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DRS Inspection

For Challenging Coatings

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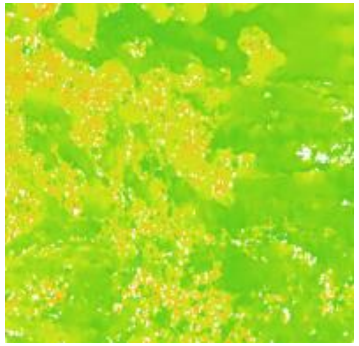
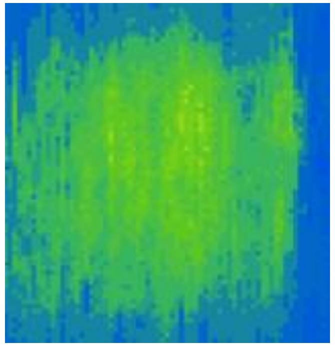
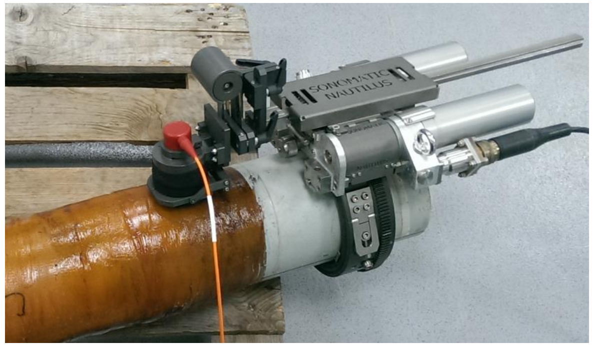
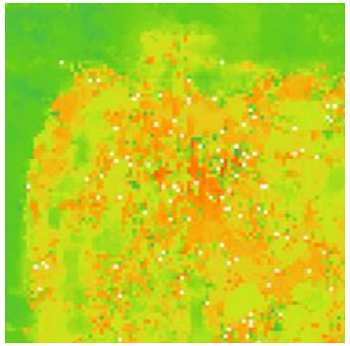
May 2018



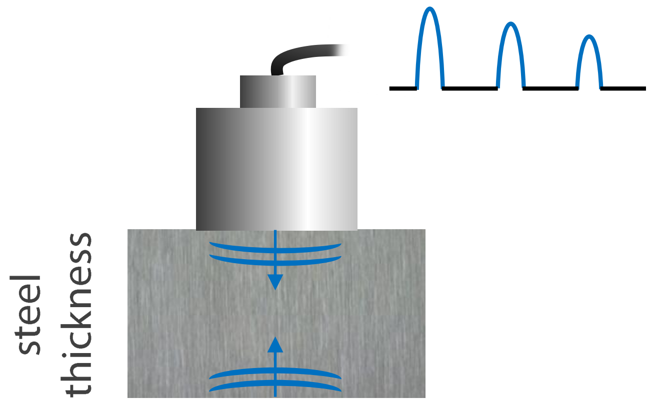

Conventional UT

Accurate measurements of steel thickness are based on reflections using

- High frequency (5 – 10 MHz) signals
- Speed, distance, time calculations

However, many coatings attenuate high frequency signals

→ *Conventional UT often not possible*

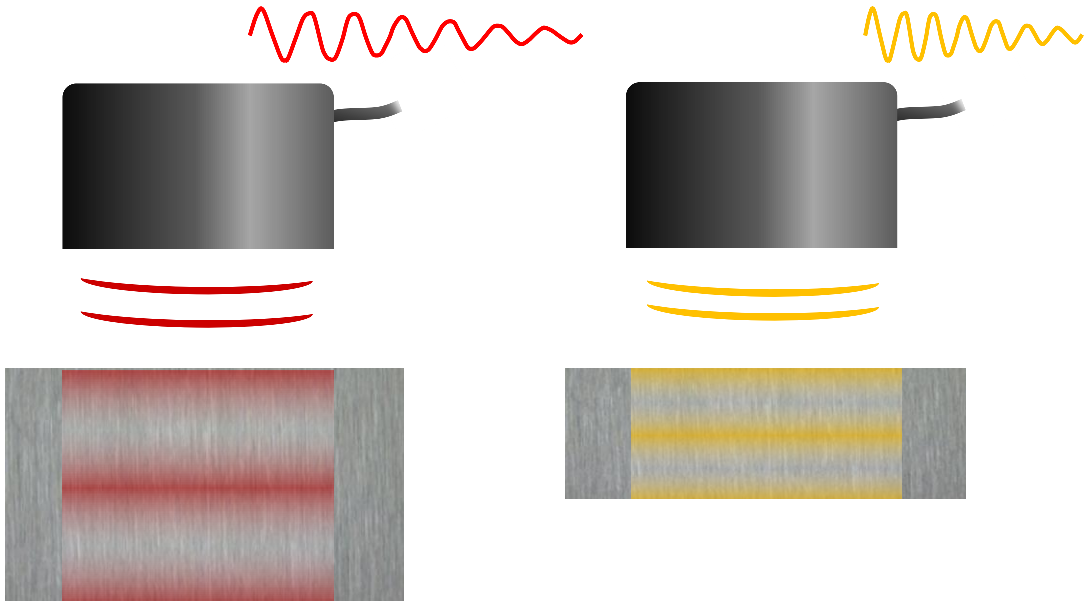


Time-based WT measurements

The DRS Technique

Uses lower frequency ultrasound to make accurate measurements of steel WT

- Low frequencies penetrate coatings more easily
- Low frequencies cause steel to vibrate at its natural frequencies (usually < 1 MHz)
- Vibration frequencies are used to calculate steel WT



