Guided Wave Inspection Report

Project:

Demo Report

Date:

25/04/2024

Document Author:

Eddie Fier

Document Reference:

GWT-001-REP

For:

Eddyfi Technologies

Reviewed By:

Pierre Review

Authorised By:

T.H.Eboss

Executive Summary

• A total of 3 pipelines were inspected using Guided Wave Testing.

(See "Guided Wave Inspection Coverage")

• A total of 5 anomalous indications were identified for follow up.

(See "Anomalies To Follow Up")

• There were 7 tests in total carried out.

(See "Test Report Appendix")

Pipeline	Number of Tests	Category 1	Category 2	Category 3
Pipeline 4in pipe loop	3	3	0	0
Pipeline 8 inch Firemain Area L	2	0	0	0
Pipeline 8in Loop	2	2	0	0

Contents

Abbreviations and Definitions

Abbreviation	Definition
NDT	Non Destructive Testing.
CSWIP	Certification Scheme for Welding & Inspection Personnel.
UKAS	United Kingdom Accreditation Service.
DAC	Distance Amplitude Correction.
dB	Decibel.
MUT	Manual Ultrasonic Testing.
Inconclusive	Data that is either devoid from recognisable pipe features or where the general level of noise is such that category 1 indications may not be identified.
Cat 1	A metal loss feature having an approximate cross-sectional area equivalent of up to 9% of the pipe wall cross-section.
Cat 2	A metal loss feature having an approximate cross-sectional area equivalent of between 10% and 14.5% of the pipe wall cross-section.
Cat 3	A metal loss feature having an approximate cross-sectional area equivalent of above 15% of the pipe wall cross-section.

Introduction

This report document contains the findings of the guided wave inspection conducted between 01/02/2022 and 10/05/2022. The purpose of this inspection is to locate potential areas of concern and highlight them through this report. This inspection consisted of guided wave inspection of pipework situated at Various at the request of Eddyfi Technologies using the Sonyks™ system.

Sonyks™ is a guided wave ultrasonic NDT technology developed for detecting metal loss in pipework. It is a pulse-echo system aimed at screening large volumes of material from a single test point. Its initial application was for detecting corrosion under insulation in petrochemical plant pipework, but it has found widespread use in other inspection situations where pipes or tubes are not easily accessible, for example where they encased in a sleeve or elevated above the ground. The aim of the inspection is to screen long lengths of pipe rapidly with 100% coverage of the pipe wall and to identify areas of corrosion or erosion for further evaluation using other NDT techniques such as radiography or conventional ultrasonic inspection. The technique is equally sensitive to metal loss on both the outside and inside surfaces of the pipe.

Further details of the Sonyks™ technique are given in Appendix C and are recommended reading prior to the study of this report.

Personnel Qualifications

Inspection Team:

Name	Date of Birth	Certificate Number	Operator level
Sam Huan	01st April 1985	123456	CSWIP GWT Level 2
I.Gopher	25th December 1990	321654	CSWIP GWT Level 1

Report Reviewer:

Name	Date of Birth	Certificate Number	Operator level
N.Ebody	29th February 1976	654321	CSWIP GWT Level 3

The certification is independently verified CSWIP: https://www.cswip.com/verification

Equipment

Tests were carried out using the following equipment.

Equipment	Item Description	Serial Numbers
Instruments	SONYKS	2111711
	SONYKS	2129901
	SONYKS	2129903
Tool Leads	Magneto-Tool	2109905
	Magneto-Tool	2125011
	Piezo-Tool	2125301

Collars	4 in MagnetoTool128Series1	2124436
	4 in MagnetoTool128Series1	2124433
	4 in MagnetoTool64Series1	2124439
	8 in StandardSeries4	2122114
Software	Sonyks PRO	Report generated using version 1.2R5

Procedures/References

All onsite activities were carried out in accordance with Eddyfi UK Ltd operating procedures/work instructions.

S-PROC-1003 – Sonyks Operation Procedure
S-WI-3001a – Work instruction for Oversize Collar Link up.

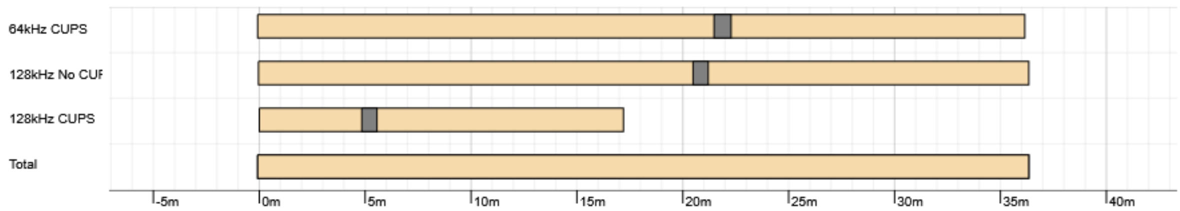
Acknowledgements

The author would like to extend thanks to Mr C.Lient and Mr N.Gineer for their assistance during this inspection.

Guided Wave Inspection Coverage

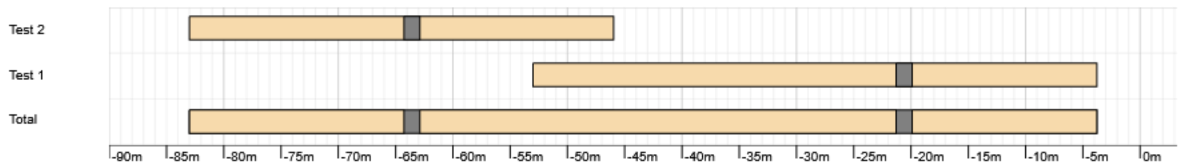
4in pipe loop, Datum 1
Datum: Pipe End West
Positive Direction from Datum: Site East
The total length inspected with guided waves is 36.3 m

Test	Range	Length	Exclusions	Range
64kHz CUPS	-0.1 m to 36.2 m	36.2 m	Dead zone	21.5 m to 22.3 m
128kHz No CUPS	0.0 m to 36.2 m	36.3 m	Dead zone	20.5 m to 21.2 m
128kHz CUPS	0.0 m to 17.2 m	17.2 m	Dead zone	4.8 m to 5.6 m



8 inch Firemain Area L, Datum 1
Datum: Flange NE corner area L
Positive Direction from Datum: Site North
The total length inspected with guided waves is 76.4 m

Test	Range	Length	Exclusions	Range
Test 2	-83.0 m to -46.0 m	37.0 m	Dead zone	-64.3 m to -62.9 m
Test 1	-53.0 m to -3.8 m	49.2 m	Dead zone	-21.3 m to -19.9 m



8in Loop, Datum 1

Datum: South Flange

Positive Direction from Datum: Site North

The total length inspected with guided waves is 16.1 m

Test	Range	Length	Exclusions	Range
Test 2	0.0 m to 16.1 m	16.2 m	Dead zone	14.1 m to 15.5 m
Test 1	0.1 m to 16.2 m	16.0 m	Dead zone	2.5 m to 3.9 m

Anomalies To Follow Up

This table gives the anomalies found during this project. All size and shape information is estimated.

