EVIDENT

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# Eddy Current Array for Corrosion Inspection

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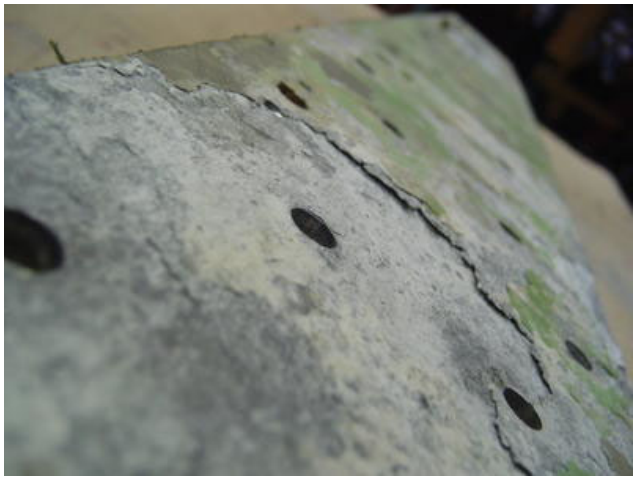
# *Eddy Current Array for Corrosion Inspection*

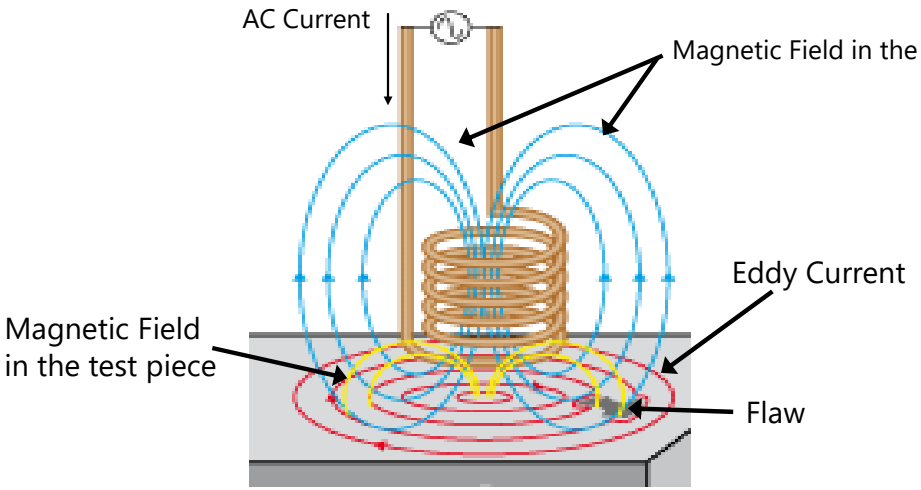
- **Corrosion presents a major threat to aircraft structural integrity. Moisture that collects between aircraft layers leads to hidden corrosion and causes multisite damage if not detected. Regular in-service inspections are required. Eddy current is one of the NDT tools that is used to accomplish this task.**

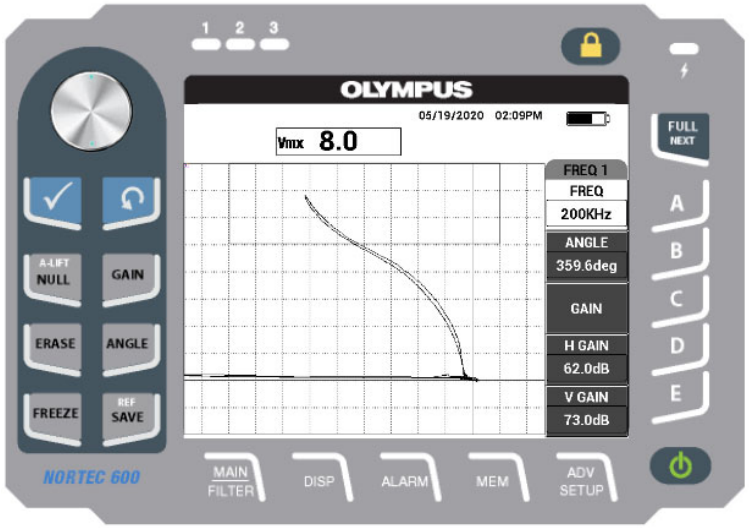
- **Corrosion can lead to weakening of the aircraft's structure and induce stress cracking if not detected.**