Frequency-based WT measurements

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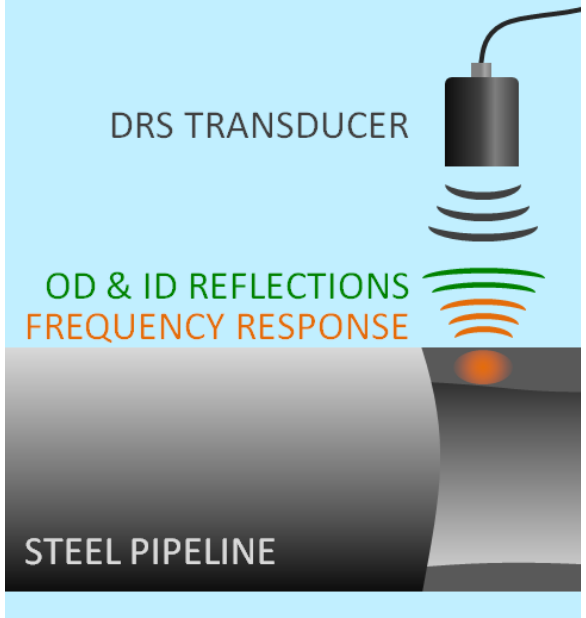
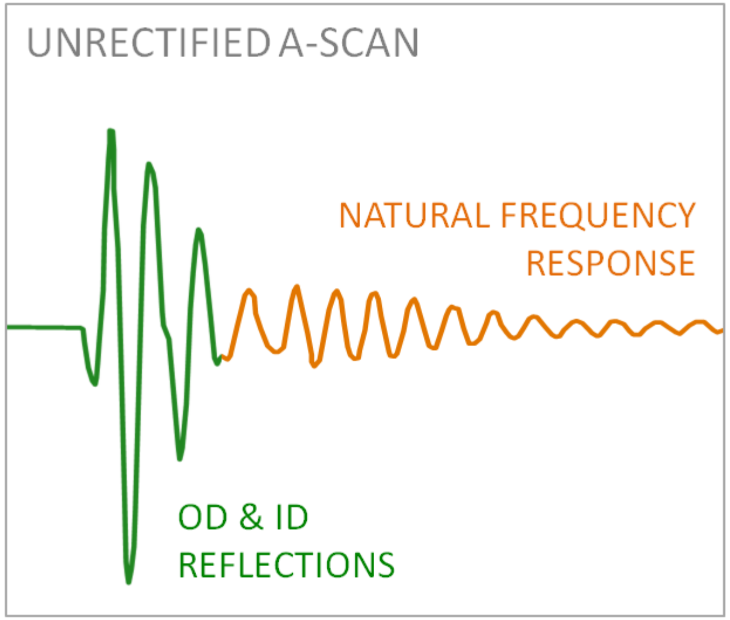
The DRS Technique

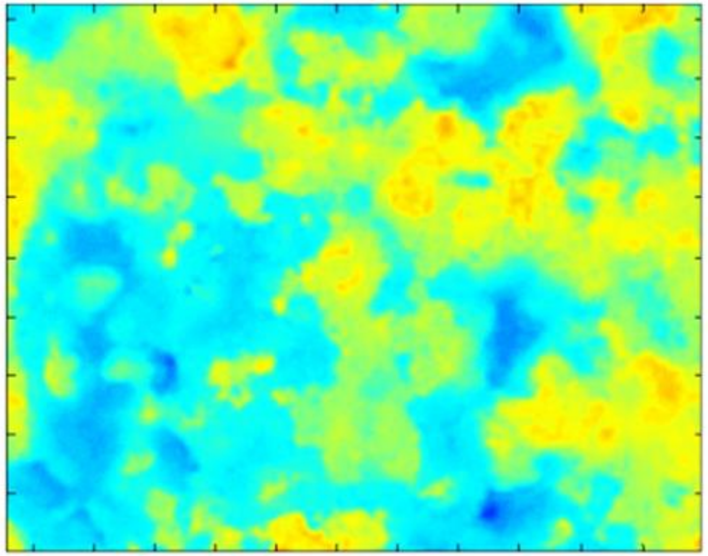
Probe excites steel with a broad range of low ultrasonic frequencies



Steel responds, vibrating at natural frequencies related to the WT



Probe rasters over area collecting response signals



Advanced signal processing algorithms extract the vibration frequencies and map the WT profile

DRS Inspection Through Composite Repairs – Ex-Service Sample

Technowrap 2K™ composite repair

Uneven surface

Severe internal corrosion

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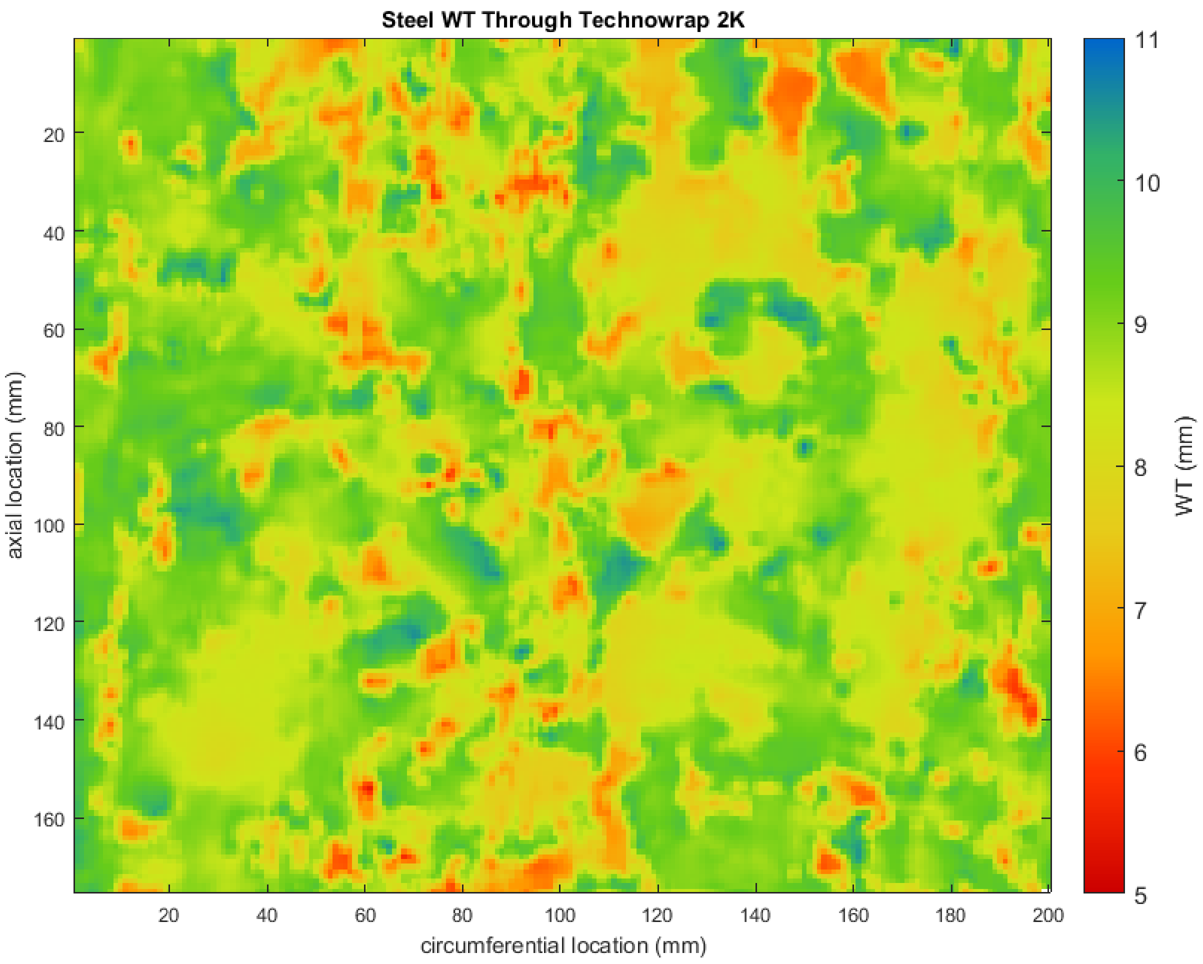
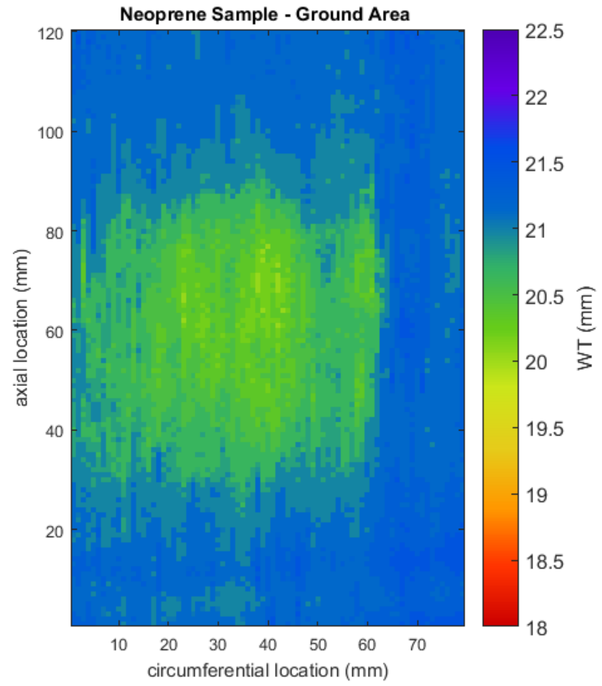
DRS Inspection Through Composite Repairs – Ex-Service Sample



