

40 inch MFL CALIBRATION REPORT

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Chapter 1. Tool Calibration Procedure

1.1. Purpose

To ensure that specified and declared tool accuracy and detection values are met during the actual in-line pipeline inspection.

1.2. Scope

This procedure is applicable to working processes of QA/QC, Production, Data Evaluation and Project Departments.

1.3. Responsibility

QA/QC, Production, Data Evaluation Department Managers are responsible for implementation of this procedure.

1.4. Definitions

ILI tool:	In-line Inspection tool/vehicle, intelligent geometry or magnetic flux leakage pig.
MFL tool	Magnetic flux leakage (MFL) is a magnetic method of nondestructive testing that is used to detect corrosion and pitting in steel structures, most commonly pipelines and storage tanks. MFL imparts an axial magnetic field and is therefore limited in defect detection for narrow axial features - cracks in seam welds, axial orientated slotting and NAEC
TFI Tool	Transverse Field Inspection (TFI) is a magnetic method of nondestructive testing that is used to detect corrosion and pitting in steel structures, most commonly pipelines and storage tanks. TFI imparts a circumferential (Transverse) magnetic field and is therefore limited to defects orientated in this manner - Girth weld cracks and circumferential slotting.
Test pipe:	Metal pipe with artificial defects, used for testing and calibration of the ILI tool
PTT:	Pull Through Test – operation used for ILI tool testing and calibration by pulling the tool through test pipe.

1.5. Materials and equipment

Test pipe. See attached drawings.

PTT Test stand

Pulling Winch

Operator PC

Connection cables

Pulling rope

Hoisting facilities

Accessories

Metal processing tools

Measurement instruments including hand held UT scanner

1.6. Procedure

Pull Through Test is carried out by pulling the magnetic flux leakage or geometry inspection vehicle through the test pipe by means of hydraulic or manual winch. The tool is moved at constant velocity of 0.3-2 m/sec. On the test pipe artificial models of defect types of different sizes are applied. Dimensions of the defects are accurately measured. Tool is switched to operating mode during the test and after the test, the received data is analyzed.

1.7. Preparation

Joint measurements of all the test pipe anomalies provided, may be checked by Sonatrach representative with our QA/ QC personnel, with inspection tools and instruments, prior to Pull through Test and to be recorded. BPCL Engineers may propose any additional defects in the test pipe, if required, to be incorporated by M/s Lin Scan just prior to commencement of PTT.

The Pull Through Test with MFL tool to be repeated minimum three times with different speeds.

The Pull Through Test with TFI tool to be repeated minimum three times with different speeds.

1.8. After Test Activities

After the Pull Through Test the inspection tool is moved from the output tray of the testing pipe with appropriate hoisting facilities.

Operator connects cables and checks the functionality of the systems and availability of the recorded data. In case systems are inoperative or/and data is not recorded tool is returned to Production Department for investigation.

Operator downloads the data to PC, records on portable memory unit and handed over to Evaluation department for analysis.

1.9. Reporting Activity

After completion of data evaluation, data analyst will issue Pull Through Test report including: ILI tool configuration includes number of primary and secondary sensors.

ILI tool functionality test report.

This report includes all defects sizing including ID/OD discrimination, axial and circumferential position. Defects in HAZ will be highlighted.