# *Eddy Current Array for Corrosion Inspection*

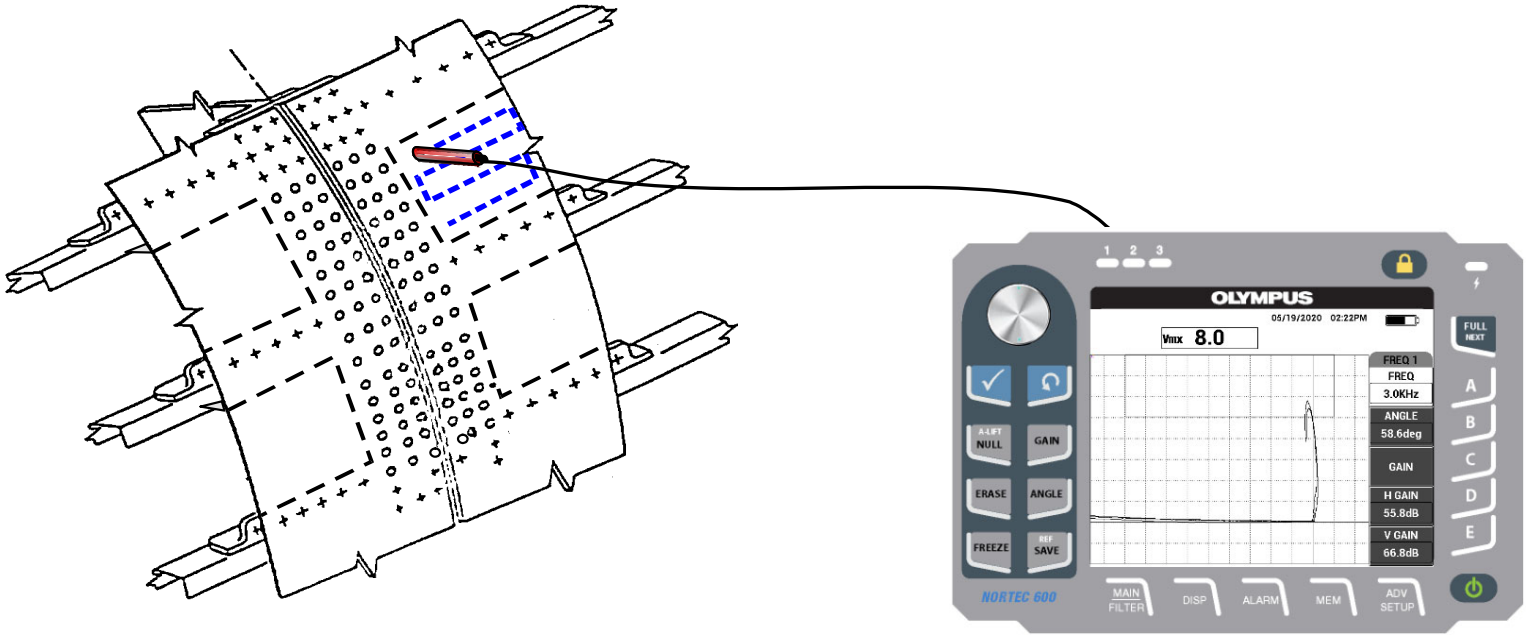
- **Eddy current testing (ECT) technology works on the principle of electrical magnetic coupling of a probe's coil operating close to a test specimen (conductive material, ferromagnetic or nonferromagnetic). The probe's induced magnetic field generates eddy currents within the test specimen and displays signals on the instrument's impedance plane.**
- **Defects within the test specimen cause a disruption to the induced eddy currents, thereby affecting the magnetic coupling. This will be displayed on the eddy current instrument.**



