



Technical Information

Eddy Current Testing of Heat Exchanger Tubes

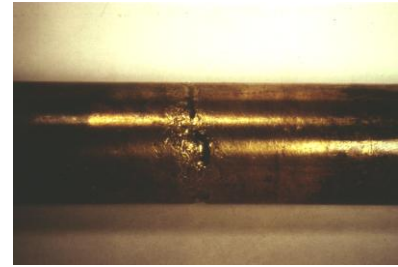
with eddyMax<sup>®</sup> Eddy Current Instruments

Status 2016

# Eddy Current Testing of Heat Exchanger Tubes with eddyMax® Eddy Current Instruments

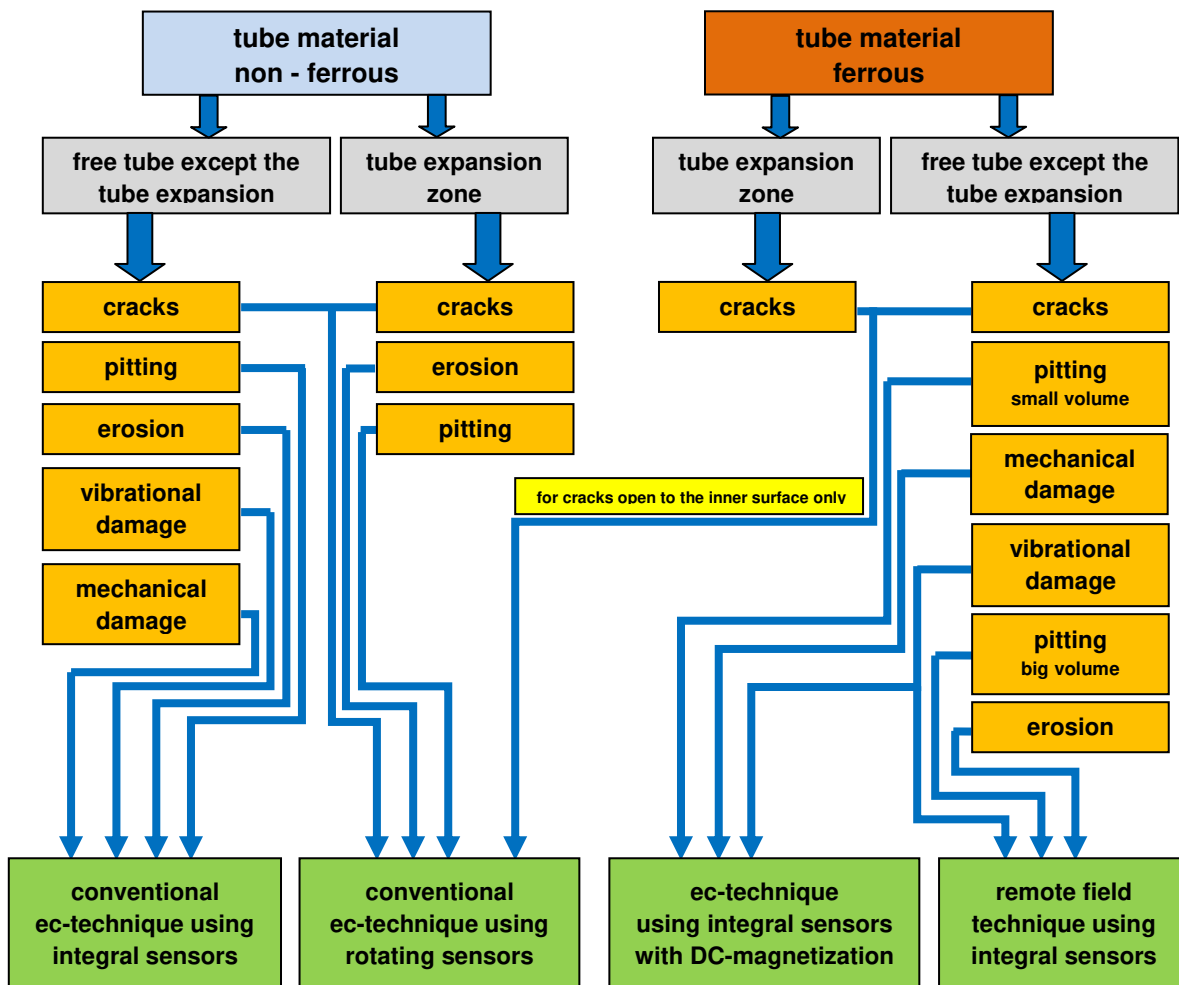
## Introduction

Damages at heat exchanger tubes may lead to loss of production or even to a complete plant shutdown. The early detection of damages enables plant operators to optimize operating parameter, and to prevent unnecessary, unplanned and costly outages by plugging of tubes or early planning of the tube bundle exchange. For the inspection of heat exchanger tubes TMT Test Maschinen Technik GmbH has developed state-of-the-art computer-integrated eddy current instrumentation, advanced sensor technology and newest