Inspection of Contact Point Corrosion Using PA-CATTM



Contact Point Corrosion (aka "CUPS")



- Occurs at touch point
- Localized corrosion cell
- Inaccessible for traditional inspection methods

Current Approaches

- Visual
- Conventional UT approaches:
 - Pulse echo
 - Pitch-catch
- Guided wave
- EMAT
- Radiography



What is PA-CAT?

PA-CAT is a new approach to inspection of contact point corrosion on carbon steel piping using phased array technology.

The goal at the outset was to determine...



"how far can we go with what we already have?"

Principles of PA-CAT

PA-CAT is based primarily on:

- Pitch-catch attenuation measurement
- Derive river-bottom based on computer modeling
- Couplant monitoring for signal stability



- Pitch-catch attenuation
- Mathematical composite signal generated over full angle range
- Attenuation patterns fitted with computer models to produce river-bottom profiles of real corrosion



- Tests completed on **realistic** CUPS corrosion profiles
- Variety of pipe diameters and wall thicknesses



Repeated at different scan directions and probe spacings



How is PA-CAT Different?



Uses existing PAUT equipment



Multiple scan directions Quantitative results



Coatings & surface condition

(Photo courtesy of Crestone Inspection)





Coatings & surface condition













Seamless pipe

- Starts as a solid round
- Heated white hot
- Pierced to make pipe shape



Axial Pitch-Catch Response

ERW Pipe

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E3: 0.0%		



Axial Pitch-Catch Response

SMLS Pipe

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Some pipe is worse than others...





Corrosion

Corrosion

5MHz vs 2.25MHz



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Effect of Lower Probe Frequency

- Increased pitch catch range
- Reduced effect of seamless piping artifacts for AOD inspections
- No impact to PA-CAT profile on welded pipe or COD inspections



2.25MHz Increased Range

2.25 MHz



5 MHz



COD 700mm PCS

2.25MHz Increased Range

2.25 MHz



5 MHz



AOD 800mm PCS

Seamless Pipe Nominal Profile



Effect on Attenuation-Based Techniques







6-inch STD (0.280") SMLS Pipe

Nominal Pitch-Catch Response (360°)



So What?



Effect on Attenuation-Based Techniques

- Attenuation variances, especially axially on SMLS pipe, will affect all attenuation-based techniques
- Effect is less with reduced probe spacing and lower frequency
- Will affect pulse-echo as well as pitch-catch techniques
- Symptom is not limited to PA-CAT

Summary of SMLS Findings

- Ultrasonic inspection using piezo-electric methods may reveal variable responses around the circumference of pipe
- Seamless pipe is more affected than welded pipe
- Effect is muted somewhat by lowering frequency, pointing to a scattering effect due to material structure
- Seamless pipe exhibits more thickness variations than welded, so some portion may be attributed to geometry

Summary in General

Benefits

- No new box
- ★ Truly quantitative results
- Automated analysis
- ✤ No complicated calibration

Challenges

- Coatings & coupling
- Scanner access/configuration
- AOD on seamless piping
- ID must be smooth