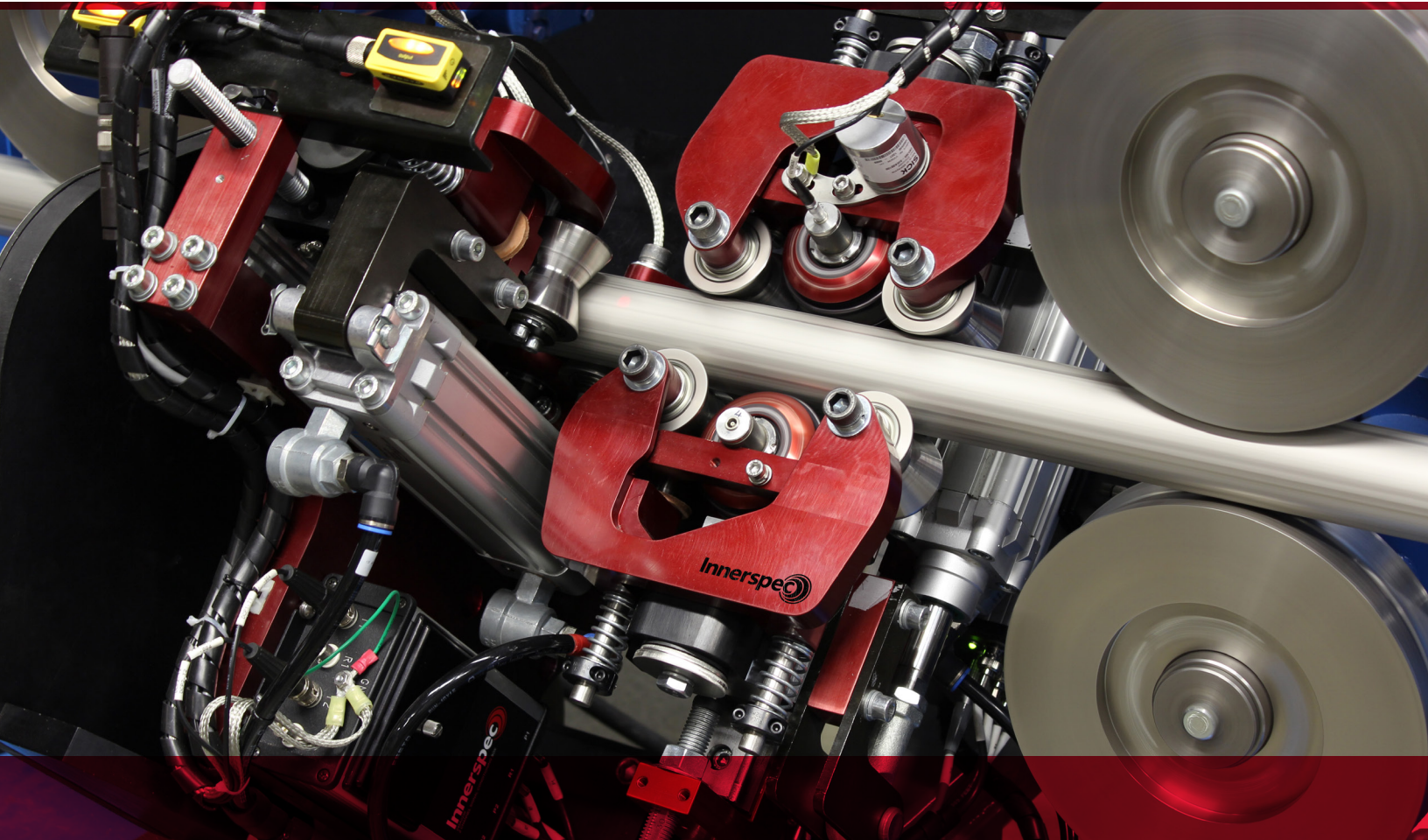


Integrated Solutions



INSPECTIONS | MRUT & LRUT

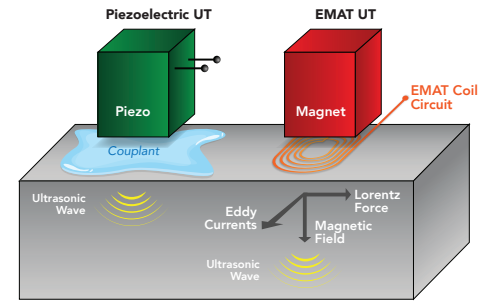
MEASUREMENTS | Thickness, Materials Properties

TECHNOLOGY

Innerspec pioneered EMAT technology in the mid-90s and has since added Phased Array UT, Eddy Current, Laser Measurement, and Digital Imaging to its growing portfolio of NDT techniques.

ULTRASONIC TESTING (UT)

UT refers to a family of non-destructive testing techniques based on the propagation of ultrasonic waves in the object tested. Ultrasound in frequencies ranging from 20 kHz to 50 MHz are transmitted into materials to detect internal flaws or to characterize materials. Ultrasound in industrial NDT can be generated with piezoelectric transducers, EMAT, or Lasers.



