

## Automated Inspection Pass/Fail Tool Using NDE on PE Pipe Butt Fusion Joints

**Description:** A technology automation to compare critical flaw characteristics in PE pipe joint based on established acceptance criteria

**Status:** NDE automation using artificial intelligence is being developed to provide pass/fail inspection results based on integrity acceptance criteria of PE pipe butt fusion joints

### BENEFITS

Automation of a Nondestructive Evaluation (NDE) processes that compare joint interrogation results with known acceptance criteria would provide insight to a non-expert NDE inspector deciding to pass or fail a field fabricated joint. An automated algorithm provides a simple pass/fail indication from NDE results that visually indicate the joint integrity (red – probability of failure and green – within acceptable limits), see Figure 1.



Figure 1: Automated NDE inspection results display indicating pass/fail.

### BACKGROUND

Currently, inspection of PE pipe butt fusion joints is performed by a visual assessment of the external side of the rolled back beads at the fusion. ASTM F2620 provides guidance for visual inspection of butt fusions based on the observation of the resulting joint configuration. The final acceptance of this assumption is the visual appearance of melt fusion beads.

Automated NDE methods have been developed in other industries that apply comparisons of known

critical flaw characteristics and acceptance criteria to the inspected results of the butt fusion joint. Some of these NDE methods are available to the gas industry today, however they require a high level of certified NDE expertise to be performed and interpreted for the NDE result to be interpreted properly.

Previous NYSEARCH projects were successful in obtaining critical flaw characteristics and acceptance criteria for PE pipe butt fusion joints. Prior extensive destructive testing and analysis of specifically designed flaws that were placed in PE pipe joint samples have provided the basis for the critical flaw characteristics and acceptance criteria for this and other projects.

Automated techniques allow for trained non-NDE LDC personnel to collect NDE interrogation data and then have a comparative algorithm to: 1) evaluate those results with critical flaw characteristics, and, 2) provide a final joint acceptance recommendation. Use of these techniques by trained non-NDE personnel would provide a broader application for LDC operations.

Eclipse Scientific is an accomplished and experience NDE developer and provider. They are active in providing NDE applications across a wide range of industries. They are also involved with national standards and certification development (ASTM, ASNT, ASME). Also, Eclipse Scientific has experience developing NDE artificial intelligence pass/fail hardware and software for other industries.

Their experience in performing research and development on new NDE applications attracted NYSEARCH to work with Eclipse Scientific in developing an automated approach for NDE application of PE pipe butt fusion joints for the gas distribution industry.

### TECHNICAL APPROACH

The objective is to develop an automated NDE Pass/Fail tool to inspect PE pipe butt fusion joints performed by properly trained but non-NDE expert LDC personnel. Eclipse Scientific is basing their development of the automation algorithms on the critical flaw characteristics and acceptance criteria information provided by NYSEARCH which is essential in setting bounds for the pass/fail interpretation.

NDE development is based on established fundamentals of Phased Array Ultrasonics (PAUT), see Figure 2. Interpretive algorithms are using PAUT NDE results for the initial technique in automation comparisons. However, the algorithms are not dependent on PAUT as one specific technology. As new and improving NDE techniques are developed, algorithms provide more in-depth insights to the butt fusion joint flaw detection. Also, the algorithm can be modified to incorporate the advanced NDE technique; thus, continually improving overall interrogation results.

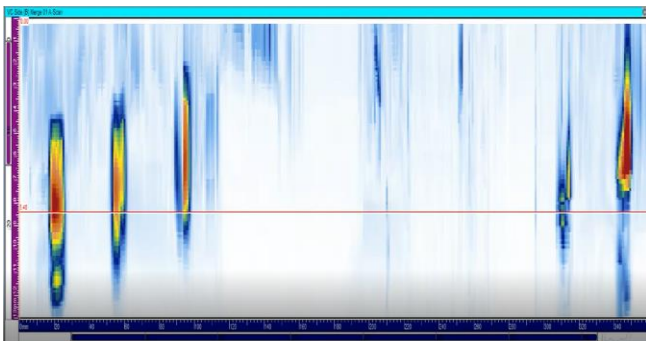


Figure 2: Typical initial results from PAUT NDE detecting anomalies within a PE pipe joint

### PROGRAM STATUS

Eclipse Scientific has developed the NDE platform for inspection on PE pipe. Inspection techniques use PAUT pitch-catch type signaling through transducers that send ultrasonic energy through the PE pipe wall and measure differential time to reflect off anomalies within the material

volume of the PE pipe and the insider diameter of the PE pipe wall, see Figure 3.

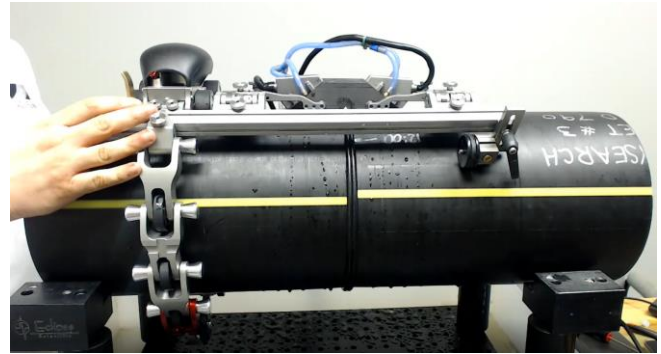


Figure 3: Typical application configuration of PAUT NDE inspection of a PE pipe joint

Currently, the automated NDE system is being exposed to defects embedded in sample PE pipe joints samples to develop the comparative bases for pass/fail decisions.

Trials in gas company laboratories and actual field trials are being scheduled.

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### Highlights

- NDE inspections allow use of PAUT with minimal NDE experience
- Automation provides a comparison between critical defect characteristics and established acceptance criteria.
- Results of the inspection shown on tool display with a simple red/green indication of the probability of joint failure