signal data analysis and reporting software, all for testing of tubes from non-ferrous as well as for testing of tubes from ferrous material, allowing a comprehensive and accurate determination of the tube condition. The use of our advanced technology guarantees our clients a high inspection standard and economical efficiency.



## The Eddy Current Inspection Techniques

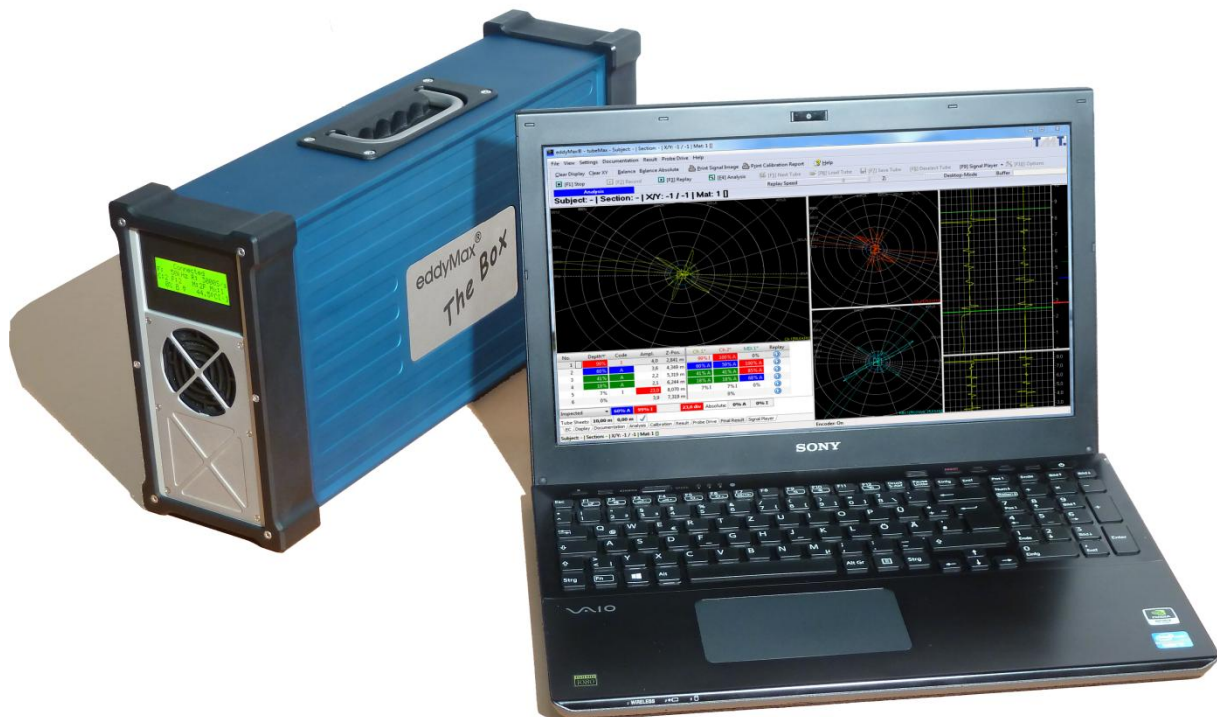
For the inspection of heat exchanger tubes different eddy current techniques can be applied. The choice of the particular eddy current technique and sensor type depends on the tube material, type and volume of the defects to be detected as well as on possible perturbations by e.g. changes of the tube dimensions in the tube expansion. The following scheme gives an overview about applicable eddy current techniques.



