WHAT SOLUTIONS can ULTRASOUNDS provide for pipelines?

ULTRASOUND COVERS MANY INSPECTIONS AREAS

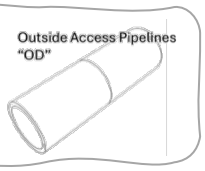
We will cover the two-outside diameter (OD) and inside diameter (ID) surface access situations where UT is commonly employed. The blog will not cover all pipeline inspection cases, but most current technologies are included.

Note: *Insulation on pipelines does not allow for the transmission of sound to the pipe below; this means for ultrasonic methods to be utilized, the insulation must be removed in the areas of interest. Alternatively, internal scanning methods such as pig crawlers can be used, or guided wave systems can be set at strategic points along the line, allowing for minimal insulation removal and screening of the pipe under the insulation.*

General PA-UT Methods

The following section contains the OD scenario and the ID examinations. For each case (where applicable), there is an example of conventional UT, PA Inspection, TFM or even a corrosion map rendering for much better visualisation. Beam Tool (Scan Plan) and CIVA Analysis (**Sonatest Compatible Advanced Analysis software**) were used to build this table below.

OUTSIDE "OD"

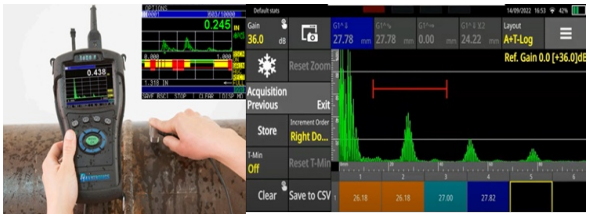


1- CORROSION MAPPING

Conventional UT

0° Manual UT
100% Manual Scanning of an Area

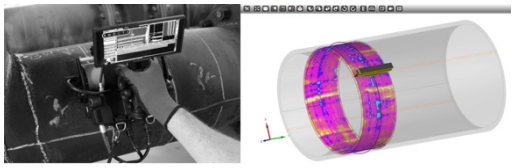
0° Manual UT
Spot Reading Grid Method



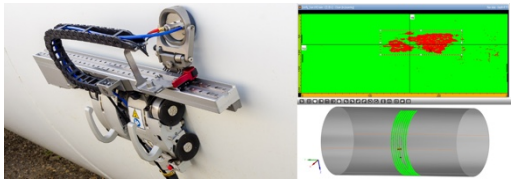
0° L-scan/TFM

Manual Inspection (Not Encoded) Scanning

Manual Example of a circumferential PA Scan corrosion survey that creates large C-scan data. The photo below is a 128E WP2 scenario.



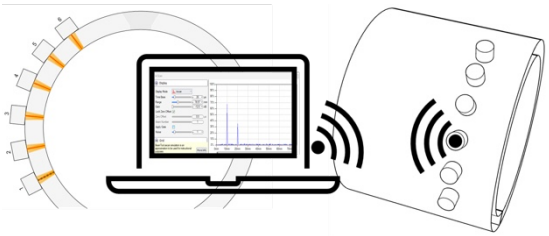
Example Automated/Semi-automated Scans: PA L-scan/UT/LL TFM Carried out with Crawler Scanners.



2- Constant Monitoring

(Belt / Single Point)

Single/Multiple Point(s) Constantly Being Monitored on Pipelines (Can Be Positioned Under Insulation)

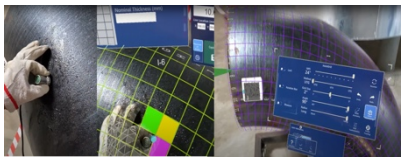


3- Elbow Mapping

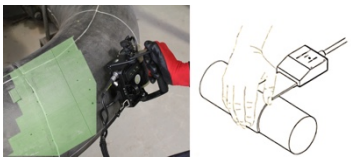
Flex Probe, Wheel Probe or Conventional UT

0° Manual UT
Spot Reading Grid

UT Automated Grid with
Augmented Reality (AR) Lens



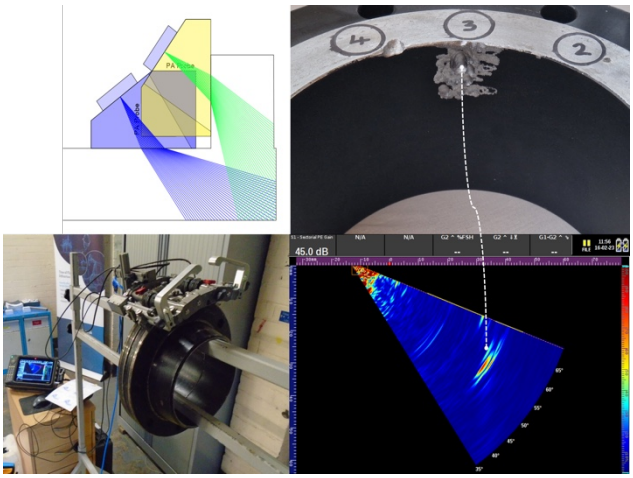
PA Using a Flexible/
Wheel Probe Array



5- Flange Face

Corrosion Inspection (Inner ROI) In-service / Phased-Array

PA or TFM can be achieved around the flange. A bolt can reduce the region of interest access. The inspection procedure is always challenging and amended accordingly because there are many flange profiles in the field.