# *Eddy Current Array for Corrosion Inspection*

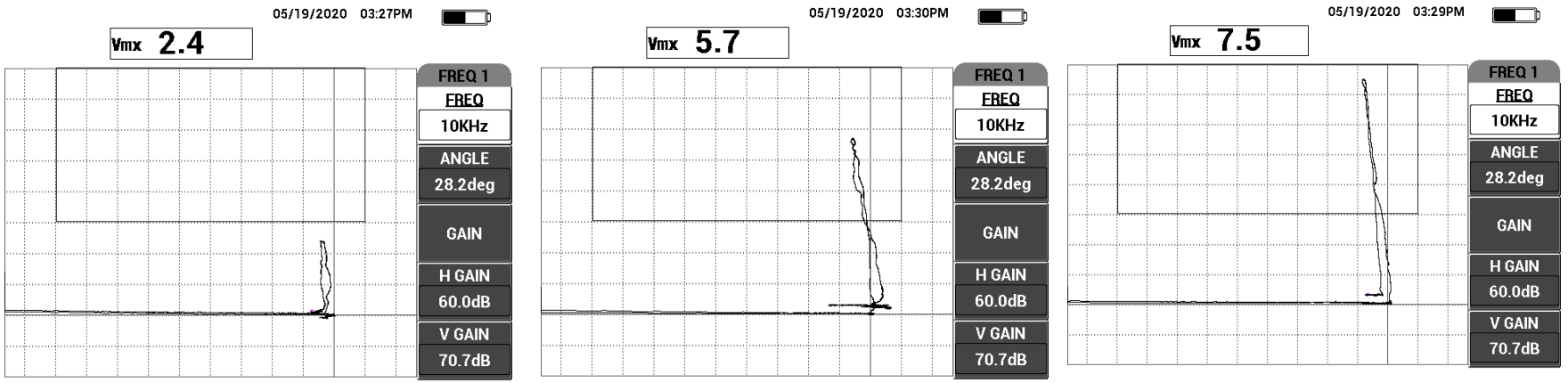
- Conventional ECT is used for corrosion inspection in multilayered structures. A single element probe is used by the NDT technician to raster scan the structure, looking for indications of possible corrosion within the structure.



# *Eddy Current Array for Corrosion Inspection*

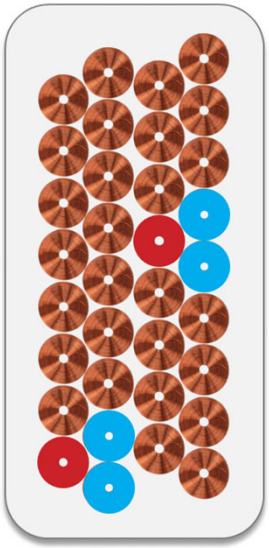
- The standard eddy current probes used for corrosion inspection are low-frequency eddy current (LFEC) spot probes. Typically, these probes are operating at frequencies between 100 Hz and 50 kHz.
- This method relies on an impedance plane eddy current instrument.

Below, we see eddy current signals acquired on engineered standards with 5%, 10%, and 20% material loss. When there is more material there is an increase in the amplitude signal and the vertical max (VMX) reading.



# *Eddy Current Array for Corrosion Inspection*

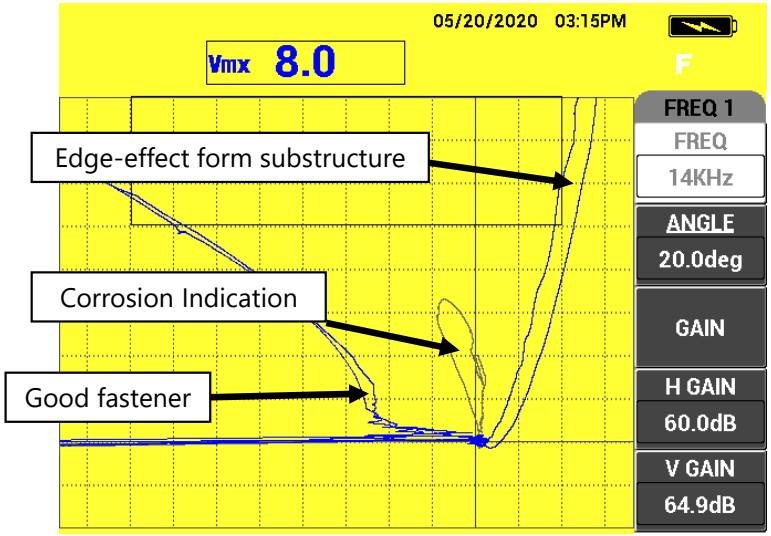
- An eddy current array (ECA) instrument such as the OmniScan™ MX flaw detector can support eddy current array inspection with C-scan imaging.

