TSC INSPECTION SYSTEMS

APPLICATIONS OF ACFM©
IN THE RAIL INDUSTRY

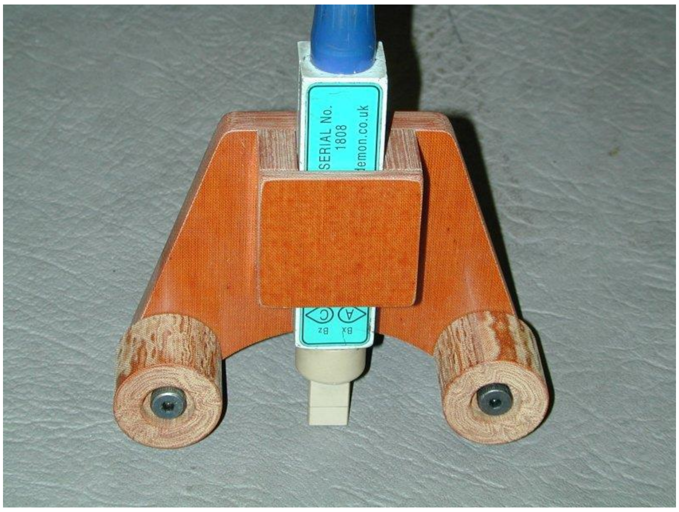
ACFM® was originally developed for use in the oil and gas industry as a technique for detecting and sizing surface-breaking defects with minimal surface preparation. It is now used in a wide variety of industries as an alternative to magnetic particle or dye penetrant inspection. In the rail industry it is being used to inspect axles, wheels, bogies and rails, where it is able to complement ultrasonic inspection:

- Axles – surface breaking defects, particularly on solid axles or in difficult access regions such as under earth-return brushes.
- Wheels – transverse cracking on wheel rims and flanges.
- Bogies – inspection without removing paint, and on internal welds through access holes.
- Rails – head checking where inclined cracks are clustered together.
- All applications can take advantage of automated interpretation for both detection and depth sizing, and storage of all data for off-line review and auditing.

The technique has been accredited for use by Bombardier Transportation and Network Rail, and certified training is available.

Axles

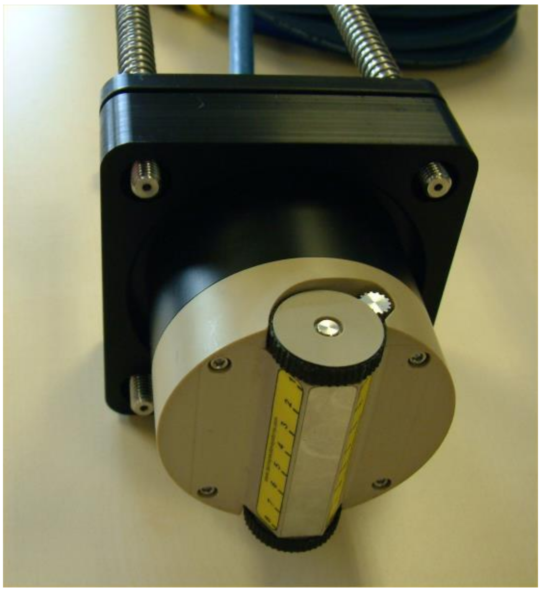
Axles can be inspected without paint removal, enabling testing to be carried out both on and off the vehicle. A number of options exist when considering inspecting axles with ACFM© depending on the required coverage, speed of deployment, type of axle and if the axle is mounted on the bogie. All use the basic ACFM technology but the mode of deployment, and in particular the degree of automation, vary considerably.



The simplest option involves a standard pencil probe mounted in a suitable holder as shown left. The holder stabilises the probe on the axle and the probe is then swept by hand circumferentially around a stationary axle. Because the probe has a small sensitive width, it must be scanned at intervals of 10mm along the length of the axle. Since a significant number of individual scans are needed, this configuration is best used for inspecting small sections of axle or around a radius. Inspection of a plain axle with a pencil probe can be speeded up, however, if the axle is rotated during inspection while the probe is scanned along the axis. This technique is made easier by the fact that the ACFM probe does not have to make contact with the inspection surface, so probe wear is avoided.