The DRS Technique – Advantages & Limitations



Steel WT measurement accuracy is typically ±0.5 mm (80% tolerance)

WT variations of <1 mm can be measured

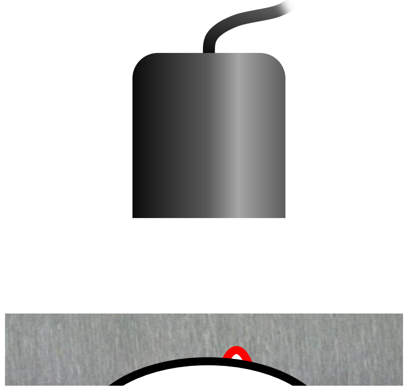
Pits smaller than 10 mm in diameter are not detected

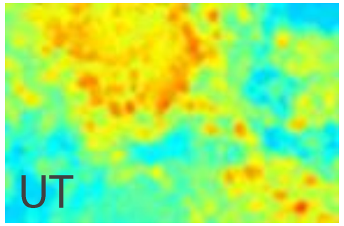
- Weak response from very small features masked by stronger response from neighbouring features

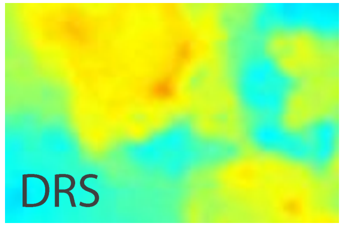
Max steel WT = 22 mm (currently)

Min measurable steel WT = 3 mm (coating dependent)

- Thin steel has high frequency response which is attenuated in coatings
- Steel WTs reported as 'below detection limit'







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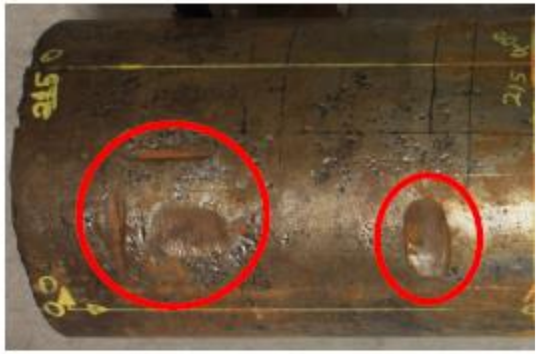
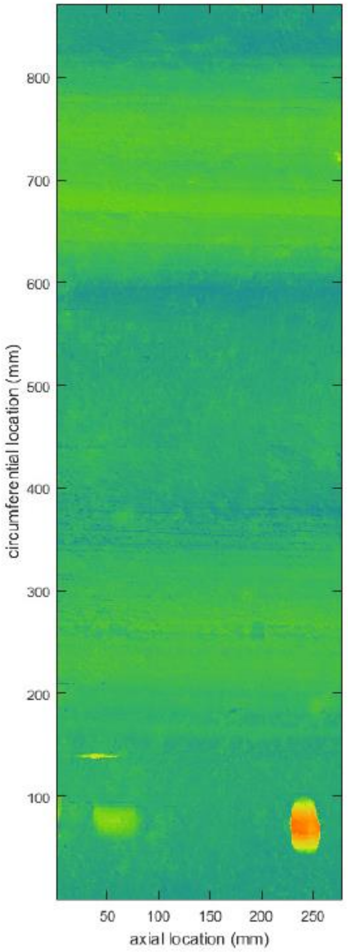
DRS Inspection Through Composite Repairs – Clock Spring® Contour