1.10. Personnel involved

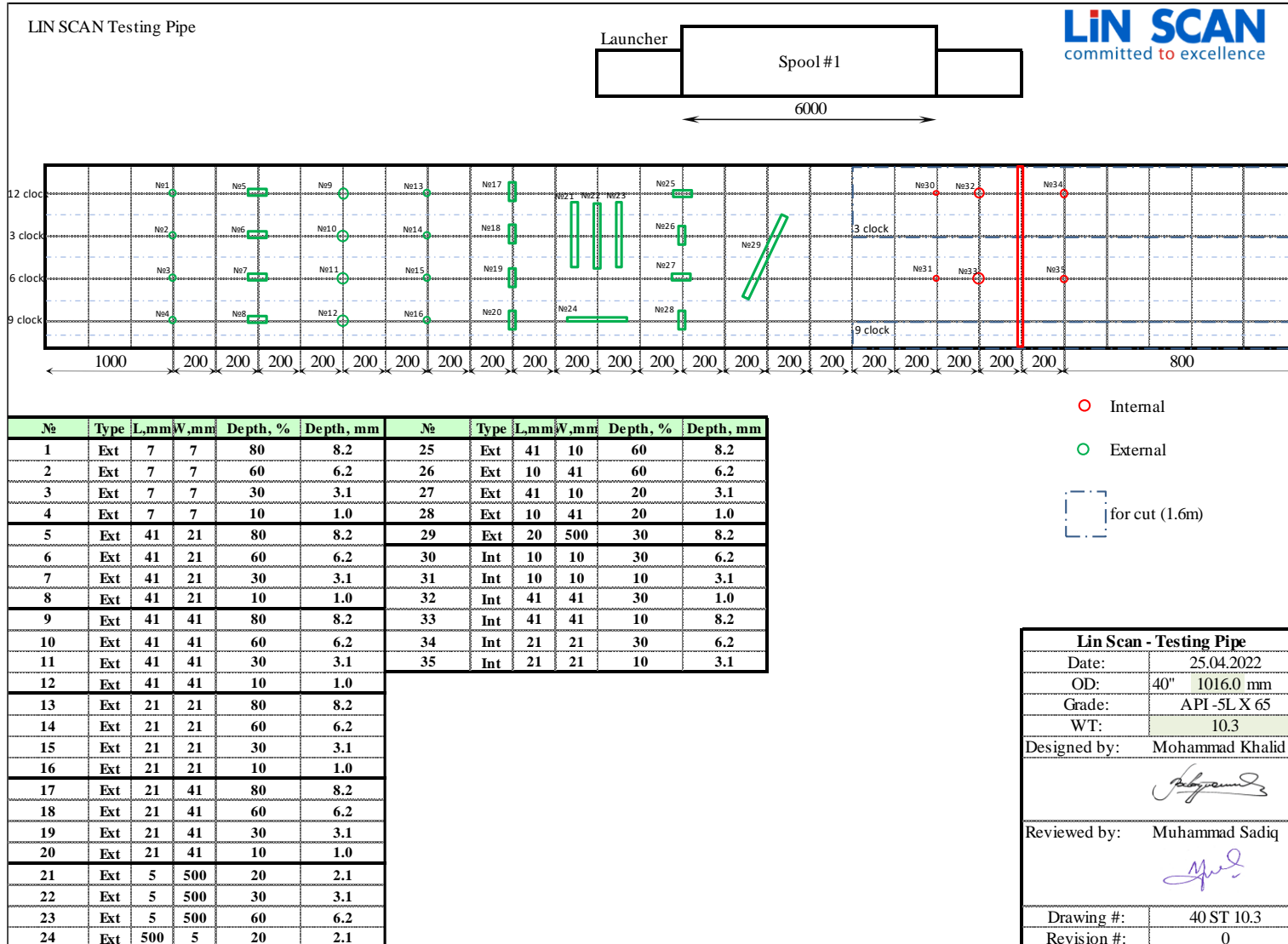
Representatives from Production, QA/QC and Projects Departments and Electronic Division are to be present during the Pull Through Test. Representatives of Production - and QA/QC Departments as well as Electronic Division are to confirm on pull through test report card readiness of the inspection tool for Pull Through Test. Evaluation department manager issues the Pull Through Test report. Representative of Data Evaluation and Projects Departments confirm that accuracy specifications of the tool meet the requirements specified based on Pull Through Test.

1.11. QA/QC

QA/QC department representative controls the whole process and documentation is checked and approved by QA/QC Manager. Pull through tests are obligatory attended by QA/QC Production representative. Pull Through Test & Calibration reports are prepared and maintained by Evaluation and Projects Department.