To speed up inspection, probes can be made containing many sensors. These array probes have the ability to scan a much larger area in a single pass.

The photo right shows an array probe that was designed specifically for inspecting the section of axle within a traction motor box where the earth return brush makes contact with the axle. Access to the axle was possible by removing the earth return brush and mounting the array in its place. The axle was then rotated and the array inspected a 70mm wide band in one pass. Arrays such as this can be deployed by hand on an axle using a suitable holder and significantly increases inspection speeds. An encoder is built into the array to give precise positioning of any defects and accurate sizing.



Beyond this, more sophisticated systems can be developed using rolling roads or robotic manipulators to further automate the inspection process.

In 2015, TSC developed an innovative product to inspect the centre section of a plain freight axle for fatigue cracks in the surface. The AXIS™ comprises a motorised crawler, which is magnetically attached to the centre of the axle while it is in place on the bogie, and is connected to a rugged, touch-screen controller. It can be deployed from the vehicle inspection pit in a depot, during general visual inspection or light refurbishment operations on a set of wagons.

The AXIS™, which can be operated by train technicians with no prior inspection experience automatically analyses the data for crack-like indications and reports a simple Pass or Fail message to the technician. If a defect is identified, the scanner will move to the location(s) of the indication(s) to allow the technician to mark the location of the defect.

Wheels

Wheel rims and flanges can be inspected using similar techniques to axles. A standard pencil probe can be deployed manually by trolley, or mounted in a jig above a rotating wheel. However, inspection is speeded up considerable by use of an array probe shaped to match the rim/flange geometry so that the whole surface is inspected in one pass.

Bogies

Bogies contain a large number of welds, usually of short length and quite often difficult to access. Such welds are traditionally inspected using MPI, but this involves removing dirt and paint prior to inspection, and reapplying the paint afterwards. This time-consuming operation is avoided with ACFM. To inspect the welds with ACFM, a variety of probes with differently angled or lengthened heads are used, depending on access.

Local geometry changes, such as angles, corners and brackets, can give rise to relatively large variations in ACFM signal, which can make interpretation difficult. To assist in this case, the

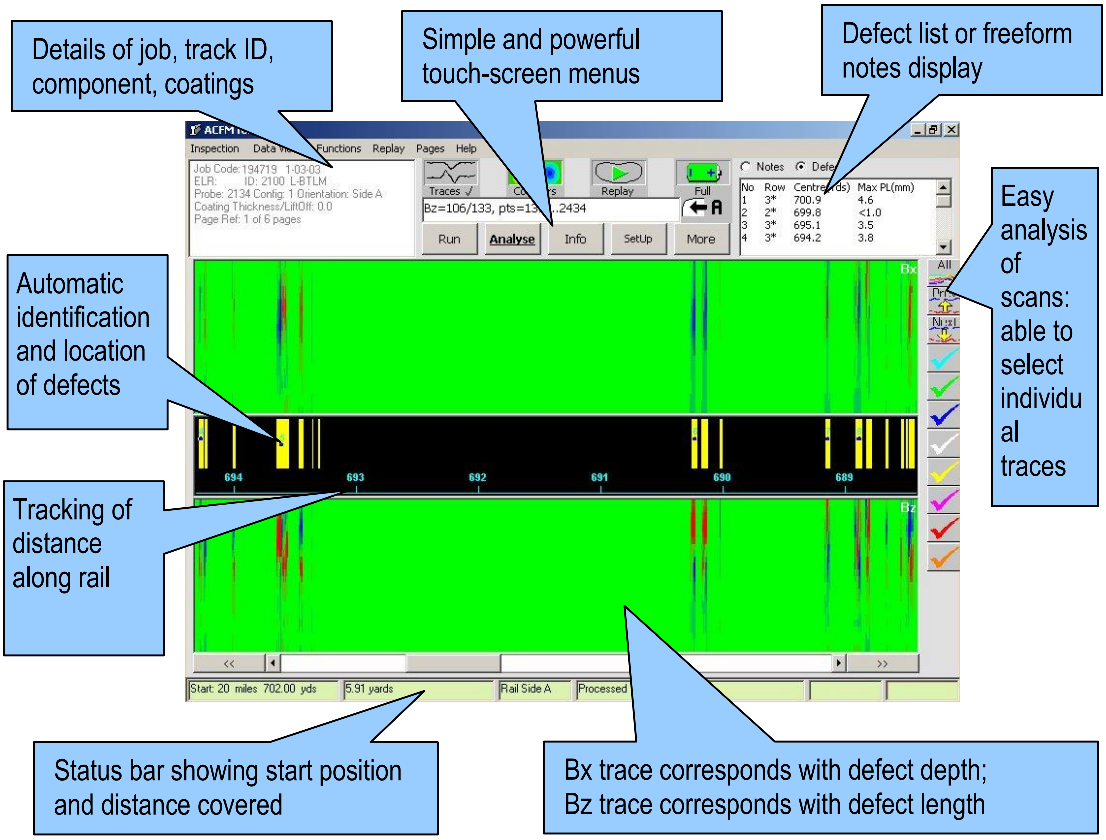
ASSIST™ software incorporates a feature whereby example data from a similar geometry can be viewed alongside the live data so that defect signals stand out from the background.