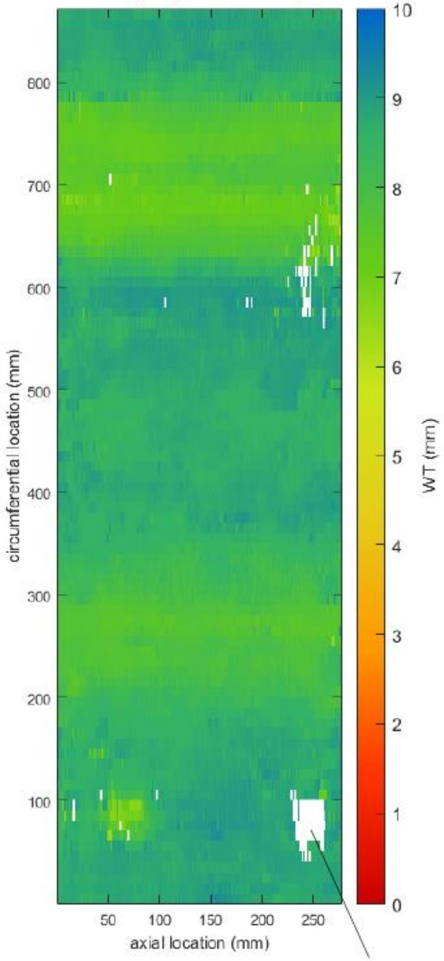
Immersion UT Pre-Repair



Immersion UT Pre-Repair



DRS Through
Clock Spring Contour Repair



Remaining WT below DRS detection limit

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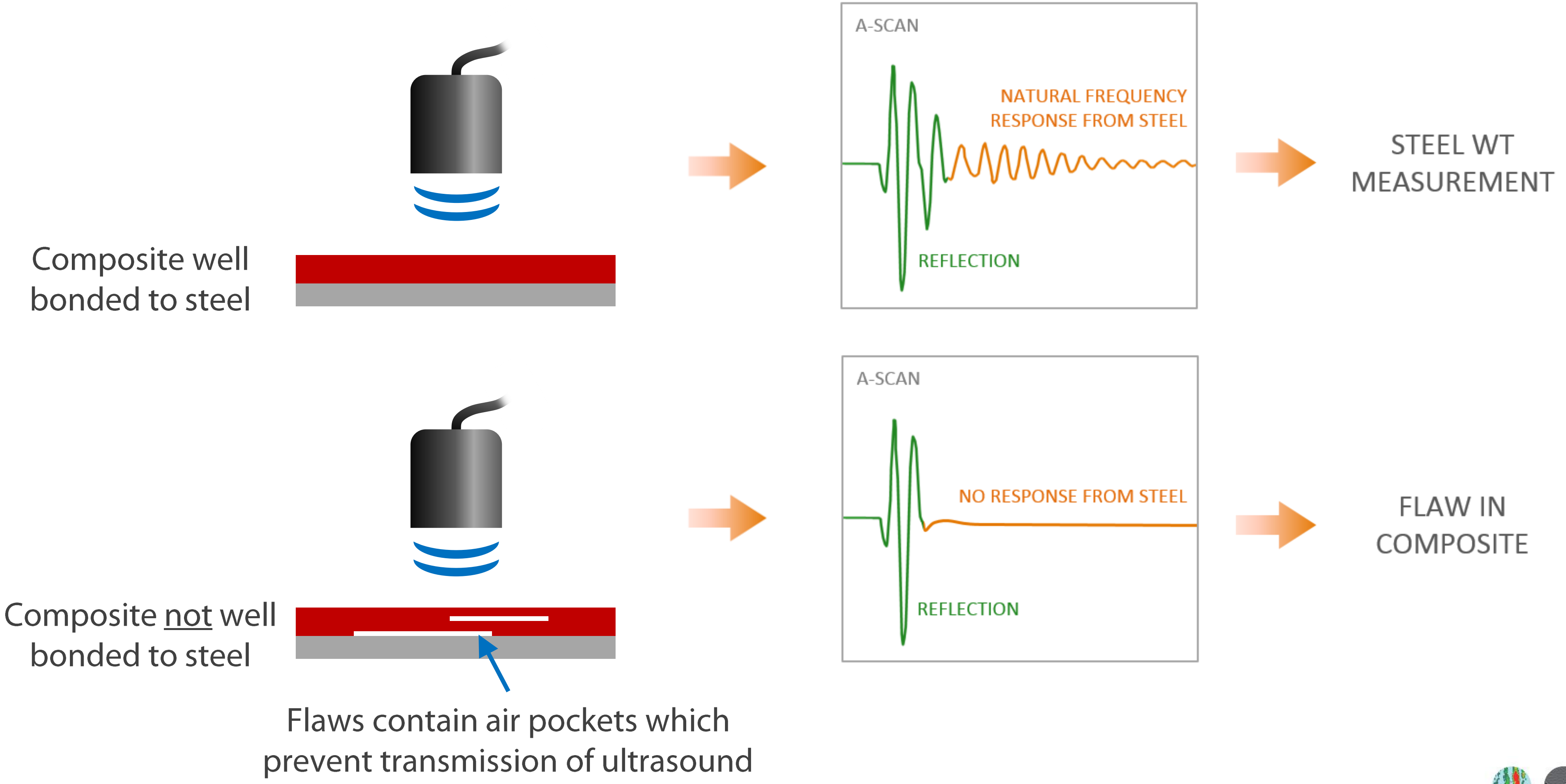
Composite Repair Flaw Detection With DRS



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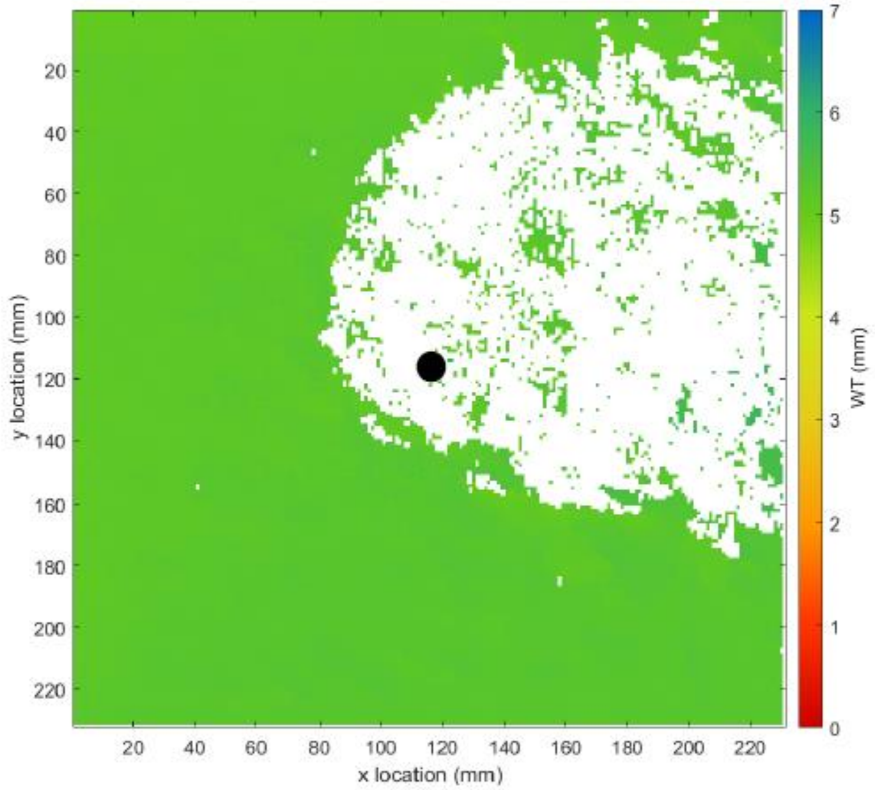
Composite Repair Flaw Detection With DRS – HOIS Trial