Pipeline, Datum, Test	Position from Datum	Estimated Cross-Section Area Change	Indicated Circumferential Response	Response Intensity	Comment
4in pipe loop, Datum 1, 128kHz CUPS Positive From Datum: Site East	3.7 m	1.2 %	Narrow	High	
4in pipe loop, Datum 1, 128kHz No CUPS Positive From Datum: Site East	18.8 m	1.9 %			
4in pipe loop, Datum 1, 64kHz CUPS Positive From Datum: Site East	18.8 m	0.5 %	Medium	Moderate	
8in Loop, Datum 1, Test 1 Positive From Datum: Site North	7.9 m	2.8 %	Narrow	High	
8in Loop, Datum 1, Test 2 Positive From Datum: Site North	7.9 m	2.8 %	Narrow	High	

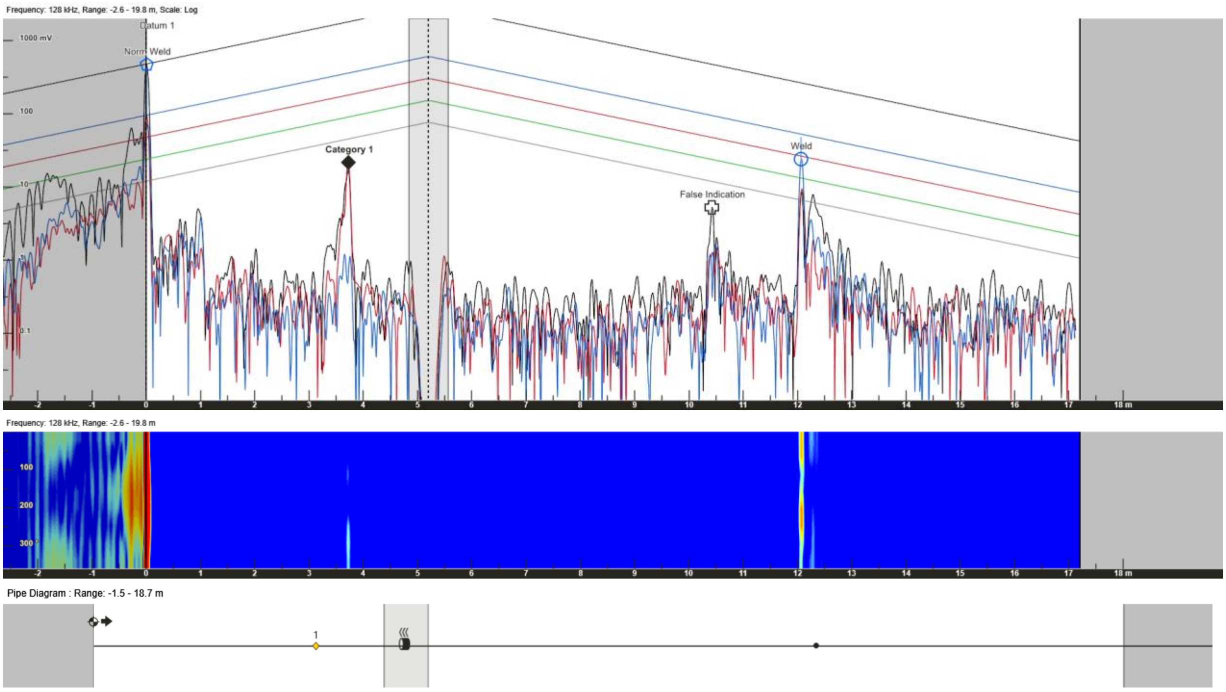
Eddyfi Technologies

Appendix A

Test Reports

4in pipe loop, Datum 1, 128kHz CUPS

Datum Description	Pipe End West	Datum Positive	Site East
Test Date	06/05/2022	Operator	Sam Huan
Nominal Diameter	4 in	Nominal Thickness	6.0 mm
Average UT Thickness	Not given	Procedure	S-PROC-1003
Pipe Orientation	Horizontal	Instrument S/N	2111711
Collar S/N(s)	2124436		

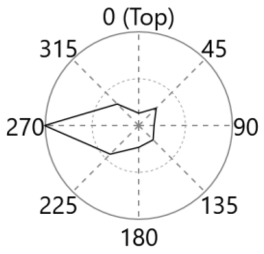


Remarks
This is a short range scan using the Sonyks 128kHz Magnetostrictive tooling. It shows a close up of the CUPS defect at the pipe support taken as the defect was grown. Note that even though this defect is small (1.2% CSC) there is still 27dB SNR.

Position	Indication Details
0.0 m	Pipe End
3.7 m	Category 1 Response Intensity: High CSC: 1.2 % (@ 128 kHz)
4.8 m	Dead zone (End)
5.2 m	Tool

Position	Indication Details
5.6 m	Dead zone (Start)
10.4 m	False Indication - Mirror signal from Flange
12.1 m	Weld

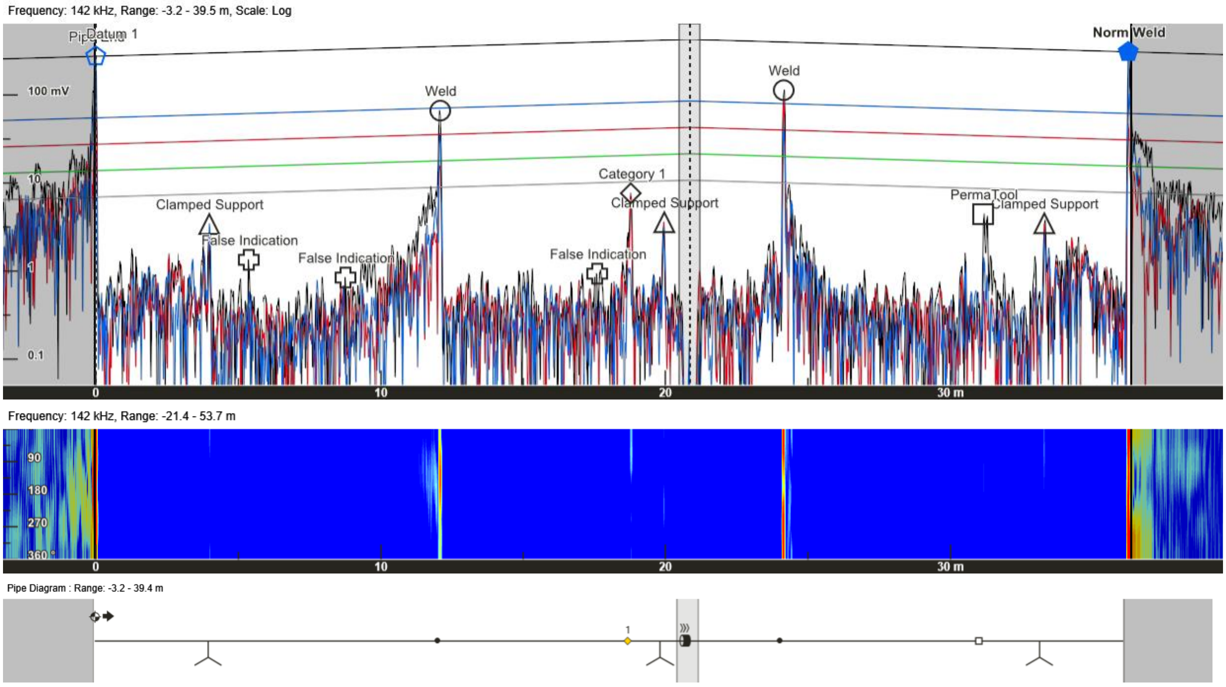
Focusing Result

3.7 m ◇ Response Intensity: High 			

The clockwise orientation given corresponds to facing in the positive direction.

