Active Alliance Ukraine
pipeline engineering

ISO 9001: 2015
ISO 29001: 2010
ISO 37001: 2016
ISO 45001: 2018
ISO 14001:2019

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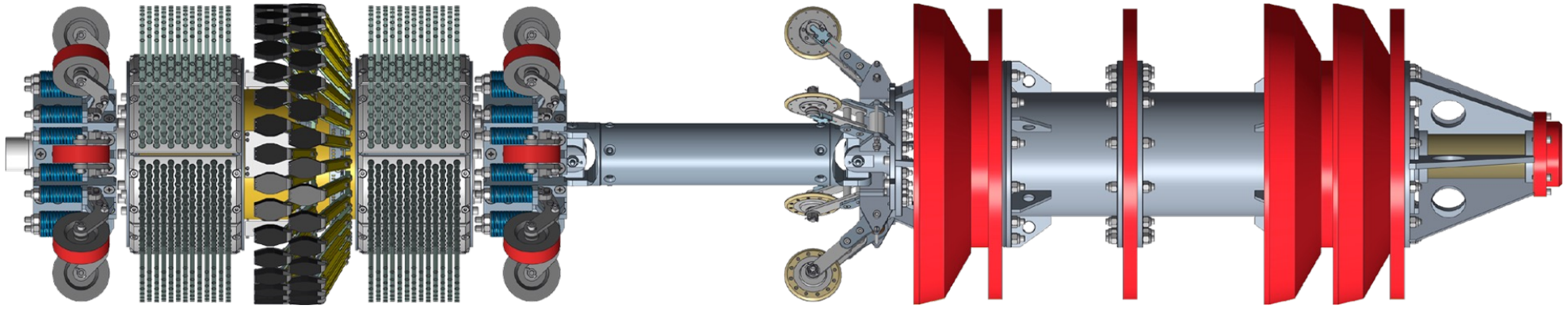
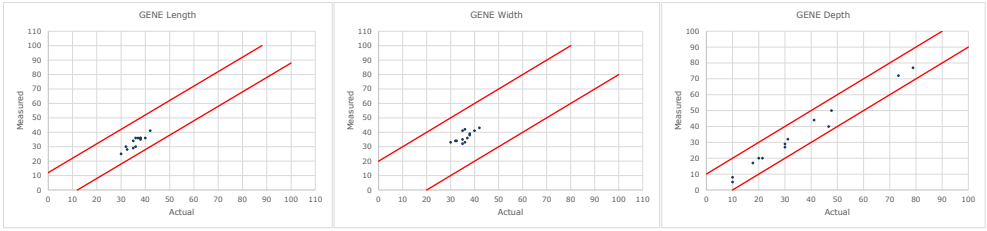
3D High-Resolution MFL with magnetic field gradient sensors



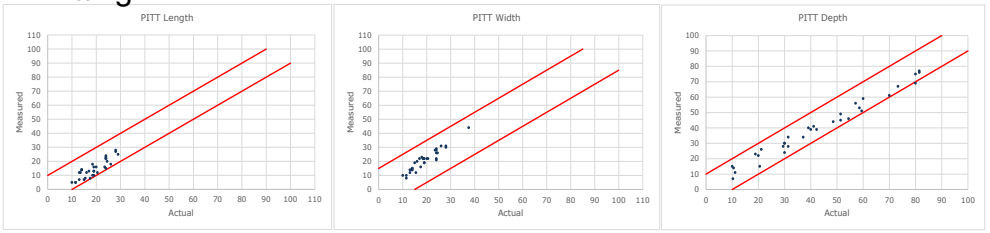
The Magnetic Flux Leakage technology is widely used for the inline inspection of oil and gas pipelines. The pipe wall is magnetized in axial direction with strong permanent magnets and the resulting magnetic field is measured at the internal surface of the pipe wall using Hall effect sensors. Metal loss anomalies cause a leakage of the magnetic field which can be measured by the sensors of the inspection tool. The length, width and depth of an anomaly can be determined from the MFL signatures using different criteria and grading algorithms. In conventional tools the longitudinal component of the magnetic flux leakage parallel to the pipeline axis is measured. Recording the other two field components is still a challenge, especially together with the constant growth of resolution and sampling rate. If 1D run data size is 500GB the 3D data is 1.5TB. When analyzing data by human the additional data views increases the load on a data analyst and slows down his work. Meanwhile, technological progress is advancing. In recent years, there has been a great progress in the field of artificial intelligence. Smartphones already have AI accelerators. Solid state drives larger than a terabyte is being installed in affordable laptops. The spread of electric vehicles has brought high-capacity batteries into our daily lives. All these changes have made achievable the use of 3D sensors in MFL inspection tools. Now all leading companies are developing or have already developed ILI tools with 3D sensors.