Composite repair on a flat plate

Pressure applied through back of plate to delaminate the composite



DRS map shows delamination in white

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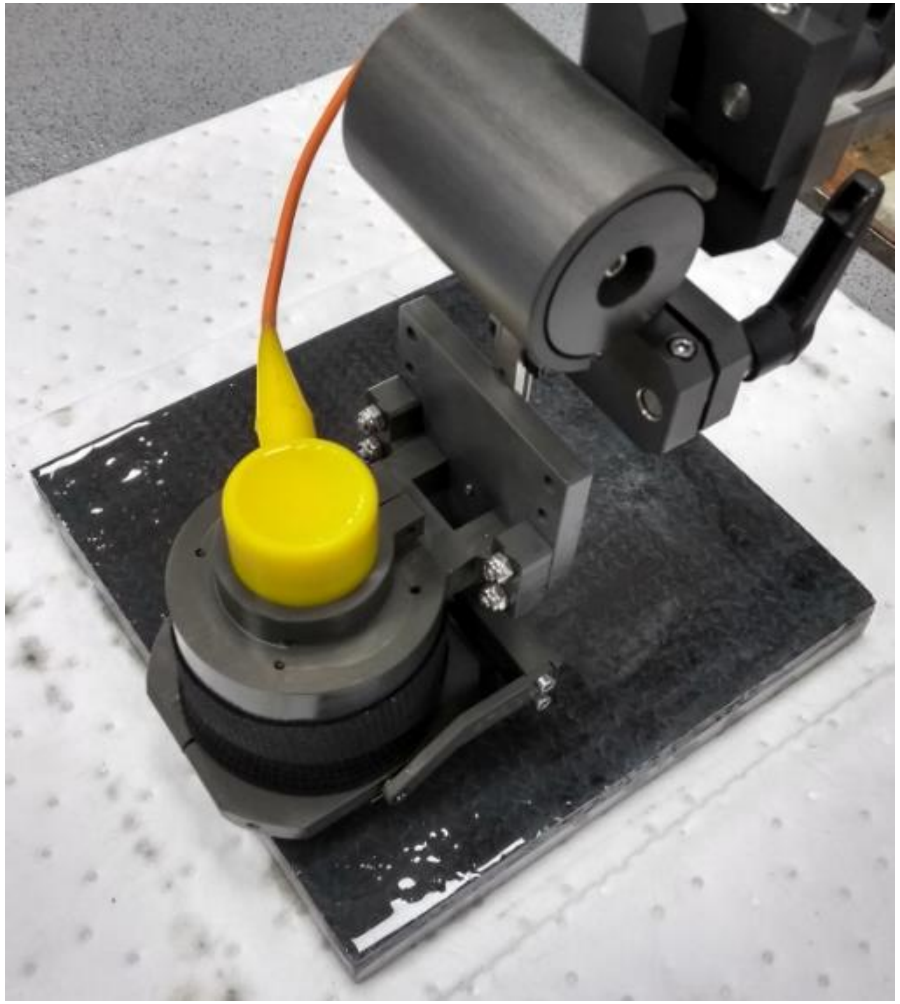
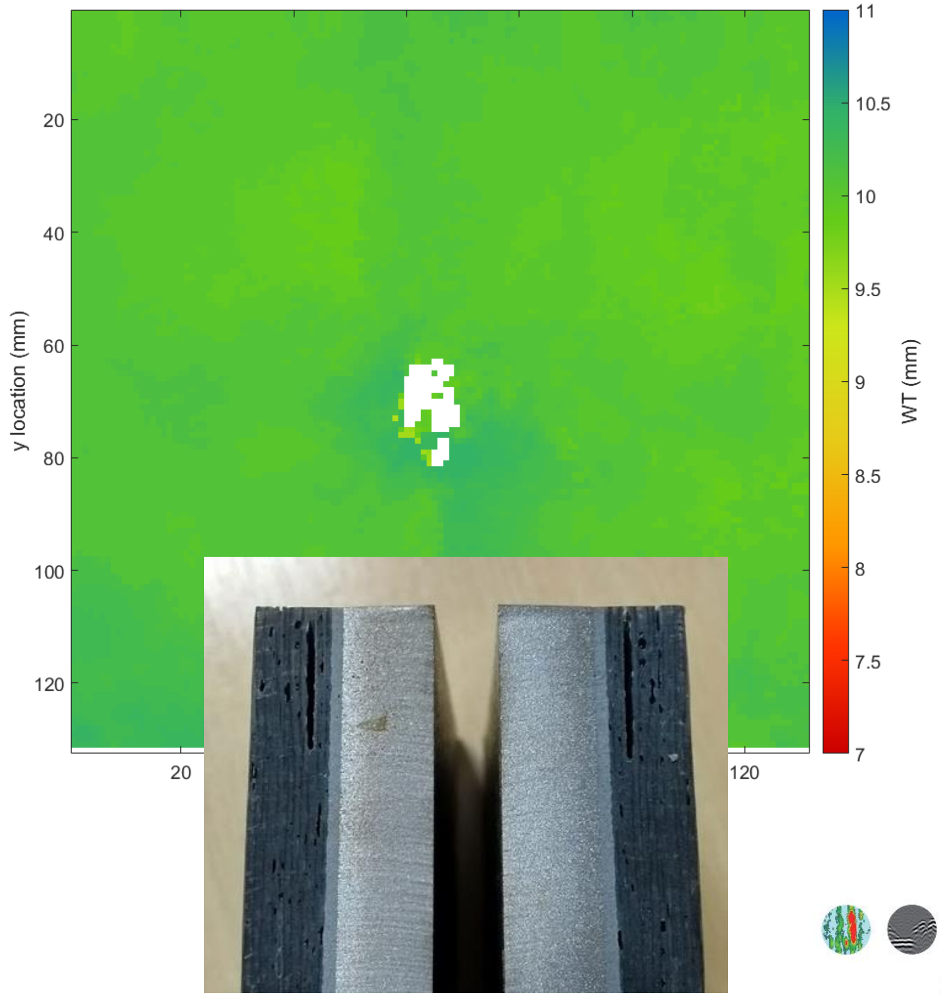
Composite Repair Flaw Detection With DRS – Belzona SuperWrap II