4in pipe loop, Datum 1, 128kHz No CUPS

Datum Description	Pipe End West	Datum Positive	Site East
Test Date	01/02/2022	Operator	Sam Huan
Nominal Diameter	4 in	Nominal Thickness	6.0 mm
Average UT Thickness	Not given	Procedure	S-PROC-1003
Pipe Orientation	Horizontal	Instrument S/N	2129901
Collar S/N(s)	2124433		



Remarks
This data was collected with the Sonyks 128kHz Magnetostrictive tooling. It shows the full length of the pipeline was acquired from one test location. This data was acquired before the CUPS defect was put in place. Note the similar response from all pipe supports.

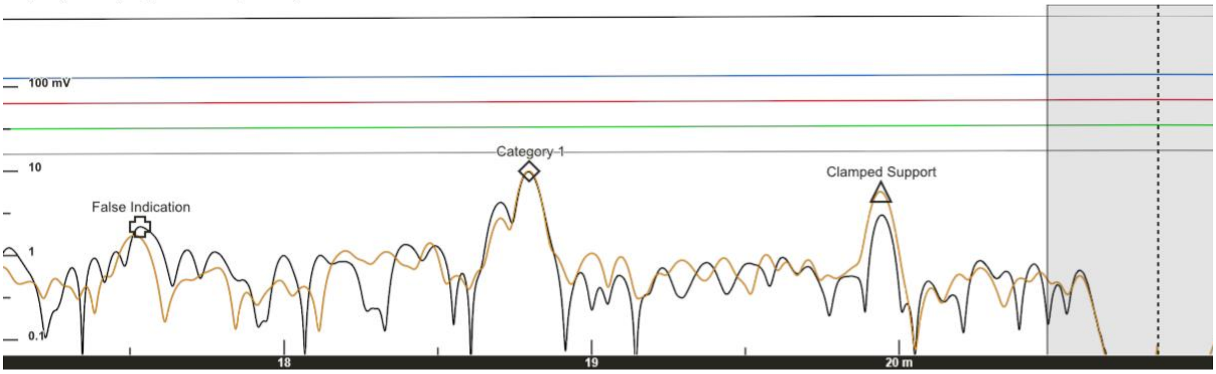
Position	Indication Details
0.0 m	Pipe End
4.0 m	Clamped Support
5.4 m	False Indication - Mirror from pipe end
8.7 m	False Indication - Repeat from weld
12.1 m	Weld
17.5 m	False Indication - Mirror from Weld

Position	Indication Details
18.8 m	Category 1 CSC: 1.9 % (@ 142 kHz)
19.9 m	Clamped Support
20.5 m	Dead zone (Start)
20.8 m	Tool
21.2 m	Dead zone (End)
24.1 m	Weld
31.1 m	PermaTool - Bonded Magneto strip

