



HARDNESS, CASE DEPTH, YIELD STRENGTH, TENSILE STRENGTH

By the way, you already know 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



Deutsche
Akkreditierungsstelle
D-PL-11140-09-00



3MA inspection system

Fraunhofer-Institut für Zerstörungsfreie Prüfverfahren IZFP

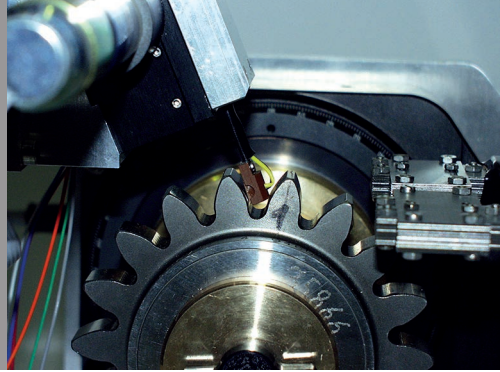
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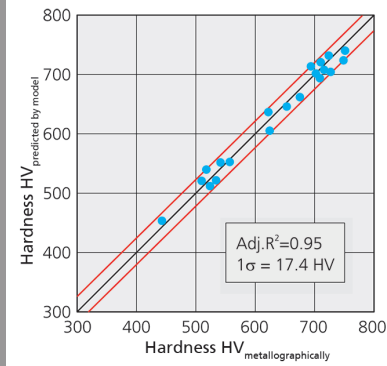




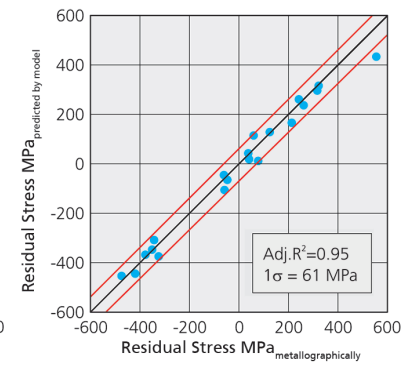
Two-part probe for automated inspection of gear wheel



3MA result of press-hardened body part testing



Left: Hardness testing with 3MA; calibration on diamond penetrator hardness DPH 0.05



Right: Residual stress state testing with 3MA; calibration by means of x-ray diffraction

Situation

Components of mechanical, automotive and facility engineering are subject to thermal as well as mechanical treatment, in order to adjust the required fitness for use. The systematic maintenance of these boundary surface layer characteristics requires the application of adequate measurement techniques. Metallographic analysis, residual stress state measurements by means of X-ray diffraction and conventional indentation hardness testing methods are used to achieve this aim. Inherent to these methods is the slow testing performance and the destructive nature of the testing procedure. Therefore, they are inadequate for in situ inspection of the boundary surface layers, during or shortly after a certain manufacturing stage in the process chain.

Solution

3MA (Micromagnetic Multiparameter Microstructure and stress Analysis) represents a modern measurement technique for characterizing boundary surface layers non-destructively. The procedure can be performed fully automated and can be integrated into the manufacturing process. Its high inspection speed enables the 100 percent inspection for most applications. The procedure allows the fast and concurrent evaluation of several relevant quality characteristics of the surface layer (0 – 8 mm of the components depth).

Procedure

3MA combines the four micromagnetic measurement procedures Barkhausen Noise, incremental permeability, harmonic analysis of the tangential magnetic field strength and multi-frequency eddy current analysis. Several inspection quantities are evaluated for every procedure, adding up to a total of 41 micromagnetic inspection quantities. The advantages of combining test statistics in a multiparameter procedure are manifold, especially if the target values (e.g. hardness, case depth) and the disturbance variables (temperature, residual stress, etc.) are subject to concurrent variations. As the individual micromagnetic inspection quantities show differently weighted sensitivity with regard to target values and inspection quantities, the influence of disturbance variables can be eliminated or at least reduced.

The sole prerequisite for this aside ferromagnetic – and thus magnetizable – material is a preceding calibration, whereby approximation functions are retrieved by means of multiple regression analysis or nearest neighbor pattern recognition that correlate the desired quality characteristics (target values) with the 3MA measurement parameters (inspection quantities).

Benefits

- Fast, non-destructive inspection
- Continuous monitoring and documentation of quality characteristics
- Substitutes destructive testing methods
- Cost-effective production due to reduced costs for testing and consequential costs (caused by nonconformities)
- Complete and comprehensive process monitoring by integration of the 3MA device into the manufacturing process
- Customization according to special requirements (probe, software)

Applications

- Locally resolved determination of hardness, case depth and residual stress state after hardness machining → Detection and characterization of defects caused by the machining process
- Continuous monitoring of tensile strength, yield strength, etc. in steel strips and plates → 100 per cent verification and documentation of steel quality
- Hardness and case depth of induction, laser and nitriding hardening → Reduced setup and change-overtime
- Deep drawing properties and residual stress states of steel sheets → Incoming components inspection for sheet metal forming
- Residual stress state determination at assembled components → Assembly-inspection, compound strength
- Early detection of thermal deterioration, neutron embrittlement, fatigue, creep damage. → Recurrent inspection of safety relevant components in service inspection