Chapter 2. 40 inch Calibration Report

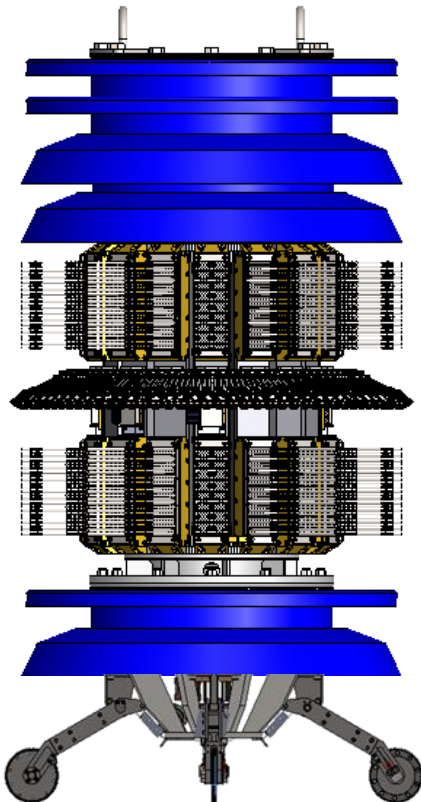
2.1 40 inch Pipe Sketch



2.2 Tool Data Sheet

TOOL CONFIGURATION SHEET

40" MFL TOOL



General Specifications:

Length	2400 mm
Weight	2044 kg
Minimum ID in Straight Line	860 mm (87.5 % OD)
Minimum ID in Bend / 3D	950 mm (93.5 % OD)
Launching Length	2200mm
Receiving Length	1500mm
XYZ GEO Mapping Unit	Optional

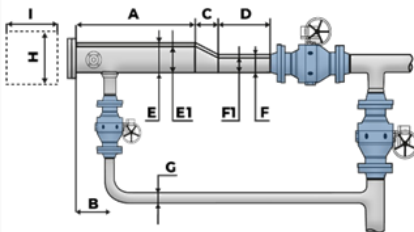
Pipeline Specifications:

Mechanical:

Pipeline Outside Diameter	40" (1016mm)
Maximum Pipeline Length	330 km*
Wall Thickness Range	6.35 – 17 mm
Medium	Gas / Liquids
Nom. Tee/Barred or Unbarred	Both
Min distance between two tees	3048mm
Min. Bore in Valve	860 mm
Max. % of H2S	2%
Min. distance between two bends	Nil

Operational:

Operating Temperature	-20 to 75°C □
Operating Pressure	1.0 - 8.0 MPa
Min. Operating Pressure in Gas	2 MPa
Tool Run Velocity	0.3 - 3m/s
Maximum Run Duration	47 Hours



	Launcher	Receiver		MFL: 6.9 mm
A	2200 mm	1000 mm	Circumferential Resolution	
B	500 mm	500 mm	Sampling Rate 1 ms	
C	711 mm	711 mm	Tool speed	Axial resolution
D	500 mm	1500 mm	1m/s	1.00 mm
E	Pipeline OD+2"	Pipeline OD+2"	2m/s	2.00 mm
E1	Pipeline ID+2"	Pipeline ID+2"	3m/s	3.00 mm
F	Pipeline OD	Pipeline OD	Sampling Rate 2 ms	
F1	Pipeline ID	Pipeline ID	1m/s	2.00 mm
G			2m/s	4.00 mm
H & I			3m/s	6.00 mm

ILI Tool Configuration : 36-00-MF-A06	Prepared : Chameera	Reviewed : Asif	Approved : Hazem	Revision No.: 00
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2.3 Tool Calibration Report

Pull Trough Test was conducted in a spool (test pipe) with artificial defects according to the drawings attached in Chapter 2.

Magnetization level in test pipe with 10.3 mm wall thickness reached 19 kA/m.

