§195.591
IN-LINE INSPECTION OF PIPELINES

2022 IEA PS CONFERENCE

Indiana Utility Regulatory Commission
INDIANA
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INTRODUCTION

In-line Inspection (ILI) is an integral part of an integrity management program and plays a significant role in the Life Cycle of a pipeline. These tools/technologies allow for a full assessment of the condition of a pipeline and its subsequent integrity.

§195.591 In-Line inspection of pipelines

When conducting in-line inspection of pipelines required by this part, each operator must comply with the requirements and recommendations of
API Std 1163, Inline Inspection Systems Qualification Standard;
ANSI/ASNT ILI-PQ, Inline Inspection Personnel Qualification and Certification; and
NACE SP0102-2010, Inline Inspection of Pipelines
(incorporated by reference, see § 195.3). An in-line inspection may also be conducted using tethered or remote control tools provided they generally comply with those sections of NACE SP0102-2010 that are applicable.

INTRODUCTION

INDUSTRY STANDARDS

Subpart A—General

§ 195.3 What documents are incorporated by reference partly or wholly in this part?

API Standard 1163, ''In-Line Inspection Systems Qualification'' Second edition, April 2013, (API STD 1163), IBR approved for §195.591

NACE SP0102–2010, ''Standard Practice, Inline Inspection of Pipelines'' revised March 13, 2010, (NACE SP0102), IBR approved for §195.591.

ANSI/ASNT ILI–PQ–2005(2010), ''In-line Inspection Personnel Qualification and Certification'' reapproved October 11, 2010, (ANSI/ASNT ILI–PQ), IBR approved for §195.591

INTRODUCTION

API STANDARD 1163

The API Standard 1163 is an umbrella document that covers ILI systems, including procedures, personnel, equipment, and associated software.

The standard is written for hazardous liquid and natural gas pipelines.

The standard is written to provide performance-based guidelines as opposed to prescriptive requirements.

INTRODUCTION
API Standard 1163

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API Standard 1163
In-line Inspection Systems Qualification

The standard facilitates the following:
- Inspection companies can make clear, uniform, and verifiable statements describing inspection system performance;
- Pipeline companies can select inspection systems that are suitable for the conditions under which the inspection will be conducted;
- The inspection equipment operates properly under the conditions specified and inspection procedures are followed before, during and after the inspection;
- Anomalies are described using a common nomenclature, as described in this standard and referenced documents;
- The inspection data, analyses, and reports provide the accuracy and quality anticipated in a consistent and verifiable manner.

INTRODUCTION
NACE SP0102

NACE SP0102, 'Recommended Practice: In-Line Inspection of Pipelines'
"… outlines a process of related activities that a pipeline operator can use to plan, organize, and execute an ILI project."

INTRODUCTION

NACE SP0102

NACE SP0102 provides a guide for choosing tools/technologies per specific integrity threats. It also covers important aspects such as:

- Definitions
- Tool selection
- Pipeline ILI compatibility assessment
- Logistical guidelines
- Inspection scheduling
- New construction
- Data analysis requirements
- Data management

INTRODUCTION

ASNT ILI-PQ

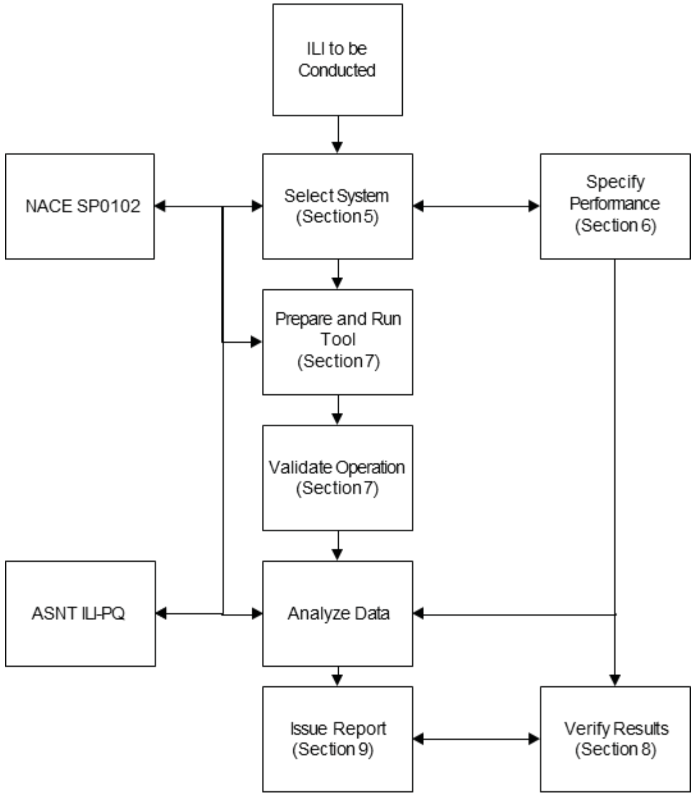
ASNT ILI-PQ is incorporated by reference as a requirement in API Std 1163.
The personnel operating the ILI systems and the personnel taking, reducing, analyzing, and reporting the resultant data shall be qualified in accordance with ASNT ILI-PQ.

Systems Qualification Process

SYSTEMS QUALIFICATION PROCESS

API STD 1163

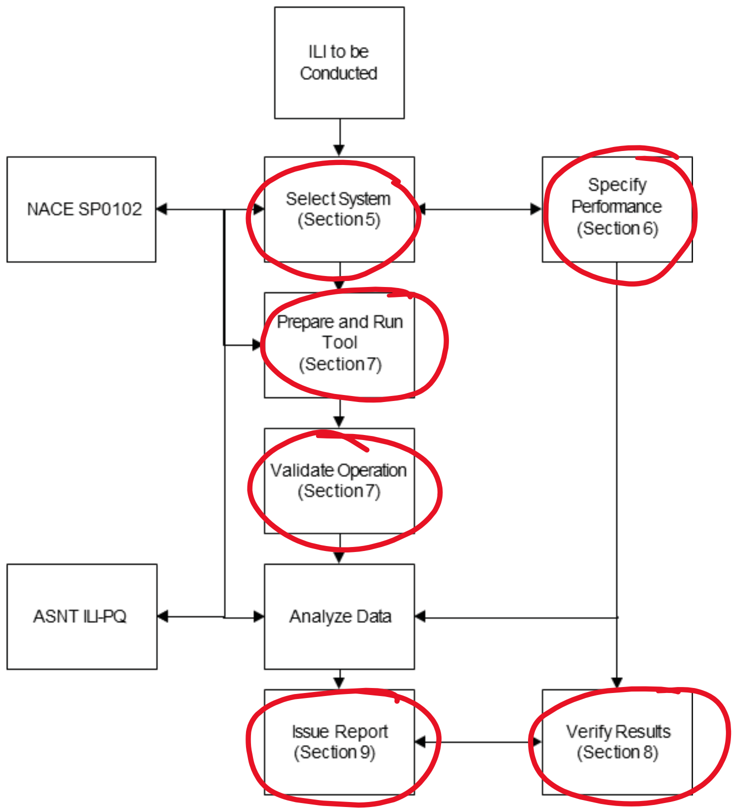
Section 4 of API STD 1163 “In-Line Inspection Systems Qualification Standard” describes the processes and personnel qualification requirements for the activities involved in using an ILI system.



In-line Inspection Process Flow Diagram

SYSTEMS QUALIFICATION PROCESS

The process flow diagram illustrates the activities involved in using an inspection tool and the associated hardware, software, procedures, and personnel required for performing and interpreting the results of an ILI sequence.



In-line Inspection Process Flow Diagram

SYSTEMS QUALIFICATION PROCESS

Select System (section 5)

• The process of successfully performing an ILI begins with the operator defining inspection goals, objectives and the pipeline system characteristics to service providers.

• Based on this information, the service provider and operator determine the relevant ILI tools to meet the project requirements.

Specify Performance (section 6)

• The processes that service providers shall use to determine the performance specifications of a family of tools that have identical essential variables.

• These performance specifications defines the ILI system capabilities in terms feature detection, classification, and characterization.

SYSTEMS QUALIFICATION PROCESS

Prepare and Run Tool, Validate Operation (section 7)

- Describes the requirements for preparing tools prior to physically performing inspections.
- It also describes the activities that shall be performed by the operator and/or the service provider during the inspection.

Verify Results (section 8)

- Describes verification of the ILI system and the processes that shall be used for validating whether or not the tool meets the performance specifications.
- It also describes what shall be done if the performance specifications are not met.

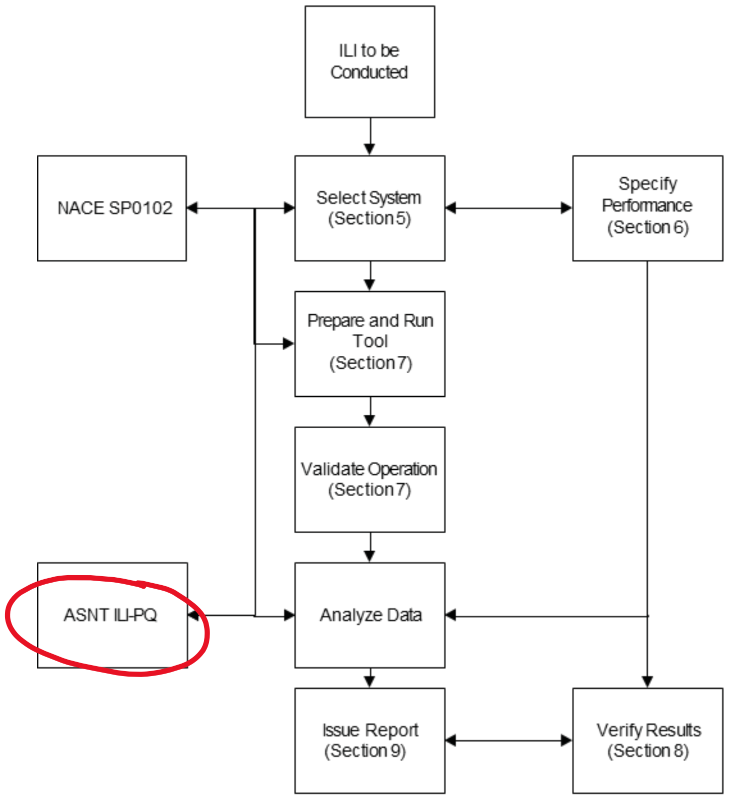
Issue Report (section 9)

- Provides reporting requirements for the results of the inspections performed.
- This standard provides the information and processes to enable operators and service providers to perform ILIs with greater consistency and accuracy.

SYSTEMS QUALIFICATION PROCESS

Personnel Qualification (section 4.2)
ANSI/ASNT ILI-PQ - 2005 is incorporated into API 1163 by reference.

- Establishes the general framework for the qualification and certification of industry specific personnel using nondestructive testing methods in the employment of ILI tools/technologies.
- In addition, the document provides minimum education, experience, training and examination requirements for the different type of nondestructive testing methods used by ILI tools/technologies.



In-line Inspection Process Flow Diagram

SYSTEMS QUALIFICATION PROCESS
PERSONNEL QUALIFICATION

ANSI/ASNT ILI–PQ–2005(2010), ‘‘In-line Inspection Personnel Qualification and Certification’’

- Establishes minimum requirements for ILI personnel whose jobs require specific technical knowledge of ILI, ILI systems operations, and pipeline industry requirements.

- Three levels of qualifications I, II, III in ascending order of technical and job experience/training.