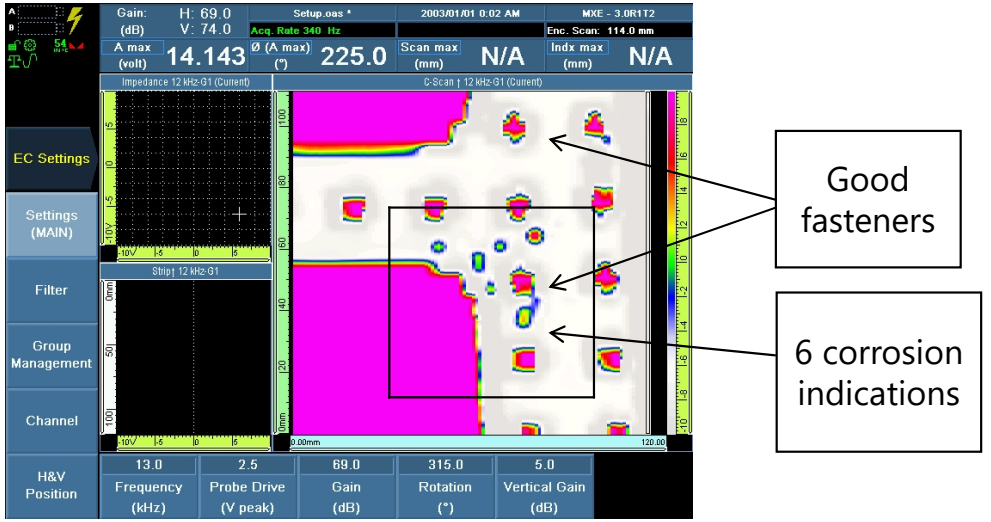



- Eddy current array probes support 32 coils (up to 64 with an external multiplexer) and work in either bridge or transmit-receive (reflection) mode. The operating frequency ranges from 20 Hz to 6 MHz, with the option of using multiple frequencies in the same acquisition.

# *Eddy Current Array for Corrosion Inspection*

- **There are some common challenges encountered when using an impedance instrument vs. an eddy current array instrument when scanning a multilayered structure with fasteners and painted surfaces. When using an impedance plane instrument, proper interpretation of the indication requires thorough training and experience. However, with an ECA instrument, the C-scan offers a good image of the inspected area, the location of the corrosion, and the ability to estimate the size of the damage. It provides easy-to-interpret data to the operation and maintenance team on how best to repair the corrosion damage within the structure.**

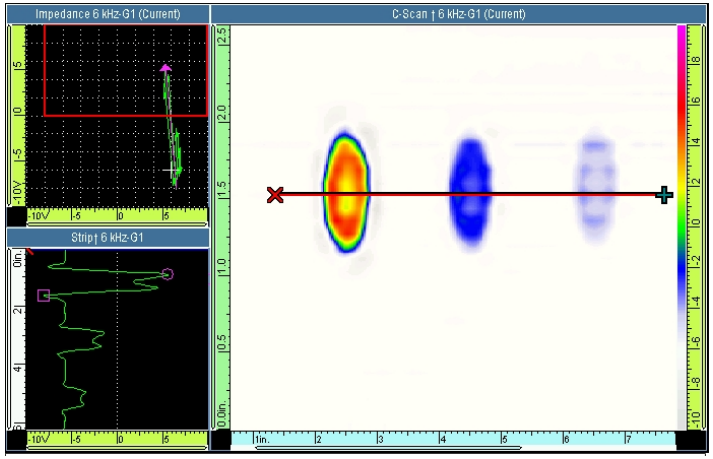


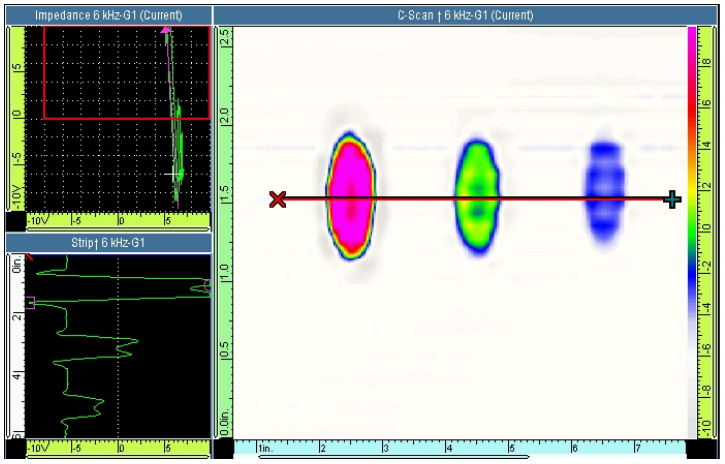
# *Eddy Current Array for Corrosion Inspection*

- After scanning an area, the operator can make post-acquisition setting adjustments of the raw data. This will enable fine-tuning of the instrument for calibration and acquisition, enabling improved analysis of the data.
- In acquisition mode, the C-scan shows real-time mapping of the part under inspection.
- In analysis mode, using the cursors shows the data in the impedance plane and a strip chart display to aid in the measurement.
- This should yield better results and detection of corrosion within the aircraft structure.