		33.3 m		Clamped Support
		36.2 m		Pipe End

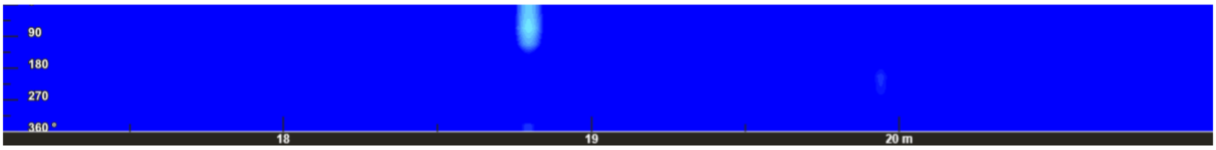
A-scan_1

Frequency: 128 kHz, Range: 17.1 - 21.0 m, Scale: Log



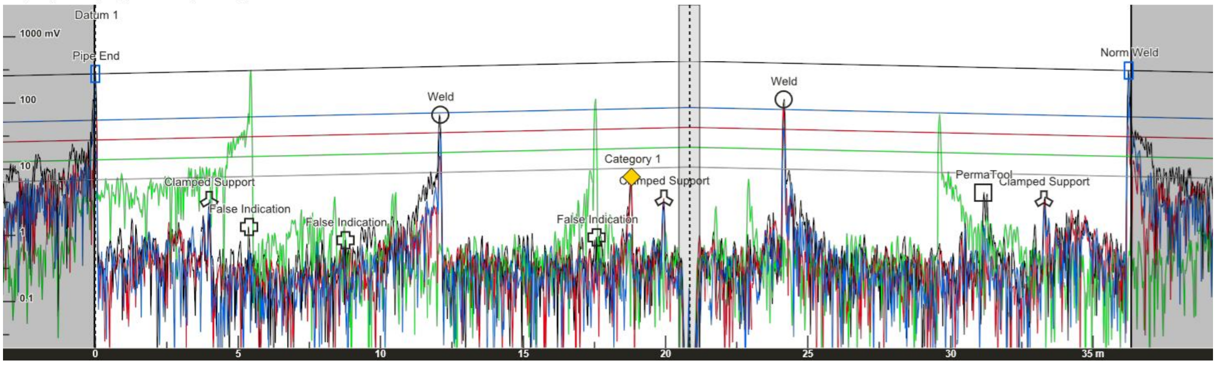
C-scan_1

Frequency: 128 kHz, Range: 14.3 - 21.2 m



A-scan_2

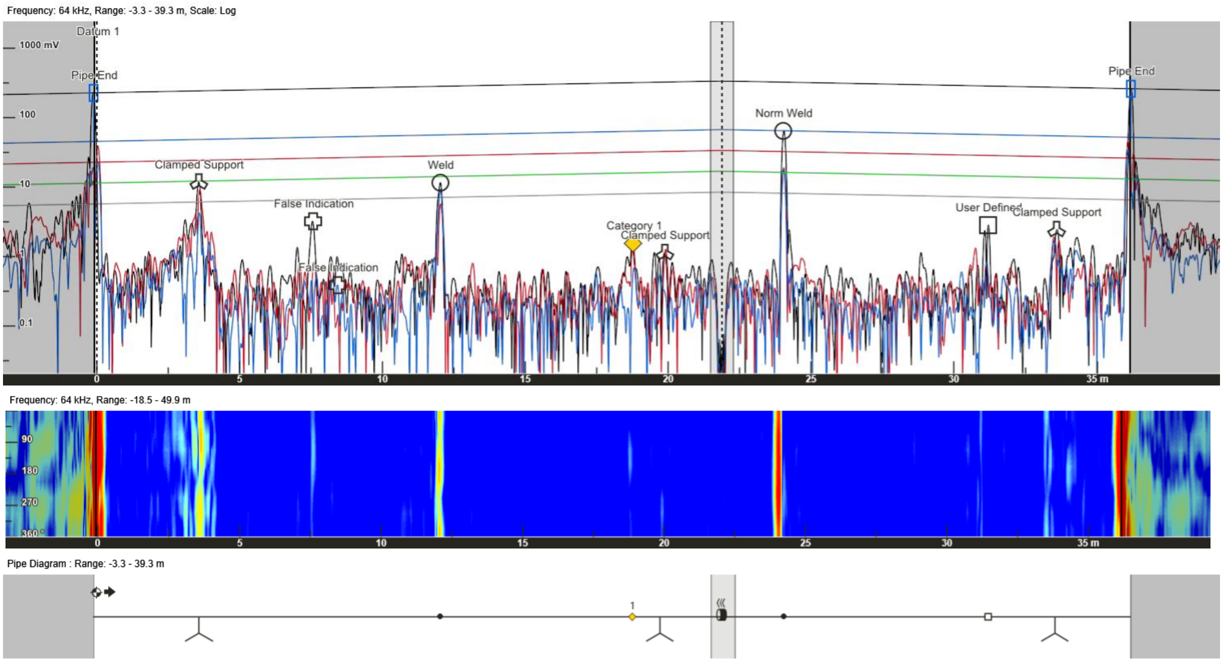
Frequency: 142 kHz, Range: -3.2 - 39.5 m, Scale: Log



Eddyfi Technologies

4in pipe loop, Datum 1, 64kHz CUPS

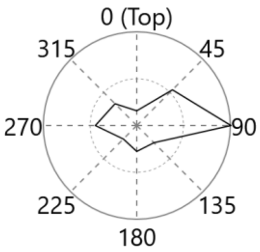
Datum Description	Pipe End West	Datum Positive	Site East
Test Date	10/05/2022	Operator	Sam Huan
Nominal Diameter	4 in	Nominal Thickness	6.0 mm
Average UT Thickness	Not given	Procedure	S-PROC-1003
Pipe Orientation	Horizontal	Instrument S/N	2111711
Collar S/N(s)	2124439		



Remarks
This data was collected with the Sonyks 64kHz Magnetostrictive tooling. The CUPS defect is in place at the Clamped support at 3.58m. It is clear that the response of this support is significantly different from the other supports. The defect had been grown to 5% CSC at this point.

Position	Indication Details
-0.1 m	Pipe End
3.6 m	Clamped Support - CUPS at this location
7.6 m	False Indication - Mirror from Pipe End
8.4 m	False Indication - Repeat from Weld
12.0 m	Weld
18.8 m	Category 1 Response Intensity: Moderate CSC: 0.5 % (@ 64 kHz)

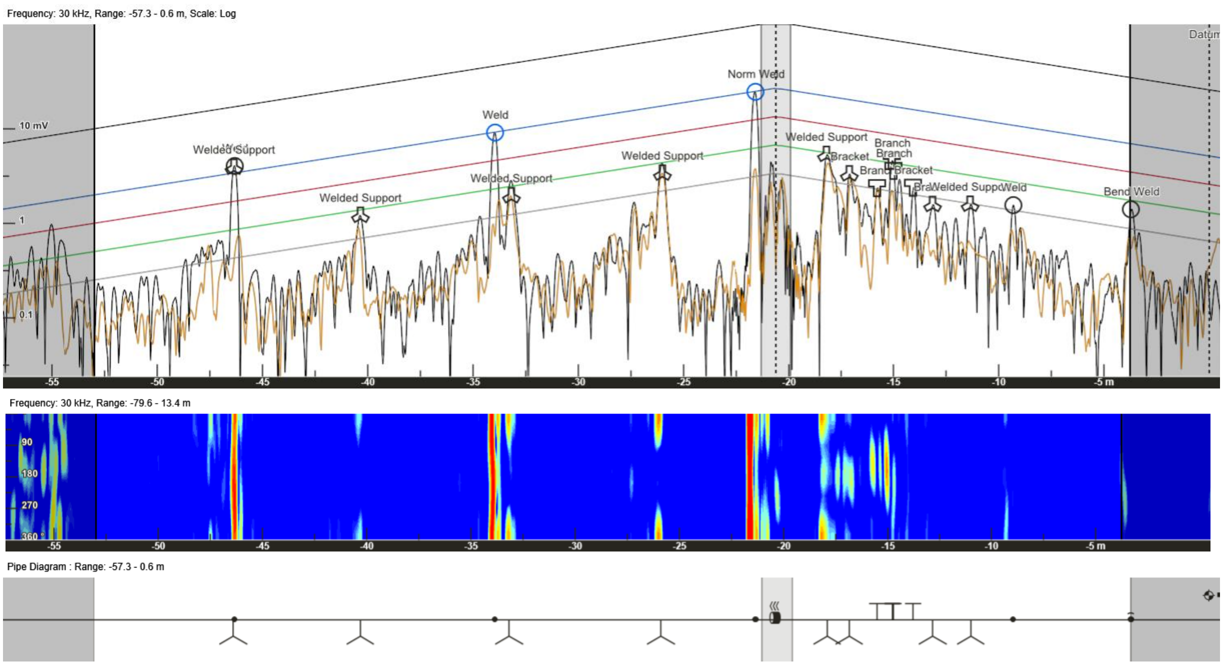
Position	Indication Details
19.8 m	Clamped Support
21.5 m	Dead zone (End)
21.9 m	Tool
22.3 m	Dead zone (Start)
24.0 m	Norm Weld
31.2 m	User Defined Perm collar
33.5 m	Clamped Support
36.2 m	Pipe End

Focusing Result			
18.8 m ◇ Response Intensity: Moderate 			

The clockwise orientation given corresponds to facing in the positive direction.