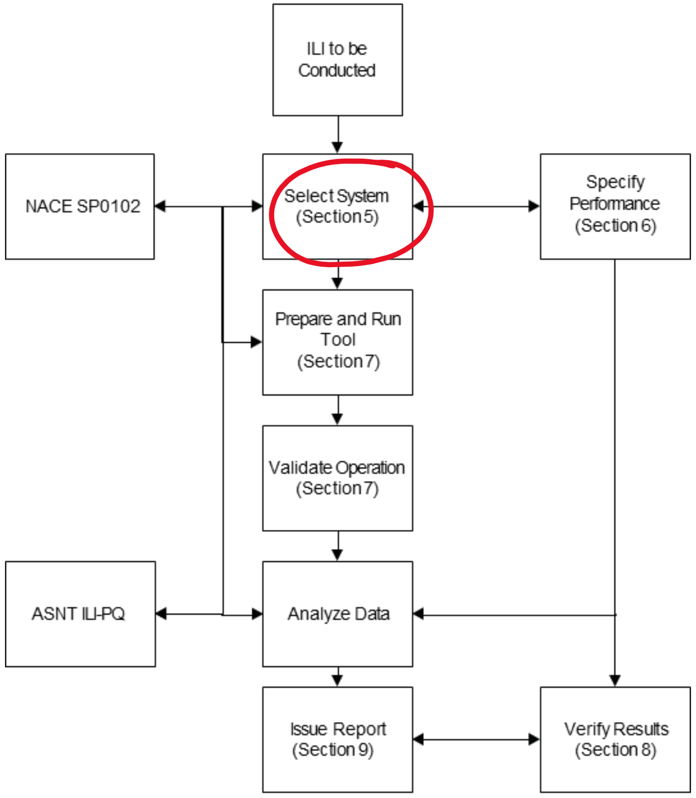
- Two types of personnel: tool operators and data analysts

- Qualified per technology

Select System

IN-LINE INSPECTION PROCESS
SELECT SYSTEM (Section 5)

• API 1163 and NACE SP0102 provide the details of the process required to select an appropriate ILI tool or tools.
• Selection of an ILI system, both the ILI system capabilities and the pipeline operational and physical characteristics shall be considered.
• Consideration of physical and operational characteristics and constraints is covered in detail in NACE SP0102.



In-line Inspection Process Flow Diagram

IN-LINE INSPECTION PROCESS
SELECT SYSTEM

Is the ILI tool/technology suitable based on specific operational limitations?
- Tool Environment
- Pipeline Features
- Product, Flow and Speed Requirements
- Surveys
- Cleaning
- Information Gathering

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IN-LINE INSPECTION PROCESS
SELECT SYSTEM

- Appropriateness of the Tool/Technology
  - Match known details of the pipeline and expected anomalies with the capabilities and performance of ILI tools/technology.
- Operational Issues
  - Characteristics and relevant limitations should be provided via pipeline questionnaire to the ILI vendor.
- Reliability of the tool
  - Should be evaluated based on specifications, history through verifications, success rate (KPI), ability to inspect full length and complete circumference and ability to identify multicause/ coincident anomalies (i.e. dents with metal loss)

IN-LINE INSPECTION PROCESS
SELECT SYSTEM

NACE Standard Practice 0102-2010
"Inline Inspection of Pipelines"

Anomaly	Imperfection/ Defect/Feature	Metal Loss Tools		Crack Detection Tools			Deformation Tools
		Axial MFL	Ultrasonic Compression Wave[A]	Ultrasonic		Transverse MFL	
				Liquid coupled[A]	EMAT		
Metal Loss							
	External Corrosion	Detection, Sizing	Detection, Sizing	No Detection	No Detection	Detection, Sizing	No Detection
	Internal Corrosion						Limited Detection[D], Sizing[C]
	Gouging	Detection[B], Sizing[B]	Detection[C], Sizing[C]			Detection[B], Sizing[B]	No Detection
Crack-Like Anomalies							
	Narrow Axial External Corrosion	Detection	Detection, Sizing	Detection, Sizing	Detection, Sizing	Detection, Sizing	No Detection
	Stress Corrosion Cracking (SCC)	No Detection	No Detection	Detection, Sizing	Detection, Sizing	Limited Detection,[E] Sizing	No Detection
	Fatigue Cracks	No Detection	No Detection	Detection, Sizing	Detection Sizing	Limited Detection,[E] Sizing	No Detection
	Long Seam Cracks, etc. (toe cracks, hook cracks, incomplete fusion, preferential seam corrosion)	No Detection	No Detection	Detection, Sizing	Detection, Sizing	Detection,[E] Sizing	No Detection
	Circumferential Cracks	Limited Detection,[E] Sizing	No Detection	Detection,[F] Sizing[F]	No Detection	No Detection	No Detection
	Hydrogen-Induced Cracking (HIC)	No Detection	Detection, Sizing	No Detection	No Detection	No Detection	No Detection
Weld Anomalies							
	Lack of fusion in LW	No Detection	No Detection	Detection, Sizing	Detection, Sizing	Detection,[E] Sizing[E]	No Detection
	Lack of fusion in GW	Detection[E] Sizing	No Detection	Detection[F], Sizing[F]	No Detection	No Detection	No Detection
	Girth Weld Anomaly (voids, etc.)	Detection, Sizing	Detection, Sizing	Detection[F], Sizing [F]	No Detection	No Detection	No Detection
Deformation							
	Sharp Dents	Detection[G]	Detection[G]	No Detection	No Detection	Detection[G]	Detection, Sizing
	Flat Dents	Detection[G]	Detection[G]	No Detection	No Detection	Detection[G]	Detection, Sizing
	Buckles	Detection[G]	Detection[G]	No Detection	No Detection	Limited Detection[G]	Detection, Sizing
	Wrinkles, Ripples	Detection[G]	Detection[G]	No Detection	No Detection	Limited Detection[G]	Detection, Sizing

IN-LINE INSPECTION PROCESS

SELECT SYSTEM

Anomaly	Imperfection/ Defect/Feature	Metal Loss Tools		Crack Detection Tools			Deformation Tools
		Axial MFL	Ultrasonic Compression Wave[illegible]	Ultrasonic		Transverse MFL	
				Liquid coupled[illegible]	EMAT		
	Ovalities	No Detection	No Detection	No Detection	No Detection	No Detection	Detection, Sizing
Misc. Components							
	In-Line Valves and Fittings	Detection	Detection	Detection	Detection	Detection	Detection
	Casings (Concentric)	Detection	No Detection	No Detection		Detection	No Detection
	Casings (Eccentric)	Detection	No Detection	No Detection		Detection	No Detection
	Bends	Limited Detection	Limited Detection	Limited Detection	No Detection	Limited Detection	Detection,[illegible] Sizing[illegible]
	Branch Appurtenances/ Hot Taps	Detection	Detection	Detection	Detection	Detection	Detection
	Close Metal Objects	Detection	No Detection	No Detection	No Detection	Detection	No Detection
	Thermite Welds	No Detection	Detection, Sizing	No Detection	No Detection	No Detection	No Detection
	Pipeline Coordinates	No Detection[illegible]	No Detection[illegible]	No Detection[illegible]	No Detection[illegible]	No Detection[illegible]	No Detection[illegible]
Previous Repairs							
	Type A Repair Sleeve	Detection	No Detection	No Detection	No Detection	Detection	No Detection
	Composite Sleeve	Detection[illegible]	No Detection	No Detection	No Detection	Detection[illegible]	No Detection
	Type B Repair Sleeve	Detection	Detection	Detection	Detection	Detection	No Detection
	Patches/Half Soles	Detection	Detection	Detection	Detection	Detection	No Detection
	Puddle Welds	Limited Detection	Limited Detection	No Detection	No Detection	Limited Detection	No Detection
Misc. Damage	Laminations	No Detection	Detection, Sizing	No Detection	No Detection	No Detection	No Detection
	Inclusions	Limited Detection	Detection, Sizing	Limited Detection	Limited Detection	Limited Detection	No Detection
	Cold Work	Detection[illegible]	No Detection	No Detection	No Detection	No Detection[illegible]	No Detection
	Hard Spots	Detection[illegible]	No Detection	No Detection	No Detection	No Detection	No Detection

IN-LINE INSPECTION PROCESS
SELECT SYSTEM

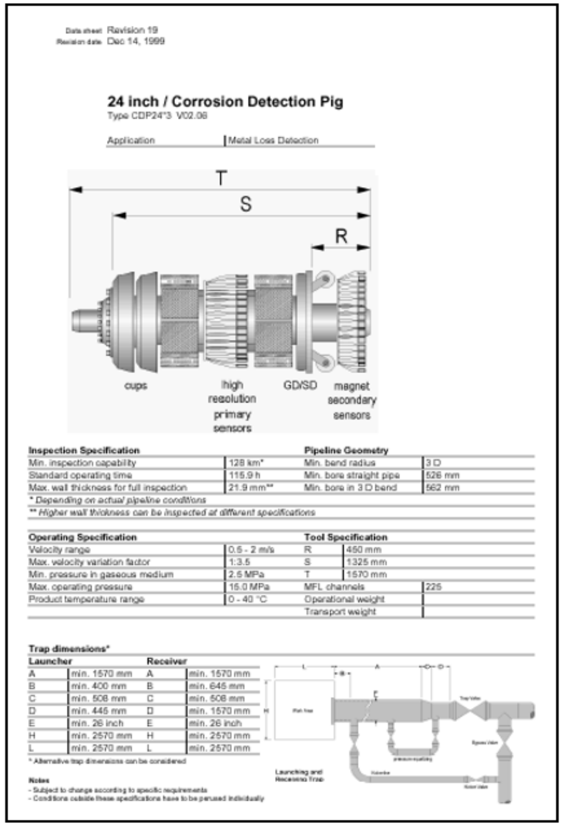
Anomaly	Imperfection/ Defect/Feature	Metal Loss Tools		Crack Detection Tools			Deformation Tools
		Axial MFL	Ultrasonic Compression Wave	Ultrasonic		Transverse MFL	
				Liquid coupled	EMAT		
	Grind Marks	Limited Detection	Detection	Detection	Detection	Limited Detection	No Detection
	Strain	No Detection	No Detection	No Detection	No Detection	No Detection	Detection
	Scabs/Slivers/Blisters	Limited Detection	Detection	Limited Detection	No Detection	Limited Detection	Limited Detection
	External Coating Disbondment	No Detection	No Detection	No Detection	Detection, Sizing	No Detection	No Detection

[illegible]
[illegible]
Detection and sizing of metal loss component only.
[illegible]
[illegible]
[illegible]
[illegible]
If tool is equipped for bend measurement.
Unless tool is equipped with mapping capabilities.
[illegible]
If tool is designed for hard spot detection.
Depending on the orientation and shape of the anomaly.
[illegible]
Only those protruding to the interior of the pipe.
Technology could potentially be used for detecting changes in coating bonding.

IN-LINE INSPECTION PROCESS
SELECT SYSTEM

Tool Specifications can be used as a basis for the level of detail
required by an operator to perform inspection and complete an evaluation of a pipeline system with regards to detection and sizing

- Tool Identification
- Tool dimensions
- Speed range
- Minimum bend radius
- Wall thickness range
- Battery life
- Sensor information
- Operating pressure ranges
- Differential pressures
- Min. passage values
- etc.



