

HTHA Detection

Application Solution July 2019





TOP⁵Z⁶⁴



Overview



- Inspection Challenge
- Recommended Solution & Results
- Probe Innovation
- Benefits of Zetec Solution

Inspection Challenge



- High Temperature Hydrogen Attack (HTHA) occurs in steels operating at high temperature, above 205°C (400°F) in hydrogen environments, in refinery, petrochemical and chemical facilities
- HTHA is the result of hydrogen dissociating and dissolving in the steel, and then reacting with carbides to form methane, which accumulates at grain boundaries, and eventually leads to the fissures and cracking
- Early stages of HTHA are very difficult to detect, because of the small size of the methane voids, typically < 0.1 mm (0.004"),
 i.e. much smaller than the applied ultrasonic wavelength

Consequences of HTHA Damage





HTHA in heat exchanger caused catastrophic fire at Tesoro Anacortes refinery (WA, USA) in April 2010

Recommended Solution



- Efficient and robust inspection strategy, combining multiple ultrasonic examination techniques
- "Damage specific" operator training on specimens with confirmed HTHA (e.g. Lavender International)
- Carefully selected UT and phased array probes
- TOP^AZ⁶⁴ portable PA UT unit, with all tools and features to efficiently set up and deploy all recommended examination techniques : TOFD, TULA, beamforming phased array UT and live TFM

Examination Technique - TOFD



- TOFD, using high-quality UT probes, is a rapid and robust technique for initial screening of base material and welded regions (HAZ)
- Probe size and frequency depend on material type and wall thickness
- Increased grain noise (short indications) and clustering (beehive) in A-Scan signals are indicative for early stage HTHA



Examination Technique - TULA

- TULA (TOFD Ultra Low Angle), conventional T/R UT probes at 10 MHz, are well suited for initial screening of thicker base material
- As for TOFD, increased back-scattering and clustering in A-Scan signals are indicative for HTHA







Examination Technique – PA UT



- Standard PA UT, with 10 MHz LW DLA probe, used for secondary inspection
- Carefully selected focusing, using 32 or 64 active elements, is key to detect clusters of small methane voids and micro-fissures



Examination Technique – TFM



- TFM, with 10 MHz LW DLA probe, used for secondary inspection
- Confirmation and assessment of HTHA damage, using strong "total focusing" capability



Examination Technique – TFM



- TFM (frame 512 x 512), with large 10 MHz probe, in direct contact for secondary inspection of thick flange specimen, T = 90 mm (3.5")
- Confirmation and characterization of HTHA damage with strong "total focusing" capability (virtual beam shown)



Probe Innovation – LW Inspection

DLA 10 MHz Probe (Pitch & Catch)

- Integrated DLA probe, NDT Paintbrush compatible
- 2 x 64 elements, small pitch for improved TFM imaging
- DLA "Autofocusing" for improved resolution in passive plane, with beamforming PA UT as well as TFM





ZETEC



Probe Innovation – SW Inspection



AL-TFM 5 MHz Probe (Pulse-Echo)





ZETEC

- AL- type housing, using standard AL- 55SW wedge
- 64 elements, small pitch for improved TFM imaging in HAZ under weld cap
- Curved active element for improved resolution in passive plane

TOPAZ64 - Versatile PA UT Unit ZETEC

- Fully integrated, portable PA UT unit
- Excellent 64 active element PA UT
- 2 high-SNR TOFD channels at 200 V
- 12" Hi-Res multi-touch display
- Best-in class « *live* » TFM
- Parallel recording of PA UT & TFM
- Bipolar pulse (150Vpp) option
- Driven by UtraVision Touch



Successfully used for Lavender HTHA Certification !

Benefits of Zetec Solution



- Complete offering of high-quality standard and application specific PA UT probes required for efficient detection and characterization of HTHA damage
- TOP⁵Z⁶⁴ portable PA UT unit, includes all required tools and features to efficiently set up and deploy all recommended examination techniques : TOFD, TULA, phased array UT and live TFM