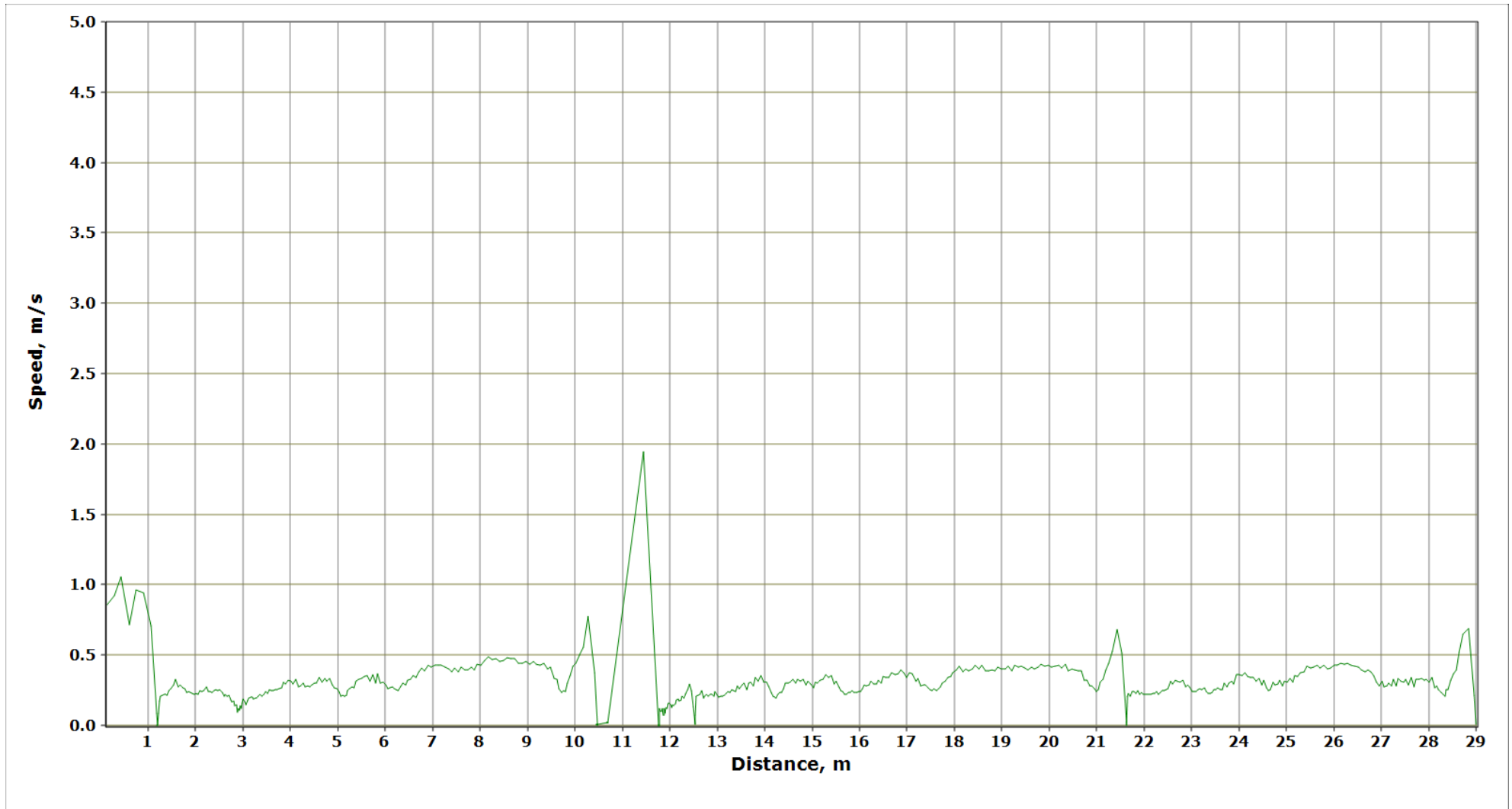
According to POF specification this level of pipe wall magnetization guaranteed good sensitivity and accuracy of the MFL ILI tool.

For the PTT run the defects will be analyzed against actual parameters.