Correlation for anomaly sizing

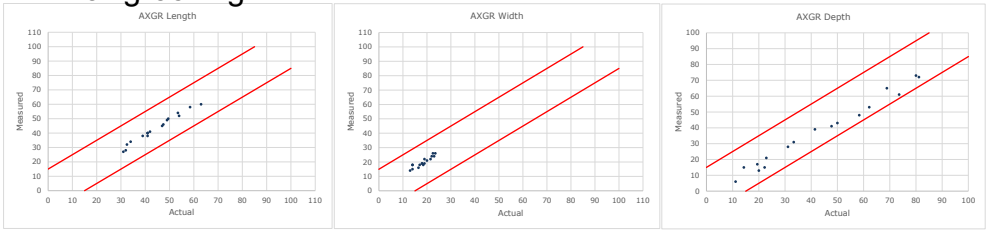
General



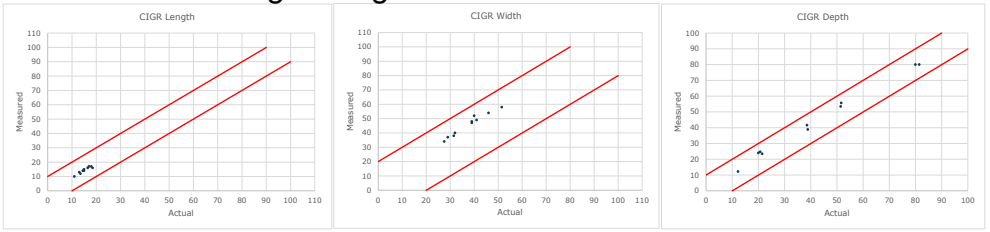
Pitting



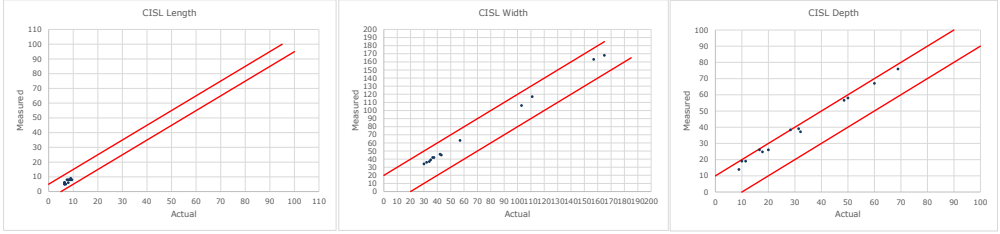
Axial grooving



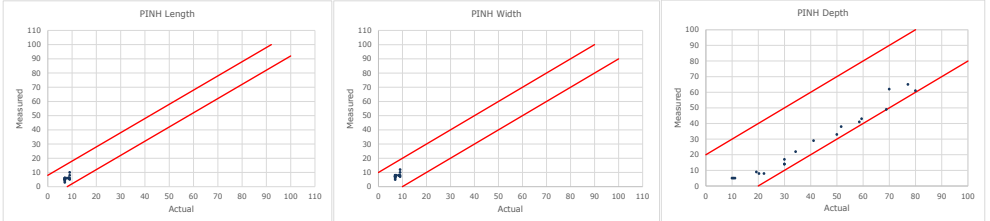
Circumferential grooving



Circumferential slotting



Pinhole



According to POF2009 and 2016 requirements all data obtained by our ILI tools are getting in proper measuring range which allow to identify and measure with high accuracy the size of proper types of anomalies

Pipeline Operators Forum (POF)

POF 2009

Table 2: Detection and sizing accuracy for metal loss anomalies in body of pipe

	General metal-loss	Pitting	Axial grooving	Circumf. grooving	Pinhole*	Axial slotting*	Circumf. Slotting*
Depth at POD=90%							
Depth sizing accuracy at 80% certainty							
Width sizing accuracy at 80% certainty							
Length sizing accuracy at 80% certainty							