Data sheet Revision 19
Revision date Dec 14, 1999

24 inch / Corrosion Detection Pig
Type CDP24"3 V02.06

Application	Metal Loss Detection

Inspection Specification		Pipeline Geometry	
Min. inspection capability	128 km*	Min. bend radius	3 D
Standard operating time	115.9 h	Min. bore straight pipe	526 mm
Max. wall thickness for full inspection	21.9 mm**	Min. bore in 3 D bend	562 mm

** Depending on actual pipeline conditions*
*** Higher wall thickness can be inspected at different specifications*

Operating Specification		Tool Specification	
Velocity range	0.5 - 2 m/s	R	450 mm
Max. velocity variation factor	1:3.5	S	1325 mm
Min. pressure in gaseous medium	2.5 MPa	T	1570 mm
Max. operating pressure	15.0 MPa	MFL channels	225
Product temperature range	0 - 40 °C	Operational weight	
		Transport weight	

Trap dimensions*

Launcher		Receiver	
A	min. 1570 mm	A	min. 1570 mm
B	min. 400 mm	B	min. 645 mm
C	min. 508 mm	C	min. 508 mm
D	min. 445 mm	D	min. 1570 mm
E	min. 26 inch	E	min. 26 inch
H	min. 2570 mm	H	min. 2570 mm
L	min. 2570 mm	L	min. 2570 mm

* Alternative trap dimensions can be considered

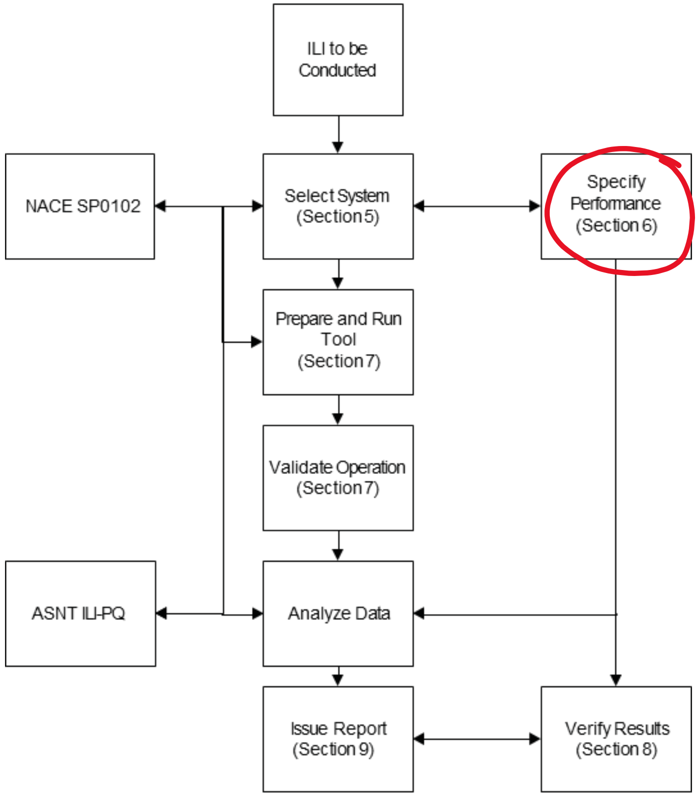
Notes
- Subject to change according to specific requirements
- Conditions outside these specifications have to be perused individually

Specify Tool Performance

IN-LINE INSPECTION PROCESS
SPECIFY PERFORMANCE

Performance specifications shall define, through the use of statistically valid methods, the ability of the ILI system when run in a specific pipeline to detect, locate, identify, and size pipeline anomalies, components, and features.

An ILI system may be capable of addressing more than one type of anomaly or characteristic during an inspection run. If so, the performance specification shall address each type of anomaly or characteristic



In-line Inspection Process Flow Diagram

IN-LINE INSPECTION PROCESS
SPECIFY PERFORMANCE

Basis for Performance
The basis on which performance specification is made shall be clearly stated for each feature type using the following:

- Modeling only
- Limited pull through tests and modeling (where effects of essential variables have not been fully tested by pull through runs and features used are predominantly manufactured)
- Extensive pull through tests covering range of speed and wall thickness using a combination of manufactured and natural features
- Limited field verification with less than 20 operational runs
- Extensive field verification results reviewed on an annual basis.

Where multiple methods are used, the Contractor shall clarify what has been used. Details of manufactured and/or natural features shall be clearly presented.

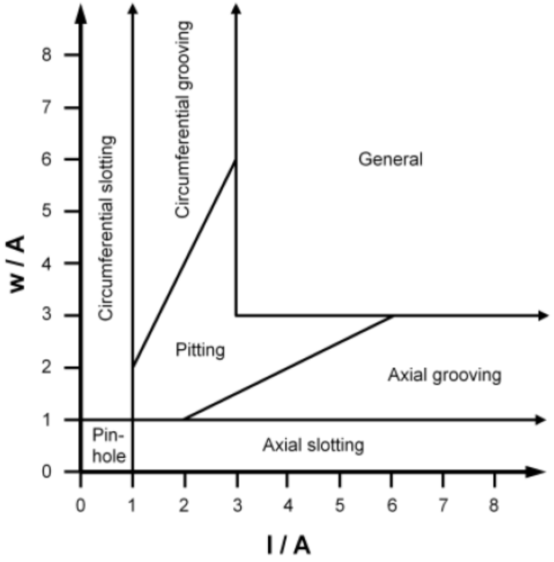
IN-LINE INSPECTION PROCESS
SPECIFY PERFORMANCE

Tool Performance Specification

Probability of Detection (POD)* and Sizing accuracies

- Metal loss anomalies in pipe body,
- Metal loss anomalies in weld or HAZ
- Crack or crack-like anomalies
- Dents and Ovalities

*The POD is the probability that a specified feature will be detected by the ILI tool.



	General metal-loss	Pitting	Axial grooving	Circumf. grooving	Pinhole	Axial slotting	Circumf. Slotting
Depth at POD=90%					N/A see below		
Depth sizing accuracy at 90% certainty							
Width sizing accuracy at 90% certainty							
Length sizing accuracy at 90% certainty							
Minimum pinhole diameter at POD=90% if depth=50%t						n.a.	
Minimum pinhole diameter at POD=90% if depth=20%t						n.a.	

	Axial crack Pipe body/weld	Axial crack colony Pipe body	Circumferential crack Pipe body/weld	Spiral crack Pipe body/weld
Depth at POD=90% of crack with L=25 mm				
Minimum crack opening (mm)				
Depth sizing accuracy at 90% certainty				
Length sizing accuracy at 90% certainty				
Orientation limits (in degrees) for detectability				

IN-LINE INSPECTION PROCESS
SPECIFY PERFORMANCE

The performance specification shall clearly state the sizing accuracies for each type and range of anomalies covered by the specification. A sizing accuracy refers to how closely the reported dimensions agree with the true dimensions.
Sizing or characterization accuracies shall include a tolerance (e.g. ±10 wt % or ±0.04 in. on depth sizing) and a certainty (e.g. 80 % of the time).

Detection and Sizing Accuracy for Anomalies in Body of Pipe

	General metal loss	Pitting	Axial grooving	Circumf. grooving	Circumf. slotting*
Depth at POD = 90%	0.10t	0.10t	0.10t	0.10t	0.15t
Depth sizing accuracy at 80% certainty	±0.10t	±0.10t	±0.15t	±0.10t	±0.10t
Width sizing accuracy at 80% certainty	±15 mm (±0.59")	±12 mm (±0.47")	±12 mm (±0.47")	±12 mm (±0.47")	±15 mm (±0.59")
Length sizing accuracy at 80% certainty	±15 mm (±0.59")	±10 mm (±0.39")	±10 mm (±0.39")	±10 mm (±0.39")	±10 mm (±0.39")
Depth sizing accuracy at 90% certainty	±0.13t	±0.13t	±0.20t	±0.13t	±0.13t
Width sizing accuracy at 90% certainty	±19 mm (±0.75")	±15 mm (±0.59")	±15 mm (±0.59")	±15 mm (±0.59")	±19 mm (±0.75")
Length sizing accuracy at 90% certainty	±19 mm (±0.75")	±13 mm (±0.51")	±13 mm (±0.51")	±13 mm (±0.51")	±13 mm (±0.51")

* Min(L,W) ≥ ½A

Event	Corrosion Class	Length [in]	Width [in]	Depth [%]	Depth Tolerance Add (%)	Adjusted depth (%)
CLUSTER	Pitting	1.5	0.91	**40**	**10**	50
metal loss-corrosion	CircumferentialSlotting	0.35	0.59	32	10	42
metal loss-corrosion	Pitting	0.71	0.91	**40**	**10**	50
metal loss-corrosion	Pitting	0.59	0.79	70	10	80
CLUSTER	Pitting	1.13	1.15	75	10	85
metal loss-corrosion	CircumferentialGrooving	0.43	1.14	75	10	85
metal loss-corrosion	CircumferentialSlotting	0.35	0.59	9	10	19
metal loss-corrosion	CircumferentialSlotting	0.35	0.63	**45**	**10**	55
metal loss-corrosion	Pitting	0.83	0.63	58	10	68
metal loss-corrosion	CircumferentialSlotting	0.39	0.59	26	10	36
metal loss-corrosion	CircumferentialSlotting	0.39	0.59	39	10	49
metal loss-corrosion	Pitting	0.43	0.59	**41**	**10**	51
metal loss-corrosion	Pitting	0.43	0.59	10	10	20
metal loss-corrosion	CircumferentialGrooving	0.83	1.81	18	10	28
metal loss-corrosion	Pitting	0.51	0.63	31	10	41

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IN-LINE INSPECTION PROCESS
SPECIFY PERFORMANCE

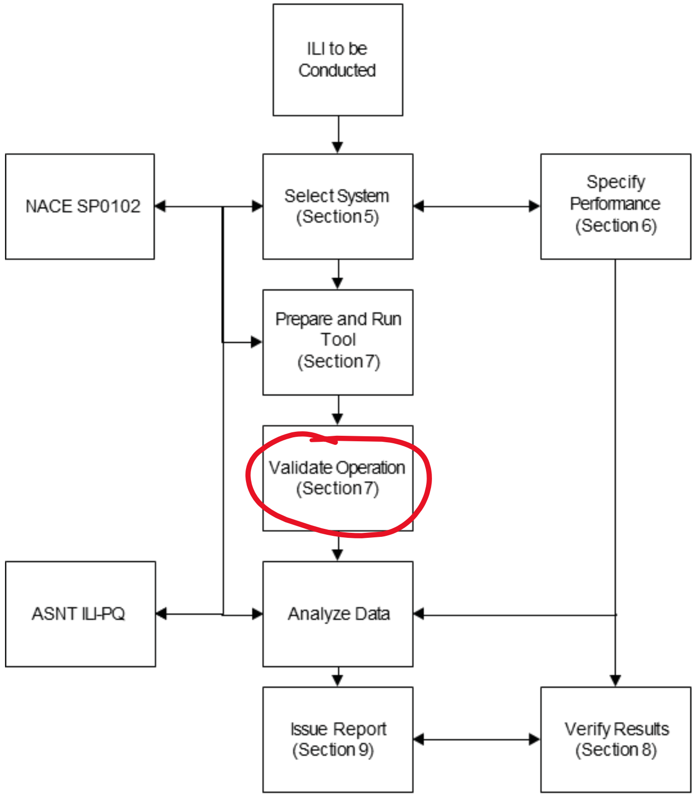
POI (Probability of Identification) is the probability that a detected anomaly or feature will be correctly identified.

Feature	Yes POI>90%	No POI<50%	May be 50%<=POI<=90%
Int. / ext. / mid wall discrimination			
Additional metal / material:			
- debris, magnetic			
- debris, non-magnetic			
- touching metal to metal			
- Other			
Anode			
Anomaly:			
- arc strike			
- artificial defect			
- buckle			
- corrosion			
- corrosion cluster			
- crack			
- dent			
- dent with metal loss			
- gouging			
- grinding			
- girth weld crack			
- girth weld anomaly			
- HIC			

Validate Operation

IN-LINE INSPECTION PROCESS
VALIDATE OPERATION

This section defines requirements for verifying that an ILI system is prepared and run in the manner defined as necessary to achieve the performance specifications as outlined in the previous section *Specify Performance*



In-line Inspection Process Flow Diagram

IN-LINE INSPECTION PROCESS
VALIDATE OPERATION

Four sets of requirements:
- Project requirements
- Pre-inspection requirements
- Inspection requirements
- Post-inspection requirements

All procedures shall be documented.