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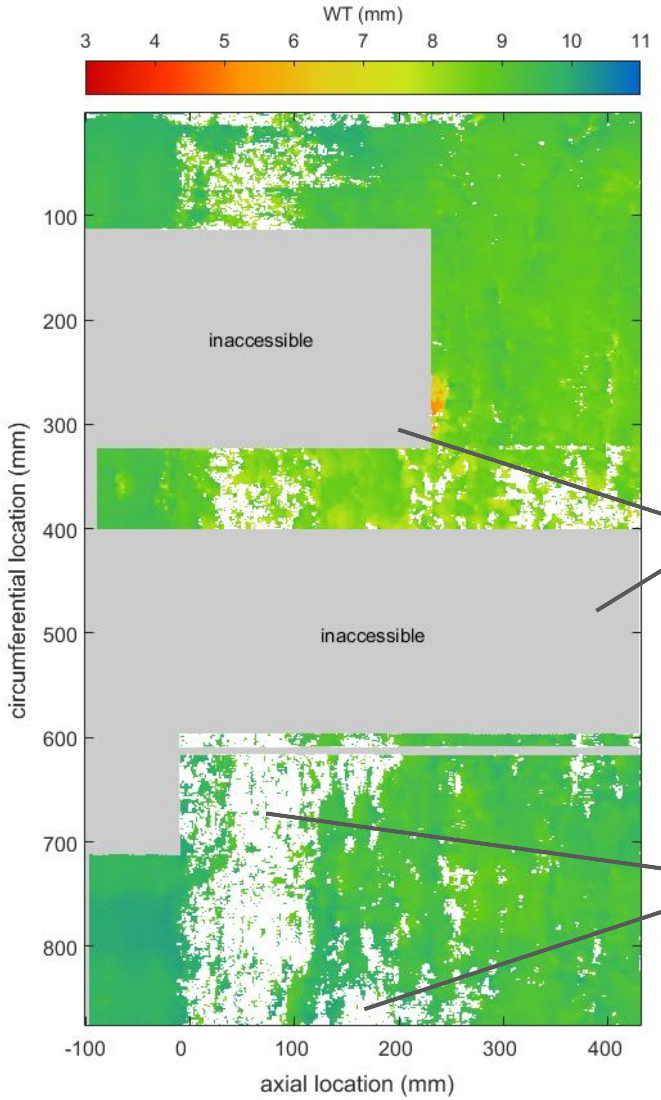
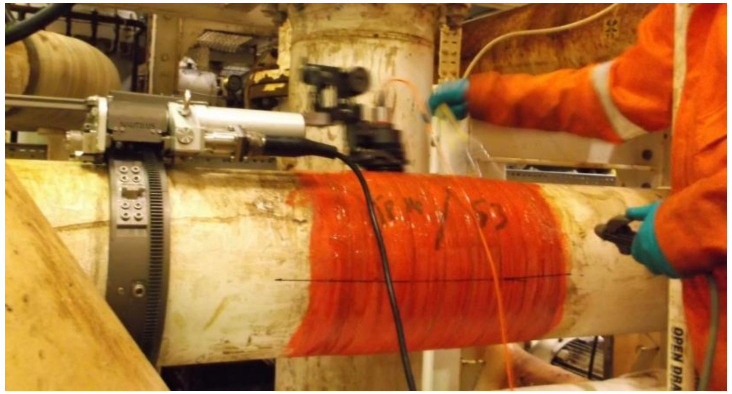
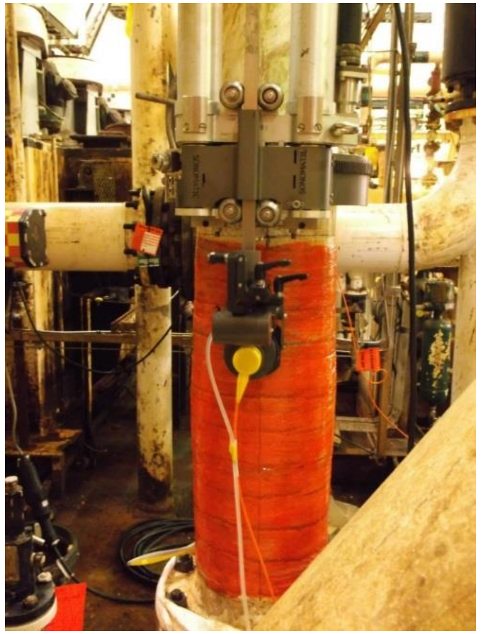
Technowrap 2K™ Composite Repair – DRS Field Trial



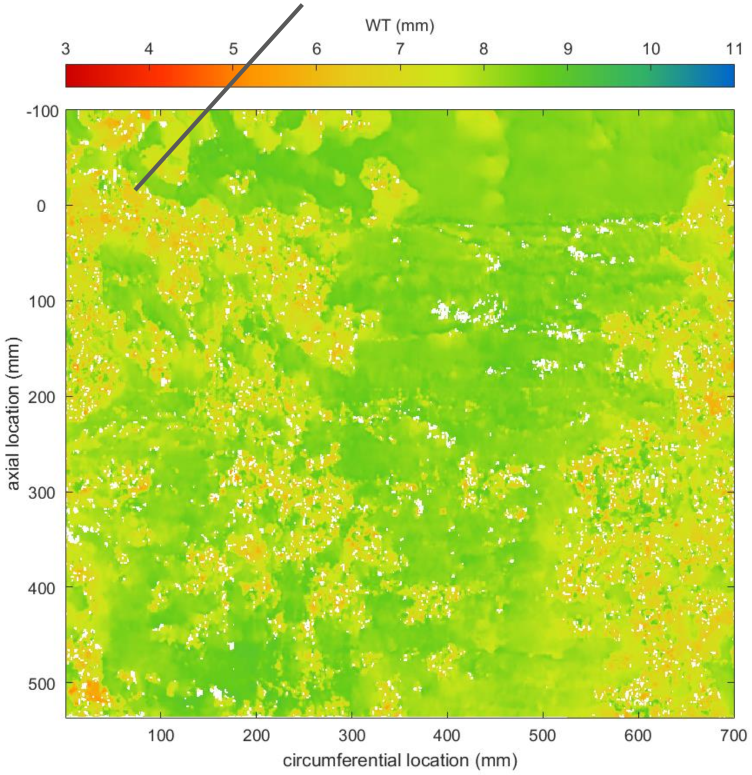


New low-profile scanner can access these areas

Flaws in composite repair



Corrosion extends beyond edge of repair



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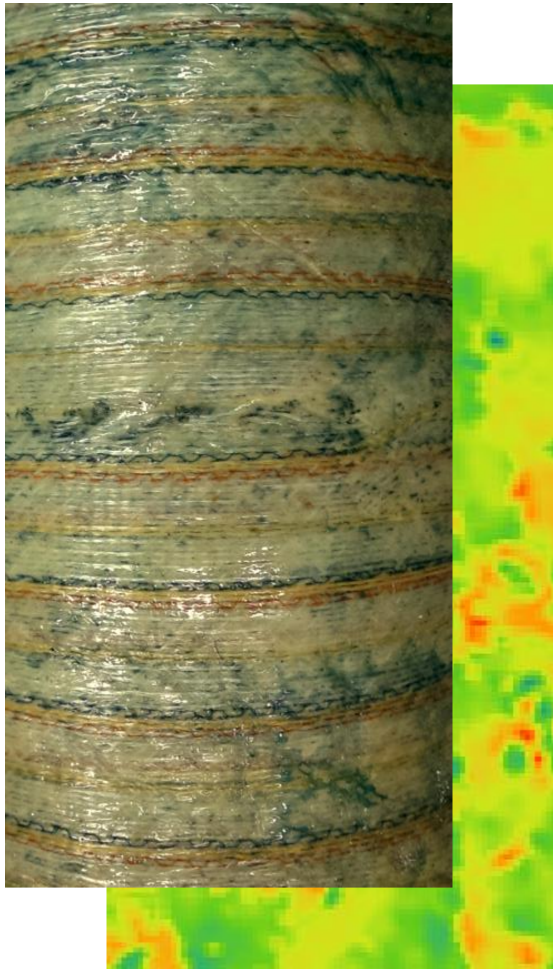
Benefits of DRS Inspection



