ACFM WALKING STICK

ACFM & Rail Inspection

THE ACFM® WALKING STICK

The ACFM® Walking Stick system is an integrated trolley, containing an ACFM® array probe, ACFM® instrument and laptop PC, which is pushed along the rail 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 automatically interpret the data.

RAIL INFRASTRUCTURE

The integrity of rail infrastructure is at the heart of a safe and economic transport system and the rails themselves form a vital part of this system. Early detection of cracking in the head of the rails performs not only a vital safety function, but also leads to a well managed maintenance regime. A tool that can assess the severity of cracking and can give the information on whether to re-rail a section of track or whether the problem can be controlled through locally grinding the rail head, is invaluable; making considerable cost savings and avoiding unnecessary re-railing projects.

Working with rail partners, TSC have developed a product which is aimed at this specific requirement within the rail industry. Based on ACFM electromagnetic inspection technology, the ACFM Walking Stick™ determines the integrity of the rail track by detecting and sizing surface breaking defects in the rail head. The system indicates the defect severity by reporting the crack pocket depth (the depth, in millimetres, of the defect along its propagation angle) and is capable of discriminating between different types of rail head defects such as head checking, gauge corner cracking, squats and lipping.

ACFM WALKING STICK FEATURES

- Shaped probe inspects the whole rail head surface in one pass.
- Audible warning of defects.
- Deepest defect per yard automatically sized and reported.
- Longitudinal position in miles and yards on rail recorded.
- Battery life in excess of 5 hours continuous use (easy swap).
- Automated export of inspection summary to Excel. Import and archive of all inspection data on an office based system.

The ACFM® Walking Stick does not suffer from some of the problems of conventional Ultrasonic inspection techniques, where large numbers of defects can render a rail un-testable. With ACFM, the deeper the crack, the larger the response.

APPLICATIONS AREAS INCLUDE:

- Use as a primary inspection tool on plain line inspection to determine the presence of surface breaking rail head defects.
- Categorising the rail for assessing and developing maintenance strategies.
- Inspecting before grinding to assess amount of material removal required.
- Post grinding inspection to confirm the removal of defects.
- Monitoring crack growth/re-growth to assess the effectiveness of maintenance strategies and machine grinding frequencies.

TECHNICAL BACKGROUND

ACFM is a well established inspection technique which has been in use in other industries such as oil and gas and petrochemical. It is an electromagnetic technique based around eddy current induction but 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 minute current to flow in the surface of the rail head. 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 rail but instead run in a very thin skin (<0.1mm deep) in the surface of the rail. Defects in the surface of the rail distort these currents and this is reflected in changes to the magnetic field just above the surface.