IN-LINE INSPECTION PROCESS
VALIDATE OPERATION

Form Calibration Certificate_CDP/AFD
Revision 1.1
Date 05-Nov-2001

Inspection Technologies
www.RosenInspection.net

Am Seltenkanal 8
49811 Lingen
Germany

ROSEN

Calibration Certificate
CDP/AFD Magnet Circuit

Certificate Number: 20015002

Tool

Tool ID:	C20-1.E	Magnet Circuit ID:	20.15
		Trip No.:	2

Calibration Sample

Sample ID:	20" segment 1

Test Conditions

Date:	19-MAI-03	Ambient Temperature:	13 °C
Weather Conditions:	dry		

Statement	result	status
Function test of electronics:	passed	o.k.
Function test sensors:	passed	o.k.
Sensor exchanged:	0	o.k.
Pulltest no. of Repetitions:	1	o.k.
Recorded data complete:	yes	o.k.
Data correlation with given geometries	100%	o.k.

Magnetization Level / Sensitivity	status
Magnetic saturation achieved for wt = 15.8 mm Note: Saturation refers to a magnetic excitation of 10kA/m or higher for X52 steel.	o.k.
Sensitivity with POD 90% for Depth $\geq$ 0.032 x t Note: Minimum detection of reference anomaly at saturation wall thickness Reference anomaly: round, flat bottom hole, 25.4mm diameter.	o.k.

Calibration Acceptance

The calibration was successfully completed. The calibration process was conducted in accordance to the ISO9001 procedure MTN-III.

Approved by

19-MAI-03	W. THALE	
Date	Name	

Note: The certificate can only be presented or copied in it's entirety.

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Form Quality Check_CDP/AFD
Revision 1.1
Date 05-Nov-2001

Inspection Technologies
www.RosenInspection.net

Am Seltenkanal 8
49811 Lingen
Germany

ROSEN

Quality Check
CDP/AFD Magnet Circuit

Tool

Tool ID:	C20-1.E	Magnet Circuit ID:	20.15
		Trip No.:	2

Function Test	result	status
Issue Date:1	19-MAI-03	
The tool passed the function test:	yes	o.k.
Method:	"Checklist - Parameter manual"	

Quality Check	result	status
Issue Date:	19-MAI-03	
Test Sample ID:	500x60x10	o.k.
Magnetic Field Probe ID:	009	o.k.
Quality Check passed:	yes	o.k.
Method:	"Magnettest"	

Quality Check Acceptance

The magnet unit passed the function test quality check. The process was conducted in accordance to the ISO9001 procedure MTN I II. This QC is applied to calibration certificate 41933.

Approved by

19-MAI-04	W. Thale	
Date	Name	

Note: This document can only be presented or copied in it's entirety.

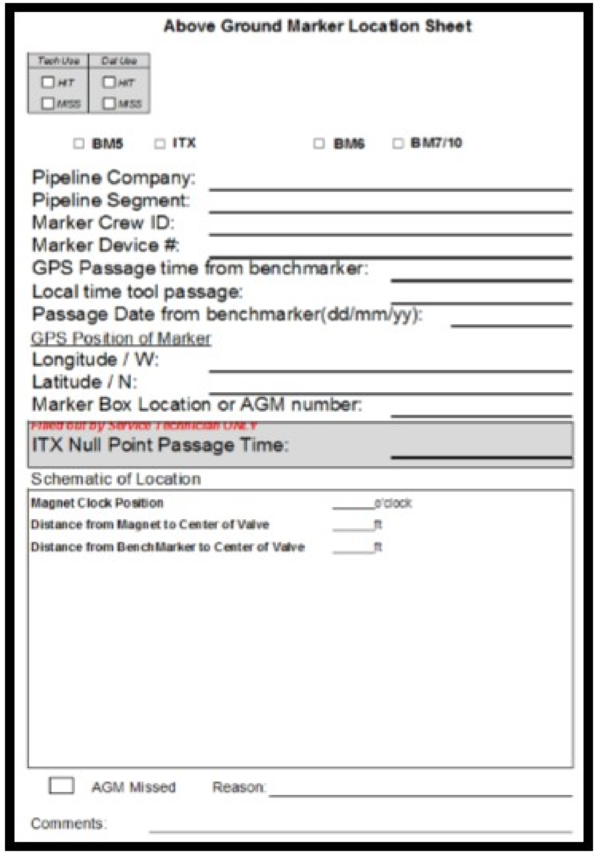
Page 1 of 1

IN-LINE INSPECTION PROCESS

VALIDATE OPERATION

Document activities that occur from the time the tool is launched till it has been removed from the receiver.

- Launching
- Running
- Above Ground Markers (AGM)
- Receiving


Above Ground Marker Location Sheet

HIT
MISS
HIT
MISS

BM5 ITX BM6 BM7/10

Pipeline Company: ______
Pipeline Segment: ______
Marker Crew ID: ______
Marker Device #: ______
GPS Passage time from benchmarker: ______
Local time tool passage: ______
Passage Date from benchmarker(dd/mm/yy): ______
GPS Position of Marker
Longitude / W: ______
Latitude / N: ______
Marker Box Location or AGM number: ______
ITX Null Point Passage Time: ______

Schematic of Location

Magnet Clock Position ______ o'clock
Distance from Magnet to Center of Valve ______ ft
Distance from BenchMarker to Center of Valve ______ ft

AGM Missed Reason: ______

Comments: ______

IN-LINE INSPECTION PROCESS
VALIDATE OPERATION

Site Survey Report [redacted]

Preliminary Survey Criteria	Standard Requirements	Inspection Findings	Acceptance
Distance [miles]	16.2	16.3	Yes
Launcher / Receiver	Launcher and Receiver Recorded	Launcher and Receiver Recorded	Yes
Max. Velocity [mph]	< 11.2	42.5	No*
Tool Condition	No Damage or Heavy Wear	No Damage or Heavy Wear	Yes
Pipeline Debris	Light	Light	Yes
Total Missing Data [ft]	< 16.4	0	Yes
AGM Coverage	TBD	TBD	TBD

Geometry Data Check	Standard Specifications	Inspection Findings	Acceptance
Sensor Coverage	100%	N/A	N/A

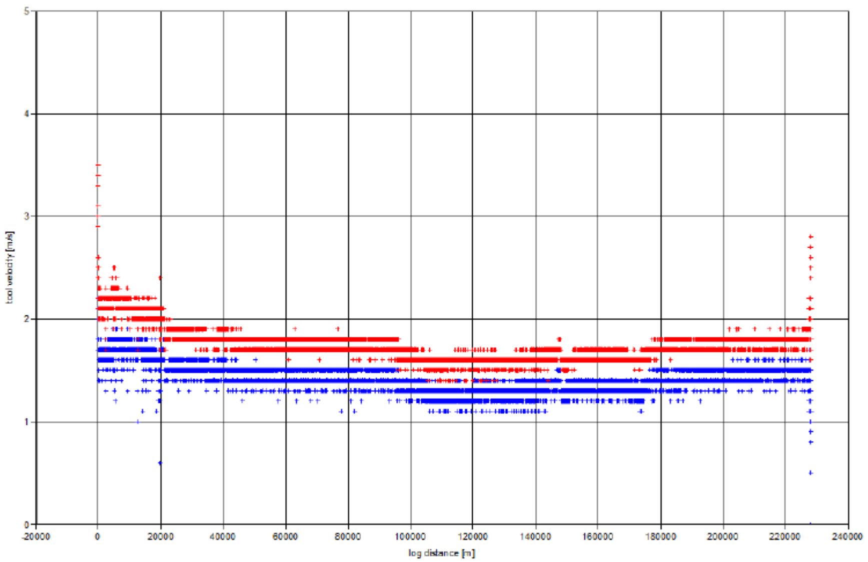
Metal Loss Data Check	Standard Specifications	Inspection Findings	Acceptance
Magnetization Level [kA/m]	10-30	18-33	No**
Sensor Loss [Adjacent Sensors]	< 6	0	Yes
Sensor Coverage	>95%	100%	Yes

XYZ Data Check	Acceptance
Gyro Acceleration	Yes*
Gyro Angular Velocity	Yes*

IN-LINE INSPECTION PROCESS
VALIDATE OPERATION

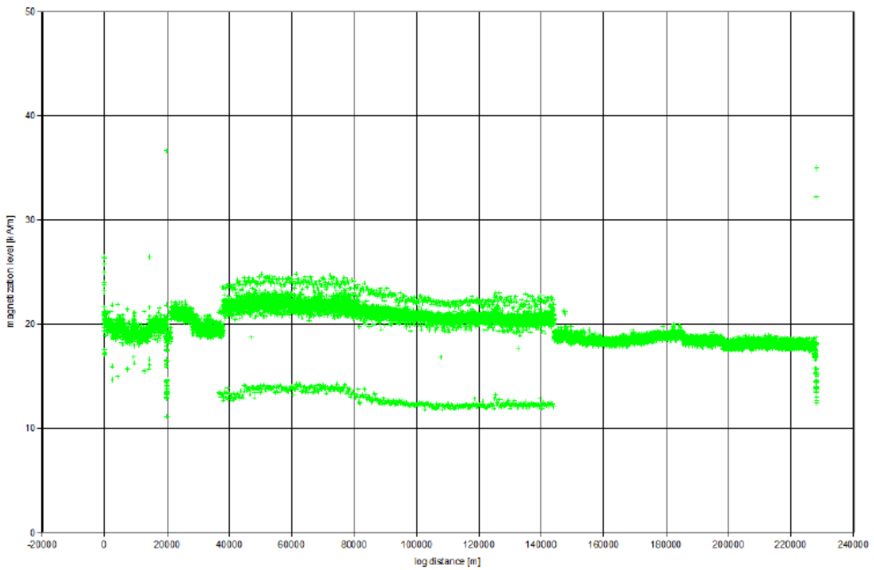
The tool was programmed to operate within the following velocity range:

min. speed	0.5 m/s
max. speed	3.0 m/s



Tool velocity chart

The minimum and maximum standard values for the magnetization level to keep the contractual specifications should be between 10 kA/m to 30 kA/m.

