

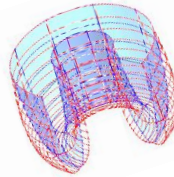


Principles of Operation

ECHO-3D is an Electro-Magnetic Field (EMF) based technology that uses Electro-Magnetic Field Imaging (EMFI) to display surface breaking defects in a three dimensional image. That is, akin to Magnetic Particle Inspection (MT), the ECHO-3D sensor creates a magnetic field. The EMF is created by a focusing element which creates a large hemi elliptical toroidal field (greater than 30 mm) below the Sensor. The EMF shape is measure by two layers of eight equally-spaced specially-shaped antenna coils.

The EMF is effected by the following:

- Proximity to a conductive material;
- The conductivity of the material;
- The permeability of the material; and
- The geometry of the material.



The ECHO-3D Sensor has the ability to cancel out these effects using a null command before scanning.

As the focused EMF from the Sensor passes over a surface breaking defect, such as a crack, SCC, or corrosion, the shape of the field is deformed. Unlike MT, the ECHO-3D Sensor measures the change in the shape of the field and converts this raw analog information to digital for processing.

Unlike MT, the EMFI process works on any electric conducting material such as, but not limited to, 300 Series stainless steel, nickel alloys, superalloys, and aluminum; yet like MT, also works on ferromagnetic materials such as carbon steel. The ability to detect the change in the EMF is not greatly affected by lift-off (distance from the sample surface) allowing the sensor to detect anomalies below cladding, paint, plastic or rubber linings, or insulation. Unlike MT, the sample is not left with a residual magnetic field and therefore does not require degaussing prior to return to service.

Like UT, the ECHO-3D can detect a defect through a coating. Unlike UT, it does not require direct contact with the surface of the sample, nor does it require the use of a couplant.

Like PT, ECHO-3D detects surface breaking cracks. Unlike PT, the surface requires little preparation and it results in a permanent electronic record of the data and report plus leaves no materials to clean up.

The ECHO-3D system is designed to produce data samples known as Shots at regular intervals. Shots can be triggered by input received from the included Encoder or an ancillary X-Y scanner. ECHO-3D software receives the digital data from the Sensor and processes it resulting in real-time B-Scan displaying defects depths.

When the Sensor is used to scan a region via multiple passes, either by hand or by mechanical encoded scanner, the software stiches the adjacent B-Scans and produces a C-Scan image in real-time. A combination of the B-Scan and C-Scan, which can be viewed and analyzed by ECHO-3D software, is utilized to determine the location, orientation and severity of a defect including crack depths to > 5mm.

Once the scan is complete, clicking on the C-Scan plot instantly produces a 3D model allowing the technician to rotate the image 360°. Clicking on the X-Y-Z icon displays an analysis screen allowing the technician to locate and mark defects that are included in the final report.

Protected Document Format (PDF) reports are generated with the ECHO-3D software and include details of: the Inspection Company; Client details; Technician details; Sensor set-up; and Project details with defect locations, depths, and optional site photographs and screen shots.