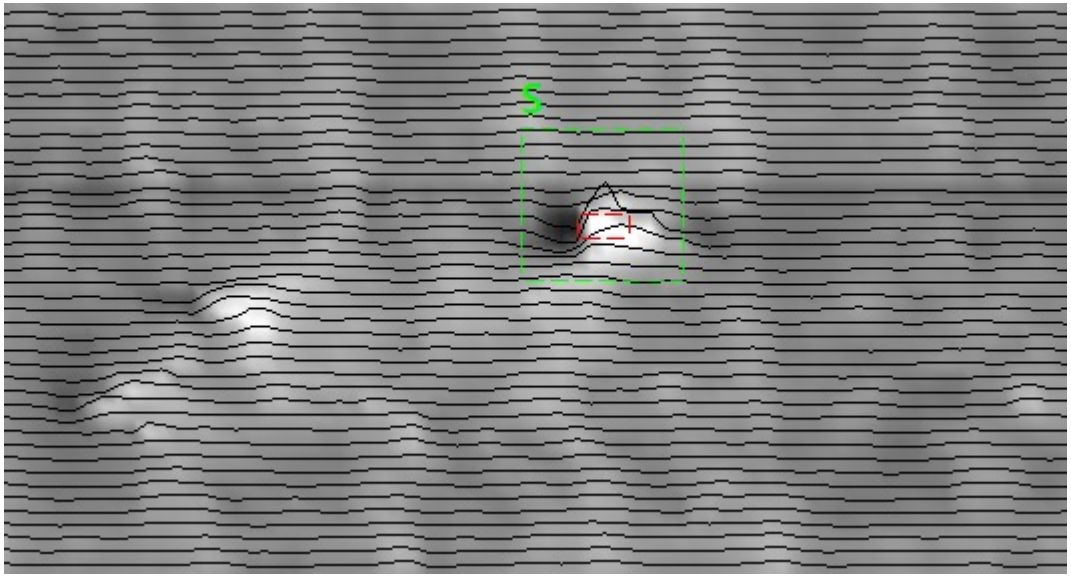
POF 2016

Table A5-2: MFL detection and sizing accuracy for metal loss anomalies

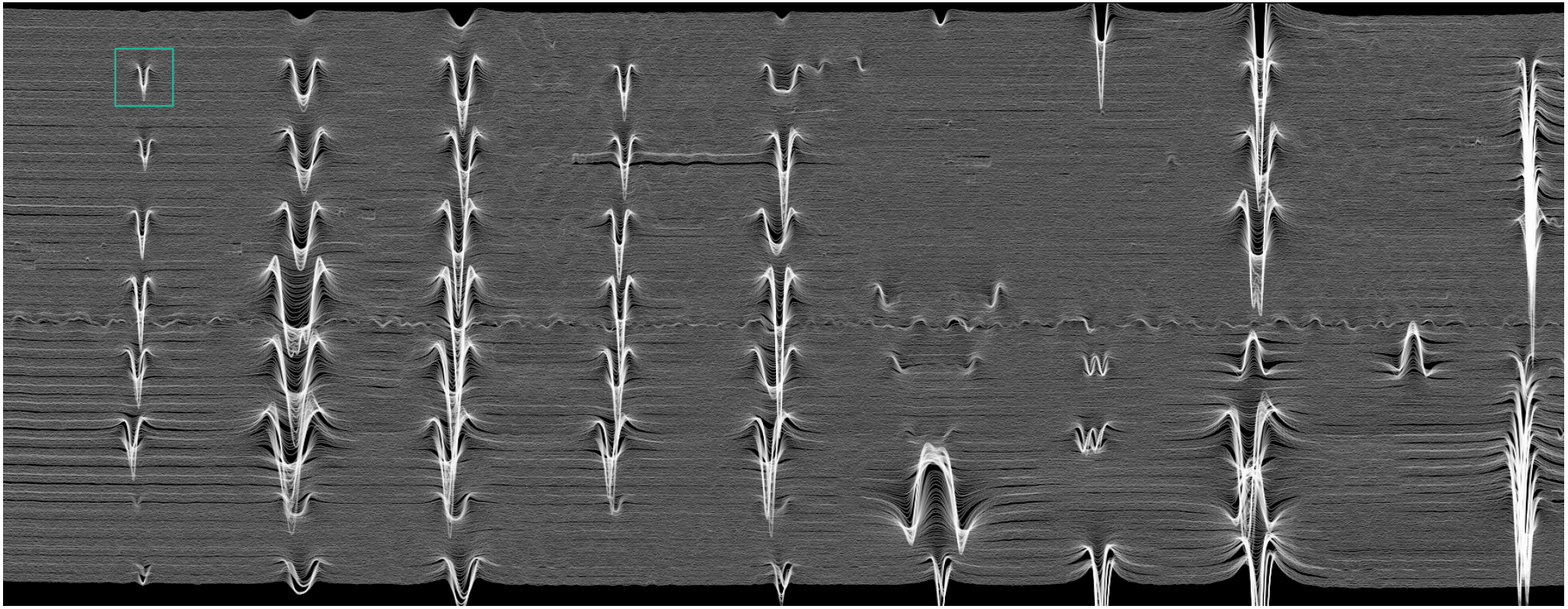
	General metal-loss	Pitting	Axial grooving	Circumf. grooving	Pinhole	Axial slotting	Circumf. Slotting
Depth at POD=90%					N/A see below		
Depth sizing accuracy at 90% certainty							
Width sizing accuracy at 90% certainty							
Length sizing accuracy at 90% certainty							
Minimum pinhole diameter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

Changing of POF requirements demand constant growing of ILI tools capabilities, so we are focus on constant improvement of ILI tool resolution.

Conventional tool data. Circumferential resolution 8mm. Indication of metal loss 10x15mm 60% in depth.

