TSC INSPECTION SYSTEMS

INTRODUCTION TO ACFM

Alternating Current Field Measurement (ACFM) is an electromagnetic technique used for the detection and sizing of surface breaking cracks in metallic components, that does not require any electrical contact with the surface being inspected.

The technique measures absolute values of the magnetic field in real time and these are used together with mathematical model lookup tables to avoid the need for calibration of the ACFM instrument using a sample piece with artificial defects such as slots.

The ACFM technique is generally insensitive to permeability changes and lift off and as it does not rely on probe contact it can be used to inspect through coatings of various thickness and material.

Advantages compared to other Inspection Techniques

- Provides data storage for improved auditability, and allowing off-line reanalysis or year-on-year comparison of crack size.
- Allows a high degree of automation, making the system very user-independent.
- Simple scanning to allow 1 or 2 man operation including deployment by abseiler.

Other advantages compared to Magnetic Particle and Dye Penetrant Inspection

- Works through coatings up to 10mm thick, so there is no need to remove and then reapply paint, or to clean off rust.
- Provides information on depth as well as length, saving time on removing defects of insignificant depth.

Other advantages compared to Eddy Current Inspection

- Relatively insensitive to material property changes, so ideal for inspecting at welds.
- Relatively insensitive to probe lift-off, allowing deployment through coatings and on rough surfaces.
- Depth sizing based on theoretical model rather than on calibration wherever possible. Avoids problems of differences between behaviour of currents at slots and cracks, and differences in material properties between calibration block and material around crack.
- Allows depth sizing of defects up to about 25mm (depending on probe type).

Originally introduced to the offshore industry for subsea weld inspection, the use of ACFM has now broadened to include inspection of pressure vessels, process piping, drillpipe threads and risers. Recent developments have included automated and semi-automated systems to reduce the reliance on operators and the use of array technology to increase inspection speeds.

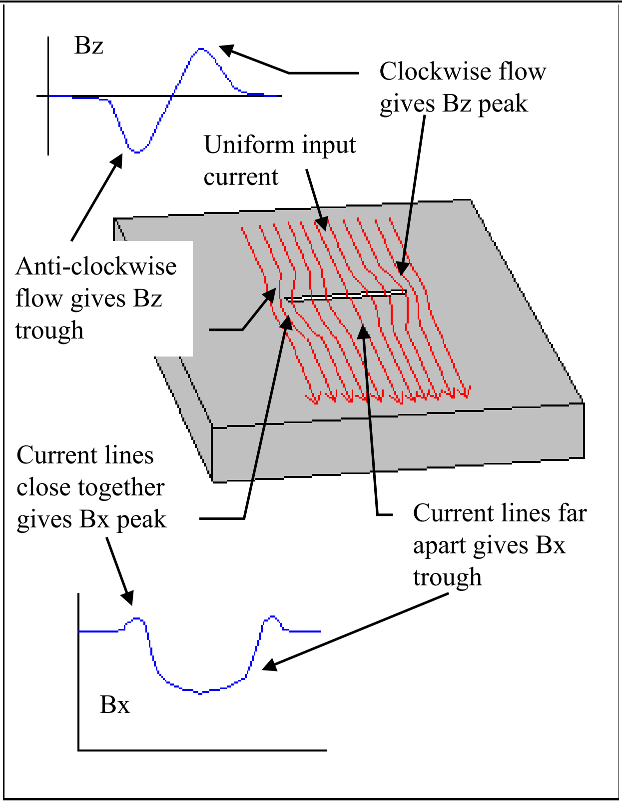

Figure 1. Qualitative explanation of the nature of Bx and Bz above a surface-breaking crack.

The technique in its simplest form uses a hand held probe containing a uniform field induction system and two magnetic field sensors. Windows software running on a PC, usually a rugged laptop, is used to control the instrument and display and analyse the data.

Figure 1 shows the basic principles of the technique. With no defect present and a uniform current flowing in the Y-direction, the magnetic field is uniform in the X-direction perpendicular to the current flow, while the other components are zero. The presence of a defect diverts current away from the deepest parts and concentrates it near the ends of a crack. The effect of this is to produce strong peaks and troughs in Bz above the ends of the crack, while Bx shows a broad dip along the whole defect with amplitude related to the depth.

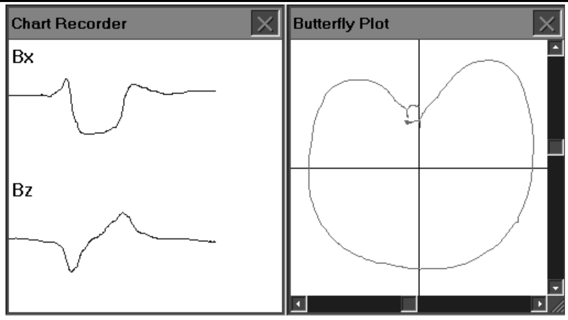

Figure 2. Data display produced by a surface-breaking crack.

Measurements of Bx and Bz from sensors in the probe are used together with software algorithms to determine the accurate length and depth of the defect. In order to aid interpretation the Bx and Bz components are plotted against each other and when a complete closed loop indication is produced this confirms the presence of a crack. This is called the Butterfly plot (Figure 2) and because it is not sensitive to probe speed aids in the interpretation of the data collected and confirms defect indications.

For further details of the technique and its applications, please contact:

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