Flaw Detection Capabilities with Eddy Current Array Technology

2018 ASNT Annual Conference

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Agenda

• Common NDT Techniques for Surface Flaws
• Eddy Current Array (ECA) Testing and Benefits
• Scan Speed, Signal-to-Noise Ratio, and Sample Rate
• Friction Stir Welds
• Multi-Layer Bolt Holes
• Conclusions
Common NDT Techniques for Surface Flaws

• Liquid or Dye Penetrant Test (PT)
  • Liquid is drawn into surface openings by capillary action
  • Defects become visible under UV light or due to the dye

• Magnetic Particle Test (MT)
  • Very fine ferromagnetic particles are applied to the metal
  • Particles are drawn into flaws which indicates their presence

• Eddy Current Test (ECT)
  • Coils apply EM field into metal, flaws disrupt EC flow
  • Can find defects in ferrous and non-ferrous materials
  • Generally no surface prep or chemicals are required
Eddy Current Array (ECA) Testing

• Multi-coil arrays take EC technology a leap ahead
• ECA probes have multiple coils in the same probe
  • positioned longitudinally, transversely, or off-axis
  • fired at coordinated times
• With an array probe, users can
  • capture more information in a single pass
  • dramatically increase speed, accuracy, and repeatability
• Inspection can now be done in a fraction of the time
Scan Speed, SNR, and SR

• ECA detectability is inversely proportional to scan speed
• Slowing down the sample rate (SR) will achieve better signal-to-noise ratio (SNR)
• A high-quality SNR ECA instrument can increase the scan speed ability while maintaining the required probability of detection (POD)
• An ideal ECA solution, consisting of instrument and probe, is one that produces the best SNR to meet these inspections needs
Scan Speed, SNR, and SR
Friction Stir Weld Inspections

• X-ray is time consuming and access can be difficult
• PT requires handling of chemicals and surface prep
• Surface breaking cracks difficult for UT to detect and size
• Grain structure of FSW can mask flaws for UT
Friction Stir Weld – ECA Solution

• ECA is an ideal technique for FSWs
• A small probe and instrument allows for fast and easy access to FSW seams
• No surface preparation or handling of chemicals required
Surface Crack Detection for FSW with ECA

Superior SNR

3 axial flaws of varying depth

No FSW Grain Noise
Surface Crack Characterization with ECA

Axial Channel

Transverse Channel

Crack-like Flaw: No Axial, Strong Transverse

3 angled flaws
Multi-Layer Bolt Hole Inspections

• Difficult to identify the layer in which a flaw occurs
  • Especially when flaw is close to transition between layers
• Current method requires use of a marker or tape on the probe to indicate depth
Multi-Layer Bolt Hole – C-Scan Solution

• C-Scan display allows the user to “see” the different layers

• Better POD and characterization of signals than standard impedance & sweep displays

• Color 2D & 3D C-Scan displays from ECA now being used for bolt hole inspections

• Superior SNR makes flaws easily identifiable
Better POD for ML Bolt Hole Inspections

- 3D C-Scan
  - 2D C-Scan or “Waterfall”
  - Easily detect flaws
  - Very high SNR
  - Flaws stay in data buffer for further analysis
Seeing Layers in ML Bolt Hole Inspections

Easily identify layers

Can see which layer the flaw is located

3 layers shown in the C-Scan
Multi-Layer Bolt Hole Inspections
Conclusions

• A high-quality SNR ECA instrument can increase the scan speed ability while maintaining the required POD

• With higher noise level there is a greater chance of missing small flaws, therefore a high sample rate is not necessarily good; what is more desirable is a high SNR

• Surface breaking flaws can efficiently be found in FSW using an ECA probe and a handheld ECA instrument in comparison to existing techniques

• During multilayer aluminum bolt hole inspections, it can be determined in which layer flaws exist by using C-Scan and dual frequencies
Thank You

Questions?