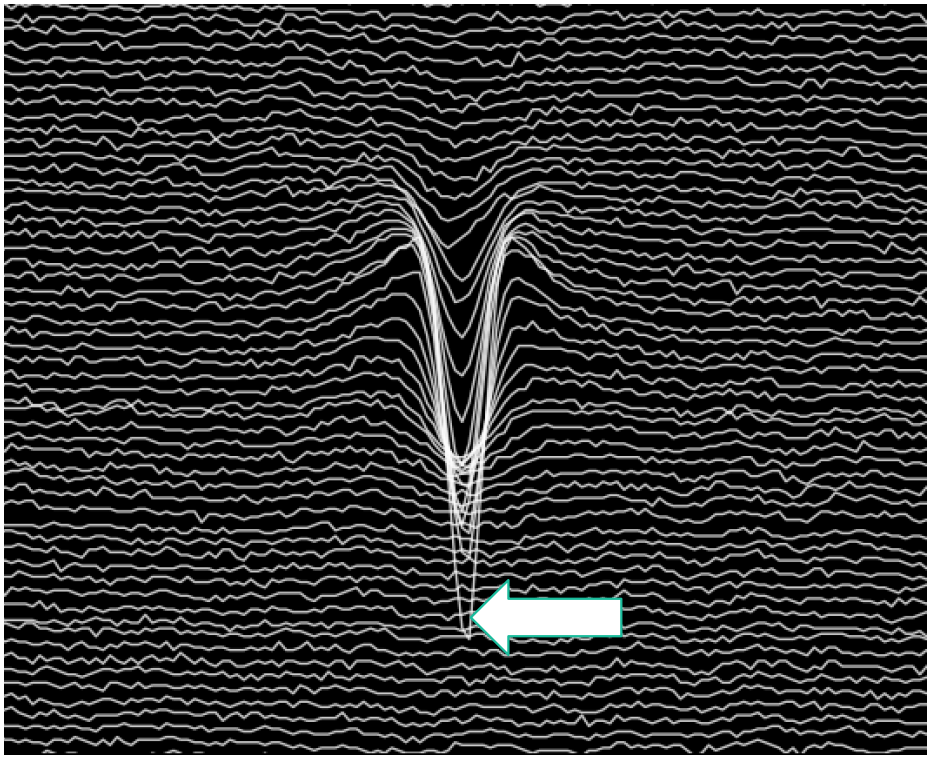


3D MFL High-Resolution data from the Pull Through Test



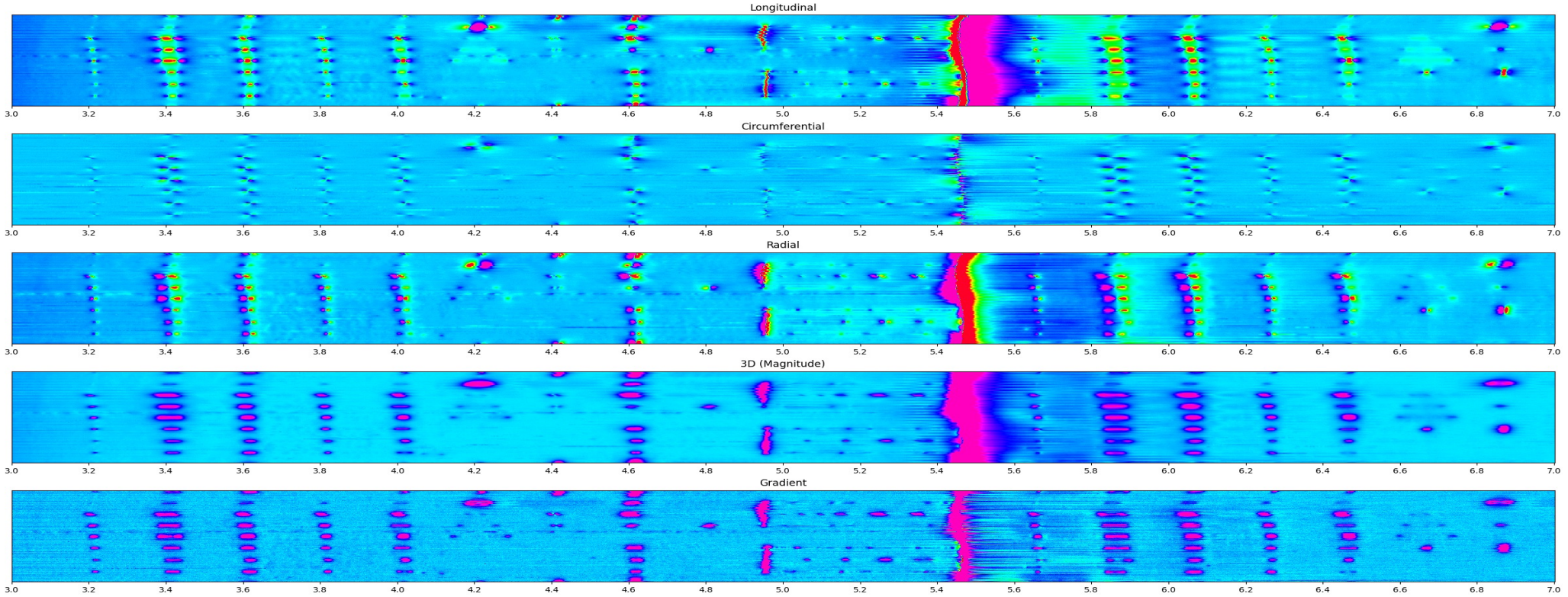
Anomaly №6, External Metal Loss, Ø9mm, depth 2.7mm

Anomaly №6 3D MFL HR data (circumferential sensor spacing 3mm, longitudinal sampling distance 1 mm)

