

Are you familiar with our industrial-grade accredited inspection services?

- Accredited laboratory in line with DIN EN ISO / IEC 17025, to qualify and validate new non-destructive testing (NDT) processes for industrial applications
- Accelerated time-to-market and opportunity for qualified, norm-compliant deployment in industrial applications as well as for complete new in-house developments or custom adaptation of innovative NDT technologies, even in fields where norms have not been established
- Certification of the corresponding quality management system in accordance with DIN EN ISO 9001

Contact

Fraunhofer Institute for Nondestructive
Testing IZFP

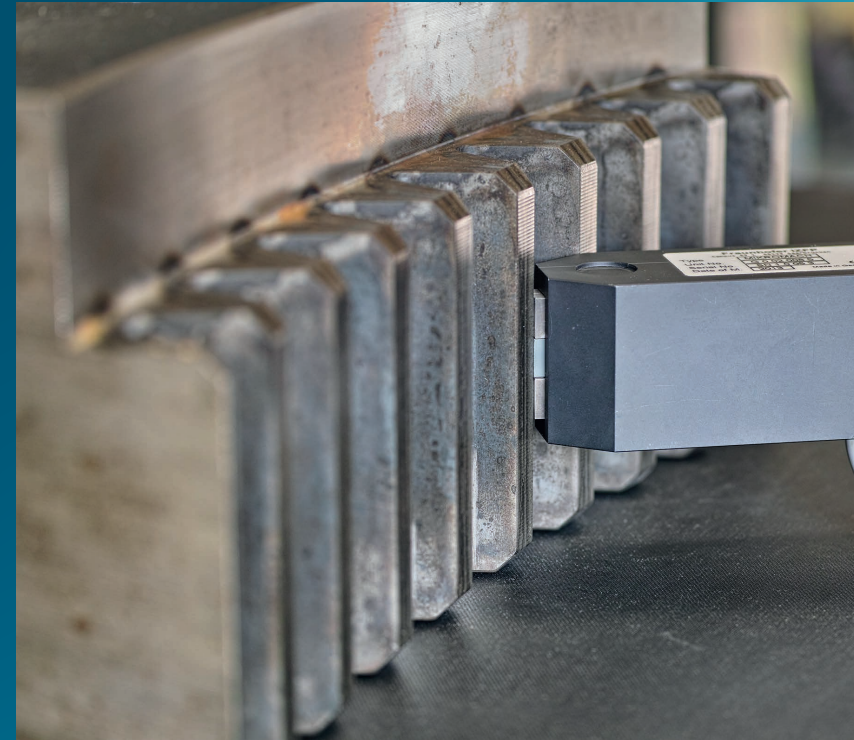
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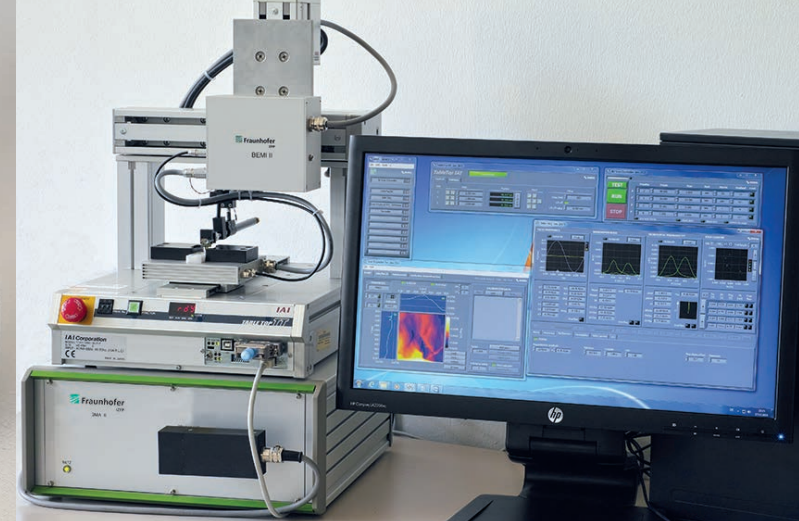
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Sensor and Data Systems
for Safety, Sustainability and Efficiency



Inspecting material properties magnetically

3MA-II, 3MA-X8, BEMI



left: Steel cable stress analysis with 3MA-X8; middle: analyzing hardness and hardness depth of induction-, case- and nitride-hardened components

right: Barkhausen noise and eddy current microscope BEMI

Micromagnetic materials characterization with 3MA-II, 3MA-X8 and BEMI

Iron and steel parts, as well as components used in machines, vehicles and plant engineering are often made from ferromagnetic materials. They are thermally treated and machined to create the desired functional characteristics. Determining the quality of the surface layer properties requires suitable inspection methods. Micromagnetic methods offer a fast, nondestructive way to characterize and analyze materials during or directly after a production step with up to 100 percent process integration.

Micromagnetic inspection systems

- 3MA-II (Micromagnetic Multiparameter, Microstructure and Stress Analysis): High-performance system for material characterization
- 3MA-X8: Simple calibration, high measuring speed, flexible sensor shaping,

concurrent operation of several sensors with a single inspection device

- BEMI (Barkhausen Noise and Eddy Current Microscope): 3MA with special high-resolution sensor; scanner for determining material characteristics (high spatial resolution up to 10 μm)

Functionality

The systems combine four micromagnetic methods:

- Harmonic analysis in the time signal of the tangential magnetic field strength (3MA-II, 3MA-X8)
- Magnetic Barkhausen noise analysis (3MA-II, BEMI)
- Incremental permeability analysis (3MA-II, 3MA-X8, BEMI)
- Eddy current impedance analysis (3MA-II, 3MA-X8, BEMI)

Carrying out these methods under multiple frequencies supplies more than 40 micromagnetic parameters representing the characterization of the material structure. By combining these parameters in a multiparameter approach, production issues such as batch fluctuations and handling/processing tolerances can be easily managed. One-time calibration using defined component conditions is required for the quantitative determination of the material characteristics.

Common target parameters:

- Hardness, hardness depth (SHD, CHD, NHD)
- Layer thickness and layer properties
- Residual and load-induced stress
- Microstructures
- Tensile test values (strength, yield, etc.)

Examples of application

- Quality assurance for induction, case, press, nitride, laser, electron beam hardening processes
- Grinding burn detection and characterization
- Detection of thermal treatment defects

- Surface hardening characterization
- Online characterization of rolled steel
- Incoming goods inspection
- Residual, load-induced stress testing, even on integrated components
- Monitoring and recurring inspections (early detection of thermal aging, neutron embrittlement, fatigue, creep damage, stress change)
- Material characterization and optimization with high spatial resolution

Benefits

- Fast, nondestructive testing of material characteristics up to a depth of 5 mm
- Simultaneous determination of multiple quality parameters
- Continuous monitoring and documentation of quality parameters
- Increase of the inspected production volume; more cost-effective production by reducing the costs associated with testing and defects (rejects, rework)
- Integrated process monitoring
- Custom implementation to meet special requirements (test probe design, software)