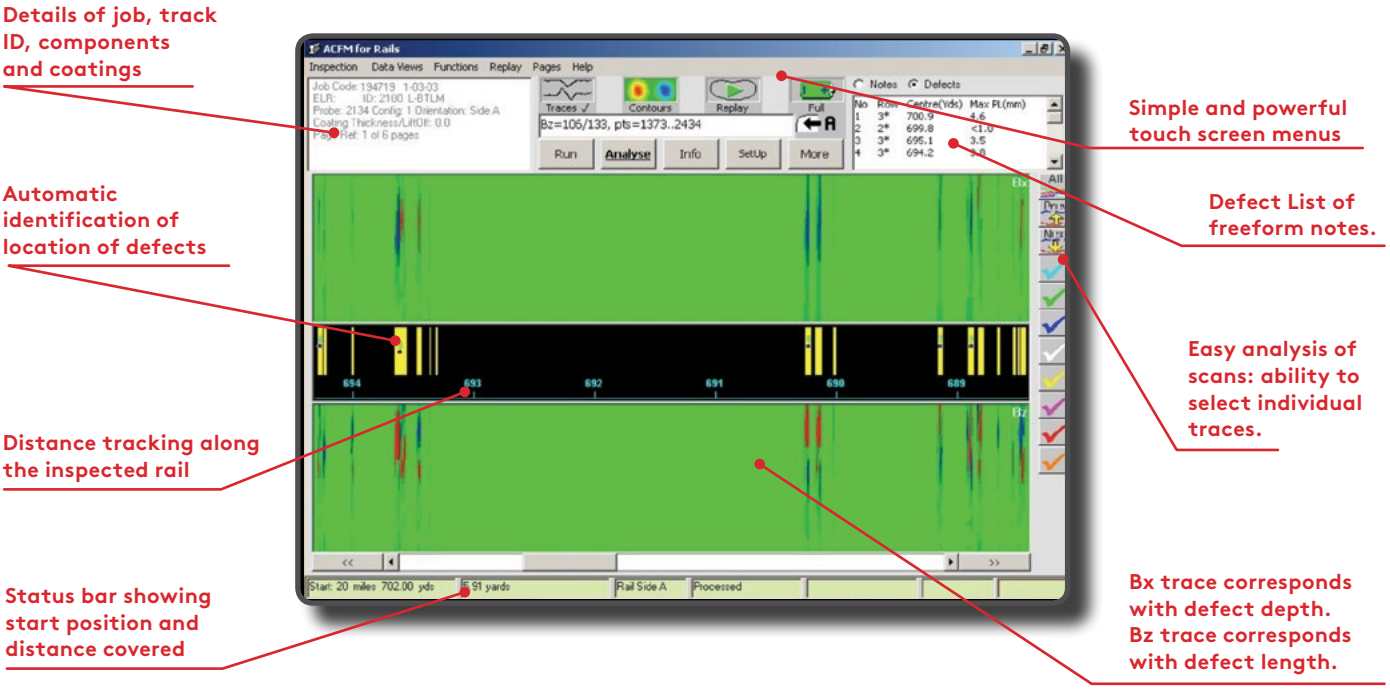
An array of sensors are located across the rail head and monitor any disturbances in the magnetic field. There are two sensor types: Bz sensors, which measure the disturbance to the current flowing around the ends of a crack, and Bx sensors, which measure the reduction in density above the deepest part 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.

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.

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. Note that the value given is the depth of the defect along its propagation face. This is not the same as the through thickness depth if the crack propagates angle internally is not normal to the surface. The location of the Bz peaks and troughs indicate the defect position across the rail.

This analysis is carried out automatically in the software which identifies and sizes the largest defect in each yard (~ 1m) of rail inspected. An encoder is built into the probe which, when provided with a start location, tracks the absolute position of the probe on the rail. This enables checks on deployment speed as well as accurately locating the position of defects on the track.



ACFM WALKING STICK SPECIFICATION

GENERAL	
Size	700mm x 300mm x 1000mm (27.5ins x 11.8 ins x 39.4ins)
Weight	21kg (46.3lbs)
Environmental	IP54
Power Supply	Integral 12V battery supply, rechargeable by domestic 110V or 240V AC40/50 Hz supply
Operating Temperature Range	-20°C to 40°C
Typical Operating Speed	1.5 - 2 mph (2-3 km/h)

APPROVALS

The ACFM® Walking Stick underwent rigorous tests for approval for use on the UK railways. The system performance was evaluated by Corus Rail Technologies who conducted an independent study on behalf of Network Rail. The study compared the ACFM® results from 72 Rolling Contact Fatigue (RCF) cracks, in rail sections that had been removed from service, with destructive analysis and summarised "...the capability of detection of the TSC ACFM® Walking Stick system has been found to be close to 100%."

Site tests were also carried out by Balfour Beatty Rail Technologies on a wide number of sites on the UK rail network to evaluate operating conditions, reliability issues and to collect real-world data. EMC tests were carried out by York EMC Services, UK. Following assessment by their Competent Body and a Certificate of Conformity was issued (No. 8209CBC1).

Eddyfi Technologies

www.tscndt.com info-tsc@eddyfi.com

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