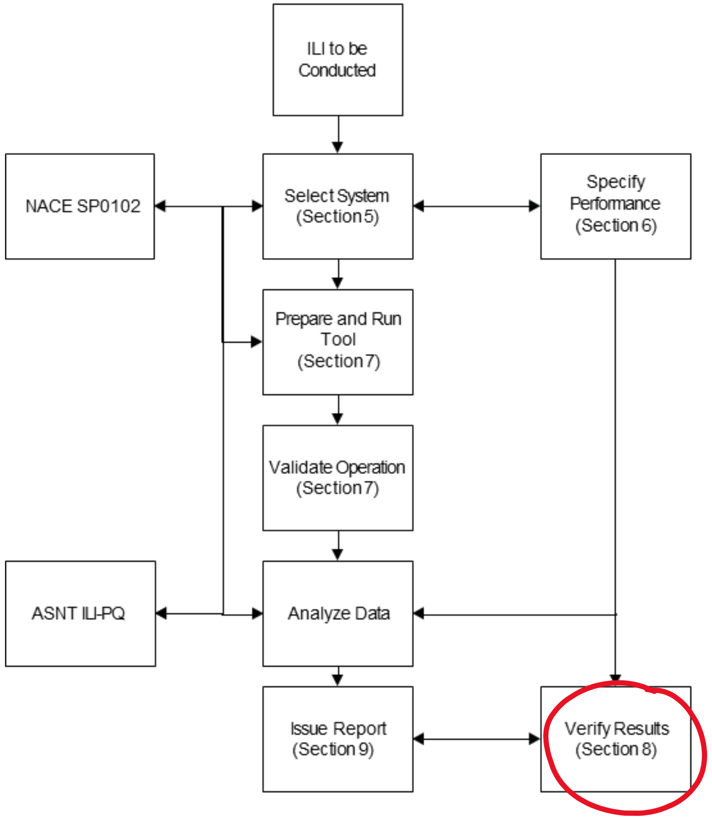


Magnetization chart

Verify Results

IN-LINE INSPECTION PROCESS
VERIFY RESULTS

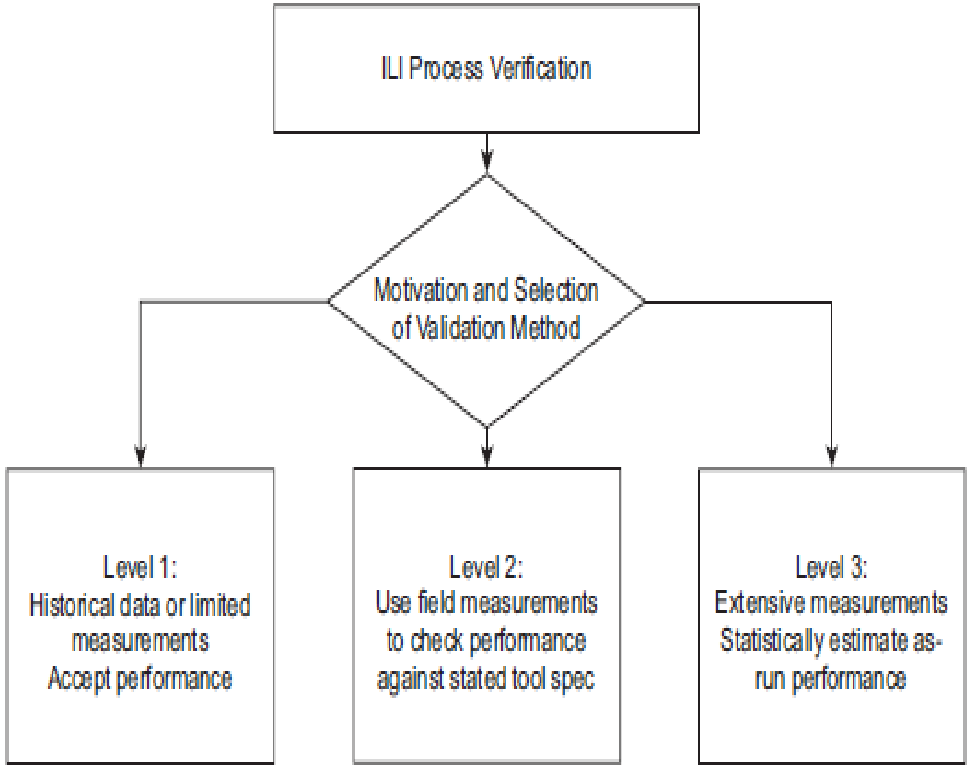
- The use of the ILI results means that the operator has verified that the inspection was successful.
- The operator may then use the ILI results to assess the specific threat which the inspection intended to address.
- The use of the ILI results shall acknowledge the accuracy of the results.



In-line Inspection Process Flow Diagram

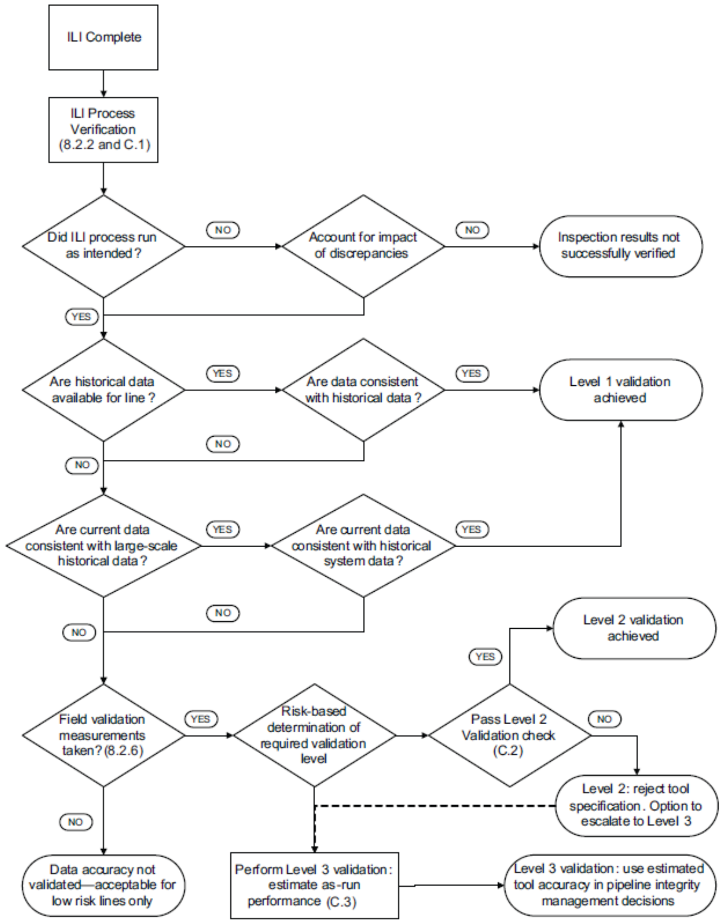
IN-LINE INSPECTION PROCESS
VERIFY RESULTS

Level 1— This level applies only to pipelines with anomaly populations that represent low levels of risk in consideration of either consequence or probability of failure.
Level 2—At this level no definitive statement is made about the actual tool performance
Level 3—At this level, extensive validation measurements are available that allow stating the as-run tool performance.



IN-LINE INSPECTION PROCESS
VERIFY RESULTS

The process shall include:
a) a process verification or quality control (QC),
b) a comparison with historic data (if available) for the pipeline being inspected, and/or
c) a comparison with historic data or large-scale test data from the inspection system being used, and
d) a comparison with field excavations results if warranted by the reporting of significant indications.



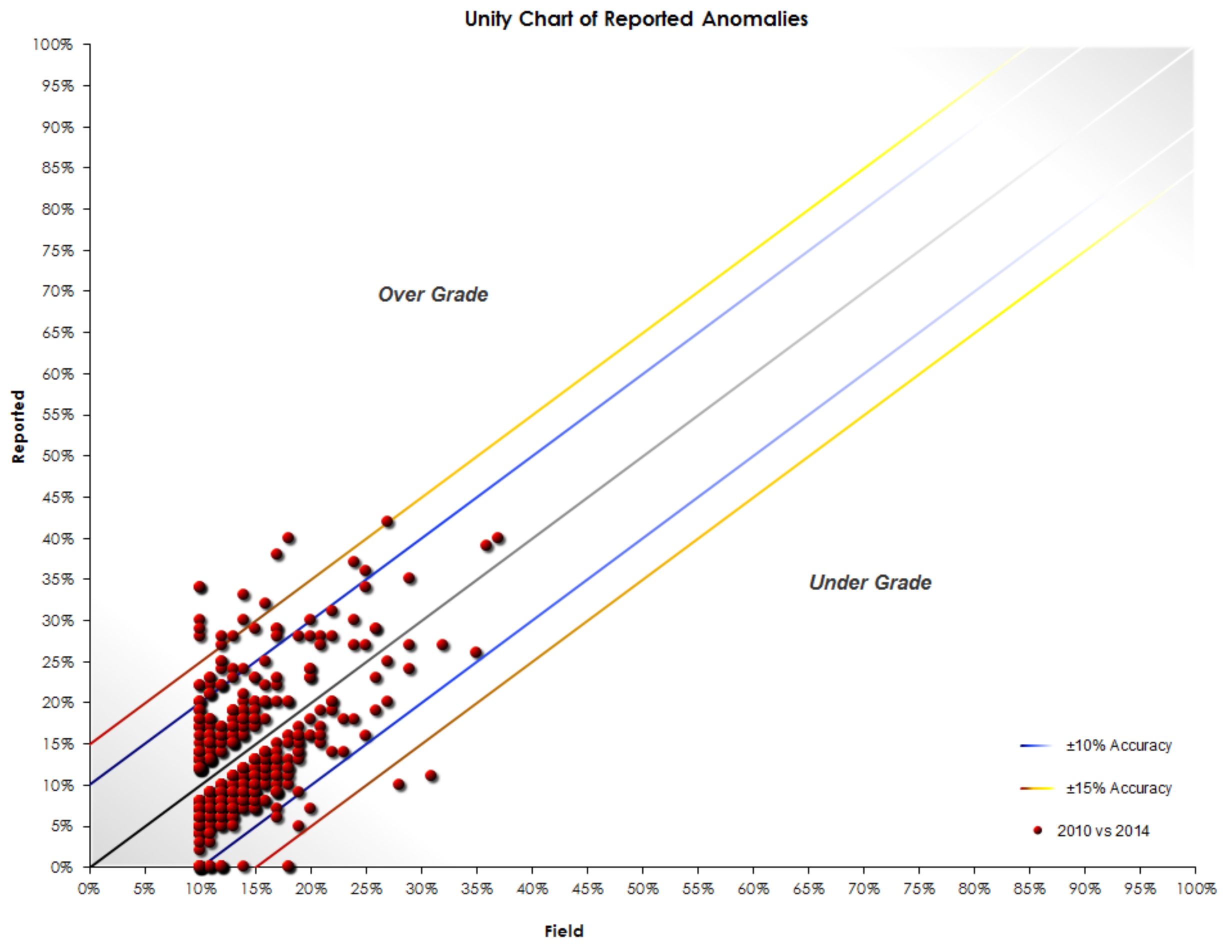
IN-LINE INSPECTION PROCESS
VERIFY RESULTS

Validation data information from field measurements should (previous version, shall) be given to the service provider to confirm and continuously refine the data analysis processes.

IN-LINE INSPECTION PROCESS
VERIFY RESULTS

Level 3 - Statistically Valid

Note: this approach requires a more in-depth understanding of statistics and should adequately consider all factors that could affect the accuracy of the results.



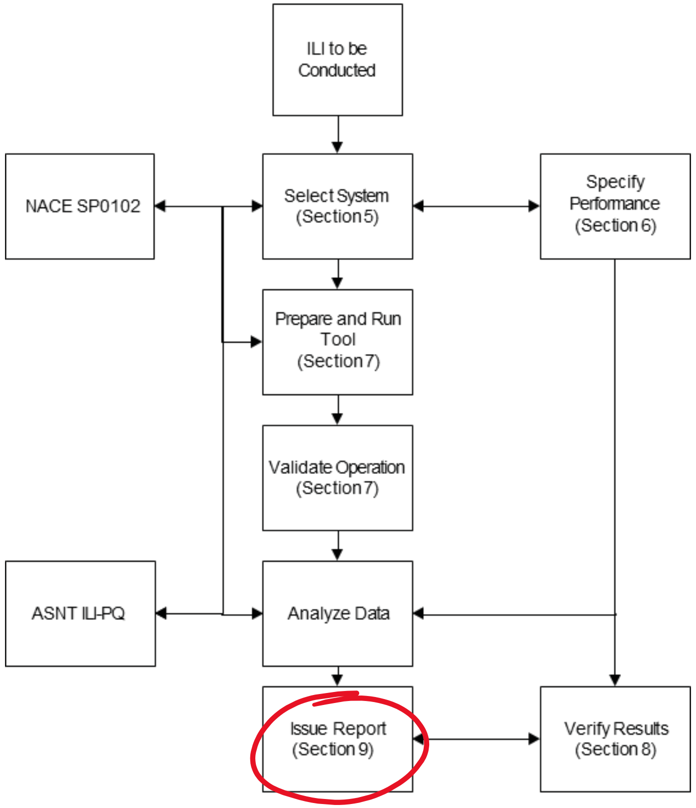
Issue Report

IN-LINE INSPECTION PROCESS
ISSUE REPORT

Reporting is an essential part of the inspection process.

