

Guided Wave Evaluation as Hydrotest Equivalent



In this project, analysis was performed to demonstrate and validate the use of Guided Wave Ultrasonic Testing (GWUT) technology as an equivalent to a hydrotest.

Project Description

Guided Wave Ultrasonic Testing (GWUT) has been shown to be a promising technology for inspecting casings and other difficult-to-access sections of pipe. However, under current regulations, GWUT use requires compliance with an “18-point checklist” of the U.S. Department of Transportation’s Pipeline and Hazardous Materials Safety Administration (PHMSA).

GWUT can be a lower-cost, more accurate alternative for pipe inspection, especially in areas where hydrotesting cannot be used. However, with the expense and uncertainty involved with the regulatory approval process, few companies have pursued the use of GWUT as a stand-alone for pipe-inspection method.

While numerous R&D efforts have been conducted to evaluate GWUT, the results have never been combined to provide a validation that equates GWUT with hydrotesting.

In this project, data was gathered and a validation of GWUT performed that is expected to lead to the acceptance of GWUT as an inspection technique equal to hydrotesting.

Deliverables

The results from this project provide a validated methodology that could be used as the basis for a new standard that could be referenced by Part 192 in the 18-point checklist and the required prior approval.

Benefits

The ability to use GWUT to inspect casings and other difficult-to-access pipe sections (via a PHMSA-referenced consensus standard, without the need to navigate the waiver process) will facilitate compliance in a cost-effective manner. Additionally, the use of GWUT as a stand-alone inspection tool will provide a means of compliance where, in some situations, no alternative exists.

Technical Concept & Approach

This project was built on previous research, including:

- More than 60 GWUT assessments performed by Gas Technology Institute (GTI) – all of which were 100% validated through visual inspection and, in some cases, additionally with high-resolution magnetic flux leakage inspection.
- A theoretical correlation between GWUT inspection results and typical failure criteria output being developed by the Interstate Natural Gas Association of America
- Inspections performed by operators to evaluate the ability to correlate GWUT with direct assessment.

The specific tasks for this project were to:

- Compile data from GWUT inspections that have been validated by design, in-line inspection, or direct measurement
- Demonstrate that GWUT finds defects that would pass a hydrotest (therefore substantiating that GWUT will find larger defects)
- Provide a validated methodology for a new standard.

Collected data was used to calculate the failure pressure for rupture using several two-parameter methods



(depth/wall vs. axial length) for all validated data points. Additionally, the validation effort will determine the limits of detection and identification and provide suggestions for limits on field use and applications.

Results

Data collection involved gathering all available and acceptable data from prior GWUT inspections and the associated dig records (defect geometry, pipe diameter, wall thickness, and grade). Data was only accepted and reported in this study if the GWUT could be verified through direct inspection.

GWUT had been used to inspect pipe segments in more than 60 dig sites where all inspection results were validated. Specifically for this project, investigators solicited and collected useable field inspections/assessments from an additional 10 operators. The collected data was used to calculate the failure pressure for rupture using the most conservative federally approved methodology, (i.e., ASME B31G) for all validated data points.

The validation calculations were undertaken to confirm or substantiate the following hypothesis:

- GWUT misses no defects that would fail a hydrotest, and
- GWUT misses no defects that were found in the direct examination.

The percentage wall loss vs. anomaly length diagrams plotted to B31G confirmed that GWUT is equivalent to hydrotesting.

The GWUT methodology found all those anomalies that would have been found by the hydrostatic testing and GWUT also found anomalies that were too small to have been detected and survive in a hydrostatic test to a pressure equivalent to the pipe's Specified Minimum Yield Strength (SMYS).

Four pipe diameters were studied and plotted:

- 16-inch-diameter, API 5L X52, 0.250-inch wall
- 20-inch-diameter, API 5L X52, 0.281-inch wall
- 24-inch-diameter, API 5L X52, 0.344-inch wall
- 30-inch-diameter, API 5L X42, 0.312-inch wall.

All but two of the defects found by GWUT (and validated by excavation) would have passed a hydrotest to 100% SMYS by B31G.

All the corrosion discovered by visual inspection after removal of the casing and/or coatings was found by GWUT (i.e., there were no false negatives). In some cases the GWUT operator estimated the corrosion damage to be somewhat worse than what was actually observed. Therefore, there is a small potential for over-calling the severity of the actual defect (this is conservative).

Project results were compiled into a Final Report released in March 2010.

The results of this comprehensive validation effort (data sets, findings, and implementation protocol) provides the foundation of a methodology for a GWUT standard.

Status

Data indicates that GWUT is an effective technology that provides reliable and valuable information for an integrity assessment.

In 2010, the National Association of Corrosion Engineers' TG-410 subcommittee developed and revised a draft standard that could facilitate the allowance of guided wave technology to be used as an accepted inspection technique similar to hydrotesting, in-line inspection, and direct assessment. The subcommittee met in September 2010 and continued to make progress; however, the standard will likely not be fully approved until 2012.

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