Ultrasonic Testing (UT) with Piezoelectric Transducers

UT with piezoelectric transducers is the most common way of generating ultrasound. The advantages of piezoelectric transducers include:

- Applicable to most materials. Including metals, plastics, composites, and ceramics.
- Highly efficient. Unlike EMAT, they can be used with low-power instruments and provide good signal-to-noise even with very small transducers.
- High-resolution and sizing capabilities. Techniques such as Phased Array (PAUT) can increase signal-to-noise, improve inspection speed, size defects, and create accurate images of objects.

Electro Magnetic Acoustic Transducer (EMAT)

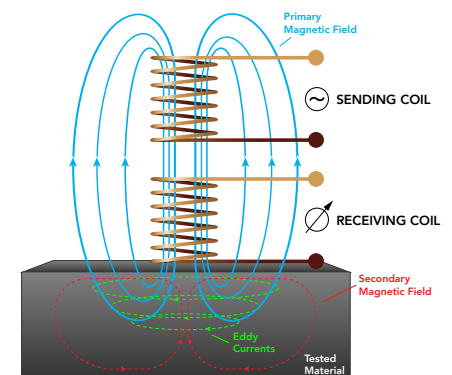
EMAT is an UT technique that uses electromagnetic induction to generate ultrasound in the part inspected instead of the transducer. EMAT works on most metals, including steel and aluminum, and has important advantages over other UT techniques:

- Dry inspection. EMAT does not require couplant for transmitting sound, which makes it very well suited for inspection of very hot and cold parts, and integration in automated environments.
- Imperviousness to surface conditions. EMAT can inspect through coatings and is not affected by pollutants, oxidation, or roughness.
- Easier sensor deployment. Not having wedges or couplant, the angle of the sensor does not affect the direction of propagation. This makes EMAT transducers easier to control is the only practical means for generating shear waves with horizontal polarization (SH waves).

EDDY CURRENT (EC)

In EC an alternating current flows through a wire coil and generates an oscillating magnetic field. When the coil approaches a conductive material, currents opposed to the ones in the coil are induced in the material. Variations in electrical conductivity and magnetic permeability of the test object and/or the presence of defects causes changes in phase and amplitude of the induced eddy currents that can be detected by measuring impedance changes in the coil. The advantages of EC include:

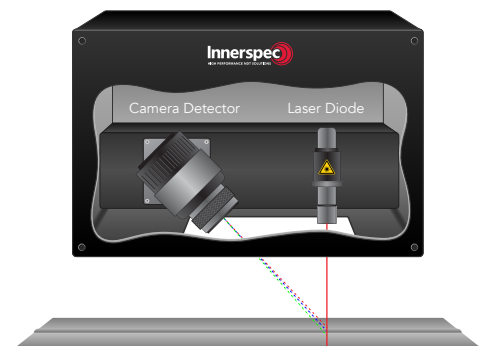
- Non-contact technique.
- Highly sensitive to surface defects.
- Capable of detecting defects in any orientation.
- Permit high lift-off using Pulsed Eddy Current (PEC) techniques.



LASER MEASUREMENT (LM) AND DIGITAL IMAGING (DI)

LM uses lasers for extremely precise measurement of parts and components using triangulation. An LM system includes a CMOS/CCD or PSD detector and a solid-state laser light source. The laser beam is projected on the target under measurement, to detect changes in position as small as 1 micron can be detected and recorded. DI systems rely on industrial high-resolution cameras to take pictures of the part during the production process. Advanced software permits detecting characteristics that are not measurable with LM. The advantages of LM and DI for our applications include:

- Non-contact technique.
- Provides measurements that are not available with other NDT techniques.
- Complements EMAT, UT, and EC to further identify defects.



APPLICATIONS

With hundreds of custom systems installed worldwide, Innerspec is a leading designer of advanced NDT systems for integration in production environments.

Weld Inspection

Thin-Welds (<10mm) with EMAT. Guided waves are the technique of choice for inspections of thin welds because of their high sensitivity and tolerance for the variability encountered in production. Innerspec has fielded guided wave weld inspection systems for tailor welded blanks (TWB), longitudinal and girth weld inspection in tubes, forged and mash welds in coil joining, and lap welds in automotive production.

Thick-Welds (>10mm) with EMAT and PAUT. EMAT provides the ability to inspect materials at high temperature immediately after welding. This technique is used on ERW tube inspections and similar applications to provide near real-time results on the quality of the weld, improve welder uptime, and reduce waste. For final quality control, Innerspec uses PAUT and EMAT for weld inspection depending on the application and customer requirements.

Multi-Pass Welds (Inspections While Welding) with EMAT. Using a proprietary technique, Innerspec has developed a system to provide in-process inspection of welds between passes. The inspection is performed on the last layer deposited (3-5mm), and can be performed during welding.

Austenitic Welds with EMAT. The ability to generate Shear Horizontal wave modes makes EMAT the best alternative for the inspection of austenitic and dissimilar metal welds.

Surface & Thin Volumetric Inspection

Thin Laminated Strip with EMAT. Guided waves are used for detection of internal and surface defects in laminated products such as coin stock and aluminum/steel bushings.

