innospection

Multiple Frequency Eddy Current Technique

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Multiple Frequency Eddy Current technique is one of the non destruction inspection techniques for heat exchanger and boiler tubes of non-ferromagnetic material.

This technique reaches a high defect detection sensitivity and accuracy. In the case of required defect verification, either various Eddy Current frequencies or specific focusing probes could be used.

Innospection's EddyMax system allows the use of a multiple frequency operation in simultaneous Differentials and Absolute Modes and handles simultaneously six mixing channels. The various modes are:

- Multiple Frequencies
- Differential Mode
- Absolute Mode
- Mixing Channels
- Low Gain / High Gain Channels

The variety of a number of Eddy Current channels and mode combinations allows an extensive analysis of defect depth and characterization.

Diagram 1 below shows the Eddy Current signal response of a differential and absolute coil system to local and gradual defects.

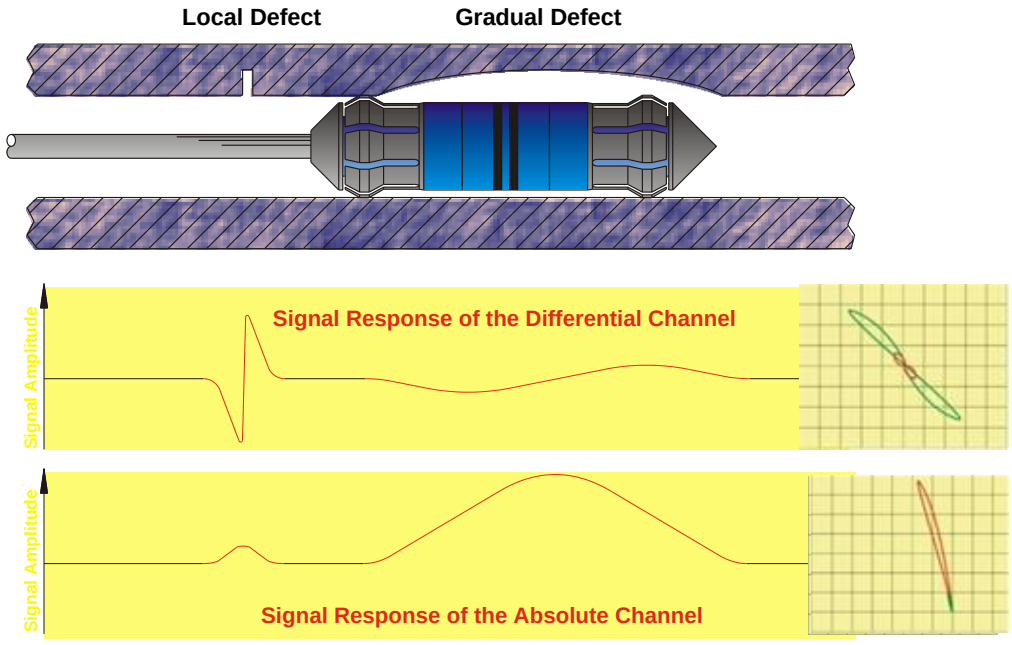

Diagram 1

Diagram 2 shows the change of the signal phase angle spread with change of test frequency in the in-service tube inspection.