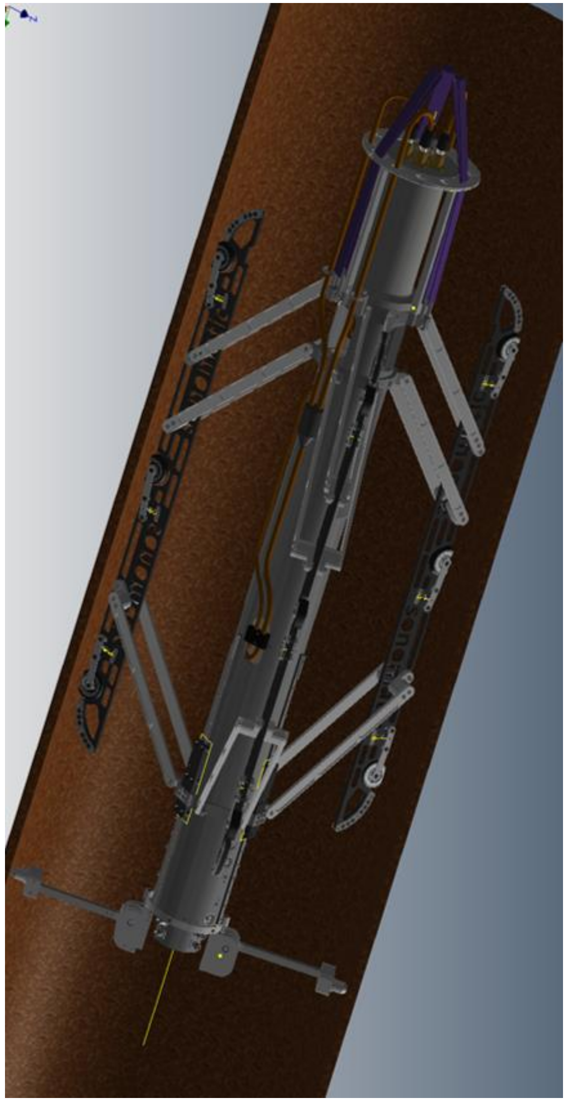
Identifies flaws in composite repairs

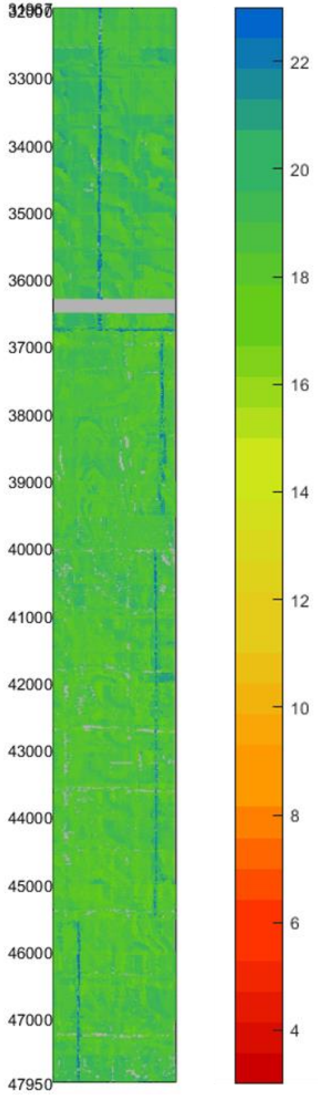
The high accuracy of DRS maps makes them suitable for

- Confirming absence of steel degradation
- Quantifying extent of steel wall loss
- Determining if corrosion growth is active
- Estimating corrosion growth rates
- Input to Fitness for Service assessment, including Level 3 using finite element analysis

Neoprene Lined Caisson – DRS Job – UK

DRS deployed on Internal Caisson Tool (ICT)





Found no wall loss

- welds are evident in blue

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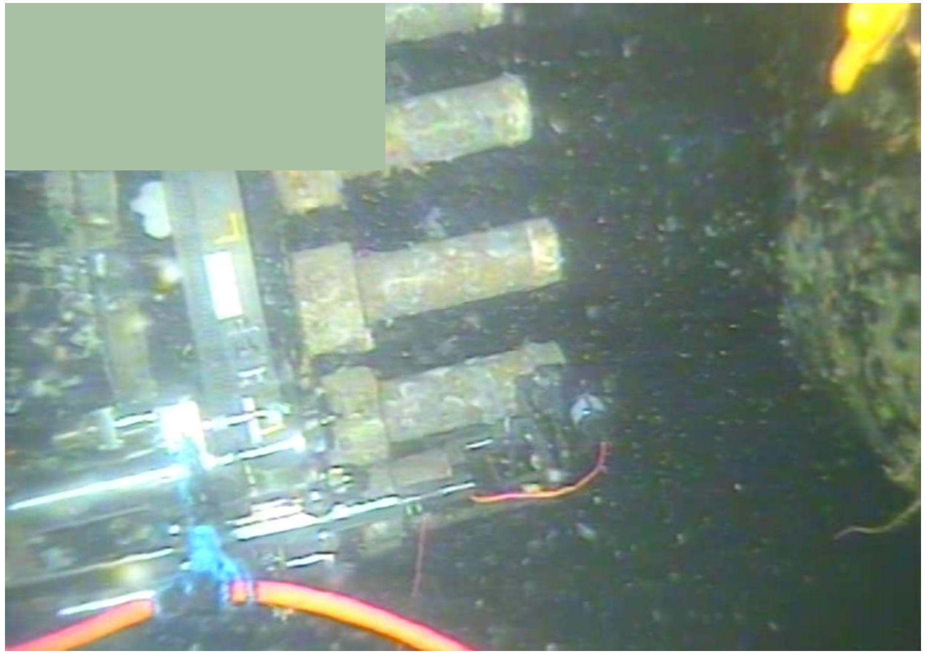
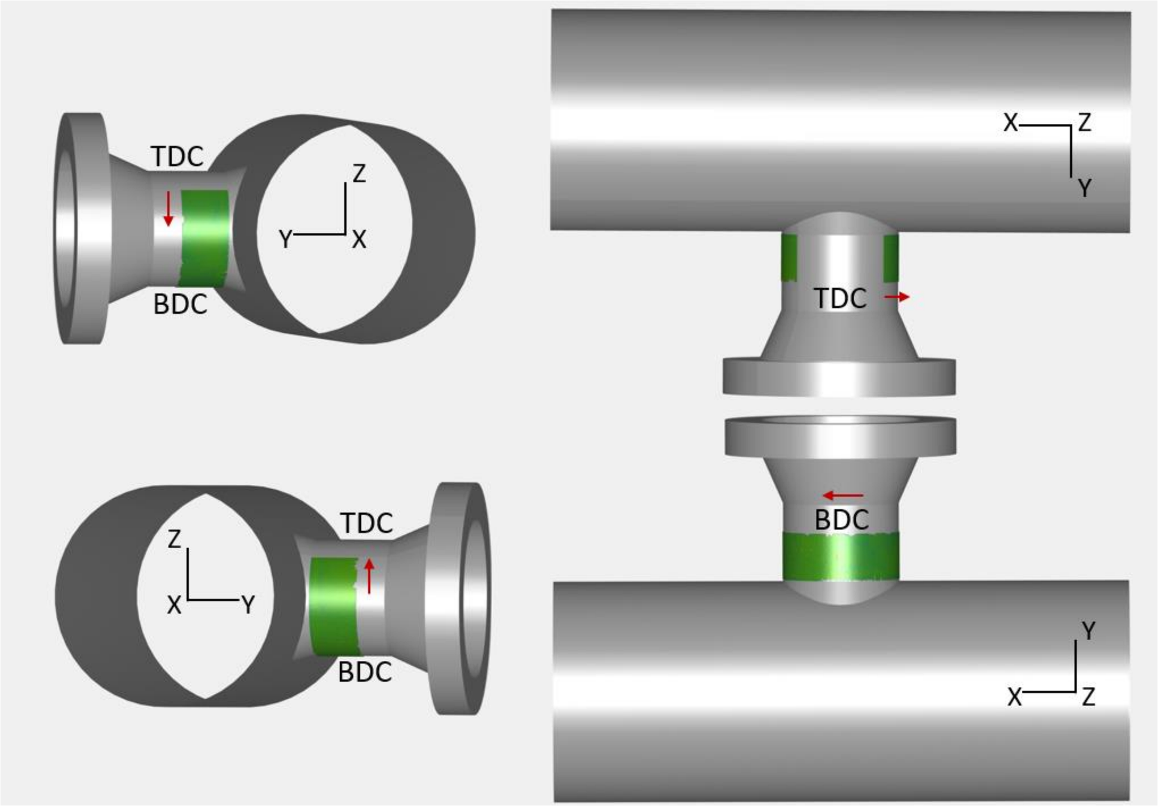
Coal Tar Enamel Coated Dead Leg – DRS Job – UK