8 inch Firemain Area L, Datum 1, Test 1

Datum Description	Flange NE corner area L	Datum Positive	Site North
Test Date	24/03/2022	Operator	Sam Huan
Nominal Diameter	8 in	Nominal Thickness	8.2 mm
Average UT Thickness	8.4 mm	Procedure	S-PROC-1003
Pipe Orientation	Horizontal	Instrument S/N	2129903
Collar S/N(s)	2122114		



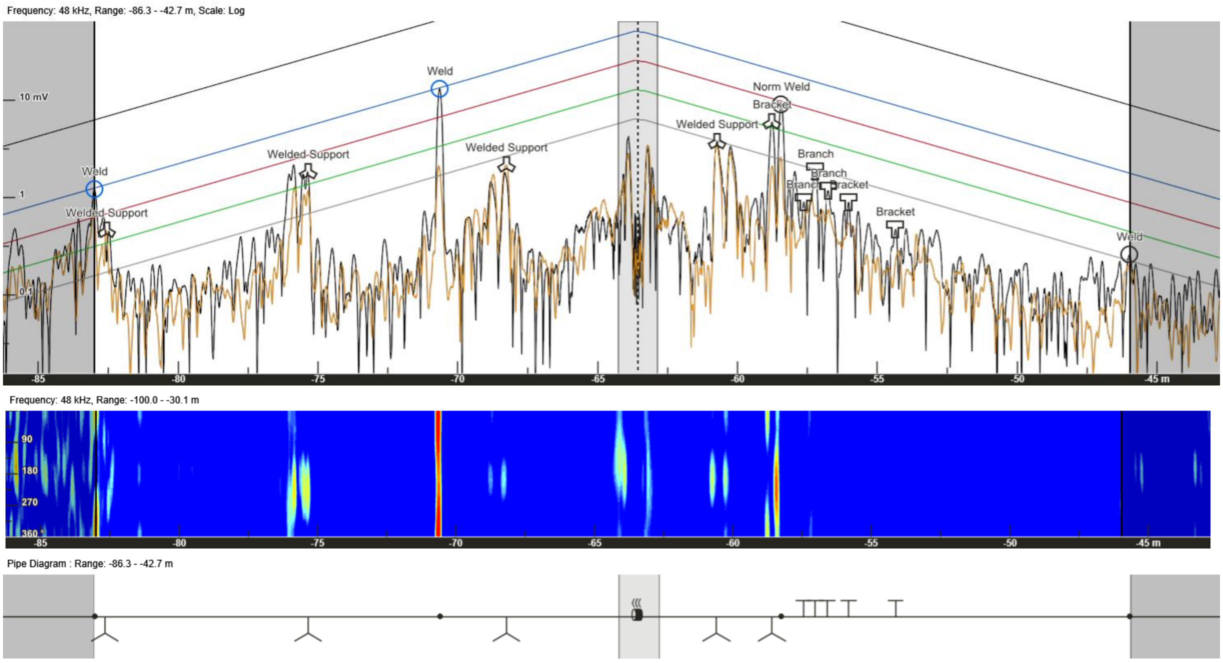
Remarks
Data collected with Sonyks Piezoelectric tooling. Note that approximately 50m of coverage, despite the presence of multiple complex structures in the geometry.

Position	Indication Details
-46.6 m	Welded Support
-46.3 m	Weld
-40.2 m	Welded Support
-34.0 m	Weld
-33.0 m	Welded Support
-26.3 m	Welded Support
-21.6 m	Norm Weld
-21.3 m	Dead zone (End)
-20.6 m	Tool
-19.9 m	Dead zone (Start)

Position	Indication Details
-18.4 m	Welded Support
-17.0 m	Bracket
-15.8 m	Branch
-15.3 m	Branch
-14.9 m	Branch
-14.7 m	Branch
-14.3 m	Bracket
-12.9 m	Bracket
-11.1 m	Welded Support
-9.4 m	Weld
-3.7 m	Bend Weld

8 inch Firemain Area L, Datum 1, Test 2

Datum Description	Flange NE corner area L	Datum Positive	Site North
Test Date	24/03/2022	Operator	Sam Huan
Nominal Diameter	8 in	Nominal Thickness	8.2 mm
Average UT Thickness	8.3 mm	Procedure	S-PROC-1003
Pipe Orientation	Horizontal	Instrument S/N	2129903
Collar S/N(s)	2122114		



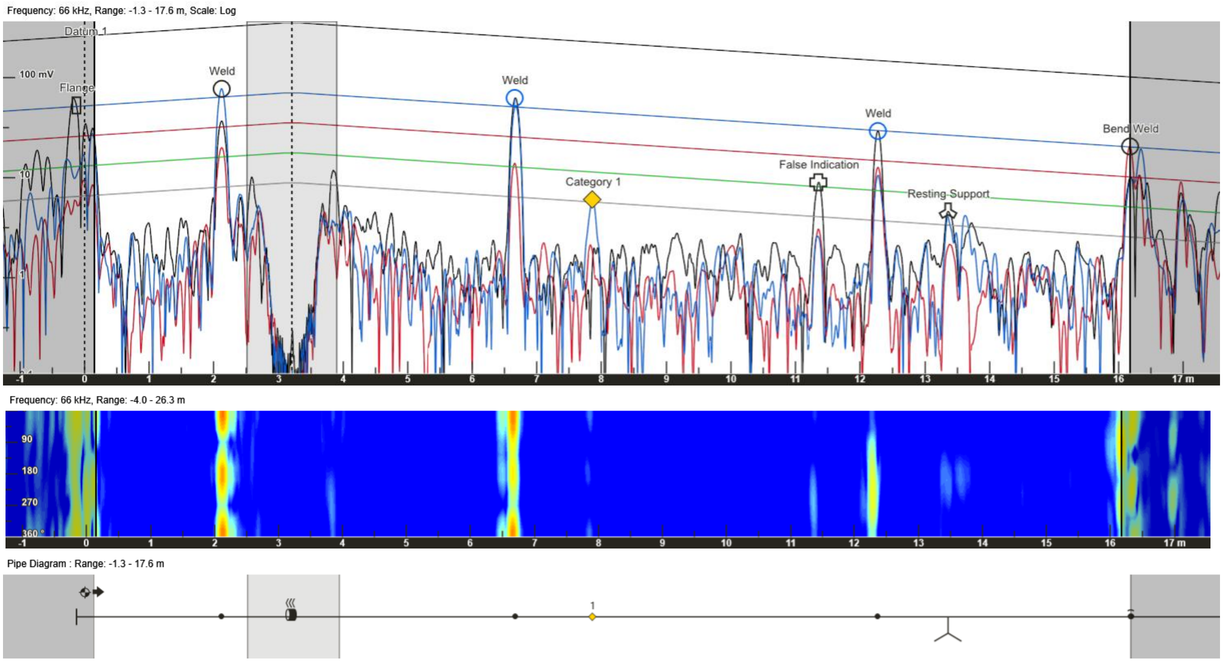
Remarks
Data collected with Sonyks Piezoelectric tooling.