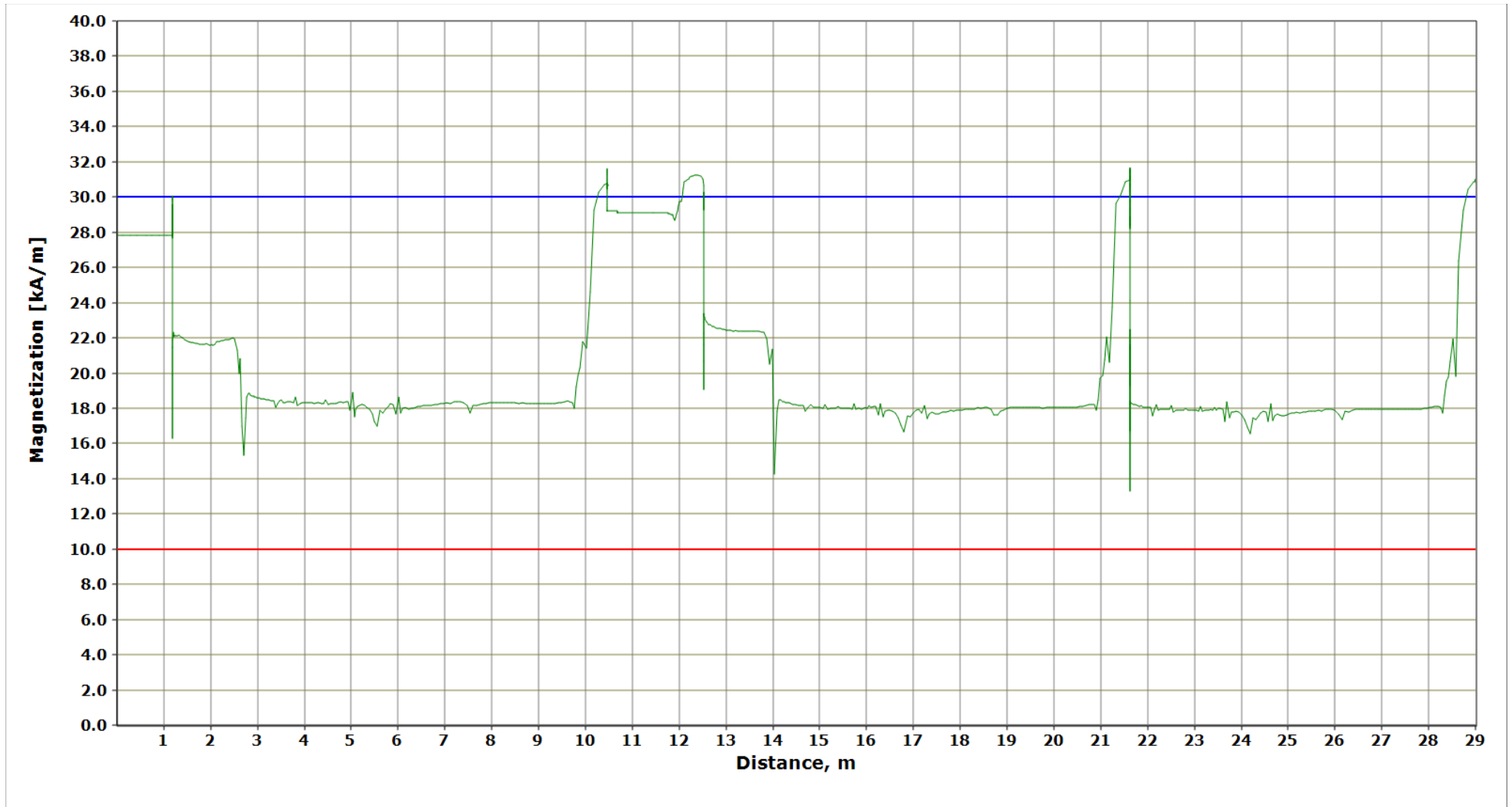
MFL log presents PTT run data. Vertical axis on the log represents degree position of the defects (0-360 degree corresponding to 12:00 o'clock clockwise positions). Horizontal axis on the logs represents recorded distance aligned with the starting of the PTT pipe - first spool.