**Frozen Raw Data**

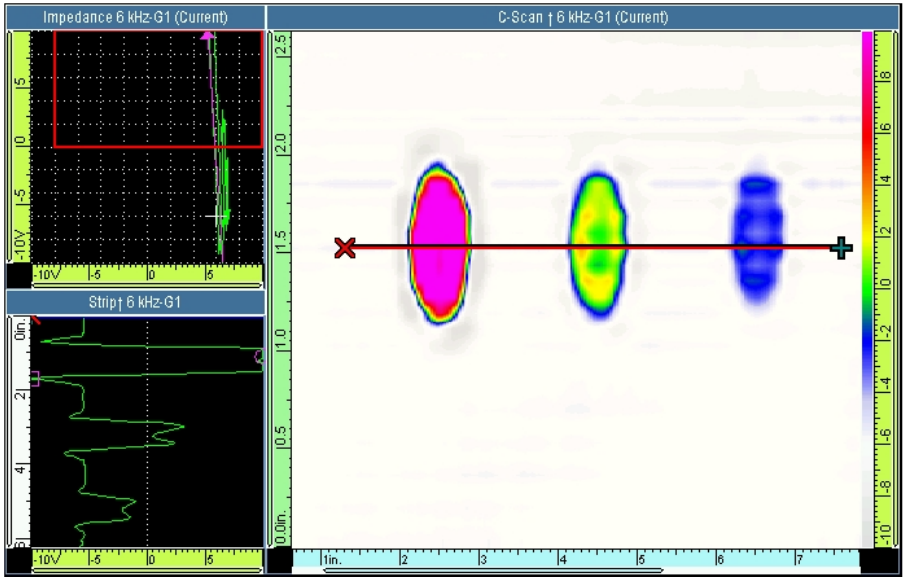



**Post-Acquisition Adjustment of the Frozen Raw Data**



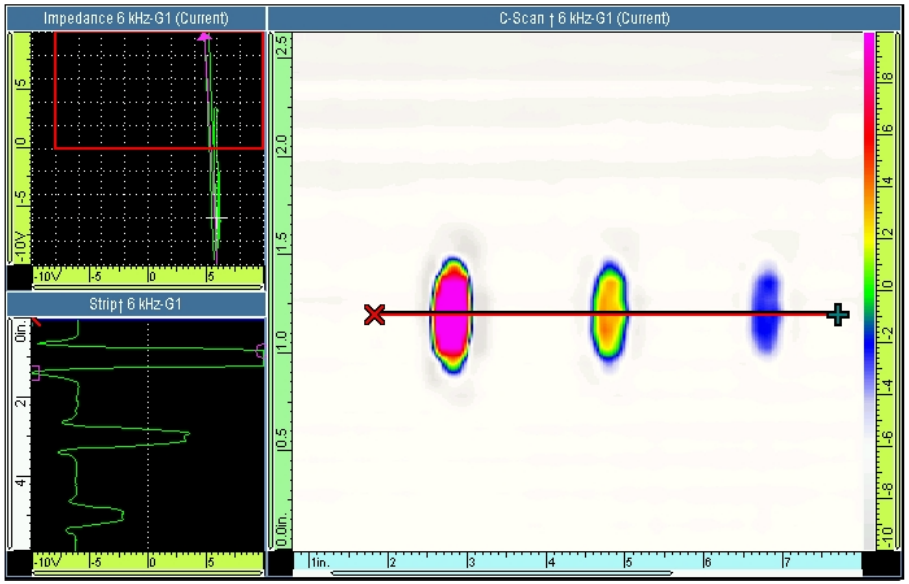
# *Eddy Current Array for Corrosion Inspection*

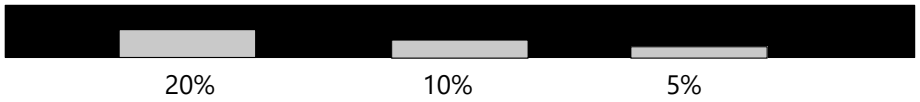
- **Aluminum sample with 0.75-inch (19 mm) milled pockets to represent corrosion. The sample is a 0.063-inch (1.6 mm) thick aluminum sheet.**
- **C-scan image of the 0.75-inch (19 mm) diameter milled pockets representing 20%, 10%, and 5% material loss simulating corrosion.**




