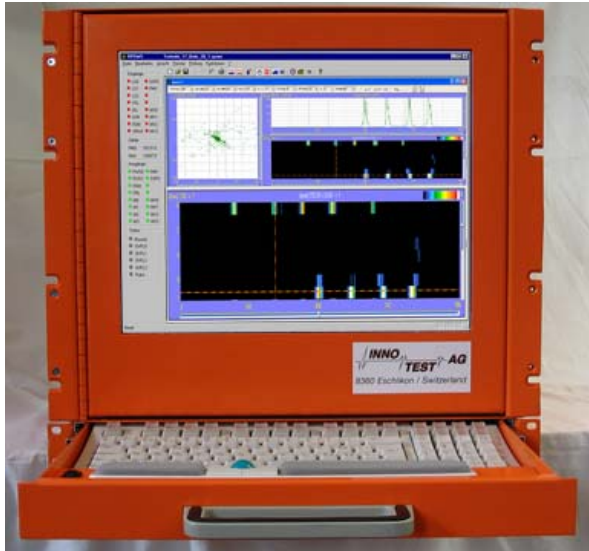**EDDY-STRIP©**

Automated Eddy Current Inspection System for Full Scale Surface Testing of Metallic Strips and Plates

UMFEC Wirbelstromelektronik, Ausführung Station XL

Economic Surface Inspection of metallic Strips and Plates

If the surface of metallic strips and plates has to be tested due to surface and subsurface flaws (e.g. cracks of different orientation, etc.) it is common to use the liquid penetrate testing method.

Necessary cleaning equipment and need of automation (fast image gathering and image processing technology) as well as the effort of correct handling and recycling of the chemicals made the liquid penetrated testing more and more expensive.

Today the demand, to get already tested strips directly from the rolling company is accepted and fulfilled in most cases. Due to the endless rolling process winding from coil to coil short defective sections can hardly be eliminated. Instead collected NDT-data (e.g. Eddy Current Data) are delivered with the coil itself. It's the buyers hard and expensive job to relocate and eliminate the defective section in his fabricating process.

With this background and on behalf of a longitudinal and transversal crack sensitive sensor family (LÄQU,) Innotest AG has developed the new image based eddy current inspection system EDDY-STRIP© for full scale inspection of strip and plate surfaces. With this, there exists an economical and effective solution to the needs outlined above.

LÄQU EC-Probe Family

The family of LÄQU EC-probes (LÄQU1, LÄQU2 und LÄQU5) have been investigated with the goal to detect longitudinal and transverse flaws (cracks, laps, scabs etc.) with high sensitivity. To prevent the probes from wear they do not need direct contact to the strip but are sensitively working in a 1 - 2 mm distance to the surface of the strip or plate (LÄQU5).

LÄQU Probe-Array and Testing Hardware

A probe-array is realized arranging quite a number of probes corresponding to a longitudinal and transversal shifted scheme in an extra probe fixture mechanics. Based on the effective width of a single probe and the desired overlapping of neighbored tracks the whole width of the strip is tested. (e.g. 16 LÄQU5 probes for about 200 mm strip width).

With an electronic switch each single probe is measured each after the other at a high rate. With the standard firmware a single EC-Salve WS2005 (2 full input channels) drives 32 probes at a measuring frequency of 1000 Hz each. With a point to point increment of 1 mm, a strip speed of about 1 m/s and an effective probe width of 12.5 mm (LÀQU5) a testing power of 0.4 m2/s results. This is not yet the limit of the WS2005!
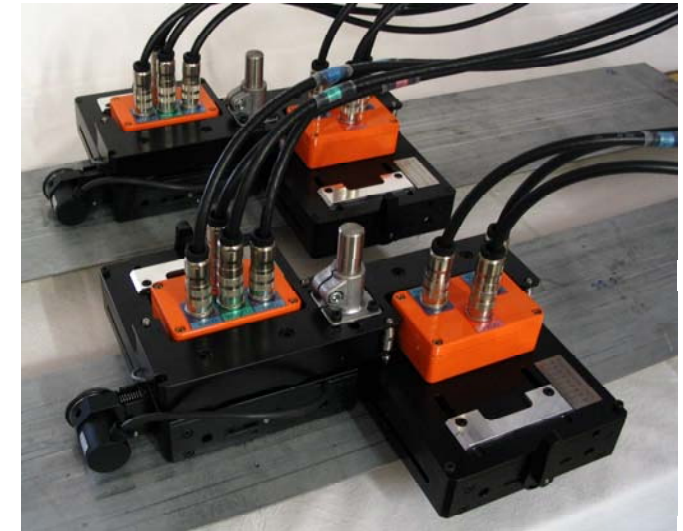
EDDY-STRIP© width scalable EC-probearray

Modular, width scalable probearray fixture

For process integrated testing of strips with changing width a width adjustable sensorarray fixture has been constructed. The fixture makes sure that all available sensors (defined by maximal strip width) help to improve system overall performance even on smaller band width (measuring increments, track overlapping, testing speed, …). The flexible fixture design is modular and scalable. This means that due to the requirements the number and dimensions of the modules can be arranged.