2.4 Telemetric Data

Velocity Profile



Magnetization level Profile



2.5 Tool Calibration Report

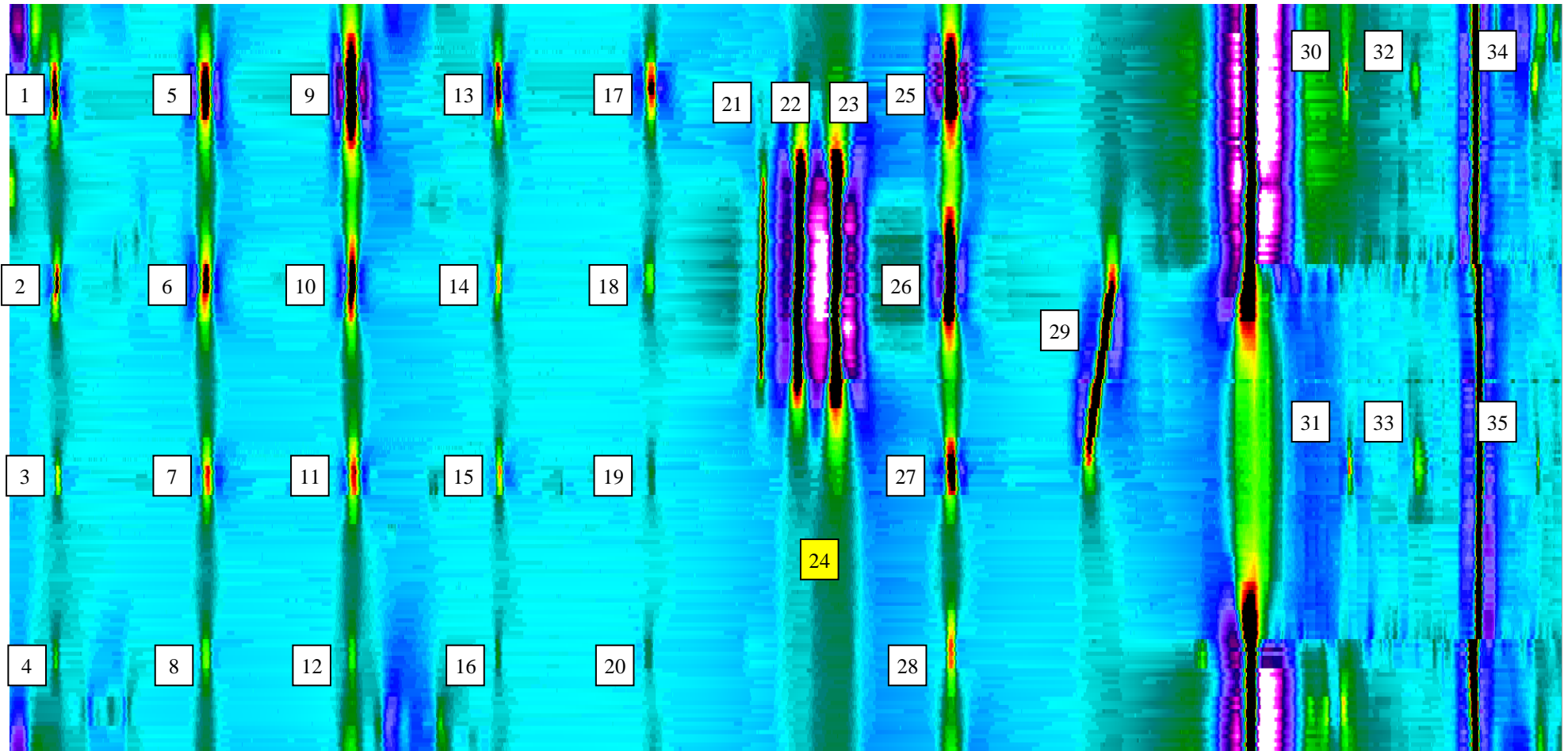
Equipment: 36-00-MF-A02

Test Pipe WT: 10.3 mm thickness

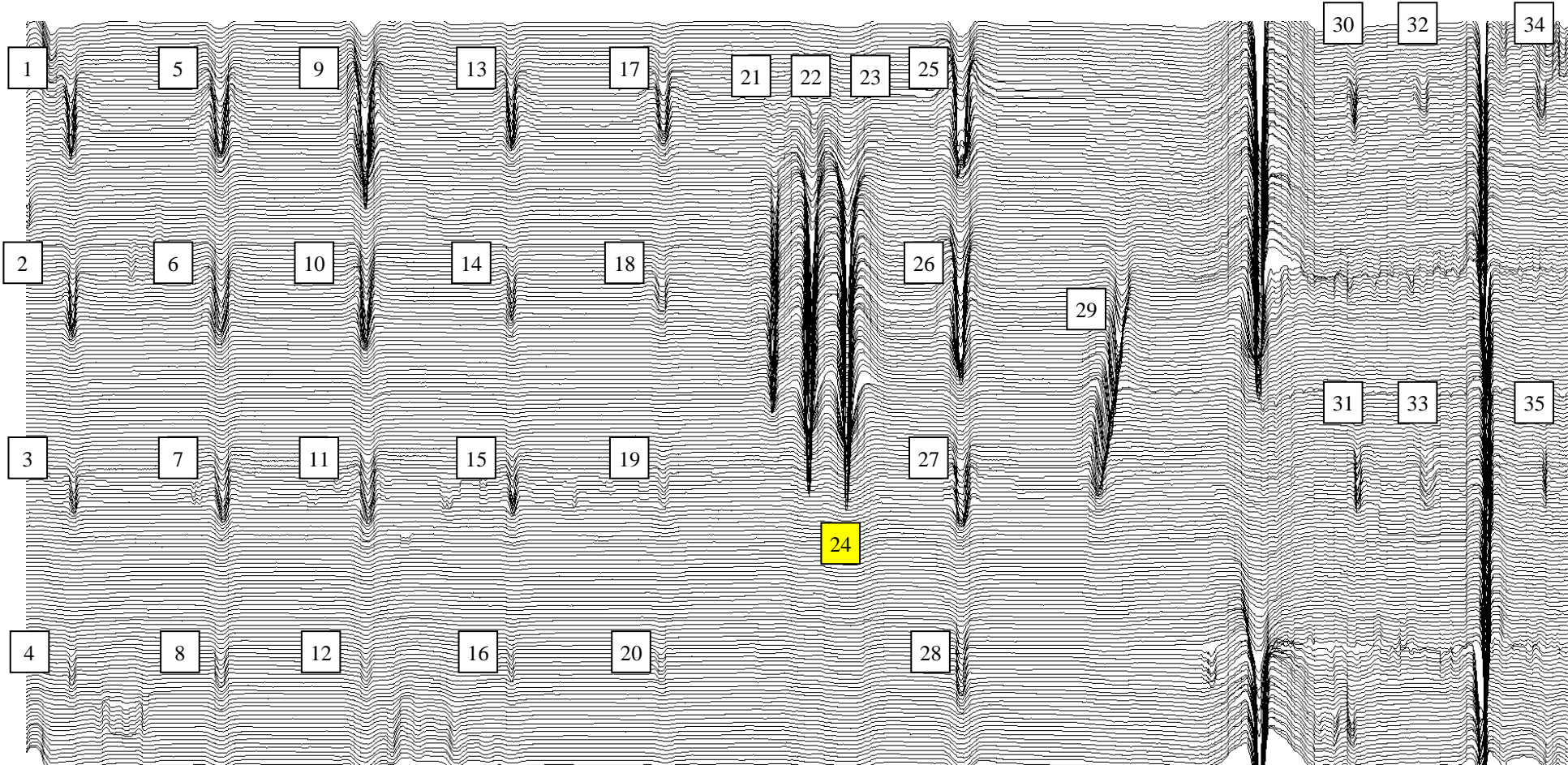
Sketch Dimension					Tool Result			Specification			Actual Vs. Spec.			
Nº	Type	L, mm	W, mm	Depth, %	L, mm	W, mm	Depth, %	L90%, mm	W90%, mm	D90%	L	W	D	Comments
1	PINH Ext	7	7	80	10	8	61	8	10	20	Y	Y	Y	
2	PINH Ext	7	7	60	12	16	41	8	10	20	Y	Y	Y	
3	PINH Ext	7	7	30	8	16	13	8	10	20	Y	Y	Y	
4	PINH Ext	7	7	10	10	16	5	8	10	20	Y	Y	Y	
5	AXGR Ext	41	21	80	33	16	66	15	15	15	Y	Y	Y	
6	AXGR Ext	41	21	60	28	8	48	15	15	15	Y	Y	Y	