The reporting requirements provide a Standardization of the Final ILI Report deliverable.

API 1163 only sets forth the minimum requirements.



In-line Inspection Process Flow Diagram

IN-LINE INSPECTION PROCESS
ISSUE REPORT

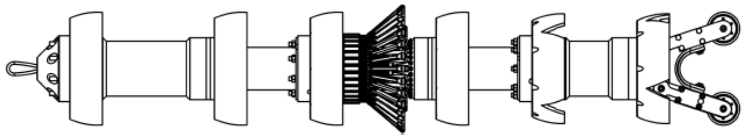
The following reporting requirements are provided to clearly tie the ILI systems qualifications to the inspection results.

- In-line Inspection System Performance Specifications
- Performance Specification
- Qualification Method
- Equipment Specifications

[redacted]

Tool Performance Specifications

10" (254mm) DEF



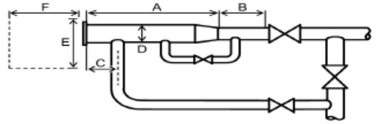
DEFORMATION SPECIFICATIONS	
Deformation sensor type	Low mass, direct measuring arms
Sampling frequency	Up to 750 samples per second
Defect detection and accuracy	See Document D1121, DEF Sizing Specification
GENERAL SPECIFICATIONS	
Data storage	Solid state non-volatile memory (flash)
Data discarded by filtering	None
Tool transmitter	ELF 22HZ
Inertial sensors	Solid State Inertial Sensors
Operating pressure range[1]	300 to 2000 psi (20.7 to 137.9bar)
In-line temperature range	14 to 131 °F (-10 to 55°C)
Maximum tool speed[3]	15.0 ft/s (4.6m/s)
Minimum local bore in straight pipe	8.100 in (205.7mm)
Minimum bend radius	1.5D
Minimum bore in minimum bend	9.250 in (235mm)
Minimum distance between bends	3D
Defect location aids	AGM's on board INS and pipeline features
Odometer resolution	0.118 in (3.0mm)
Number of odometers	2
Bill code	DEF.10
Bill code description	DEFORMATION INSPECTION, 10"
Tool config #	108571

[redacted]

Geometry Channels	Length[2]	Weight[2]	Standard Run Time[2]
31	65 in (1.65m)	140 lbs (64kg)	59 hrs

Suggested Minimum Trap Dimensions

Traps	A	B	C	D	E	F
Launcher	>6 ft (1.8m)	>1 ft (0.3m)	2 ft (0.6m)	12 in (305mm)	>4 ft (1.2m)	>8 ft (2.4m)
Receiver	>6 ft (1.8m)	>6 ft (1.8m)	2 ft (0.6m)	12 in (305mm)	>4 ft (1.2m)	>8 ft (2.4m)



FEATURE CHARACTERIZATION AND LOCATION	
Bend radius	±0.25D
Bend angle	±10°
Location from closest girth weld	±0.5%
Circumferential orientation	±10°

Notes

1. Approximate pressure range. [redacted]
2. Standard configuration. [redacted]
3. For full reporting accuracy. Features can often be sized at a reduced accuracy when tool is operated at higher speeds or in thicker wall.
4. Specifications subject to change

IN-LINE INSPECTION PROCESS
ISSUE REPORT

Executive Summary

a. Date of survey.

b. Pipeline parameters and whether the information was observed (i.e. evident within the ILI data) or provided (i.e. provide by the operator or third party):

- pipe manufacturing method
- outside diameter
- nominal wall thickness
- pipe grade
- line length

Pipeline name	Gusher
Launcher	Valve Station 0+00
Receiver	Valve Station 142+00
nominal diameter	12.75
type of pipe	seamless, unknown
rade	Gr. B, X-42, X-52
wall thickness [inches]	0.219", 0.250", 0.312", 0.375"
MAOP [PSI]	500, 800
Design Pressure	1039, 1468, 1482, 1779, 1832
SMYS	35000, 42000, 52000
minimum bend radius	1.5D
length [miles]	142
built in	1985
pipeline product (during run)	Natural Gas
inspection history	ILI in 2004

IN-LINE INSPECTION PROCESS
ISSUE REPORT

Executive Summary (continued)

c. ILI data quality—a statement regarding the quality issues with the ILI data should be included within the summary and described in the report. These issues would include, but not be specifically limited to:

- sensor malfunction,
- speed excursion,
- proximity to long seam
- Etc.

Data Quality Summary

The data recorded during the HR Geometry run, performed on April 20, 2016, was accepted and used for evaluation purposes. The tool velocity during the HR Geometry run was mainly within the pre-agreed ranges. It should be noted there are velocity excursions outside the pre-agreed range in both inspection technologies. Generally, in all areas where the velocity is out of range, the vendor standard accuracy might not be achieved. Please refer to Section 3 for more information.

The data recorded during the Axial MFL run, performed on April 22, 2016, was accepted and used for evaluation purposes. The tool velocity during the Axial MFL run was mainly within the pre-agreed ranges. It should be noted there are velocity excursions outside the pre-agreed range in both inspection technologies. Generally, in all areas where the velocity is out of range, the vendor standard accuracy might not be achieved. Over the complete survey line length, the magnetization level was mainly higher than the standard magnetization values of 10 – 30 kA/m. Generally, in all areas where the magnetization level is out of range, the vendor standard accuracy might not be achieved. Please refer to Section 3 for more information.

IN-LINE INSPECTION PROCESS
ISSUE REPORT

Inspection Results
a. Location (primary)
1) Odometer distance or absolute distance
2) Identification of upstream girth weld
3) distance from feature to upstream girth weld
4) circumferential position
5) northing coordinate
6) easting coordinate
b. Location (secondary)
1) identification of upstream and downstream markers
2) distance from anomaly to upstream and downstream markers
3) three upstream and three downstream joint lengths

c. Feature characterization (primary)
1) feature classification (e.g. anomaly, component, non-relevant indication)
2) depth or depth range
— percent wall thickness or depth measurement (metal loss and cracking),
— percent of outside diameter or measurement of deflection from concentric pipe (deformation),
— percent of expansion (deformation),
— reduction in cross section (deformation);
3) Length
4) Width
5) Position through wall (ID, OD, or midwall)

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IN-LINE INSPECTION PROCESS
ISSUE REPORT

Inspection Results (continued)

d. Feature classification and characterization (secondary) specific to feature types:

1) geometry:
— dent, ovality, wrinkle, etc.;

2) cracking:
— individual vs colony,
— location (body vs weld seam),
— proximity to girth weld,
— length of longest interaction crack,
— reflector visibility in the sound path (i.e. half, one and one, and a half skip),
— shadowing of the girth weld,
— profile (continuous vs discrete),
— failure pressure;

3) metal loss:
— average depth,
— failure pressure;

4) metadata (essential variables may affect the quality and
accuracy):
— tool speed,
— projection and vertical datum of GPS coordinates and how they were obtained.

IN-LINE INSPECTION PROCESS
ISSUE REPORT

<u>Report Formats</u>

The following tables and plots should be included in the final report. These deliverables are recommended to aid in the integration of inspection results with pipeline integrity assessment programs.

Results of the ILI system should be:

- provided in a queryable tabular listing e.g. spreadsheets or database tables
- provided in a viewing application such that the pipeline operator can review the processed data used by the ILI vendor analysts to generate the tabular listing of features.

IN-LINE INSPECTION PROCESS

ISSUE REPORT

Report Formats

a. A table of all girth welds, joint lengths, pipeline components.

b. A table(s) of all anomalies and their assessments if applicable.

c. Summary and statistical data. The following reporting items should be considered in the development of reporting requirements:

1) number of features for the entire line or defined segments, possibly shown as histograms, based on:

- feature type
- feature subtypes (as applicable),
- internal/external discrimination,
- depth ranges;

IN-LINE INSPECTION PROCESS
ISSUE REPORT

Report Formats (continued)
2) Circumferential position plots looking at similar subsets of features per preceding item.
The report may include pressure-based assessment of metal loss anomalies or cracks and strain calculations for deformations. If this deliverable is stipulated, the following information should be included in the report of ILI system results:

a. assessment methodology;
b. severity ratio and definition (if a severity ratio is used);
c. pipeline parameters, other than those provided in the anomaly listings, used in calculations (e.g. maximum allowable operating pressure/maximum operating pressure, safety factor, specified minimum yield strength).

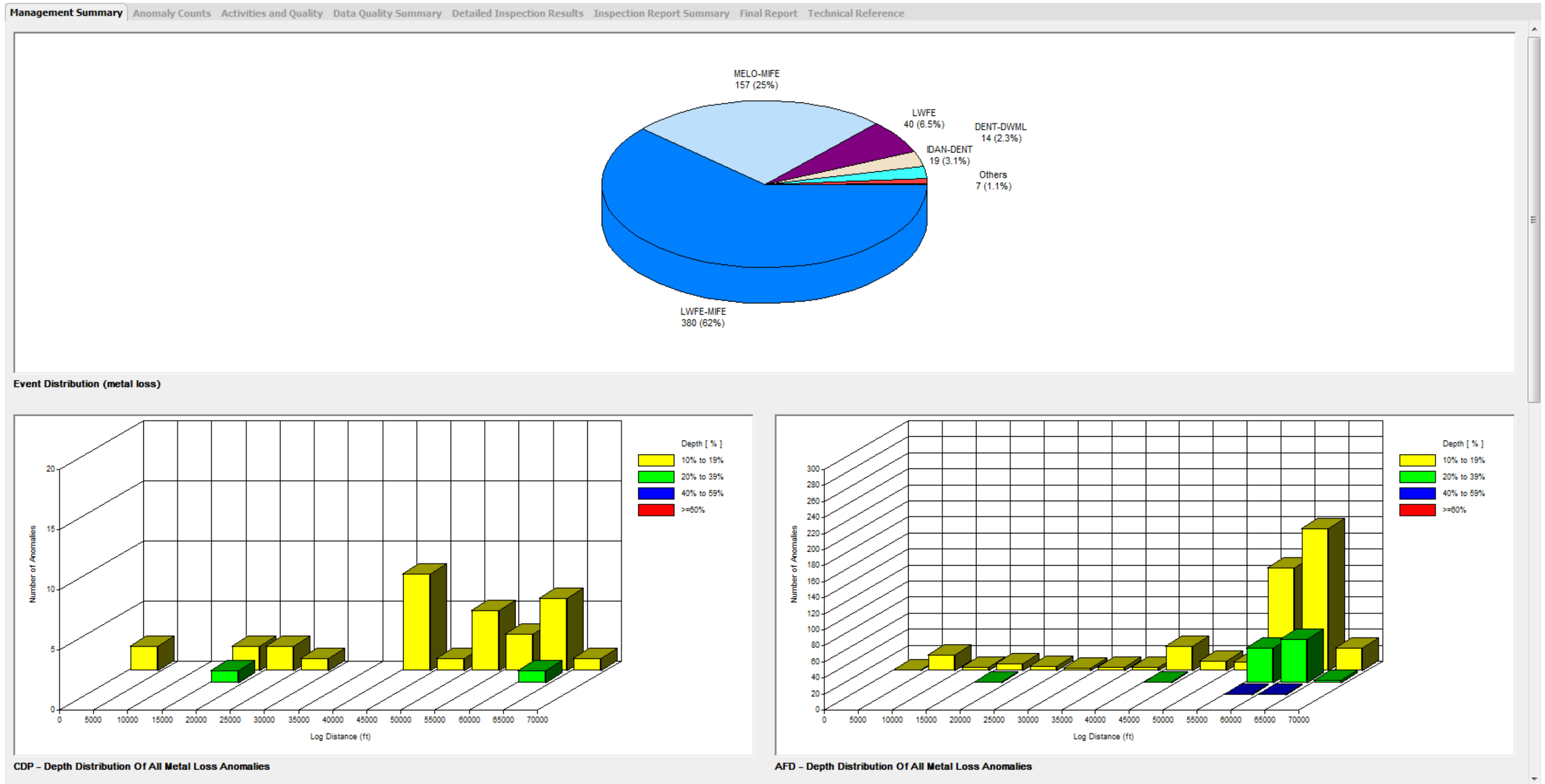
PIPELINE OPERATORS FORUM STANDARD
REPORTING REQUIREMENTS

A Pipe Tally can be standardized or customized/tailored to the operator's requirements to satisfy as an input for their IMP program. Lists of features included are of Welds, Installations, Anomalies and Clusters (two or more adjacent anomalies in the wall of a pipeline or component of a pipeline that may interact to weaken the pipeline more than either would individually.)

