MISTRAS
A World of NDT Solutions
Services Division

**Application Brief**

# ACFM Examination of Cargo Cranes

## *ACFM History*

MISTRAS Services Division, a member of MISTRAS Group Inc., offers a sophisticated surface examination technique utilizing variable frequency Alternating Current Field Measurement (ACFM) equipment. The ACFM technique was initially developed to examine offshore structures below sea level and through thick coatings to minimize costs associated with weld examination.

ACFM is a non-contacting electromagnetic technique for the detection of surface breaking defects in conductive materials. The ACFM probe induces a uniform electric current into the material to be inspected which then produces a magnetic field which will be disturbed and flow around the edges of a defect if present. Small detectors or sensors are built into probes, which are used to detect these magnetic field disturbances. Two components of the magnetic field are measured and displayed as Bx and Bz signals. The Bx is used to estimate crack depth and the Bz is used to estimate crack length. These measurements, together with software algorithms, are used to determine accurate length and depth of the defect.

By using the technique, paint coatings do not need to be removed and reapplied thereby saving the cost of surface preparation and reapplication of the coatings. Inspection costs are also substantially reduced as NDT technicians do not require down time while waiting for the surface preparation to be completed. Finally, the unit is

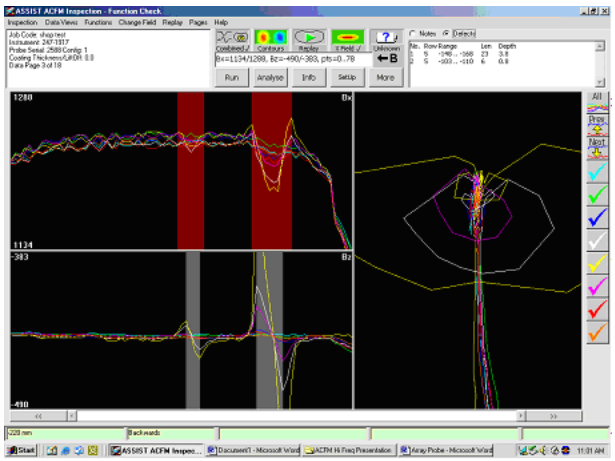



*Figure 1 ACFM Screen Display*

coupled to a suitable probe for the material and geometry being tested and utilizes state of the art software. This combination represents a quantum leap in the speed and accuracy of the ACFM technology. Our ability to position and locate anomalies and size them in real time for both length and depth, makes this a highly effective surface examination system. The ACFM technique has been approved for weld examination by many distinguished authorities around the world, including Lloyds; ABS; Bureau Veritas; DNV and OCB Germanischer Lloyd.

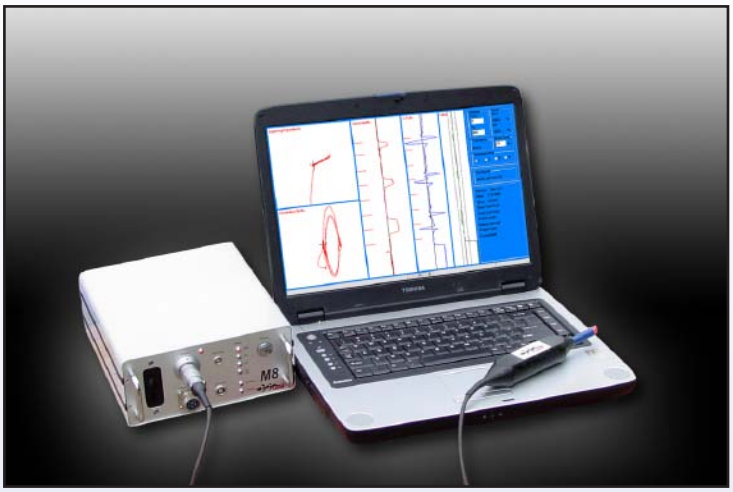
Figure 1 shows a typical ACFM data display produced when the probe is scanned over a defect. In the left hand side of the screen, the Bx and Bz readings are plotted. A defect is indicated by a trough in the Bx plot, the deepest point coinciding with the deepest part of the crack, associated with a peak and trough in the Bz plot, which indicates the location of the crack ends. To aid in interpretation, the Bx and Bz readings are plotted against each other on the right hand side of the screen where a characteristic loop is formed in the presence of a defect. This display, called the "butterfly plot", is unique to ACFM and, because it is insensitive to probe speed, greatly enhances interpretation.

## ACFM Benefits

- Requires little, if any, surface preparation
- Does not contaminate sterile environments
- Quick and efficient by utilizing dedicated probes and software
- Indications are sized for both length and depth
- Provides a permanent record of inspection that can be reviewed and audited for maximum accountability and repeatability
- Superficial surface indications can be disregarded through signal interpretation

## Case Study: Cargo Crane Inspection

A container terminal in Pennsylvania purchased two cranes previously used by another terminal. All welds on the two booms needed to be inspected for cracks and the inspection needed to be completed quickly in order to limit down time of the cranes. Because of their age, some cranes were removed from service to gain complete knowledge of their condition in the absence of a suitable inspection technique. Although an inspection and confirmation of their structural integrity may elongate a crane's useful life, a crane can be out of service for a number of weeks while the coating is removed, the magnetic particle inspection is performed and the coating is reapplied.



The height and location of the crane added to the complexity of the issue, in fact the surface preparation required for magnetic particle inspection may have contaminated the marine environment where the cranes were located. Lastly, traditional techniques such as magnetic particle and Dye penetrant only yield visual indications of length. Since no depth information is available, this information can be misleading as the indication may only be a surface scratch and not a relevant crack like indication.

## Project Approach Utilizing ACFM

After carefully considering these factors, MISTRAS Services Division proposed ACFM as an alternate effective inspection method. Very little surface preparation was required and was easily performed by the inspector while the inspection was in progress. The ACFM inspectors were able to complete the inspection without the need for any specialized access equipment, such as scaffolding or a high reach.

Crack like indications were sized for both length and depth at the time of the inspection, giving the customer a more complete and accurate basis for evaluating the structural integrity of the cranes. Easy to read screen displays were included in the final report. In conclusion, the choice of ACFM versus traditional techniques allowed the customer to complete the project in less time, with little or no surface preparation and associated recoating and provided more accurate data for the engineering evaluation of the structural integrity of the cranes.

For additional information, contact MISTRAS Services Division headquarters.

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