7	AXGR Ext	41	21	30	26	23	17	15	15	15	Y	Y	Y	
8	AXGR Ext	41	21	10	28	16	6	15	15	15	Y	Y	Y	
9	GENE Ext	41	41	80	39	31	90	12	20	10	Y	Y	Y	
10	GENE Ext	41	41	60	31	23	70	12	20	10	Y	Y	Y	
11	GENE Ext	41	41	30	43	23	27	12	20	10	Y	Y	Y	
12	GENE Ext	41	41	10	43	31	5	12	20	10	Y	Y	Y	
13	PITT Ext	21	21	80	22	30	76	10	15	12	Y	Y	Y	
14	PITT Ext	21	21	60	23	33	57	10	15	12	Y	Y	Y	
15	PITT Ext	21	21	30	26	23	36	10	15	12	Y	Y	Y	
16	PITT Ext	21	21	10	20	23	13	10	15	12	Y	Y	Y	
17	CIGR Ext	21	41	80	19	39	82	10	20	10	Y	Y	Y	
18	CIGR Ext	21	41	60	21	39	52	10	20	10	Y	Y	Y	
19	CIGR Ext	21	41	30	18	23	21	10	20	10	Y	Y	Y	
20	CIGR Ext	21	41	10	17	58	13	10	20	10	Y	Y	Y	