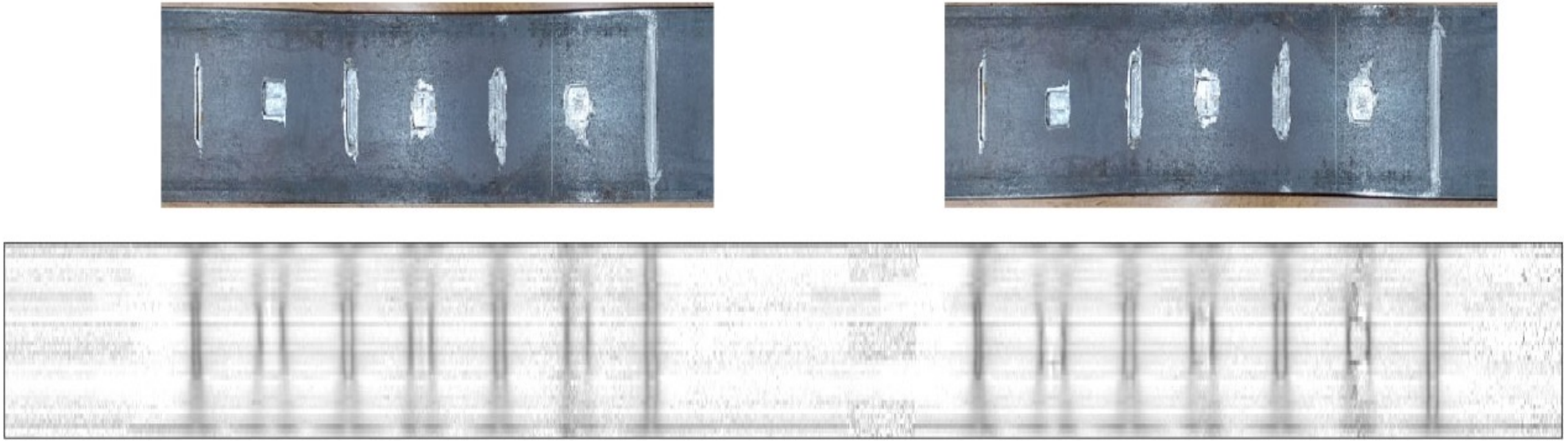


This is High-Resolution MFL data where circumferential sensors spacing is 3 mm and longitudinal sampling distance is 1 mm. The anomaly indication amplitude recorded by only one sensor and neighboring sensor is far from this value. This means that the anomaly was digitized with some error. That's why the industry is moving to Ultra-High-Resolution.

3D MFL and magnetic field gradient data

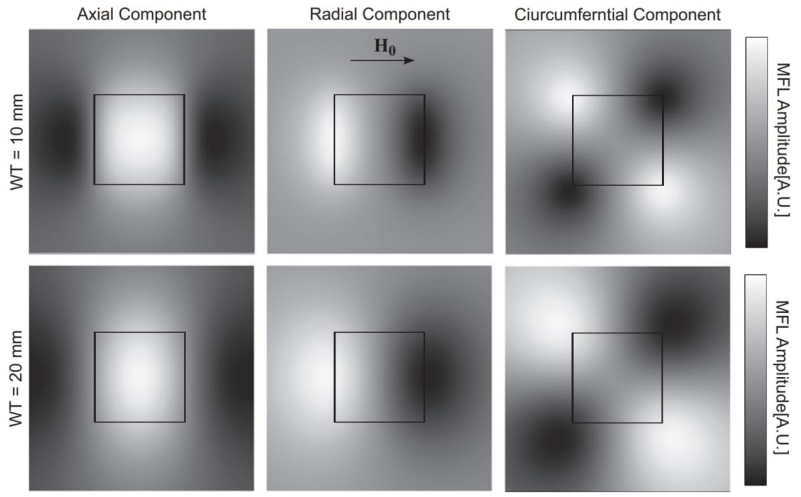


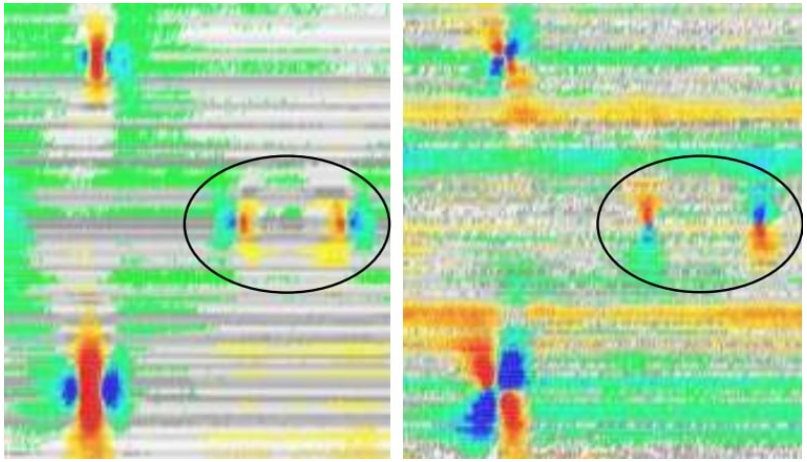
3D MFL and magnetic field gradient data



Anomaly sizing is performed automatically by machine learning algorithms. This picture shows the internal data that the machine works with. You can see outlined edges. This has been achieved using magnetic field gradient sensors which applied in our tools.