	GPS coordinates			Feature type and ID			Reference joint						Joint gobal geometry		Feature location on joint			Anomly sizing and further information										
																		Deformations			Cracks and metal losses							
Log distance [m]	latitude	longitude	altitude [m]	Feature type	Feature identification	Comment / Cluster ID	Girth weld Nr	Joint manufacturing type	Joint / component length [m]	Diameter [mm]	Nominal thickness [mm]	Measured/reference thickness [mm]	Ovality [%]	Bend Y/N	Abs. Dist. to upstream weld [m]	Clock position seam / anomaly	Surface location	Inward/Outward	Depth / height [%.D or mm]	Size (lenght x width) [mm]	Mean depth [%.t or mm]	Max. depth [%.t or mm]	Length [mm]	Width [mm]	Anomaly dimension classification	ERF (metal losses)	Reference table for performance	Comments
35.801				Anomaly	Gouge Cluster	GOCL-01						8,3			2.8	0:10	Ext				8%	15%	38	20	AXGR	Not calculated	A3-2	
35.801					Gouge	GOCL-01.01						8.3			2.8	0:10	Ext				7%	12%	30	11	AXGR	Not calculated	A3-2	24° angle
35.811					Gouge	GOCL_01.02						8.3			2.8	0:14	Ext				5%	15%	28	12	AXGR	Not calculated	A3-2	35° angle
44.999				Anomly	Corrosion Cluster	COCL-01						12.1			0.855	8:36	Ext				32%	32%	42	25	PITT	Not calculated	A3-2	
44.999					Corrosion	COCL-01-01						12.1			0.855	8:36	Ext				24%	24%	12	12	PITT	Not calculated	A3-2	
45.015					Coprrosion	COCL-01-02						12.1			0.871	8:43	Ext				36%	36%	26	20	PITT	Not calculated	A3-2	
47.151				Anomaly	Mill anomaly Cluster	MACL-01						8.4			1.003	8:53	Int				17%	36%	159	120	GENE	Not calculated	A3-2	
47.151					Grinding	MACL-01-01						8.4			1.003	9:16	Int				14%	36%	64	70	GENE	Not calculated	A3-2	
47.221					Non-metallic inclusion	MACL-01-02						8.4			1.073	9:42	Int				12%	12%	10	12	PITT	Not calculated	A3-2	
47.232					Lamination	MACL-01-03						8.4			1.084	8:53	Mid				11%	24%	78	55	GENE	Not calculated	A3-2	

PIPELINE OPERATORS FORUM STANDARD
REPORTING REQUIREMENTS

Summary and statistical data (graphics).



PIPELINE OPERATORS FORUM STANDARD

REPORTING REQUIREMENTS

Anomaly rankings ERF – most significant anomalies

	log dist. [ft]	Latitude [°]	Longitude [°]	Height [ft]	event	comment	o'clock	depth [%]	OD Reduction [%]	length [in]	width [in]	ERF_0.85dL	internal
1	7049.60	35.21826280	-119.55444191	1155.87	cluster	near seam weld	06:38	45		4.78	4.37	0.95	External
2	995.61	35.22973833	-119.56908521	1252.03	cluster		04:10	41		4.31	1.45	0.91	Internal
3	747.49	35.23022324	-119.56966824	1251.85	cluster	Repaired	12:53	37		6.52	1.55	0.90	Internal
4	750.07	35.23021821	-119.56966217	1251.85	cluster		08:58	40		3.97	2.46	0.89	Internal
5	743.17	35.23023167	-119.56967840	1251.89	cluster	Repaired	09:35	46		2.76	1.56	0.89	Internal
6	7050.17	35.21826175	-119.55444046	1155.86	cluster	near seam weld	07:29	36		5.12	2.20	0.88	External
7	759.26	35.23020028	-119.56964054	1251.88	cluster		01:05	39		3.82	2.26	0.88	Internal
8	994.82	35.22973988	-119.56908705	1252.04	cluster		04:10	39		3.73	1.98	0.87	Internal
9	723.72	35.23026981	-119.56972393	1252.35	cluster		10:32	35		4.93	3.23	0.87	Internal
10	1237.01	35.22926761	-119.56852065	1250.08	cluster		12:44	38		3.78	1.38	0.87	Internal
11	748.91	35.23022048	-119.56966491	1251.85	cluster	Repaired	09:29	36		4.34	2.92	0.87	Internal
12	762.63	35.23019370	-119.56963262	1251.89	cluster		09:54	35		4.67	2.23	0.86	Internal
13	739.25	35.23023934	-119.56968761	1251.95	cluster		08:07	43		2.70	1.54	0.86	Internal
14	17733.89	35.19805788	-119.52869512	1107.54	cluster	near girth weld	06:03	33		4.94	3.12	0.85	External
15	749.55	35.23021922	-119.56966339	1251.85	cluster	Repaired	09:30	40		2.93	1.15	0.85	Internal
16	731.73	35.23025410	-119.56970521	1252.13	cluster		10:15	33		4.84	1.53	0.85	Internal
17	755.48	35.23020766	-119.56964943	1251.86	cluster		09:38	31		4.99	1.50	0.84	Internal
18	1224.04	35.22929291	-119.56855102	1249.06	cluster		10:39	31		4.32	1.39	0.83	Internal
19	672.07	35.23037094	-119.56984503	1253.00	cluster	near seam weld	07:40	34		3.34	2.54	0.83	Internal
20	1249.86	35.22924249	-119.56849049	1250.52	cluster		06:24	33		3.58	1.31	0.83	Internal
21	758.08	35.23020258	-119.56964332	1251.87	cluster		01:07	36		2.84	2.15	0.82	Internal
22	706.33	35.23030393	-119.56976461	1252.67	cluster		07:51	37		2.69	2.09	0.82	Internal
23	682.36	35.23035084	-119.56982083	1252.92	cluster		08:14	31		3.92	1.58	0.82	Internal
24	758.93	35.23020093	-119.56964132	1251.88	cluster		09:38	33		3.35	2.85	0.82	Internal
25	701.05	35.23031427	-119.56977698	1252.72	cluster	near seam weld	01:33	26		6.91	1.80	0.82	Internal
26	748.59	35.23022109	-119.56966566	1251.85	cluster	Repaired	09:38	44		1.81	1.15	0.81	Internal
27	1240.61	35.22926058	-119.56851221	1250.26	cluster		09:40	39		2.16	1.06	0.81	Internal
28	723.03	35.23027115	-119.56972553	1252.37	cluster		01:02	35		2.53	0.63	0.81	Internal
29	765.30	35.23018848	-119.56962635	1251.90	cluster	near seam weld	01:29	31		3.14	1.79	0.80	Internal
30	757.83	35.23020307	-119.56964390	1251.87	cluster		10:01	28		3.86	2.18	0.80	Internal
31	1000.61	35.22972852	-119.56907349	1251.99	cluster		06:29	31		3.04	1.46	0.80	Internal
32	736.81	35.23024413	-119.56969333	1252.00	cluster		08:01	27		4.10	1.60	0.80	Internal
33	702.07	35.23031229	-119.56977460	1252.71	cluster		03:17	27		4.06	3.07	0.80	Internal
34	984.14	35.22976081	-119.56911206	1252.19	cluster		07:57	31		2.96	0.97	0.80	Internal
35	702.08	35.23031226	-119.56977457	1252.71	cluster		09:31	30		3.16	2.63	0.80	Internal
36	758.19	35.23020237	-119.56964305	1251.87	cluster		09:42	24		5.74	3.24	0.80	Internal
37	763.25	35.23019249	-119.56963117	1251.89	cluster		09:50	24		5.56	2.61	0.80	Internal
38	746.49	35.23022519	-119.56967059	1251.86	cluster	Repaired	09:58	35		2.32	1.14	0.80	Internal
39	1864.59	35.22804426	-119.56704329	1238.33	cluster		04:12	27		3.83	0.66	0.80	Internal

Pipe Tally | Anomaly | Reference | XYZ_DATA | Pipe Parameters | Markers | Installations | Significances | Bookmarked Significances

IN-LINE INSPECTION PROCESS
ISSUE REPORT

Pipeline Operators Forum (POF) gives further guidance.

Reporting is based on at least two separate documents unless otherwise agreed

- Operations report
- Final report

In addition to the above mentioned reports, one or more of the following reports can be requested and agreed between Client and Contractor:

- Preliminary report
- Raw data report
- Multiple run comparison report
- Additional reporting

IN-LINE INSPECTION PROCESS
ISSUE REPORT

Operations Report

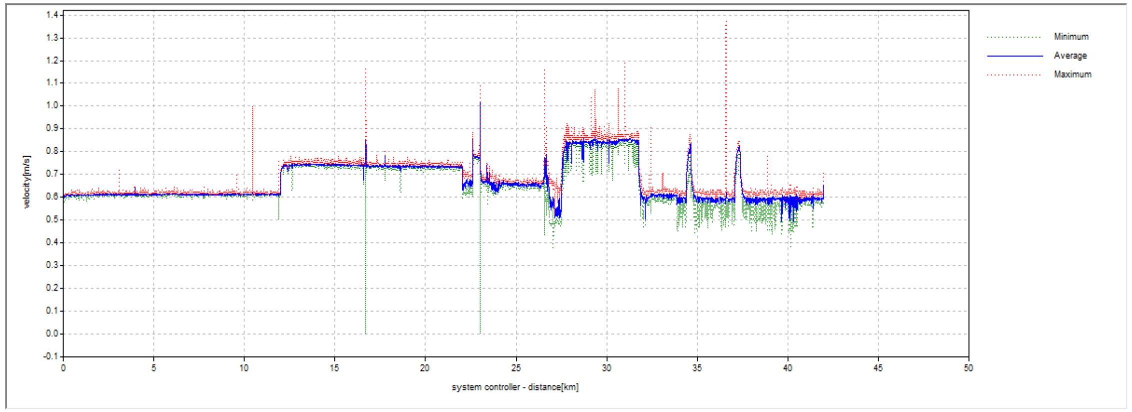
- Any reported safety observation (e.g. near miss)
- A description of the operations (cleaning, gauging, dummy tool run, ILI tool run) including run conditions
- Used tool(s) identification (serial number) with tool(s) data sheet and calibration
- AGM statistics (if applicable)
- Cleaning results and comparison to criteria
- Gauging/dummy tool run results and comparison to criteria
- The suitability of the recorded data to allow a successful evaluation.