# *Eddy Current Array for Corrosion Inspection*

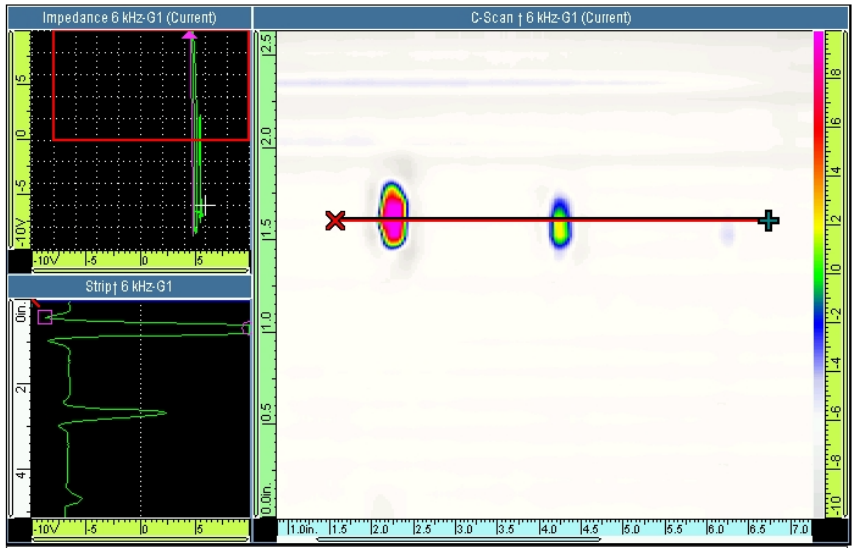
- **C-scan image of a sample with 0.50-inch (12.7 mm) milled pockets representing 20%, 10%, and 5% material loss.**

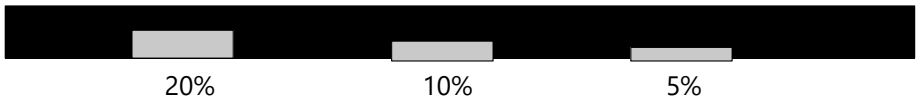


# *Eddy Current Array for Corrosion Inspection*

- **C-scan image of a sample with 0.25-inch (6.35 mm) milled pockets representing 20%, 10%, and 5% material loss. The C-scan shows that the eddy current is barely detecting the 5% material loss.**

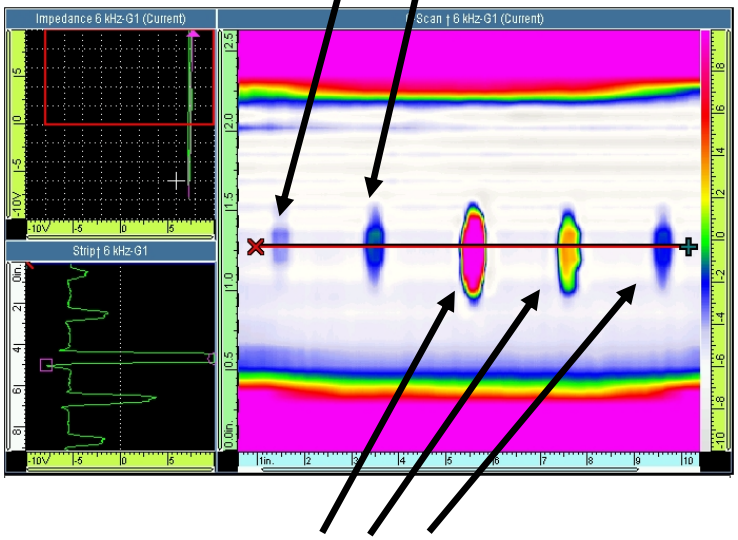


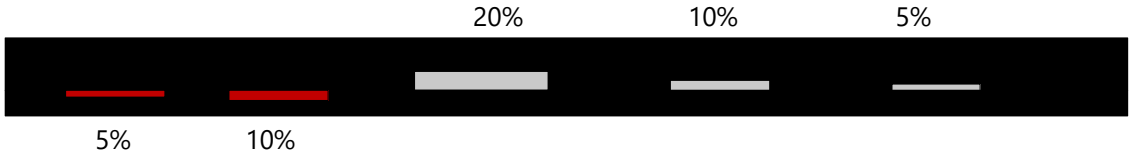



# *Eddy Current Array for Corrosion Inspection*

- In this C-scan example, we see the scan of a 0.050-inch (1.27 mm) thick substrate (bottom sheet) added to the 0.063-inch (1.60 mm) thick aluminum top sheet with 0.50-inch (12.7 mm) diameter milled pockets. The top sheet still has 20%, 10%, and 5% material loss, whereas the bottom plate only has 5% and 10% material loss.

