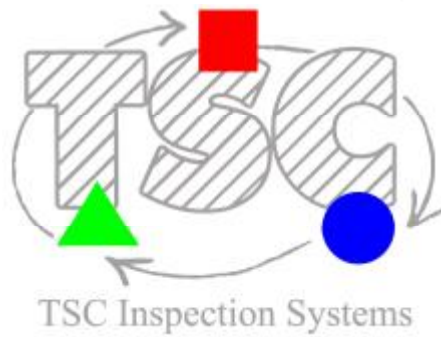


**The ACFM Tank Floor Weld Inspection Trolley**



## INTRODUCTION

Petrochemical storage tanks consist of cylindrical walls welded onto floors, which are made up of overlapping flat plates. Inspection of the floors of such tanks is usually confined to thickness measurements on the plates themselves, generally using electromagnetic techniques to detect corrosion. However, these techniques are not able to inspect the welds between the plates, which are another potential source of leaks.

To rectify this, TSC have produced the Tank Floor Weld Inspection Trolley. Based on ACFM® electromagnetic inspection technology, the Tank Floor Trolley detects and sizes surface breaking defects in the various welds found in a storage tank floor. The system incorporates a uniquely shaped array probe designed for tank floor welds. This probe is able to inspect the annular fillet welds at the join between wall and floor, the butt-welds between floor plates adjacent to the wall, and the lap-welds found where plates overlap on the rest of the floor. The system is also capable of discriminating between crack-like defects and surface pitting.