# Eddy Current Testing of Heat Exchanger Tubes with eddyMax<sup>®</sup> Eddy Current Instruments

## The Eddy Current Equipment

TMT Test Maschinen Technik GmbH has developed state-of-the-art computer-integrated eddy current instrumentation, sensor technology and signal data analysis software. The TMT eddyMax<sup>®</sup> “The Box” eddy current instruments allow the application of all eddy current techniques conventional eddy current, remote field eddy current, near field eddy current as well partial saturation eddy current technique in multi-frequency and multi-channel mode integrated in one instrument. The combination of the instrumentation with the advanced tubeMax<sup>®</sup> data acquisition / data analysis software and WinDevos Reporting software, based on more than 35 years experience in heat exchanger tube inspection enabling our clients with an objective, comprehensive and fast multi-channel online signal analysis and result reporting software solution.

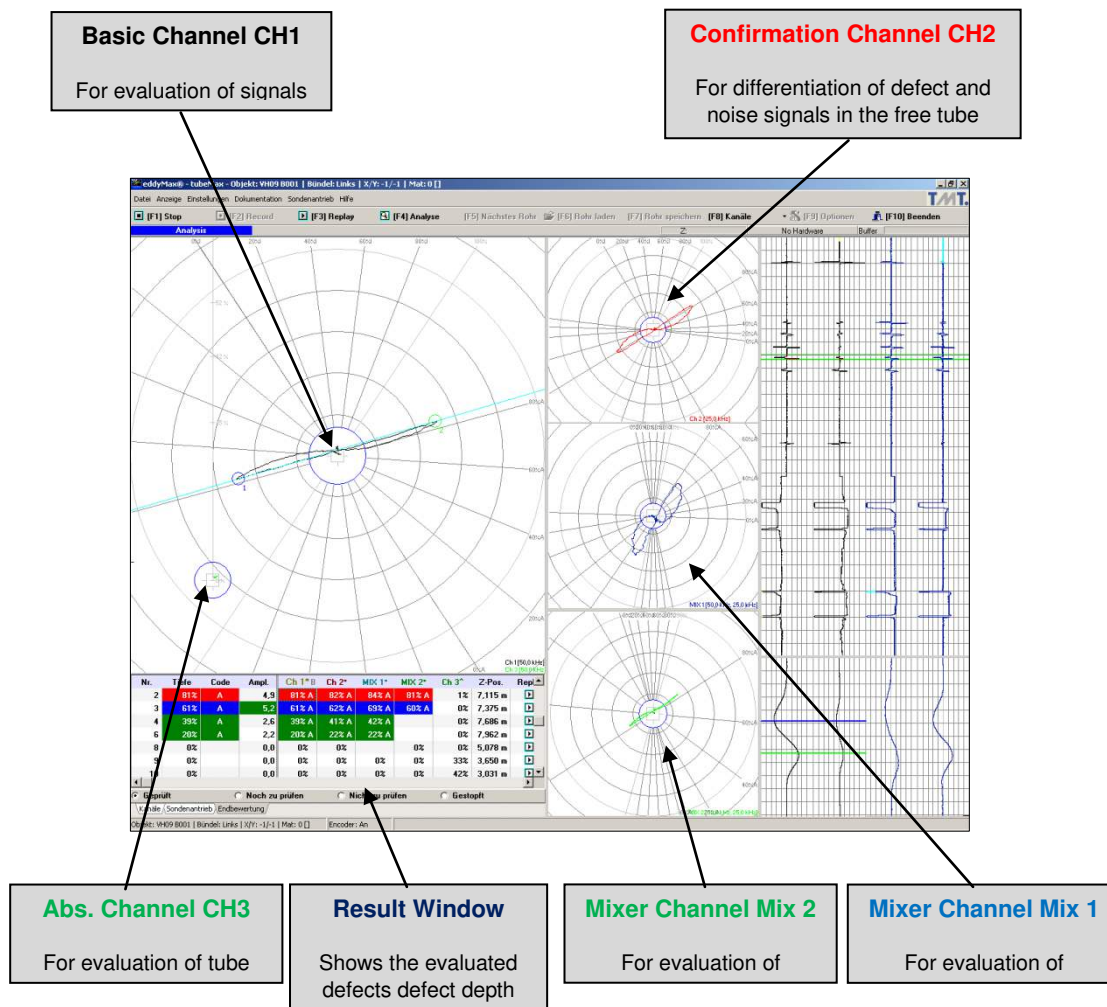


## The TubeMax<sup>®</sup> Software

The TubeMax software is developed for signal data acquisition and online or offline signal data analysis of differential and absolute signals in eddy current inservice tube inspection applications. The main TubeMax<sup>®</sup> software features are:

- user configuration of inspection frequencies and number of differential, absolute and mixer channels
- user configuration of the screen display for impedance and chart windows
- input, edit, storage, read and delete of phase versus defect depth or amplitude versus defect depth calibration curves for inservice tube inspection according to ASME-Code or user selected requirements
- determination of master evaluation and confirmation channels
- automatic phase and sensitivity adjustment of reference signals
- automatic online (direct after data acquisition) or offline signal evaluation of up to 1000 indications for all selected frequency channels
- direct automatic storage of inspection result with code for internal/external defect, defect position and signal amplitude to the selected tube coordinate (in combination with WinDevos software)

# Eddy Current Testing of Heat Exchanger Tubes with eddyMax® Eddy Current Instruments



Example for a configuration in the TubeMax® software

## The WinDevos Reporting Software

The WinDevos software is a high sophisticated inspection planning and result reporting program for inservice heat exchanger tube inspections. Result outputs like colored tube sheet maps as well as plugging plans, inspection statistics and automatic comparison of inspection results can. In combination with the eddyMax TubeMax® software convenient handshake data handling can be performed

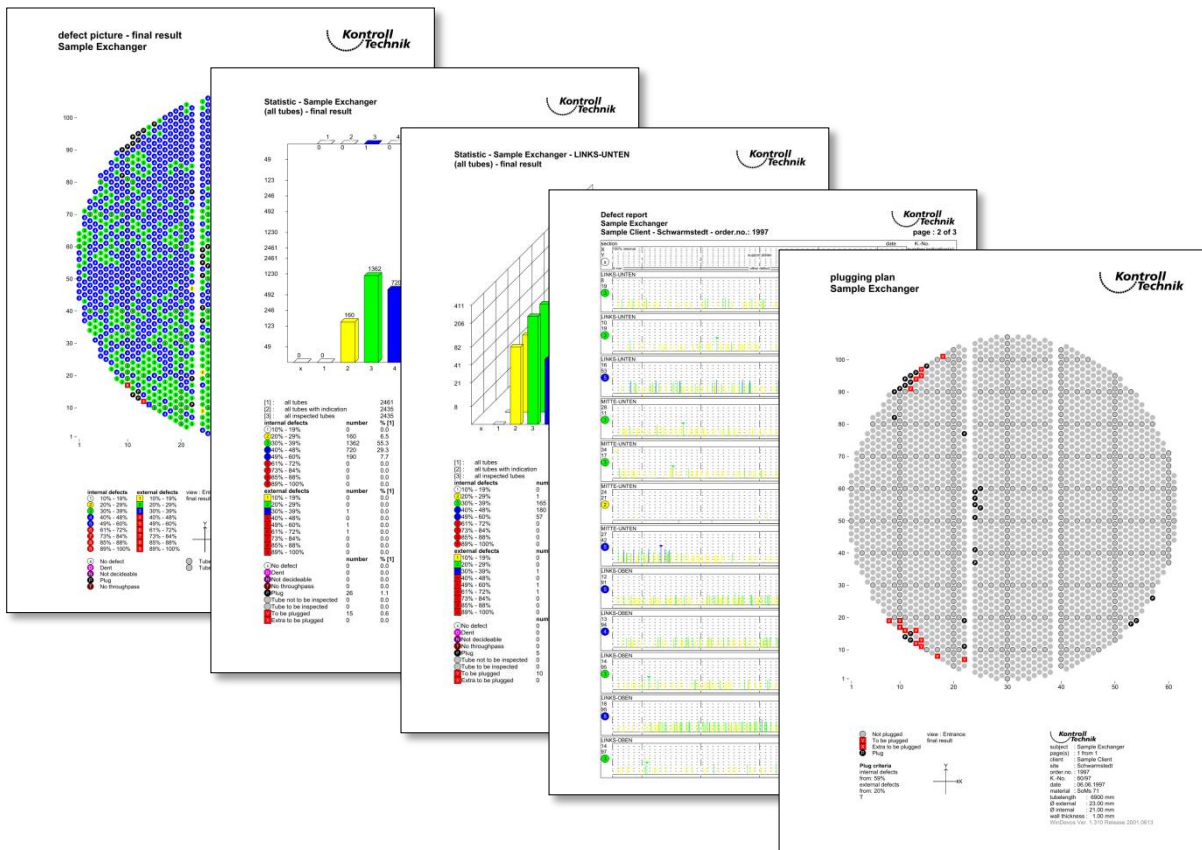
The main WinDevos software features are:

- generation, copy and reflection of tube sheet map views inclusive automatic coordinate marking
- all object data as tube size, length, material, number and position of support plates etc. are stored in the object data file
- free positioning of all tube map views and the additional marking on the sheet within the selected format
- selection of 60 degree, 30 degree or 90 degree tube division
- selection of different tube numbering and coordinate systems
- editor for selection of the defect class ranges.
- automatic generation and output of plugging maps

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## WinDevos Result Documentation

The WinDevos result documentation gives our clients a comprehensive overview about the condition of the tube bundle. Besides the “Defect Picture”, showing the classification for each tube according to the maximal wall loss the documentation and the „Inspection Statistic“, showing the distribution of the defect depth and the statistical distribution of defects in direction of the tube axis, the result documentation contains the “Defect Report”, showing in graphical form the distribution of defects in the tube for each inspected tube and the “Plugging Plan”. By the information given by our result documentation besides the immediate measures as plugging or exchange of defective tubes in many cases the source of corrosion can be evaluated and preventive actions can be initiated.



# Eddy Current Testing of Heat Exchanger Tubes with eddyMax® Eddy Current Instruments

## Additional Features of the eddyMax System

### Automatic Hand-Held Probe Pusher Puller

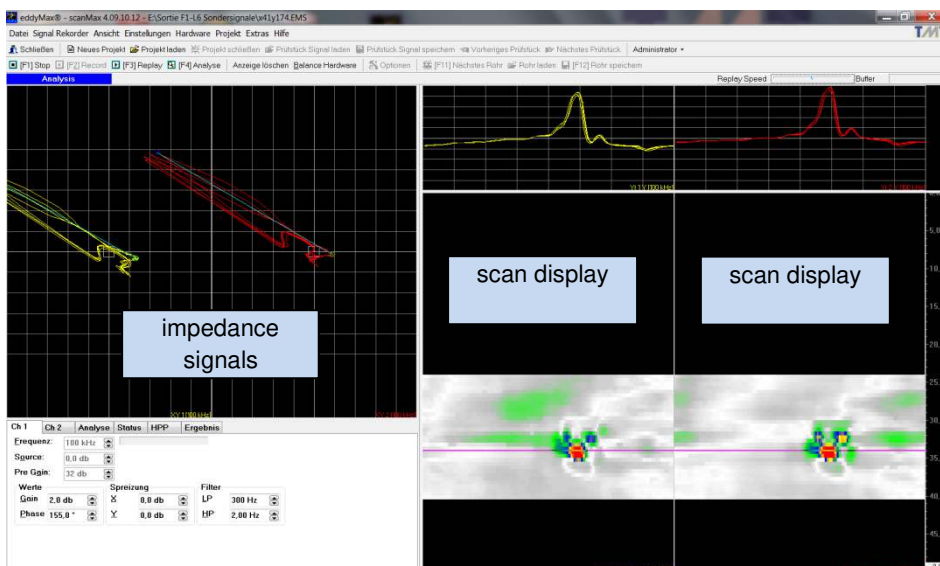
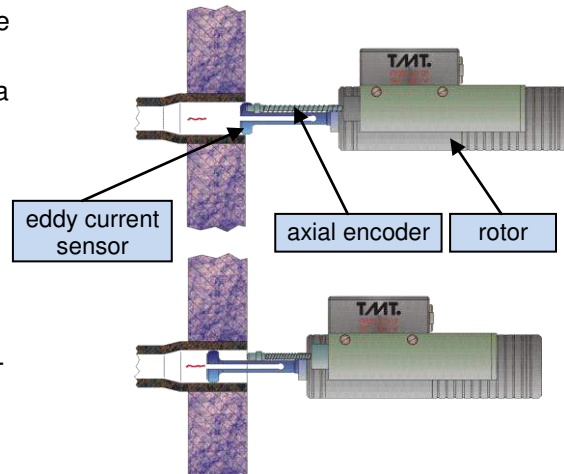
For inspection of big numbers of tubes or for inspection requiring an accurate evaluation of defect positions the application of probe pusher puller has an vital advantage.