Position	Indication Details
-83.0 m	Weld
-82.6 m	Welded Support
-75.4 m	Welded Support
-70.6 m	Weld
-68.3 m	Welded Support
-64.3 m	Dead zone (End)
-63.6 m	Tool
-62.9 m	Dead zone (Start)

Position	Indication Details
-60.8 m	Welded Support
-58.8 m	Bracket
-58.4 m	Norm Weld
-57.6 m	Branch
-57.4 m	Branch
-56.8 m	Branch
-56.0 m	Bracket
-54.4 m	Bracket
-46.0 m	Weld

8in Loop, Datum 1, Test 1

Datum Description	South Flange	Datum Positive	Site North
Test Date	02/02/2022	Operator	Sam Huan
Nominal Diameter	8 in	Nominal Thickness	6.4 mm
Average UT Thickness	Not given	Procedure	S-PROC-1003
Pipe Orientation	Horizontal	Instrument S/N	2129901
Collar S/N(s)	2122114		

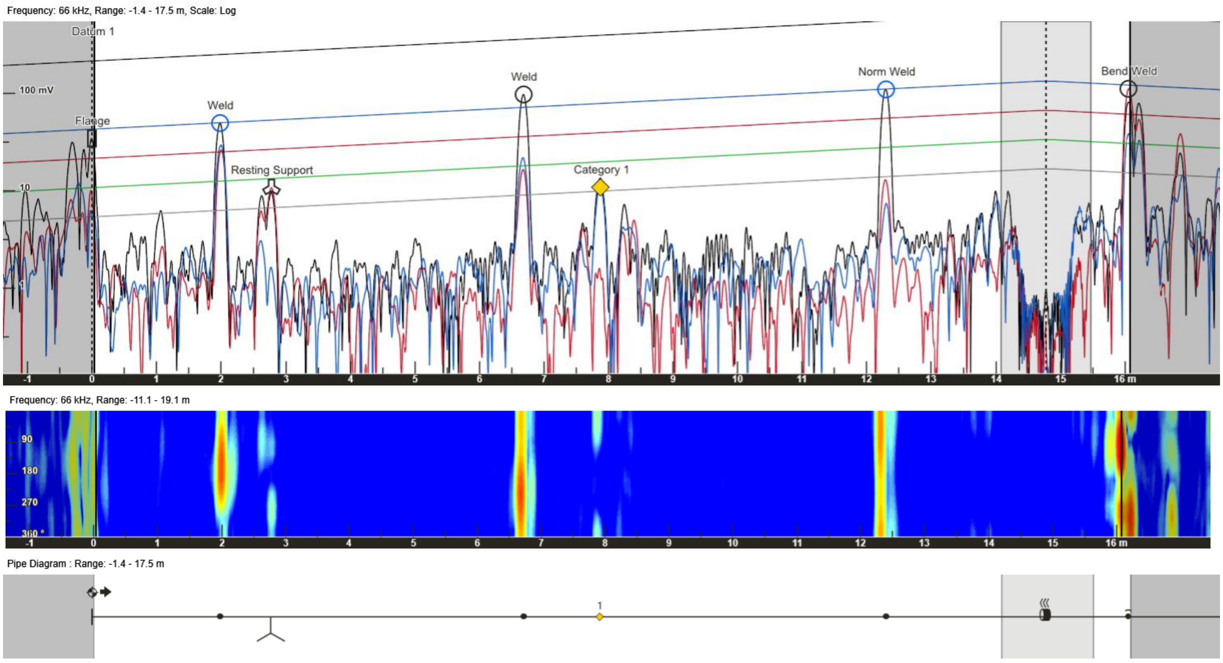


Remarks
Data collected with Sonyks Piezoelectric tooling.

Position	Indication Details	Position	Indication Details
0.0 m	Flange	7.9 m	Category 1 Response Intensity: High CSC: 2.8 % (@ 66 kHz)
2.1 m	Weld	11.4 m	False Indication - Second echo of first weld
2.5 m	Dead zone (End)	12.3 m	Weld
3.2 m	Tool	13.4 m	Resting Support
3.9 m	Dead zone (Start)	16.2 m	Bend Weld
6.7 m	Weld		

8in Loop, Datum 1, Test 2

Datum Description	South Flange	Datum Positive	Site North
Test Date	02/02/2022	Operator	Sam Huan
Nominal Diameter	8 in	Nominal Thickness	6.4 mm
Average UT Thickness	Not given	Procedure	S-PROC-1003
Pipe Orientation	Horizontal	Instrument S/N	2129901
Collar S/N(s)	2122114		

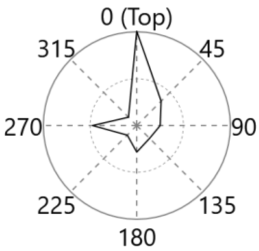


Remarks
Data collected with Sonyks Piezoelectric tooling.

Position	Indication Details
-0.1 m	Flange
2.0 m	Weld
2.8 m	Resting Support
6.7 m	Weld
7.9 m	Category 1 Response Intensity: High CSC: 2.8 % (@ 66 kHz)

Position	Indication Details
12.3 m	Norm Weld
14.1 m	Dead zone (End)
14.8 m	Tool
15.5 m	Dead zone (Start)
16.1 m	Bend Weld

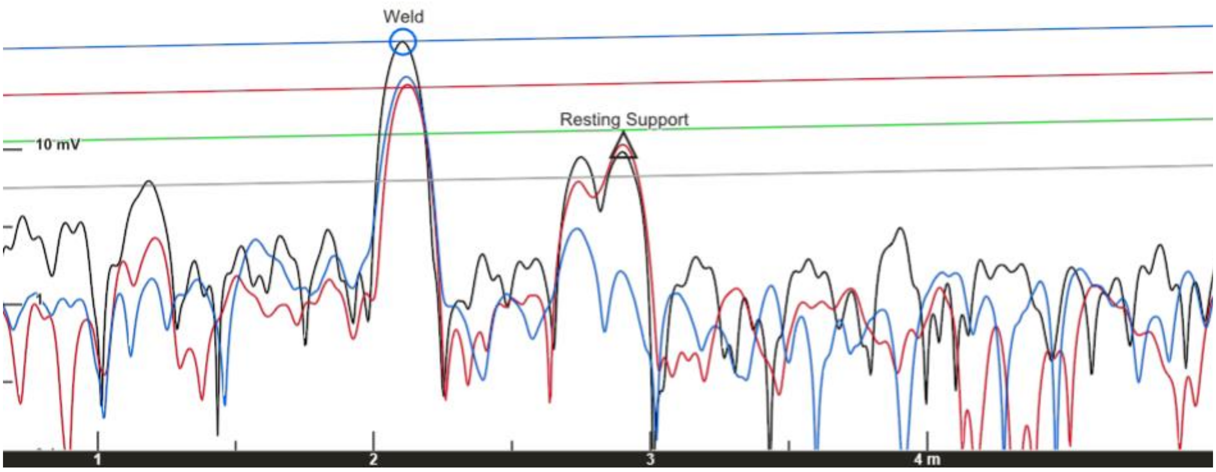
Focusing Result

7.9 m ◇ Response Intensity: High 			

The clockwise orientation given corresponds to facing in the positive direction.

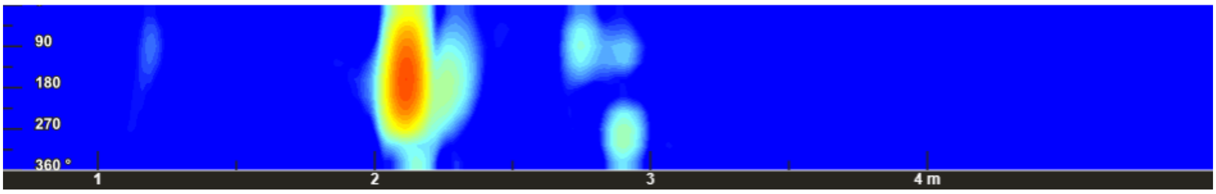
A-scan

Frequency: 66 kHz, Range: 0.7 - 5.1 m, Scale: Log



C-scan

Frequency: 66 kHz, Range: 0.7 - 5.1 m



Appendix B

Photographs and Related Detail

Image 1

4in pipe loop – West End

Showing clamped support with cups.