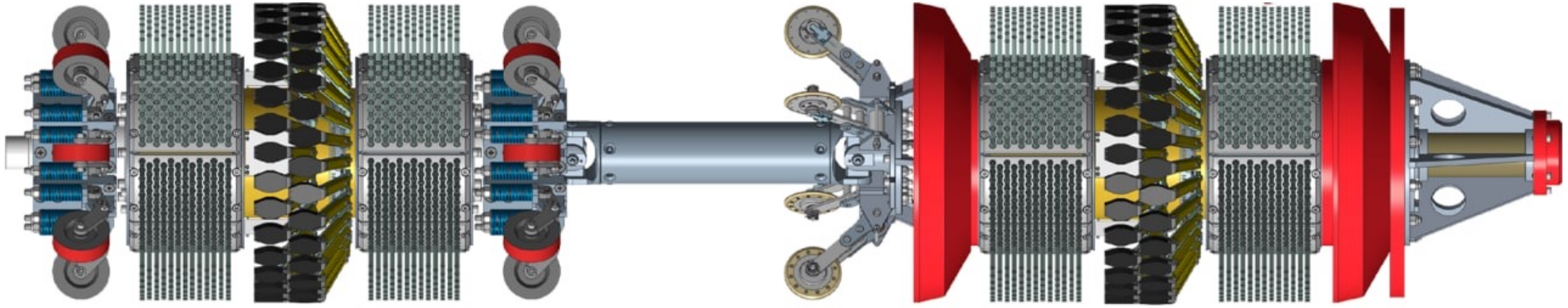
3D MFL data and real metal loss size in the left image Lonhithudinal anomaly 3D indication in the right image



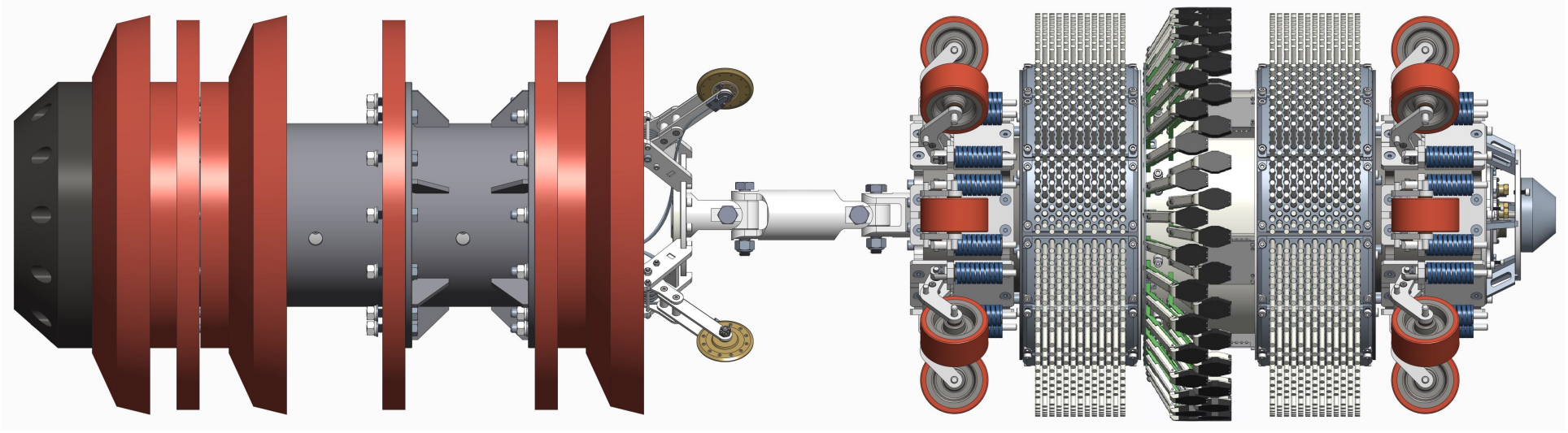


This is a simplified principle of 3D MFL. The axial (longitudinal) component has a maximum at the anomaly deepest point. The radial component highlights the edges along the length. The circumferential component highlights the edges along the width.