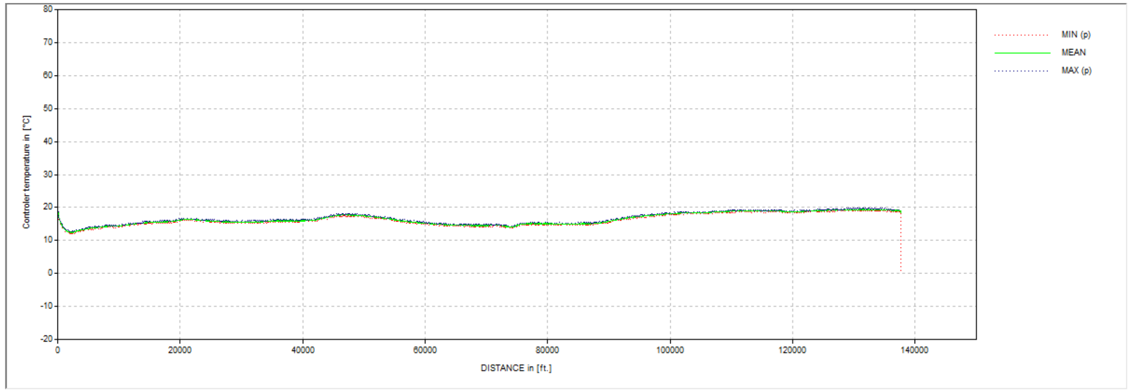
IN-LINE INSPECTION PROCESS

ISSUE REPORT

Operations Report (continued)

- Details of ILI run(s):
  - Time and date of tool launching and receiving
  - Travelling time
  - Min/max tool velocity, and tool velocity plot over the length of the pipeline
  - Min/max pressure
  - Etc.





IN-LINE INSPECTION PROCESS
ISSUE REPORT

Formulation for Acceptable Data Loss

- The formulation for acceptable data loss shall be, unless specified otherwise:
- Continuous loss of data less or equal to 0.5 % of pipeline length
- Discontinuous loss of data less or equal to 3% of pipeline length
- Continuous loss of data from less than 4 adjacent sensors or 25 mm circumference (whichever is smallest).
- The criteria apply to each section of the pipeline i.e. each diameter, wall thickness and pipe manufacturing process.
- If data loss exceeds one of the criteria above, this shall be discussed between Client and
- Contractor to reveal the cause and decide on follow-up actions which might be:
  - A re-run of the tool
  - Check if the data loss has an effect on anomaly detection and sizing capability of the ILI tool.

IN-LINE INSPECTION PROCESS
ISSUE REPORT

Preliminary Report

- Preliminary report is a list of features, including by their dig sheets.
- The reporting format is as per the list of anomalies in the final report.
- The preliminary report shall be delivered if requested by the Client or if the Contractor finds an anomaly (or anomalies) during the analysis of the ILI data which might be (are) an integrity threat to the pipeline.

NOTE: If the Contractor finds an anomaly during the inspection and/or evaluation of the ILI data which could be an immediate threat to the integrity of the pipeline, he has the duty to report this to the Client without delay

IN-LINE INSPECTION PROCESS
ISSUE REPORT

Preliminary Report

Aims at summarizing the most important features (individual and clustered) based on Client criteria as defined in the contract, in order to guarantee a safe pipeline operation. Typical reporting should include:

- Features with an ERF ≥ 0.8
- Metal loss features ≥ 50
- Dents, Wrinkles/Buckles ≥5%
- Cracks with depth ≥ 4.0 mm

12" GUSHER PIPELINE

Client:
Project No.: 0-1000-12345
Line Name: 12" Gusher
Inspection Type: MFL-A, XT **Date of Inspection:** April 22, 2016
Revision No.: 0

Significances

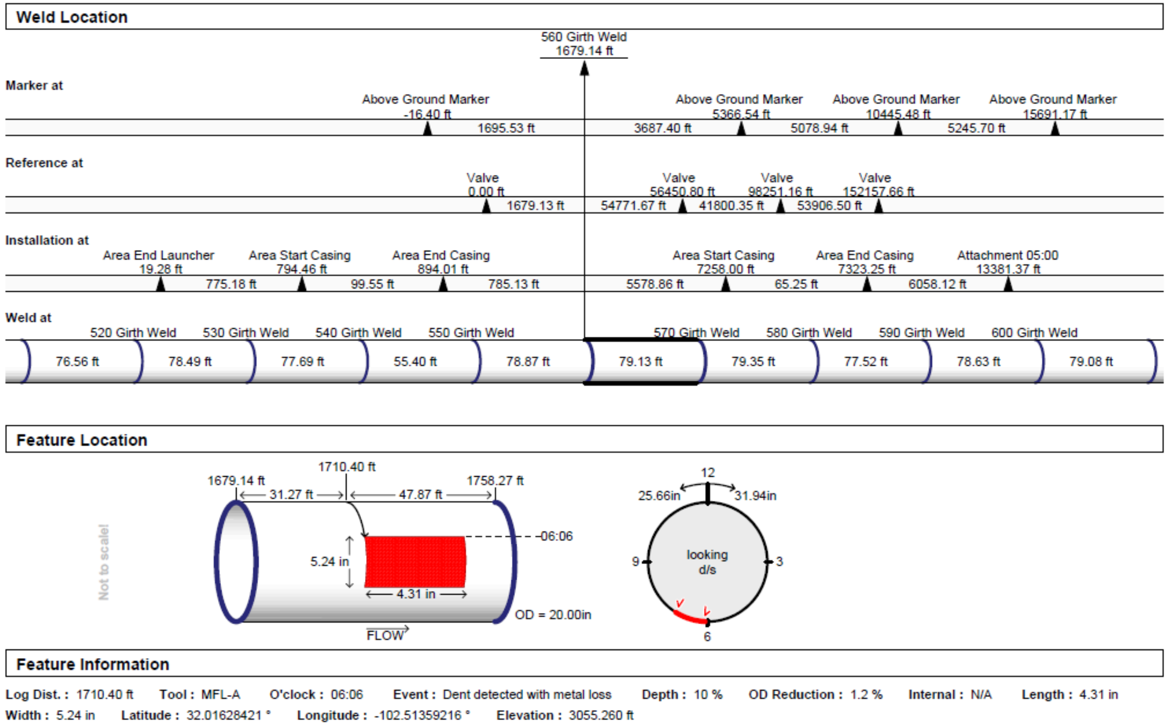
Log Distance ft	Event	Comment	Max. Depth %	Diameter Reduction %	Length in	Width in	center o'clock	Wall Location
119347.38	dent-detected with metal loss		12	1.6	7.03	3.84	08:55	N/A
119654.05	metal loss-corrosion		68		0.53	0.64	11:57	ext
119851.92	metal loss-corrosion		82		0.86	0.84	12:58	ext
119956.45	metal loss-corrosion		74		0.46	0.80	10:29	ext
122475.70	metal loss-corrosion		84		0.50	0.88	04:13	ext

IN-LINE INSPECTION PROCESS

ISSUE REPORT

<u>Components of a Dig Sheet</u>

- Length of pipe joint and (when present) orientation of longitudinal or spiral seam at start and end of every joint
- Length and longitudinal or spiral seam orientation of the 3 upstream and 3 downstream neighboring pipe joints
- Wall thickness of the pipe joints (up to the 3 upstream and 3 downstream joints)
- Log distance of anomaly



IN-LINE INSPECTION PROCESS

ISSUE REPORT

Components of a Dig Sheet (continued)

- Log distance of closest features like magnet markers, fixtures, steel casings, tees, valves, etc.
- Orientation of anomaly
- Anomaly description and dimensions
- Internal/external/mid-wall indication
- Distance of anomaly to upstream girth weld
- Distance of anomaly to downstream girth weld
- Distance of upstream girth weld to nearest, second and third upstream marker
- Distance of upstream girth weld to nearest, second and third downstream marker
- Geographical coordinates of an anomaly if a mapping unit was applied

IN-LINE INSPECTION PROCESS

ISSUE REPORT

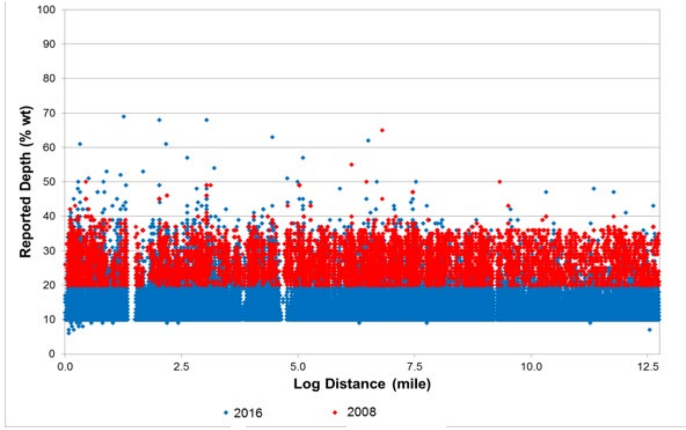
<u>Multiple Run Comparison Report</u>

Anomaly data from two or more successive ILI runs carried out on the same pipeline, shall be compared individually and clustered.

Goal: To detect discrepancies between reported anomalies of successive runs like new or missed features, corrosion growth, etc.

DATA RUN 1 (yyyy-mm-dd)															DATA RUN 2 (yyyy-mm-dd)															Difference				Comment
Log distance [m]	Latitude	Longitude	Altitude	Girth weld number	Joint / component length [m]	Wall thickness [mm]	Abs. dist. feature to upstream weld [m]	Feature	Clock position	Length [mm]	Width [mm]	Depth %	Int / Ext	…	Log distance [m]	Latitude	Longitude	Altitude	Girth weld number	Joint / component length [m]	Wall thickness [mm]	Abs. dist. feature to upstream weld [m]	Feature	Clock position	Length [mm]	Width [mm]	Depth %	Int / Ext	…	Δ Length [mm]	Δ Width [mm]	Δ Depth %	…	
10,250.250				7500	14.651	10.0		weld							10,250.000				7500	14.811	10.5		weld											Weld matched
10,256.630						10.0		corrosion	6:00	35	40	12	Int		10,257.000								corrosion	5:42	120	80	18	Int		85	40	6		Corrosion matched
															10,262.650								corrosion	4:12	15	10	5	Int						New corrosion
10,263.305						10.0		grinding	11:04	120	80	8	Ext		10,263.500								corrosion	11:00	140	90	12	Ext		20	10	4		Identification correction: grinding to corrosion
10,264.910				7510	15.100	10.0		weld							10,264.818				7510	15.080	10.5		weld											Weld matched
10,280.008				7520	15.000	10.0		weld							10,279.898				7520	3.110	10.5		weld											Weld matched
															10,283.000				7522	7.000	12.5		weld											New weld
															10,290.064				7524	4.905	10.5		weld											New weld
10,294.800				7530	14.805	10.0		weld							10,294.900				7530	14.805	10.5		weld											Weld matched

IN-LINE INSPECTION PROCESS
ISSUE REPORT



Corrosion Growth Rate (CGR)

Why calculate a Corrosion Growth Rate (CGR)?

- Key input into Integrity Management Decisions
- Repair / In field investigation Plans
- Effective mitigation planning
- Re-inspection intervals

Methods of Estimating CGRs

- Historical Corrosion Rates
- Industry guidance on typical corrosion rates (e.g. NACE RP0502, ASME B31.8S)
- Comparison of repeat inspection data

Thank you for coming to this presentation on 195.591 In-Line Inspection of Pipelines.

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