The hand-held probe pusher puller system developed by TMT Test Maschinen Technik GmbH allows a fast, convenient and accurate probe handling. All drive functions are controlled from the eddyMax system. Optionally the probe insertion can be supported by compressed air allowing an operation even under hard conditions.



### Tube End Testing with Rotating Sensors

The limitation of bobbin type sensors is that due to the geometrical changes of the tube expansion zone and the conductivity changes of the surrounding material a sensitive defect detection in the tube zone is not possible. For this reason for testing of the tube ends rotating eddy current sensors are used. By use of a motor-driven rotor the pen tip sensor in is put into rotation. The tube is scanned by axial movement and simultaneous rotation. By this procedure cracks, corrosion and erosion in the tube in the tube sheet zone can be safely detected. For this application TMT Test Maschinen Technik GmbH has developed a motor-driven rotor with integrated motor-driven axial movement, ensuring a safe, repeatable covering of the inspection zone.



Example for a screen display tube end testing with rotating sensor

# Eddy Current Testing of Heat Exchanger Tubes with eddyMax® Eddy Current Instruments

## Technical Data

### Frequency Range

10 Hz up to 2.5 MHz

### Number of Frequencies

up to 4 adjustable frequency channels.  
Adaption of the transmitter output signal to the probe, range -40 up to 8 dB, adjustable in 0.1 dB increments

### Probe Matching

adjustable preamplifier for optimal matching to the sensitivity of the probe, range 0 up to 78 dB in 6 dB increments with signal level indicator

### Amplifier

total gain range from -48 up to 126 dB  
main gain range from -48 bis 48 dB, adjustable in 0,1dB increments, preamplifier range from 0 up to 78 dB, X/Y axis spread from -20 dB up to 20 dB, adjustable in 0.1 dB increments

### Phase

360° in 0.1°- increments

### Filter

adjustable low pass and high pass filter range from 0.1 Hz up to 5000 Hz

### Dimensions

Height : 225 mm  
Width : 125 mm  
Length : 460 mm

### Weight

approx. 6 kg

### Power Supply

external 24 V DC  
incl. 100 - 240 V AC adaptor

### System In- / Outputs

Ethernet remote connector  
eddyMax probe connectors  
eddyMax system connectors

### Operation

operation of The Box is remotely performed by an external PC, e.g. a notebook using the appropriate software for the inspection task

### Flexible Channels

depending on the inspection task and the application used for the inspection several channels for signal processing including signal mixing channels are available.

### Signal Display

colored signal display in impedance and chart mode, switchable to display in impedance mode with several signal windows.

The dot can be displayed in store or non-store mode with highlighted signal trace.

### Signal display in C-Scan Mode

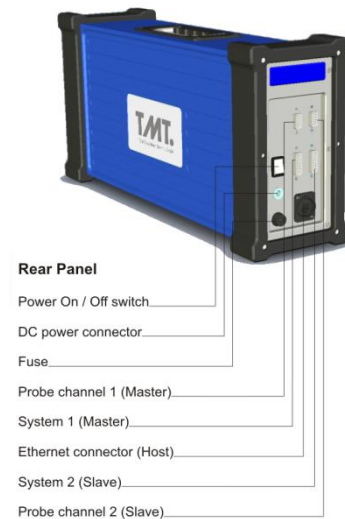
colored signal display in the impedance window and colored C-Scan display in the chart window

### Modes of Operation / Probe Types

the instrument can be used for static testing with hand probes or dynamic operation with rotating probes. All types of probes like SR-probe, bridge probes and reflection probes can be connected.

### Applicable Techniques

conventional eddy current - ECT  
remote field technique - RFT  
near field technique – NFT  
partial saturation ec - PSEC



For further information please contact :