Surface Inspections with EMAT and EC. EMAT-generated surface waves are used for detection of defects covering large areas with a limited number of sensors. Current EMAT applications include surface inspection of plates, ingots, billets and tubes. EC systems are used for surface inspection of rod and wire during production and in final quality control.

Large Volumetric Inspection

Plate and Ingot Inspection with EMAT. EMAT is used for low-resolution inspection of steel plates and aluminum ingots.

High-Resolution Volumetric Inspection with PAUT. PAUT is used for detection of small defects in large forgings and any volumetric inspection that requires detection of very small defects.

Roll Inspection. Our patented UT and magnetic technique permits detection of surface and internal defects on mill rolls.

Thickness Measurement

Thickness Measurement with EMAT and DCUT. Provide micrometer accuracy (12µm) in harsh environments, and at extreme temperatures on rough and coated/dirty materials. Dry-Coupled UT (DCUT) is used for UT measurement without couplant on non-metallic or highly-resistive materials.

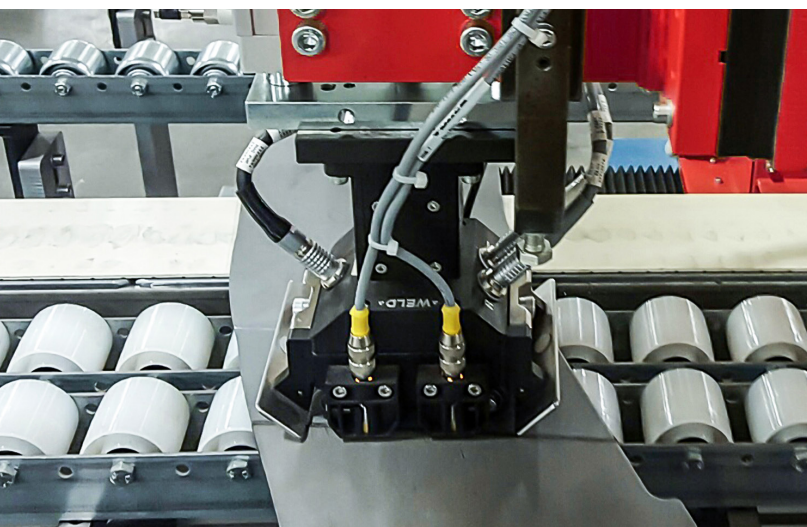
Other Measurements

Stress Measurement with EMAT. Used for measurement of internal stress on plates, train wheels, and other thick components.

Bolt-Load Measurement with EMAT. Proprietary dual-wave technique for measurement of load in bolts.

Conductivity Measurement with EC. Provides fast scanning and measurement of top and bottom conductivity in aluminum plates.

New, custom solutions are added frequently. Visit our website for up-to-date information.



Weld Inspection with the TEMATE SI-WB



Mill Roll Inspection with ROLLMATE

PORTABLE SOLUTIONS

In addition to Integrated Systems, Innerspec offers portable instruments and custom sensors for in-service applications. Visit our website for the newest instruments, and to download our EMAT and DCUT catalogs of standard sensors and accessories.

MRUT

(Medium Range UT)

MRUT (Medium Range UT) describes a suite of techniques that permit covering an area between approximately 25 mm to 3000 mm from the location where the inspection is performed. MRUT uses guided wave and/or bulk wave techniques and complements LRUT (Long Range UT) by covering the near field area where LRUT cannot be used.

LRUT

(Long Range UT)

LRUT (Long Range UT) describes the inspection technique that uses guided waves to cover distances from 1 to 100 m. The LRUT technique is used exclusively for pipeline inspection to cover long distances from one inspection point.

WELD INSPECTION

EMAT technology coupled with custom instrumentation, software, and sensors permit weld inspections that are not feasible or very difficult with conventional ultrasonic techniques. Innerspec has developed unique solutions including: inspections of thin-welds (<6 mm) using guided waves, inspections-while-welding of multi-pass welds during the welding process, and inspections of dissimilar metal welds using Shear Horizontal waves. Lack of couplant permits using these techniques below freezing and at high temperatures.

STRESS

Custom and off-the-shelf applications for internal stress measurement on plates, train wheels, and thick structures. The technique uses two orthogonal linearly polarized Shear Horizontal waves at 0 and 90 degrees to provide a birefringence measurement that is directly correlated with internal stress.

BOILER INSPECTION

The TEMATE TG-IS(B) is designed for detecting and measuring wall loss, hydrogen damage, and caustic gauging in boiler tubes. The TEMATE TG-IS(B) is available for purchase or rental from Innerspec Technologies.

THICKNESS MEASUREMENT

Off-the-shelf and custom solutions for thickness measurement in the field using EMAT and DCUT (Dry-Coupled UT) sensors.

BOLT LOAD

The TEMATE BL is used to measure bolt-load by measuring ultrasonic Time-Of-Flight corresponding to changes in bolt elongation. Innerspec uses a patented two-wave solution to determine load on bolts without knowing the original length.



sales@innerspec.com
www.innerspec.com

USA | Spain | UK | China | Mexico

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