3D High-Resolution MFL with High-Resolution ID/OD secton

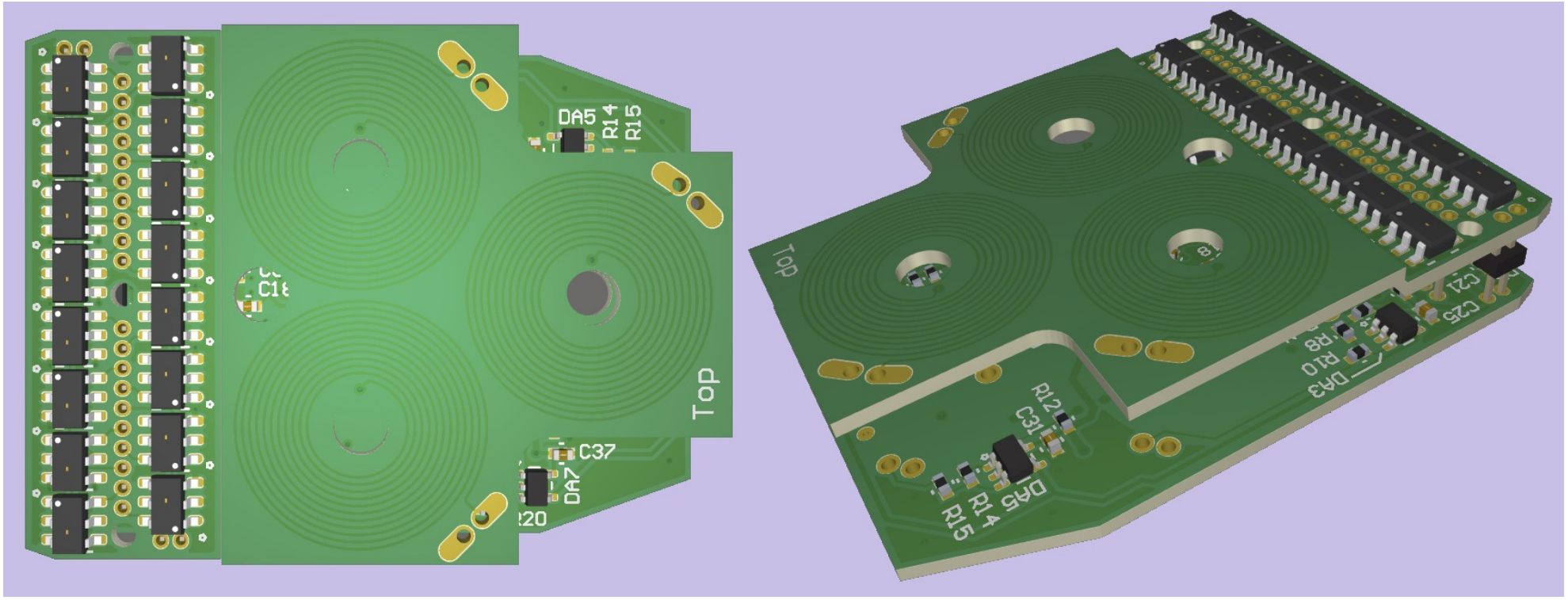


3D Ultra-High-Resolution MFL

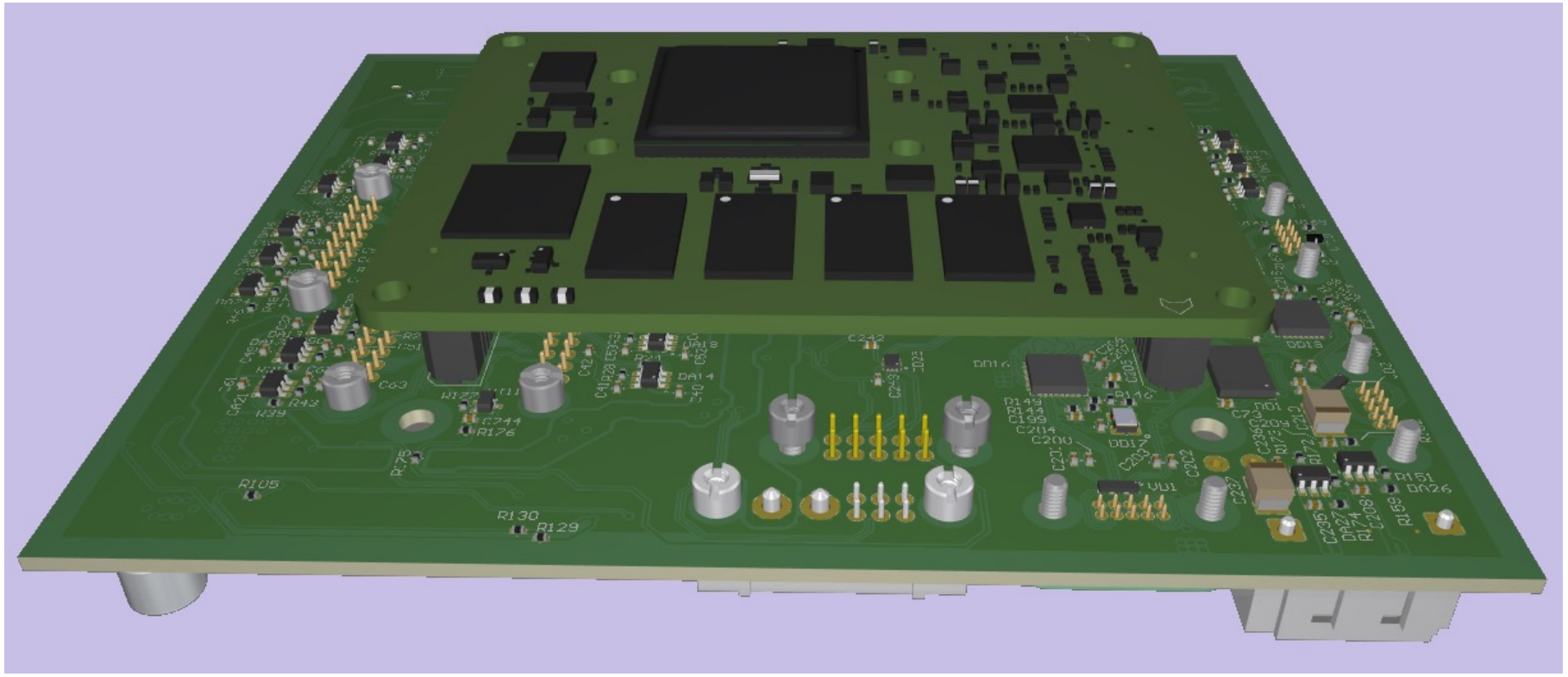


The sensors quantity in few times bigger than in previous generation of ILI tools which allow to improve significantly the resolution of tool