Image 2

4in pipe loop – West End

Picture of cups at support.

Image 3

4in pipe loop – Central

Category 1 anomalous indication.

Image 4

4in pipe loop – East End

PermaTool - Bonded Magneto strip

Appendix C

GWT Principles of Operation

Introduction

Sonyks™ is a guided wave ultrasonic NDT technology developed for detecting metal loss in pipework. It is a pulse-echo system aimed at testing large volumes of material from a single test point. Its initial application was for detecting corrosion under insulation in petrochemical plant pipework. Still, it has found widespread use in other inspection situations where pipes or tubes are not easily accessible, for example, encased in a sleeve or elevated above the ground.

Sonyks™ is primarily a screening tool. The inspection aims to test long pipe lengths rapidly with 100% coverage of the pipe wall and identify areas of corrosion or erosion for further evaluation using other NDT techniques such as radiography or conventional ultrasonic inspection. The method is equally sensitive to metal loss on both the outside and inside surfaces of the pipe.

The system enables data acquisition and analysis via the touch screen and Sonyks™ Go. This process can also be performed using a personal computer using the Sonyks™ Pro software.

Principles of Operation and Interpretation

Sonyks™ employs low frequency guided waves, operating just above audible frequencies, propagated from a ring of transducers fixed around the pipe under test. These low frequencies (in ultrasonic terms) are necessary to generate the appropriate wave modes. A liquid couplant between the transducers and the surface is not required at these frequencies. The satisfactory ultrasonic coupling is achieved with mechanical or pneumatic pressure applied to the back of the sensors to maintain contact with the pipe surface. The uniform spacing of the ultrasonic transducers around the pipe circumference allows guided waves to be generated, which propagate symmetrically about the pipe axis. These may be visualised as circular waves that sweep along the length of the pipe. The whole pipe wall thickness is excited by the wave motion, the pipe acting as a waveguide - hence the term guided waves.

The propagation of these guided waves is governed principally by the wave's frequency and material thickness. Where the wave encounters a change in pipe wall thickness, whether an increase or a decrease, a proportion of the energy is reflected back to the transducers, thereby providing a mechanism for detecting discontinuities. In the case of a girth weld, the increase in thickness is symmetrical around the pipe. The advancing circular wavefront is reflected uniformly. Thus the reflected wave is symmetrical, consisting predominantly of the same wave mode as the incident wave. In the case of an area of corrosion, the decrease in wall thickness is likely to be localised, leading to scattering of the incident wave. In this case, reflection and mode conversion both occur. Therefore, the reflected wave consists of the incident wave mode plus the mode converted components. The mode-converted waves tend to cause the pipe to flex as they arise from a non-uniform source. The presence of these signals is a reliable indicator of discontinuities such as corrosion. Sonyks™ can detect and distinguish between symmetrical and flexural waves, and both types are presented on the data display.

The reflections are displayed as rectified signals in an amplitude vs distance 'A-scan' display, similar to that used in conventional ultrasonics, but with a time-base range measured in tens of metres rather than centimetres.

A significant complication for guided wave systems as distinct from conventional ultrasonics is the dispersive nature of guided waves; that is to say, the velocity of most guided waves varies with their frequency. Velocity variation causes various complications, one being that calibrating the time base of the A-scan to read distance and not time requires a computer program to read in velocity for the selected test frequency from a calibration, or 'dispersion' curve. A library of dispersion curves is built into the Sonyks™ software for a range of pipe diameter/wall-thickness combinations.

Girth welds produce dominant signals in the A-scan and act as important markers, used to set distance amplitude correction (DAC) curves on the display with which signals from anomalies can be compared.

Before the signals on the A-scan can be interpreted, DAC curves are placed on the display. The signals from girth welds in the pipe that gradually decays away with distance make ideal reflectors to set the DAC. From both research work and experience, it is known that the reflection from a girth weld with a regular cap and root profile is 14dB (a factor of 5) less intense than the reflection from the pipe end (i.e. total reflection). Furthermore, experience also shows that an area of thinning which has resulted in a loss of cross-sectional area of 5% in the pipe wall will produce a signal that is a further 12dB less intense than the signal from the girth weld. This –26dB level is used as a threshold for evaluating signals.

Under certain circumstances, the general background noise level may be such that it is impossible to distinguish any features on the time base. This can occur when the external surface of the pipework is in poor condition. If the internal surface is generally pitted, the pipe is coated with an attenuative coating, such as Denso and Bitumastic wrappings, or an internal build-up of scale or sludge. It is impossible to set the test sensitivity in this situation, and the test will be deemed inconclusive. This may also apply where it has not been possible for the ultrasound to propagate any suitable distance due to a very high attenuation rate.

There are 5 DAC curves on the Sonyks™ A-scan display:

0 dB Curve

A pipe end or flange acts as a near-perfect reflector. This may be demonstrated on a single length of pipe in the laboratory and may be used to set an absolute reference sensitivity. This reference is generally described as a 0dB reflector. This DAC curve is the solid black line if visible on the A-scan display.

-14 dB Curve

A field girth weld typically provides a reflectivity equivalent to 20% (-14dB) of a pipe end. While there is a small variability from weld to weld, this premise holds up well in practice. The –14dB DAC curve is a blue line on the A-scan display.

-20 dB Curve

The –20dB DAC curve is a red line on the A-scan display. This line is the midpoint between the -14dB (Weld) curve and the -26dB (5% Threshold Level) curve. It marks the breakpoint between Category 2 and 3 anomalies.

-26 dB Curve

A fully circumferential metal loss feature with a cross-sectional area of 5% also gives a reflectivity equivalent to 5% (-26dB) of the pipe end. This threshold level, viewed on the A-scan as a green line, is used as a start point to sentence anomalies. Anomalies giving signals close to but not breaking the –26dB curve are typically sentenced as Category 1. Anomalies, which provide signals exceeding the –26dB curve but not exceeding the -20dB curve, are described as Category 2. Anomalies that produce signals that exceed the –20dB curve are described as Category 3.

-32 dB Curve

This curve is used to determine the effective test range. It effectively acts as a limit of both test range and sensitivity to low amplitude anomalies. This enables a callable anomaly (-26dB) to have a signal to noise ratio of 6dB or better. This level of signal to noise is necessary for adequate interpretation of the test data.