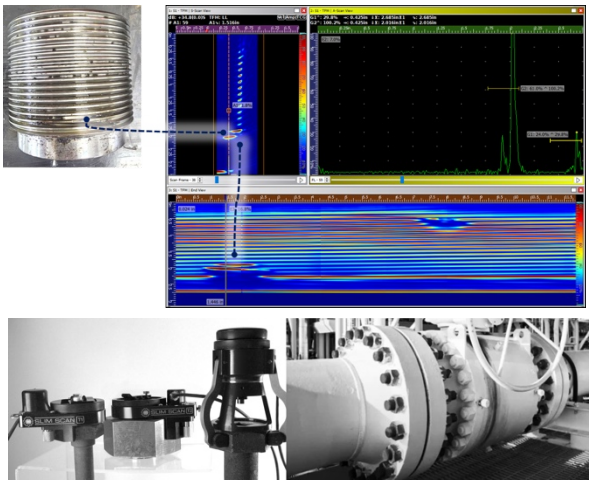


4- Flange (Bolts)

Corrosion Inspection Phased-Array

PA and/or TFM Bolt Scanning

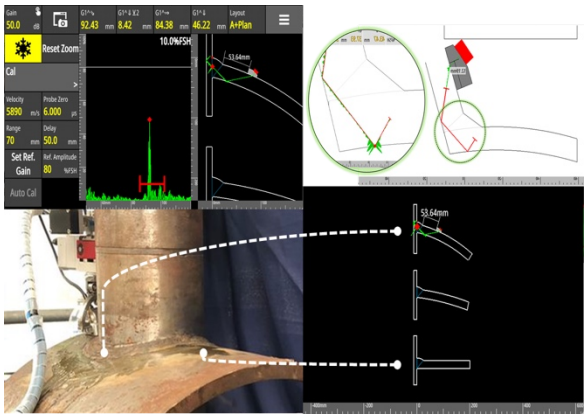
New Infallible Option: Slim Bolt Scanner (By a Valve or 2 Side-by-side Flanges). SONATEST Wide Bolt Scanner Offer Depending on the Bolt Size Requirement and Height Clearance.



6- Nozzle Inspection

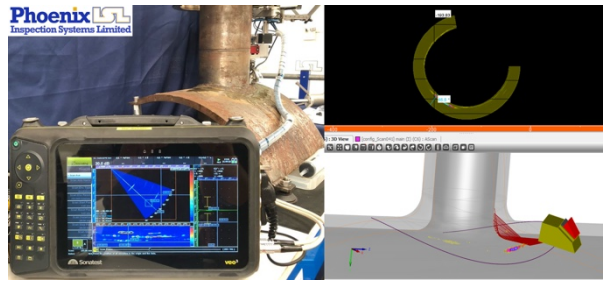
Conventional UT

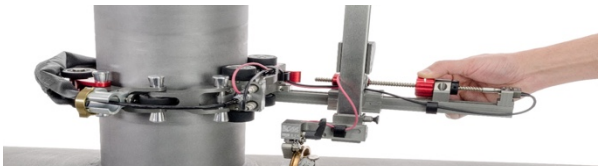
A-Scan with an Imported Nozzle Geometry for a Reliable Flaw and Geometry Echo Location.



Phased-Array

Sectorial and/or Linear Scan with B-Scan and C-Scan (End and Top Scan Views)



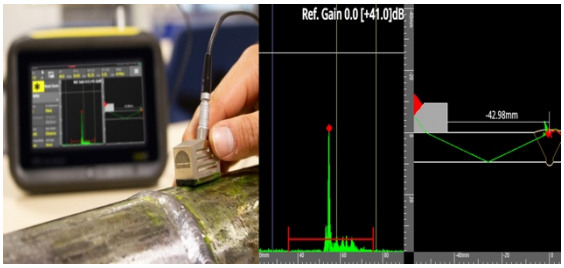


PA inspection with folded S-scan and rotated around the nozzle

7- Butt Welds

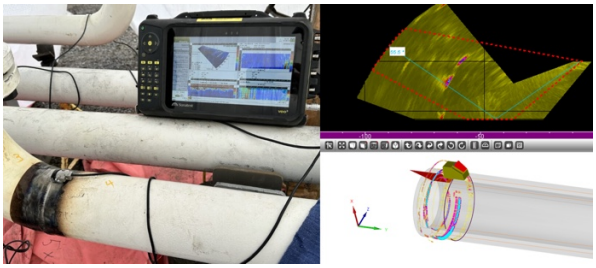
Conventional UT

A-Scan with an Interactive Scan Plan; A Live A-scan Is Displayed in the Butt Weld Geometry.