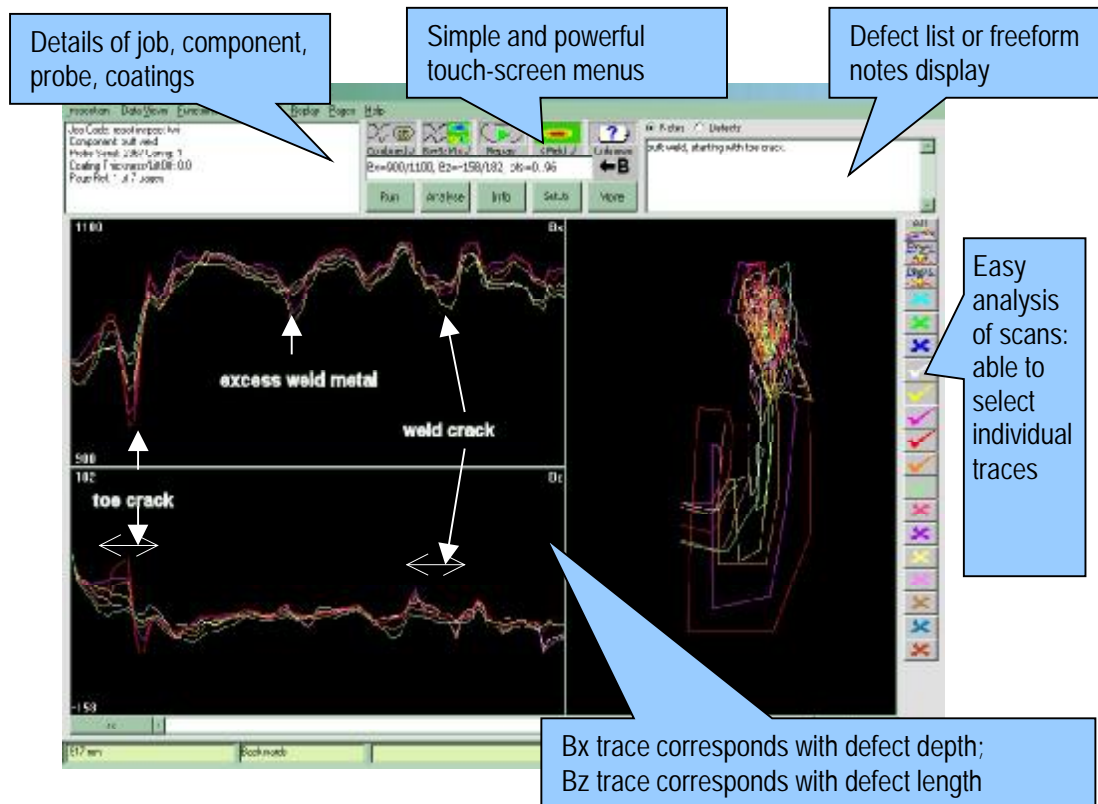
### The ACFM Tank Floor Trolley

The ACFM Tank Floor system is an integrated trolley, containing an ACFM array probe, instrument and laptop PC, which is pushed along the tank floor welds by an inspector. Data is displayed in real time on the PC screen and stored as a permanent record of the inspection. State of the art software uses easy to read displays and powerful processing algorithms to interpret the data. The system has the following key features:

- Shaped array probe allowing inspection of fillet, butt and lap welds without changing probes.
- Ability to work through rust, sludge or non-conducting coatings.
- Total weld length inspected is recorded, as well as the longitudinal position of any defects.
- Battery life in excess of 5 hours continuous use.
- Import and archive of all inspection data on an office based system.



Array probe taken out of trolley to show deployment positions on fillet and lap welds



## TECHNICAL BACKGROUND

ACFM is a well established inspection technique which has been in use in other applications in the petrochemical industry for many years. It is an electromagnetic technique based around alternating current induction with some significant differences from conventional eddy current techniques.

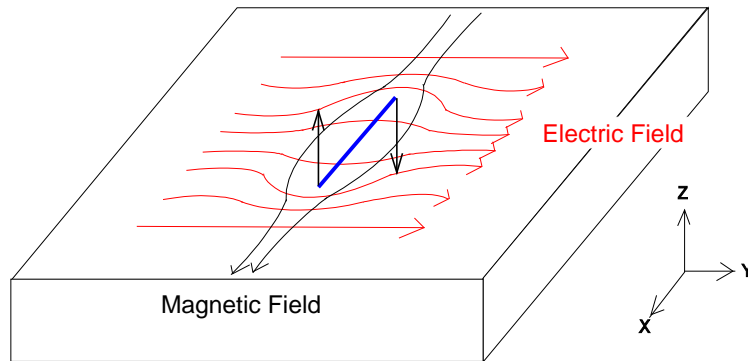
The main components of an ACFM system are a probe connected to an ACFM instrument, which communicates with a controlling PC. Windows based software on the PC controls the instrument and displays and stores the inspection data.

The probe contains an integral field generator that induces a current to flow in the surface of the tank floor. Through use of a constant current generator in the instrument and special design of inducer in the probe, the currents under the probe are uniform in direction and strength. They do not penetrate deep into the plate but instead run in a very thin skin (<0.2mm deep) in the surface of the plate. Defects in the surface of the plate distort these currents and this is reflected in changes to the magnetic field just above the surface.

An array of sensors is located across the weld and monitors any disturbances in the magnetic field.