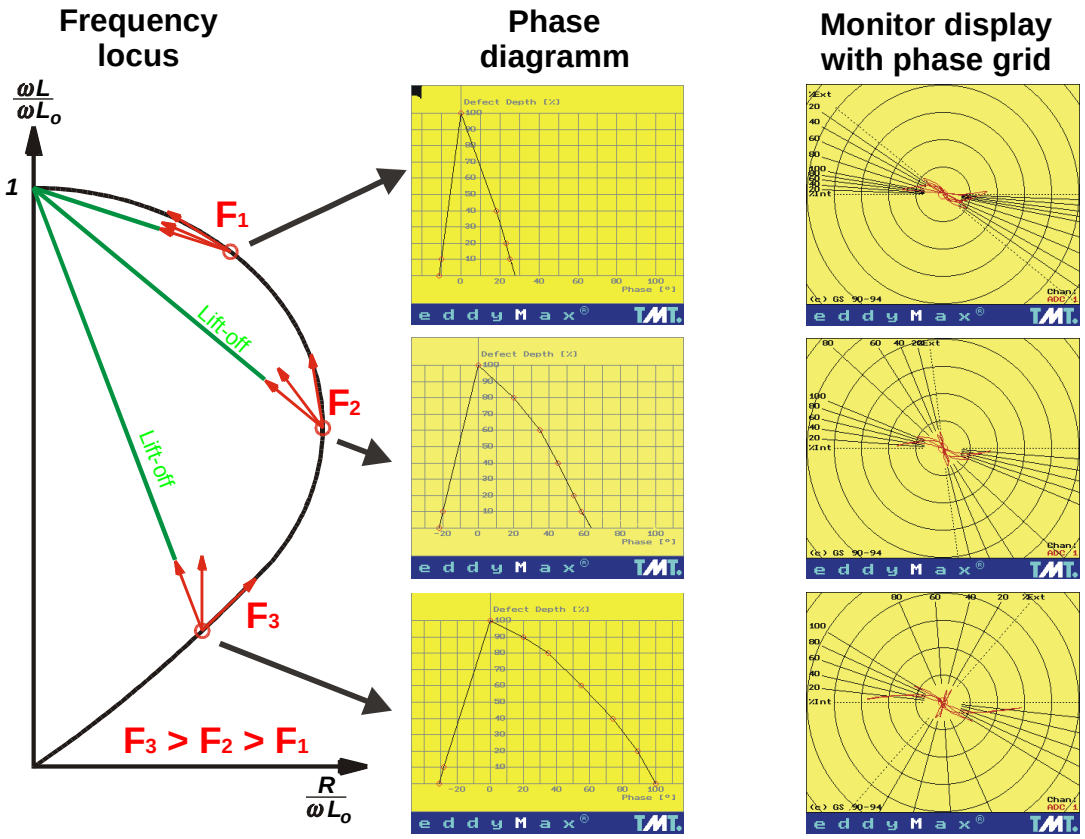

Diagram 2

The functions of the various frequencies, modes and channels are explained below:

Multiple Frequencies:

Multiple frequencies are used to achieve the best signal to noise ratio in order to reach an optimum sensitivity on the internal and external tube wall side.

Absolute Mode:

Absolute channels are very sensitive for the detection and analysis of gradual-type defects such as thinning, erosion, material characteristically changes, etc. The system operates with parallel different frequencies absolute channels. The higher frequencies are used to focus on internal thinning and lower frequencies for focus on external thinning.

The difference in signal phase allows the external and internal thinning to be distinguished. As the thinning itself decides the signal amplitude as well as the thinning volume, the analysis is to be taken with care and in comparison to the calibration defects.

Differential Mode:

Differential modes are very sensitive to the detection and analysis of local defects such as corrosion, pitting, vibration damages, cracks, etc.

The system operated by Innospection handles multiple parallel differential channels. The advantage is that the individual frequency is focused at its respective best sensitivity while the other different frequencies are used for verification. For example, principle frequency is used for standard depth penetration and with equal good defect detection at inner and outer tube wall.

In addition, a higher frequency can be used for higher defect detection capability on the inner surface whereas a parallel lower frequency can be chosen for higher sensitivity at the outer tube wall side.

Should defect indications be confirmed, identified with the frequency selected for the standard depth penetration, the parallel running frequencies can be used to confirm phase and amplitude run in comparison, which indicates confirmation of defects or false calls.

The signal phase is used to identify the defect depth, external/internal defect or type of occurrence e.g. dents, support plate, etc. In addition, the signal amplitude can be used as indicator of the defect (occurrence) volume

Mixing Channels:

“Mixing Out” refers to subtracting unwanted signal influence and the channels are mixed for the analysis of equal positional events, such as the case of a vibration defect at the baffle plates, denting due to wear off damage, fins signal for general defects, etc.

The mixing channels are running a signal vector addition between two different frequency channels. The vector addition is used to eliminate the unwanted signal components, e.g. baffle plate indication.

The remaining signal components display the wanted signals, e.g. defects below a baffle plate. In this way, the combined occurrences such as the baffle plates, fins, dents (deformation) and some deposits can be “mixed out”.

Low Gain / High Gain Channels:

The described Differential-, Absolute- and Mixing Channels are set in phase and amplitude accordingly to agreed standards.

However, a variety of different type defects with different volumes require to display the set standard sensitivity in higher or lower amplitudes without changing the standard sensitivity set channel.

For this reason, the system can run in additional channels which are duplicating the set standard setting channel but choosing increased or decreased amplitudes.