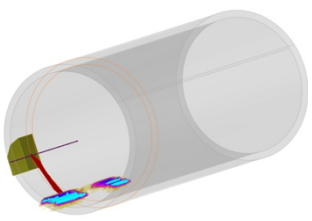
Phased-Array

Sectorial and/or Linear Scan. This Ultrasound Solution Can Run Both the PA S-scan and TFMI™ (TT+TTT+TTTT) in Parallel.



8- Special Cases

OD Surface Corrosion under Pipes Support: PA-CAT™ - Remaining Wall of External Piping Assessment, Underneath Saddle Supports on Vessels – PA Pitch-catch S-scan with Post-analysis Profile Extraction.



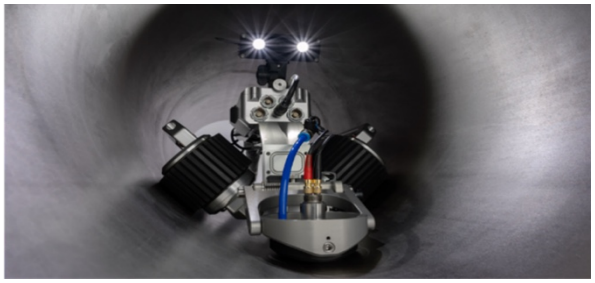
Internal Side "ID"

Internal Corrosion Mapping Inspection

UT or PA probe for medium/large diameters

Internal Scanners Better Suit Diameters Around 2 to 6 Inches. (TSIS Scanner Below)

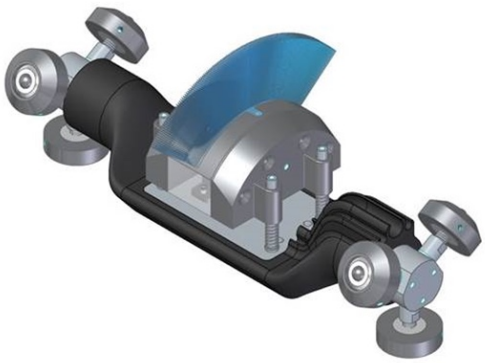
For phased array inspections, we recommend a linear array and a motorised crawler like the following Jireh TERAX crawler.

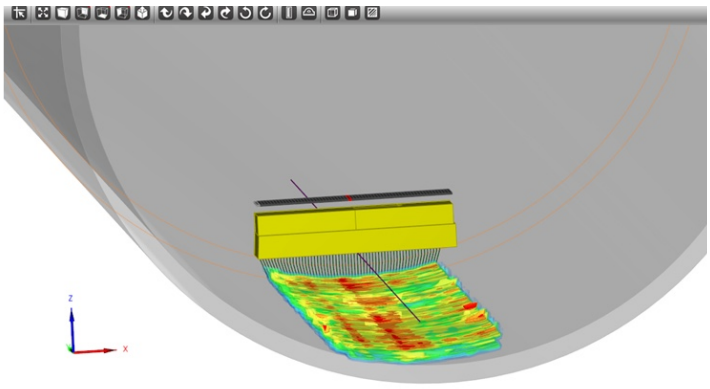


Internal Corrosion Mapping Inspection

Curved ID Linear Array

Special curved 19-inch AOD array design for ID inspection. Irrigation and encoder are included in that solution.





Get in touch with your local SONATEST expert, who is available in more than 50 countries and over 5 continents!

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Pipeline Integrity Guide for NDT Specialists

Non-Destructive Testing

Most common methods

Introduction

This blog is the first article regarding a broad pipeline integrity SONATEST campaign as NDT insights. We will start with an overview of pipeline inspections. We will then develop more specific ultrasound content (blogs, solution notes, etc.) that is always related to pipeline assets. The goal is to provide NDT insights throughout this educational journey.

Pipeline Codes Driving its Integrity

The life cycle of pipelines should be monitored because they require critical quality control analysis. For example, there are pressure hazard factors to deal with, its intrinsic money asset value, the potential environmental accident consequences, and more to consider. Many standards regulate pipe structures to avoid disasters and hazards. The most known codes provide all the necessary requirements to achieve viable quality control. Among them are API, ASME, ASTM, and ISO.

There are also existing codes that cover distinctive cases, such as plastic pipe butt joints and austenitic steel lines and welds, high-pressure lines made of hardened steel, etc. Since you are now aware of the common regulations, let us check out the main non-destructive scenarios that can be applied to pipelines.