Control-, Test- and Evaluation Software BPSWS 4.0, Imaging Eddy Current Testing Software

Based on WINDOWS 2K/XP operating systems BPSWS is a standard MFC (Microsoft Foundation Classes) based MDI-application software (Multiple Document Interface). Using the MFC and the Microsoft defined application standards BPSWS has a distinct Document- Window-View Architecture and includes the full functionality of a standard Windows application.

For the operator and user this results in a short and effective introduction and learning phase. BPSWS can

be handled as easy as the standard WINDOWS applications as they are e.g. WORD, EXCEL, etc.

Intuitive symbols of the BPSWS application software

As standard for WINDOWS 2K/XP applications BPSWS can be easily controlled by the mouse and / or the keyboard using intuitive symbols, buttons, menus and functions.

Reporting by Result- and Data imaging, continuous time controlled EC measuring and testing mode

The application software BPSWS sets all parameters and controls all available modules in the inspection system. In addition it interfaces to higher level control systems as well as to third party slaves etc. In the measuring, manual testing and automated inspection mode the EC-Slave sends the required and preprocessed EC-measurement data with corresponding time and space information by Ethernet or USB 2.0 to the master system.
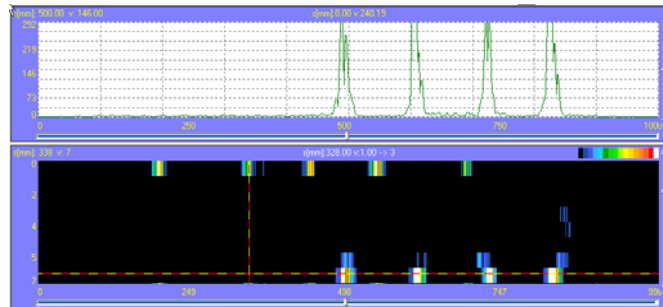
Inspection result: upper 8 tracks of the strip surface with longitudinal, crosssectional and 45°-notches

The results of the Eddy Current measuring and testing can be displayed and documented channel- and / or trackwise with realtime imaging of the X-/Y-impedanceplane, time or space traces and/or color coded C-Scans. On fingertip the signals real part (X), imaginary part (Y) or power is evaluated and displayed.

Similar to a real C-Scan Image one can arrange the track specific color-code data one above the other or side by side. The common x- or y-coordinate therefore

is exchanged by the track number. The result is a C-Scan-like „Quasi C-Scan).

Dataacquisition, Automated Testing

Once the Eddy-Current- and testing parameters are set (of course one can load and edit a setting of a preliminary inspection job) an inspection job is started just pressing the corresponding symbolic icon bar. The testing now proceeds automatically. The compression of the measuring / testing data before saving with the testing document (infos on job, strip and testing parameters) is parameterized by the operator corresponding to the testing requirements.
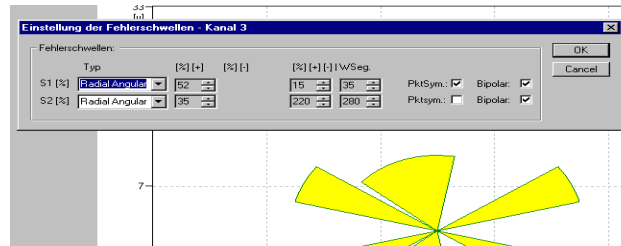
Setup of e.g radial angular thresholds

Setup of threshold and flaw indication

The testing parameters for each channel are directly set by visible counters and buttons. For each EC-channel two thresholds of free selectable type can be defined and parametrized (radial, radial angular, linear Y, linear X, linear XY). The thresholds are displayed in the images and signal window.
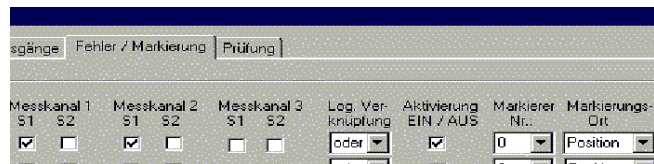
Flaw definition by logical combinations of 2 channels threshold overflow, flaw indication and sophisticated marking settings

Threshold overflow can be combined logically to a flaw indication and are marked / transferred due to the selectable setups and distance values in the parameter setup.

Input- / Output functionality, error states

The EC-testing system incorporates realtime input- and output capabilities by optodecoupeld inputs (5 and/or 24 V at customers choice) and relais- or MOSFET-driven potentialfree outputs (24 V, industrial standard). The state of the inputs / outputs are indicated by "graphical LEDs" in the application software itself.

Indication of inputs / outputs and status by „graphical LEDS"

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