Restricted access to dead leg between bolts and main line



Corrosion mapping with automated Nautilus scanner



DRS showed no evidence of active wall loss (nominal WT in green)

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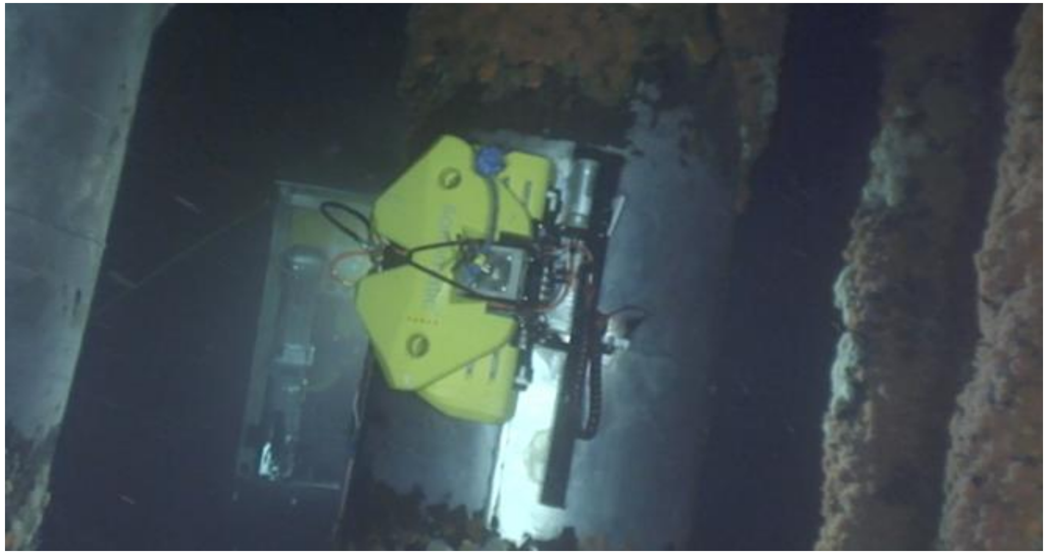
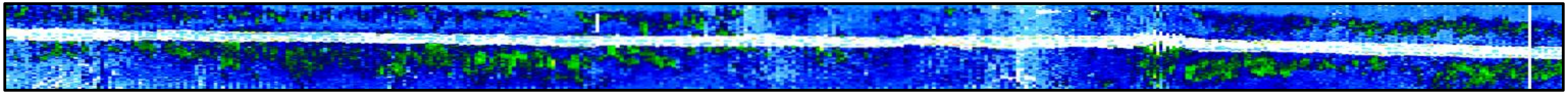
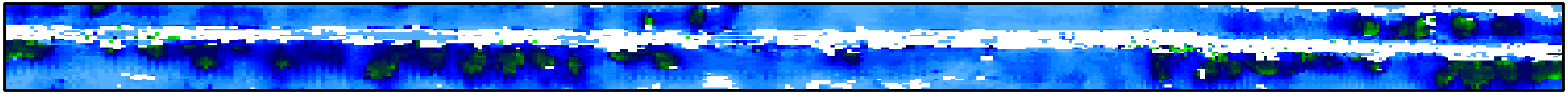
Coal Tar Enamel Coated Caisson – DRS & UT Job – UK



UT



DRS



DRS signals are less affected by poor surface condition, results show some wall loss near weld.

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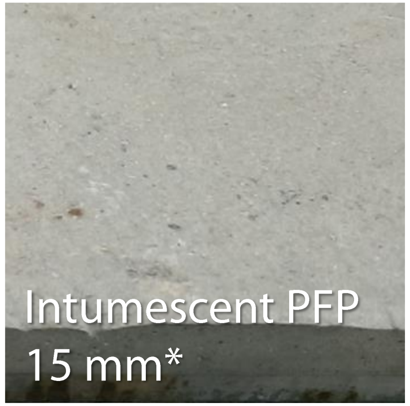
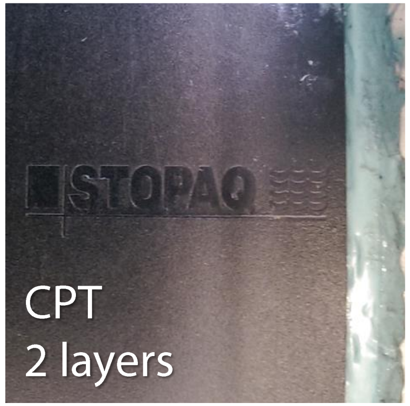
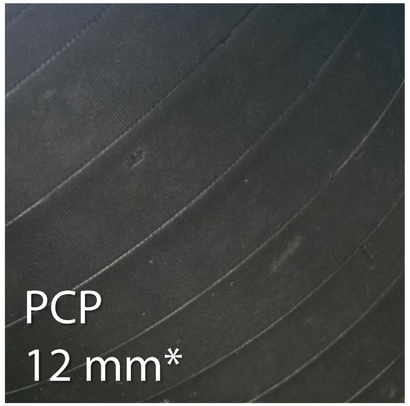
DRS Applications

Topside / Onshore





Subsea



*Thickest samples inspected so far, thicker coatings may be possible.

Several other coating types are currently under evaluation