**5% and 10% milled pockets on the top side/faying surface on the bottom plate**



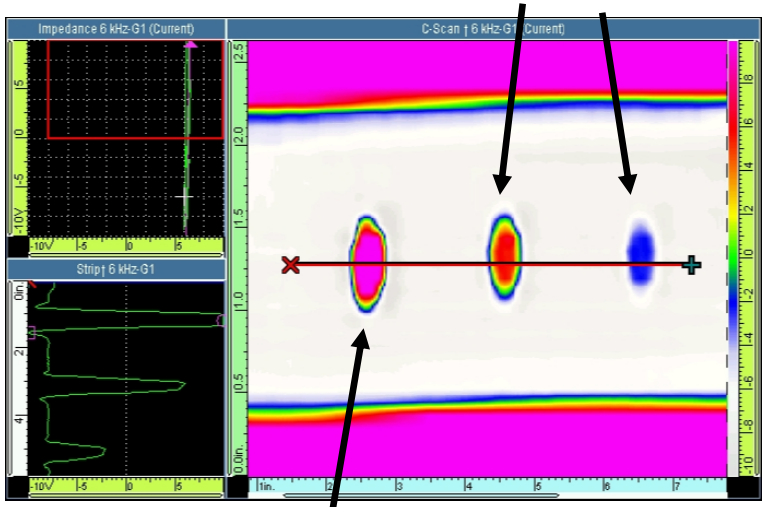



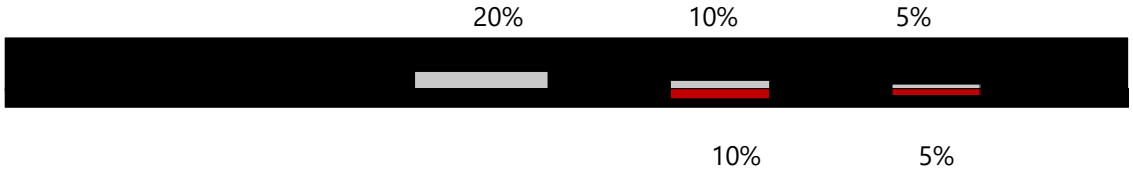

**20%, 10%, and 5% milled pockets on the back side/faying surface of the top plate**

# *Eddy Current Array for Corrosion Inspection*

- Looking at the same sample, with the 0.050-inch (1.27 mm) thick substrate (bottom sheet) rotated and attached to the 0.063-inch (1.60 mm) thick aluminum top sheet with 0.50-inch (12.7 mm) diameter milled pockets. The top sheet still has the 20%, 10%, and 5% material loss, whereas the bottom plate has 5% and 10% material loss.