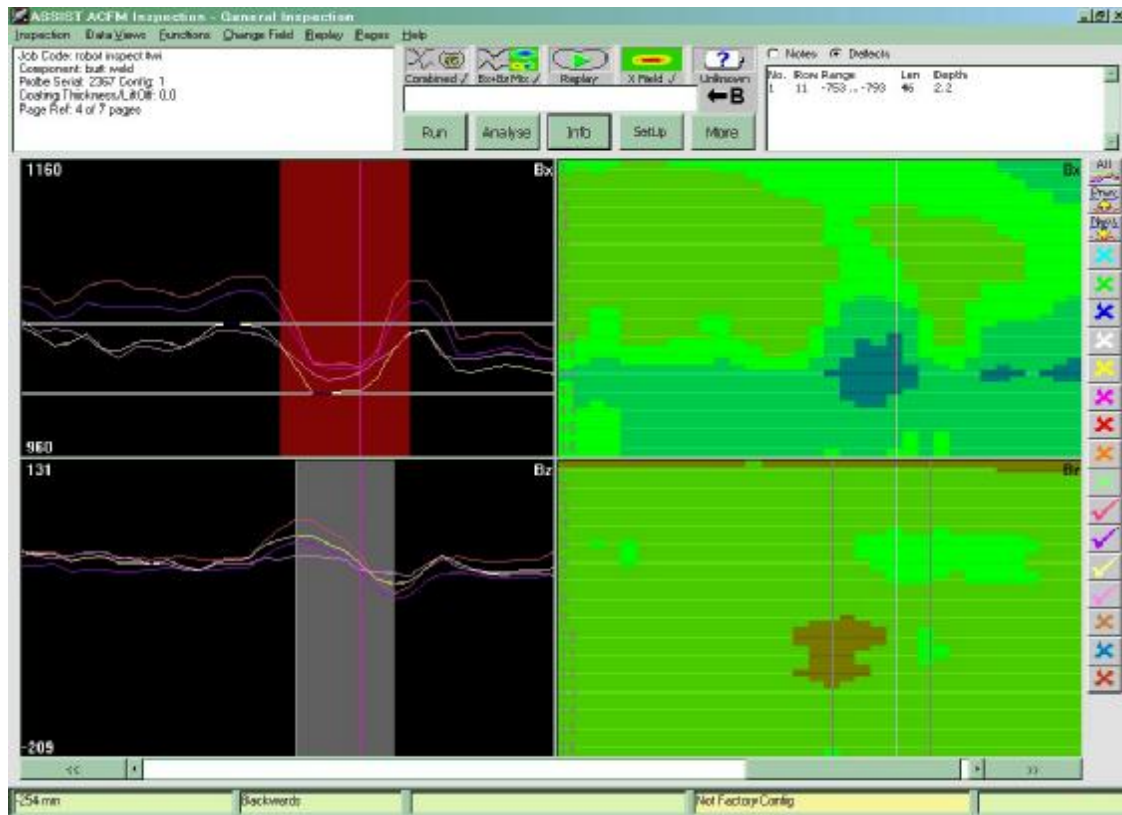
There are two sensor types: Bz sensors, which measure the disturbance to the current flowing around the ends of a crack, and Bx sensors, which measure the reduction in density above the deepest part of the defect.

The figure below shows the way that a uniform electric current flows around a surface breaking crack and the shape of the resultant magnetic field.



*Electric current flow and resultant magnetic field around a crack.*

The ACFM software records and displays the results from the Bx and Bz sensors. Defect signals are shown by distinctive traces in both the Bx and Bz signals, which are shown below. The Bx signal shows a trough which is related to the defect depth: the bigger the trough the deeper the defect. The Bz shows a peak over one end of the defect and a trough over the other.



Signals from toe crack on lap weld

Analysis of the Bx signals is used to determine the depth of a defect by reference to a mathematical model which relates Bx signal deviation to crack depth. In this way there is no prior calibration required by the operator. The location of the Bz peaks and troughs indicate the defect position along and across the weld.

An encoder is built into the probe which, when provided with a start location, tracks the absolute position of the probe along the weld. This enables checks on length of weld inspected and deployment speed as well as accurately locating the position of defects.

## APPROVALS

The ACFM technique has received approvals and recommendations from many bodies including DNV, Bureau Veritas, Lloyds and ABS. Documents covering its use have recently been issued by ASTM (E2261-03), and COFREND.

The probe was developed as part of a semi-autonomous robot-deployed system for complete tank floor inspection under a joint industry CRAFT project (ROBOT INSPECTOR - G1ST-CT-2002-50183) with financial assistance from the E.U.

## SPECIFICATIONS

Size:	700 x 300 x 1000mm
Weight:	21kg
Environmental:	IP54
Power:	Integral 12V battery supply, recharged by domestic 110V or 240V AC 40 / 50 Hz supply.
Operating Temperature range:	-20°C to 40°C
Typical operating speed	0.5 mph (1 km/h)

## CONTACT

For further information on the ACFM Tank Floor Trolley or to discuss a particular implementation, please contact:

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