DRS Inspection
For Challenging Coatings

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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

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
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

Severe internal corrosion

Uneven surface
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’
DRS Inspection Through Composite Repairs – Clock Spring® Contour

Immersion UT Pre-Repair

Clock Spring Contour

Immersion UT Pre-Repair

Clock Spring Contour Repair

Remaining UT below DRS detection limit
Composite Repair Flaw Detection With DRS

Composite well bonded to steel

Composite **not** well bonded to steel

Flaws contain air pockets which prevent transmission of ultrasound

A-SCAN

NATURAL FREQUENCY RESPONSE FROM STEEL

RELECTION

STEEL WT MEASUREMENT

A-SCAN

NO RESPONSE FROM STEEL

RELECTION

FLAW IN COMPOSITE
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
Composite Repair Flaw Detection With DRS – Belzona SuperWrap II
Technowrap 2K™ Composite Repair – DRS Field Trial

- Corrosion extends beyond edge of repair
- New low-profile scanner can access these areas
- Flaws in composite 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
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)
Coal Tar Enamel Coated Caisson – DRS & UT Job – UK

Coating partially removed in some areas

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

Topside / Onshore

- Technowrap 2K™
  - 12 mm
- Intumescent PFP
  - 15 mm*
- CPT
  - 2 layers

Subsea

- PCP
  - 12 mm*
- Coal Tar Enamel
  - 10 mm*
- Thermotite MLPP
  - 67 mm*

*Thickest samples inspected so far, thicker coatings may be possible.
Several other coating types are currently under evaluation