**10% and 5% milled pockets on the top side/faying surface on the bottom plate**

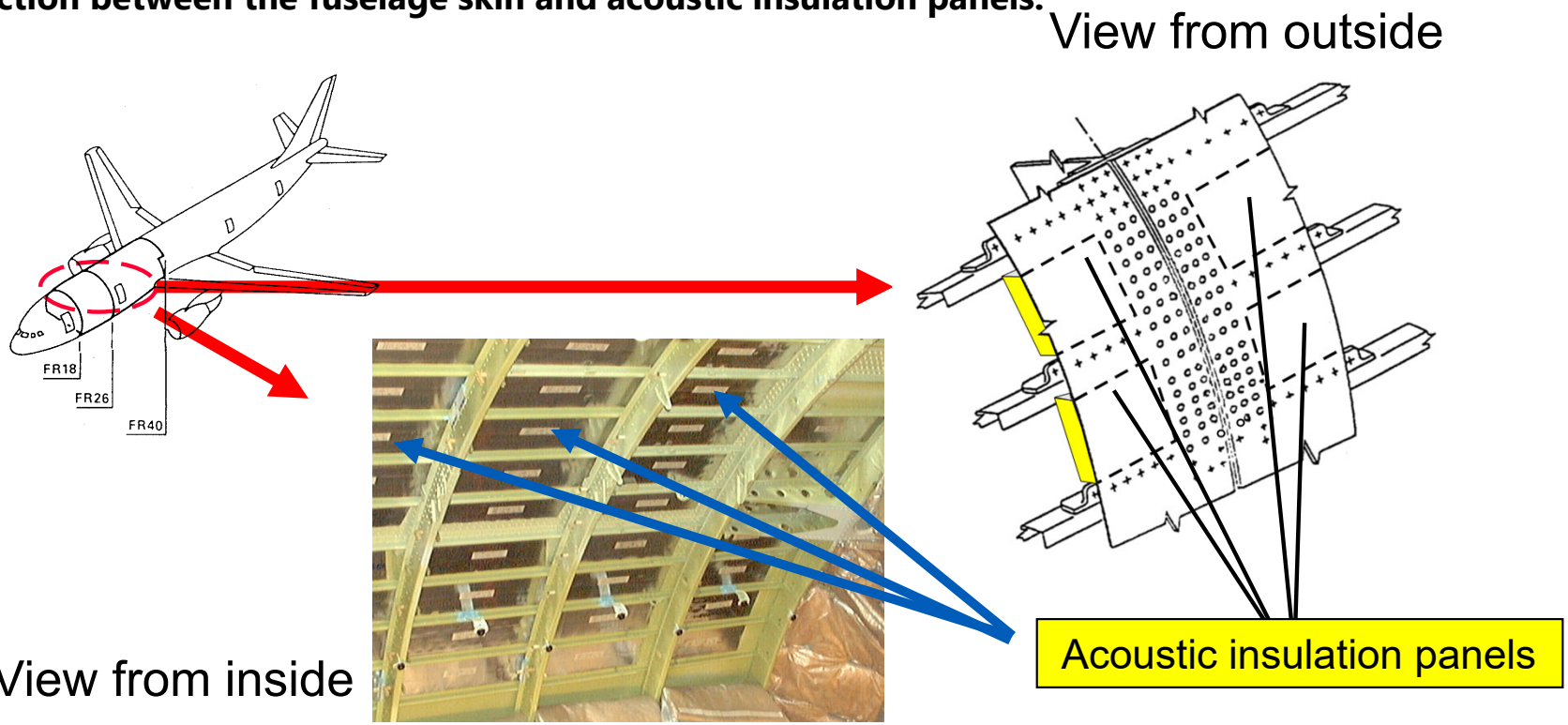



**20% milled pocket on the back side/faying surface of the top plate**

# *Eddy Current Array for Corrosion Inspection*

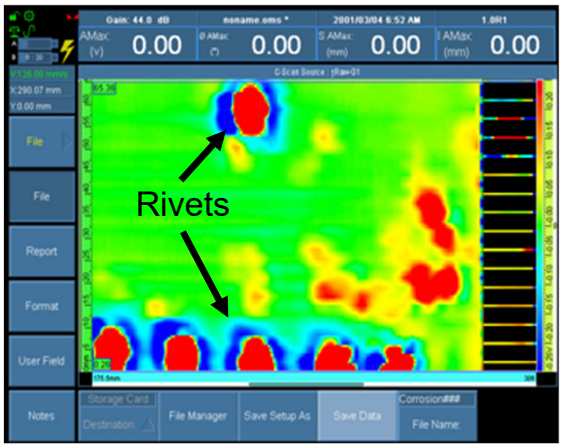
- **Example of a commercial aircraft fuselage inspection using eddy current array for corrosion detection between the fuselage skin and acoustic insulation panels.**



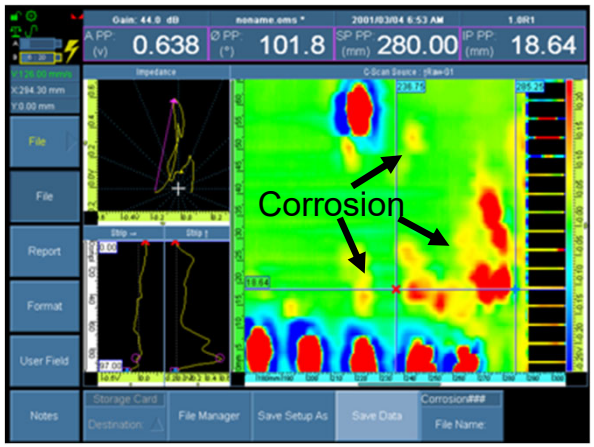
# *Eddy Current Array for Corrosion Inspection*

- **In this inspection procedure, the SAA-112-005-032 probe is operating at 5 kHz and covering 112 mm (4.4 inches)**
- **With the probe's large footprint, raster scanning can be performed more efficiently as it covers a larger area.**
- **With a conventional eddy current (ECT) probe, the inspection would normally take about 9 hours; with an eddy current array (ECA) probe, it would only take about 1 hour to complete the inspection.**

**In acquisition mode**




**In analysis mode**



# *Eddy Current Array for Corrosion Inspection*

**Conclusion:**

- **Eddy current array enables quick and easy inspection for corrosion over a large area.**
- **The C-scan images make it easier to interpret the results and to identify corrosion and other damage within the structure.**
- **The saved data can be used for reference in the maintenance and repair of the damaged structure.**

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# Thank you for your attention