Rail

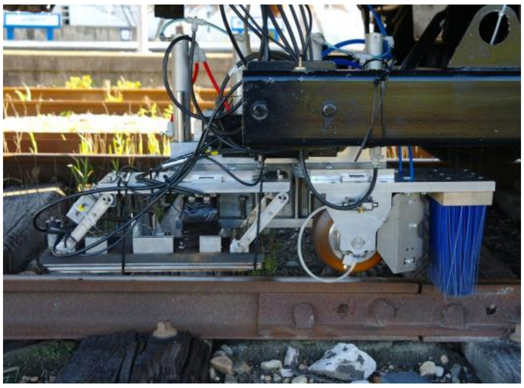
Ultrasonic testing techniques are widely used to detect and size defects throughout the cross-section of a rail. However, the techniques can have problems with so-called “head-checking” or “gauge corner cracking” where clusters of parallel cracks occur together such that shallow cracks at the edges of the cluster can block signals from deeper cracks in the centre of the cluster. The ACFM technique avoids this problem, so has been used in a trolley-mounted system, the ACFM Walking Stick™, specifically to detect and size gauge-corner cracking on the surface of 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 gauge corner cracking, squats and lipping. By providing information on the severity of cracking, a decision can be made between controlling the problem through locally grinding the rail head for shallow defects, or re-railing a section of track for deep defects. In this way saving unnecessary re-railing of shallow cracks or wasted grinding of deep cracks can make considerable cost savings.

The system has the following key features:

- Shaped probe inspects the whole rail head surface in one pass
- Audible warning of defects
- Deepest defect per yard automatically reported and sized
- 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



In 2011, TSC joined the INTERAIL consortium which was funded by the EU to bring together Universities and technology companies with the aim of formulating inspection technologies which could inspect rail tracks at high speeds. The prototype ACFM® system produced during the project was capable of detecting RCF oriented defects 12mm x 2mm in size at 80kph.

For further information, please contact:
TSC Inspection Systems
Davy Avenue,
Knowhill, Milton Keynes, MK5 8PB
UNITED KINGDOM
Tel No: +44 (0) 1908 317444
Fax No: +44 (0) 1908 220959
Email: sales@tscis.com
Web: www.tscis.com

References:

1. D Topp and M Smith, 'Application of the ACFM inspection method to rail and rail vehicles', Insight, Vol 47, No 6, 2005.

2. M. Papaelias et al., "High-Speed inspection of rails using ACFM technology", Journal of NDT&E International, Vol. 42, Number 4, June 2009.

Please Note: As part of its continuing programme of product improvement, TSC reserve the right to alter specifications without prior notice.