Sketch Dimension					Tool Result			Specification			Actual Vs. Spec.			
Nº	Type	L, mm	W, mm	Depth, %	L, mm	W, mm	Depth, %	L90%, mm	W90%, mm	D90%	L	W	D	Comments
21	CISL Ext	5	500	20	3	517	28	5	20	15	Y	Y	Y	
22	CISL Ext	5	500	30	3	511	33	5	20	15	Y	Y	Y	
23	CISL Ext	5	500	60	4	520	68	5	20	15	Y	Y	Y	
24	AXSL Ext	500	5	20	-	-	-	20	8	25	-	-	-	
25	AXGR Ext	41	10	60	26	20	47	15	15	15	Y	Y	Y	
26	CIGR Ext	10	41	60	19	58	70	10	20	10	Y	Y	Y	
27	AXGR Ext	41	10	20	31	21	29	15	15	15	Y	Y	Y	
28	CIGR Ext	10	41	20	5	39	18	10	20	10	Y	Y	Y	
29	CIGR Ext	20	500	30	29	518	37	10	20	10	Y	Y	Y	
30	PITT Ext	10	10	30	10	22	29	10	15	12	Y	Y	Y	
31	PITT Ext	10	10	10	15	18	11	10	15	12	Y	Y	Y	
32	GENE Ext	41	41	30	40	43	34	12	20	10	Y	Y	Y	
33	GENE Ext	41	41	10	40	42	9	12	20	10	Y	Y	Y	
34	PITT Ext	21	21	30	24	36	31	10	15	12	Y	Y	Y	
35	PITT Ext	21	21	10	24	30	11	10	15	12	Y	Y	Y	

Internal Defect map – Line View (highlighted numbers were not detected)



Internal Defect map – Colour View (highlited numbers were not detected)



Chapter 3. Calibration Certificate

Equipment : 36-00-MF-A02
Pipe Specifications : API 5L X65, 6.0 m length, 10.3 mm thickness
Number of runs : 1

PTT Runs' specifications (10.3 mm test pipeline):

PTT Run #/Sensitivity value	PTT 1/ O2G0
Min defect visible	Yes
Max defect visible	Yes
Average achieved	~110 amp
Saturation level achieved	No
Overall data quality	Good
Senor loss	None

Tool specifications:

PTT tool run specifications:

Speed	0.3 – 3.0 m/s
Distance	330 km
Pitch measurement in longitudinal direction	1.0 mm
Pitch measurement in circumferential direction MFL	6.9 mm
Wall thickness	6.35 – 17mm
Outside pipeline diameter	40 inch

The 40 inch MFL Tool has been tested and accordingly calibrated.

The 40 inch MFL tool is approved for pipeline inspection.

The tool sensitivity acceptable with sensitivity O2G0 and optimum sampling rate is 1 ms.



Authorized Signature 1

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Date: 27.05.2024



Authorized Signature 2

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Date: 27.05.2024

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