A new Barkhausen noise device (Smart-Inspec) for Residual Stress and Hardness tests

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It is generally observed that the Barkhausen noise amplitude or analogous parameters increase for growing tensile stress and fall progressively down with increasing compressive stress. On the other hand, a nearly linear correlations between certain Barkhausen noise parameters and measured hardness values was established. However, the challenging tasks exist to obtain reliable quantitative results for both quantities when residual stress and microstructure are changing at the same time. Just for that purpose the new device was developed, which is based on a new concept for the simultaneous determination of residual stress and hardness for field inspection practice of various industrial steel components with different residual stresses and hardness at different component positions. For this purpose, a scaling algorithm is used for the measured Barkhausen noise amplitude as a function of the magnetization field. Subsequently, an autocalibration procedure is used to deliver absolute values of the required mechanical values of internal stress and hardness. In this way, the standard calibration for both stress and hardness is avoided. This calibration task is cumbersome, tedious and cost-intensive. Most industrial customers are not willing to do so, and in many cases this calibration is even impossible since reference materials are not available at all. Therefore, the planned new test equipment should be welcome in many industries, e.g. for testing forming and welding products, machined surfaces, cast materials and fatigue-damaged components. The proposed device is constructed on the basis of already existing Barkhausen noise techniques, but a completely new algorithm for data analysis is implemented with corresponding user-friendly firmware to improve sensor handling and to control of the measurement process. Finally, new possibilities for material characterization with respect to fatigue damage and stress and hardness gradients are integrated. For validation of the data obtained with the new device bending experiments and mechanical hardness tests are performed.