Reporting

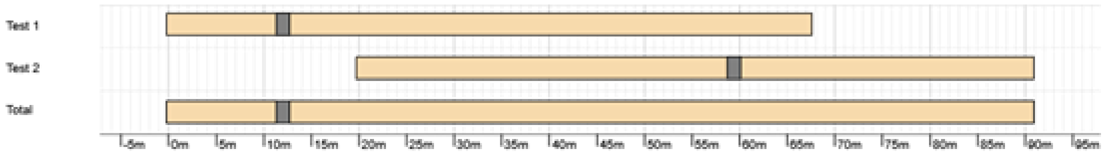
The Sonyks™ operator uses the A-scan display for interpretation purposes. The client is provided only with a series of reports generated by the Sonyks™ software for routine service work. The test operator selects relevant signals in the A-scan to record signals in the report. The program automatically measures the signal's peak as a value above or below the –26dB DAC curve (the signal amplitude obtained from 5% reflectors). It measures the axial distance of the signal from the centre line of the transducer tool. An offset may be entered, allowing distance to be measured from a known reference point rather than the sensor.

The Sonyks™ report also contains information about the test entered by the operator before collecting data, for example, pipe identification, test location, and pipe size.

Test Coverage

The Sonyks™ report contains visual information so the reader can quickly identify test guided wave coverage for each pipe.

Test	Range	Length	Exclusions	Range
Test 1	-0.2 m to 67.3 m	67.6 m	Dead zone	11.1 m to 12.9 m
Test 2	19.7 m to 90.9 m	71.1 m	Dead zone	57.6 m to 59.4 m



The example presentation above shows two tests on a single pipeline. The grey areas on the chart represent the dead zone regions. The orange sections represent the inspection coverage for each test. The information from each test is combined to construct a total display at the bottom of the graph. As can be seen, the dead zone region from test two has been removed from the total as it was inspected from test 1. A combined diagnostic length from 0m to 91m is displayed, excluding the dead zone from test 1, ~ 11m to 13m.

Flaw Classification

The classification of 'Category 1', 'Category 2' and 'Category 3' anomalies detected is qualitative. While there is a relationship between the amplitude of reflection from idealised defects and their size, such as large-amplitude reflections arising from large defects. Responses from real flaws are much more complicated. Therefore, while large amplitude responses are only likely to result from significant flaws, the converse is not necessarily true, as the shape and orientation also affect the response amplitude.

Indications identified on the A-scan plots are evaluated by combining their signal amplitude and directionality from focused data. This considers that large-amplitude responses will be from a significant cross-sectional area defect. Small defects cannot produce large amplitude reflections. However, a low amplitude response does not necessarily mean that the flaw is minor, as several factors may affect the response.

To identify potentially significant defects in terms of the pipe's integrity, it is also necessary to examine how localised the response is in terms of the pipe circumference. This information is obtained from the focused data and is plotted on a polar response chart. The results from focused tests are assessed in terms of the directionality of the response.

Suppose the polar plot shows a high level of directionality, indicated by a single peak in the plot at one focus angle. In that case, it is classified as directionality 3 (Figure 1). This suggests that the defect is highly localised on a narrow part of the circumference. It is likely to be deep for a given amplitude of the response.

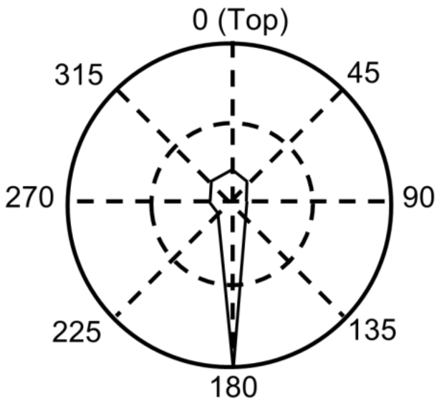


Figure 1. Directionality 3 response from a focused test

If the polar plot has two adjacent high amplitude responses, it is classified as directionality 2 (Figure 2). This suggests that the defect is localised but has some circumferential length.

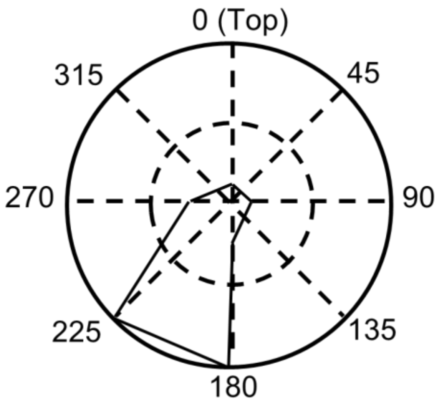


Figure 2. Directionality 2 response from a focused test

If the polar plot has 3 or more adjacent high amplitude peaks, it is classified as directionality 1 (Figure 3). This suggests that the defect is spread over a wide circumference area. It is likely to be less deep for a given response amplitude.

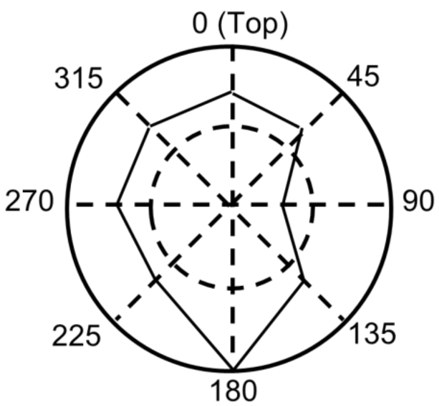


Figure 3. Directionality 1 response from a focused test

If the polar plot shows a reduced level of directionality, indicated by multiple peaks at several angles, it is classified as directionality 0 (Figure 4). Under these circumstances, the anomaly can only be classified using signal amplitude criteria.

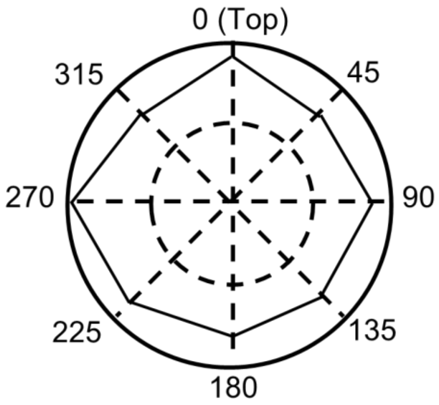


Figure 4. Directionality 0 response from a focused test

The overall classification is obtained by multiplying the category x directionality values. A score of 3 or higher recommends a High priority follow-up. A score of 2 gives a Medium priority, and a score of 1 provides a low priority. This is summarised in the table below.

Classification Matrix:

Category	Directionality	Score	Response Intensity
3	3	9	High
3	2	6	High
3	1	3	High
2	3	6	High
2	2	4	High
2	1	2	Moderate
1	3	3	High
1	2	2	Moderate
1	1	1	Low

Hence, a high amplitude response defect always results in a high priority follow-up (unless deemed to be a feature such as a weld), as does a low amplitude response that is highly directional.

Interpretation of the Sonyks™ data requires a thorough understanding of the factors which influence the test output and, as with any other sophisticated examination method, experience of the interpretation process.

Quantitative inspections such as Radiography or Conventional UT are recommended on all classifications of anomalies.