262). Monitoring this residual stress consistently is crucial to prevent part failure, e.g. as a consequence of thermal transverse cracks. For this, ultrasonic testing enables reliable control. Due to its flexibility, the WS-RS is not only suitable for train wheels, but also for a number of other parts and materials. Additionally, this method can localise and analyse stress inhomogeneities, which is highly important in quality assurance and control.

WS-RS: The residual stress is determined with an ultrasonic flaw detector with extremely precise time-of-flight measurements and a custom probe.

BTD Company Profile
A KARL DEUTSCH Group Company

KARL DEUTSCH in Wuppertal has been developing equipment for nondestructive testing since 1949. The company currently employs 140 highly motivated staff members. An additional 20 employees in our international offices serve our customers worldwide. KARL DEUTSCH offers a wide range of products: portable instruments such as ultrasonic flaw detectors, ultrasonic probes for automatic or manual use, magnetic particle testing systems, and chemical testing agents (magnetic particles and penetrants). Over the years, two works have been built for development, manufacturing, and administration. KARL DEUTSCH maintains a rigorous quality management system in accordance with DIN EN ISO 9001.

BTD was founded in 2001 by Wolfgang Spruch in Kirchmöser near Berlin as “Office for Technical Diagnostics” and has, over the years, commissioned a large number of ultrasonic testing systems for the railway industries. In 2024, the company was integrated into the KARL DEUTSCH Group and its headquarters were relocated to the newly built Material Science Campus in Magdeburg. The complex was inaugurated in 2025 and provides modern facilities for exchange and collaboration in the fields of materials engineering and nondestructive testing, not only for companies, but also for research, education, and a DGZfP (“German Society for Non-Destructive Testing”) training centre.

Material Science Campus: Centre for research, industry, and education under one roof

Headquarters KARL DEUTSCH: Works 1 (left) houses management, administration, development, and production; works 2 (right) houses system construction.

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