- **ASTM E213 – 22**: Standard Practice for Ultrasonic Testing of Metal Pipe and Tubing
- **ASTM E1961 – 21**: Standard Practice for Mechanized Ultrasonic Testing of Girth Welds Using Zonal Discrimination with Focused Search Units
- **API STD-1104** Welding of Pipeline and Related Facilities
- **ISO 17635** – Non-destructive testing of welds – General rules for metallic materials
- **ISO 5817** – Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels for imperfections

General NDT Methods for Pipeline Inspection

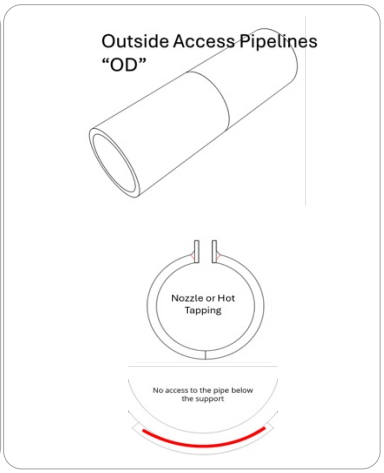
The next section contains two scenarios for inspection from the outside diameter surface (OD) and inspection from the inside diameter surface (ID). These locations get different inspection techniques separately because the defect characterization requirement may differ from time to time. For example, a full phased array mapping would not get the same remaining wall thickness data density and precision as a pulse eddy current mapping, even if both serve an adequate NDT evaluation approach.

Pipeline External Inspection Techniques:

- Automatic UT Corrosion Mapping
- Phased Array Ultrasound (Planned inspections or Constant Monitoring Systems)
- MFL Pipe Scan
- LRUT Guided wave.
- EMAT (Surface & Subsurface)
- Thermal Imaging
- UT grid with A Scan feature.
- Acoustic Emission

EXTRA CHALLENGES (Limited access & complex geometries):

- Flanges (bolt-in survey with limited access)
- Elbows (especially mitered elbows)
- Valves
- Reducers
- Dissimilar materials/layered pipes, Etc.



Pipeline Internal Inspection Techniques:

- Automated & Semi-Automated Phased Array Ultrasound & UT
- Visual Inspection using Remote Cameras (RVI)
- In-line Inspection with UT and MFL (Pigging)

EXTRA CHALLENGES

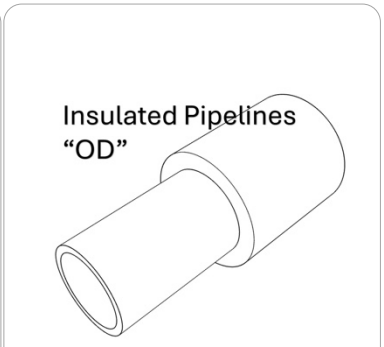
- Height clearance
- Scanners and crawlers' technologies investment (pigging)
- Inner surface conditions may affect crawling and NDT evaluation performance
- The overall setup requires reliable components of:
  - Remote controls (visual and signal acquisition)
  - Constant irrigation
  - Post-analysis software
  - Qualified NDT and crawler operators' teamwork

Pipeline Insulated Inspection Techniques:

- Pulsed Eddy Current Array
- Guided Wave (AKA LRUT)
- Radiography
- Permanent Monitoring Systems
- Acoustic Emission

EXTRA CHALLENGES

- Insulation is not ultrasound compatible
- Buried pipelines
  - Pipe configuration is sometimes unknown
- Small diameter pipeline configuration may not allow all ID crawlers
- Lower precision techniques may require further NDT assessments



Challenges for some locations and flaw characterisations

The previous tables contain only the typical challenges that an NDT service provider can face. Fortunately, there are many solutions to overcome most of the difficult aspects of pipeline inspections. Here are a few examples of when the NDT advances through the pipeline industry requirements.

- Small footprint PA probe → Low clearance access, single access weld on flanges.
- Rolling probes with Glycol under cold conditions → Clear off the water coupling freezing issues.
- EMAT probe → When water coupling is now allowed.
- Pulsed Eddy current mapping → Allows a full screening mapping without preparation. (Magnetic field penetrates through the insulation)
- The use of CAD overlay → to superimpose ultrasound images or RT shots to spot any dissimilarities.
- AI & smart post-analysis software tools → Some NDT data is hard to interpret (like TOFD, Acoustic emissions or LRUT data) The software will detect and flag anomalies. Software evaluation tools are also more precise.

What's Next?

Because we are engineering ultrasound solutions, the NDT piping solution focus will move on to PAUT, TFM, TOFD, etc. There are indeed many ultrasound techniques that gravitate around the pipeline asset. Each has pros and cons, but certainly, achieving reliable quality control that also fulfills a good practice standard.

Please contact applications@sonatest.com if you have any questions.