- User interface in terminal case (except "UER-mobil", see separate booklet)
  - 19" TFT | PC unit | Power supply | Signal light (okay / not okay)
- 4 installation versions
  - Stationary: pedestal or swivel arm
  - Mobile trolley
  - Portable system without wired power supply
- Software providing rich options for documentation
  - Results recorded in PDF format, with or without stress distribution
  - Result recorded as a XML file
  - Straight result transfer via in-house network

Are you already familiar with our industry-standard services?

- Accredited testing laboratory in accordance with DIN EN ISO/IEC 17025 for various NDT methods
- Certificate of competence of the accredited laboratory to qualify and validate (new) nondestructive testing methods for industrial testing practice in the field of ultrasonic testing
- Rapid transfer to market readiness for qualified, standard-compliant use in industrial applications, both for new developments (in-house developments) or for adaptations
- Our associated quality management system is certified in accordance with DIN EN ISO 9001

Contact

Fraunhofer Institute for Nondestructive Testing IZFP

Campus E3 1
66123 Saarbrücken

+49 681 9302 0

info@izfp.fraunhofer.de
www.izfp.fraunhofer.de

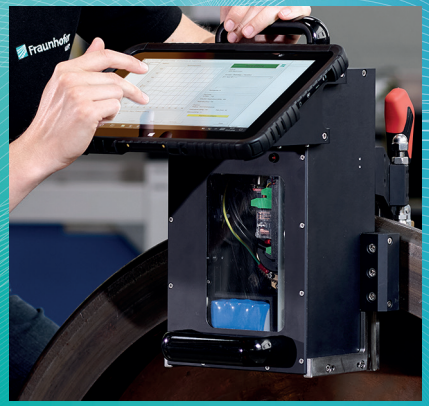
Fraunhofer IZFP

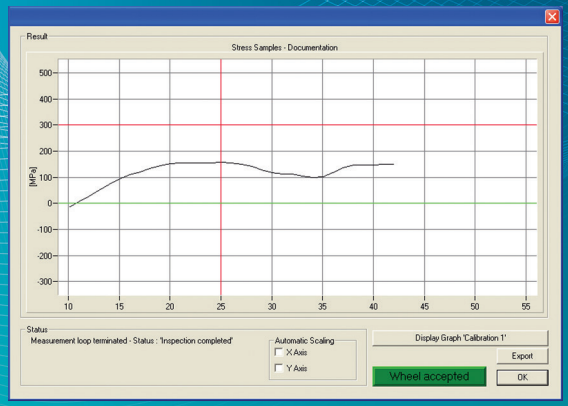
Sensor and Data Systems for Safety, Sustainability and Efficiency

Ultrasonic system for stress measurement in the rim of railroad wheels

UER

Left: UER system in operation; right: Pedestal UER version





Left: Operation of UER-mobil; right: Result screen

UER – Ultrasonic system for stress measurement in the rim of railroad wheels

Break shoes used for braking wheels of freight cars are subject to steadily recurring heating and cooling processes that vary greatly depending on the braking situation. These thermomechanical loads change the residual stress state of the rims considerably during their intended service life by gradually transforming the production-induced compressive stress state into a circumferential tensile stress. Small cracks – almost omnipresent in the tread due to the contact between wheel and rail – may grow by the influence of the mentioned tensile stress until the wheel breaks. This is why determining the residual stress states in the rims is crucial.

To determine the residual stress state of freight car wheel rims, UER uses the so-called acousto-elastic effect, describing the influence of strain and stress states on the propagation velocity of ultrasonic waves in the volume of solid bodies. The magnitude of this effect depends on the ultrasound propagation and vibration direction in relation to the principal strain or stress state directions. For the residual stress measurement on freight car wheels a linearly polarized shear wave is induced without couplant agent by an electromagnetic acoustic transducer (EMAT) with the ultrasound waves propagating from the inner side of the rim. To this, the EMAT is moved along the rim in radial direction. In millimeter increments two highly accurate time-of-flight measurements are performed, first with tangential, then with radial vibration direction of the ultrasonic wave. Since the residual stress in the radial direction is not significantly influenced by the thermomechanical processes during braking, the residual stress in circumferential direction can be determined by analyzing the time-of-flight differences of the two measurements taking into account the material-specific acousto-elastic constant.

Numerous stationary and portable Fraunhofer IZFP developed UER systems are operating woldwide in the workshops of railway companies, wheel manufacturers and service providers.

Applications

- Heavy and light maintenance
- Wheel production (DIN EN 13262)
- Wheel development

UER III

- Decades of experience in industrial application
- Frontend solution to minimize electromagnetic interferences
- Development of a mobile version 2018
- Comprehensive service and flexible technical support
- Selection of long-term available hardware components
- Compatible with modern IT infrastructure in workshop environment
- Comfortable handling, easy to learn and reliable
- Identical cross-platform inspection software for all variants

Technical characteristics

- Digital data transfer between manipulator and handling unit
- Miniaturized ultrasound electronics for manipulator frontend
  - Couplant-free electromagnetic ultrasonic transducer
  - Ultrasonic transmitter and receiver
  - Digitization with online signal preprocessing
  - Preamplifier and filter
  - FPGA unit

1 Cover picture, picture above left © *Uwe Bellhäuser*

2 Picture above left © *Uwe Bellhäuser*