3D Ulta-High-Resolution MFL sensor with eddy current coils, circumferential sensor spacing is 1.5 mm, coil spacing 8 mm

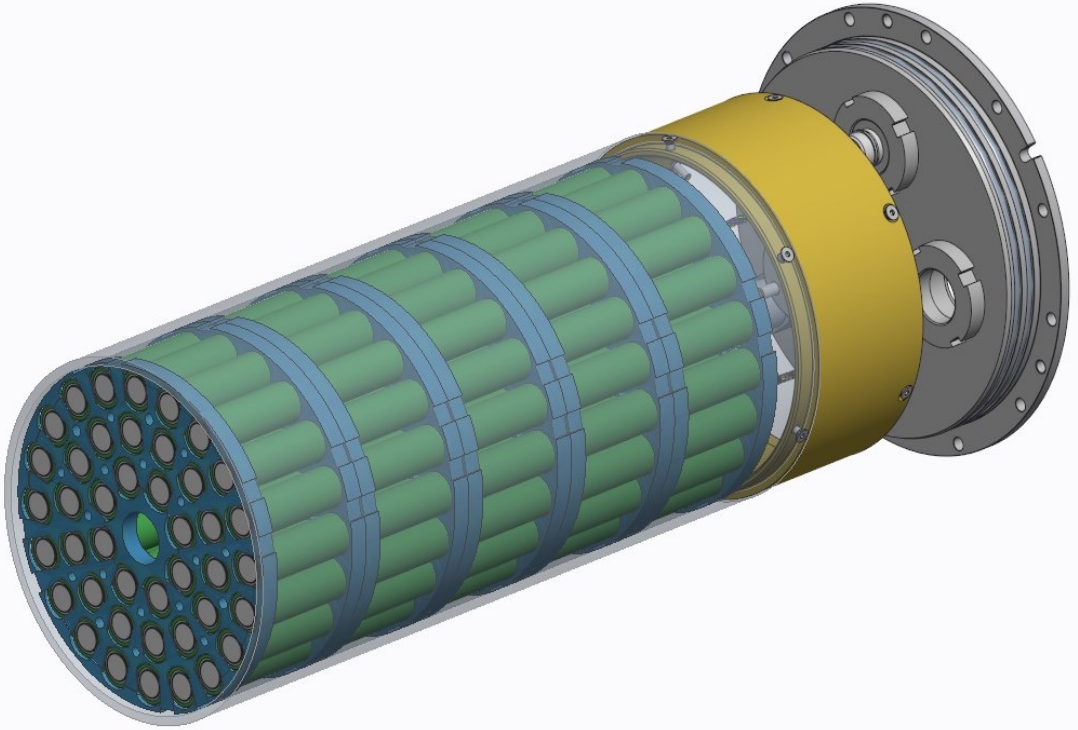


Inline inspection tool internal electronics



Primary battery and Rechargeable battery

Application of rechargeable battery allows to decrease operational expenses



ATEX certification

Certificate of Conformity

pyramid

Active Alliance LLC

Andriushchenka str. 4D, Kyiv, 01135, Ukraine

This is to certify that the Requirements of the above organisation has been assessed 2014/34/EU Directive by Pyramid Certifications LLP applicable to following products for

ATEX

Product : In-Line Inspection GEO & MFL Tool (4"- 56")

Description of product:
In-Line Inspection Tools are used for detection, measurement and categorisation of metal loss, corrosion, cracks and geometry features within the pipe wall of high pressure steel pipelines. The tools are pushed by the product stream and scans the wall of the pipeline with specific sensors. Data is processed and stored in electronics sub-systems inside the tool. These section include: battery section, electronics sections and sensor carrier sections, which can be combined. Standalone battery section or combined battery/electronics sections of the tool are considered explosion protected sections. Explosion protection is provided by hermitically sealed container filled and pressurised with inert gas and intrinsic safety system that prevents energising any part of the tool in potentially explosive zones.

Certificate No. : FATINT157921
Initial Certificate Date : 02.06.2021
Certificate Date : 23.09.2021 (Reissue)
Valid Until : 01.06.2024

Ex II 2G Ex pxb ib IIB T4 Gb

DIRECTOR

The certificate of conformity is issued against sample meeting the Essential Safety Requirements for the above directive. The Sample is tested against IEC 60079-1,18 and has been registered on the request of the manufacturer by Pyramid Certifications LLP. The Certificate is the result of Tests carried out on samples and does not represent the serial production of these products. The certificate remains valid until the manufacturing conditions or the quality system are changed.

This certificate is the property of Pyramid Certifications LLP and must be returned on request.
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Certificate of Conformity

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Active Alliance LLC

Andriushchenka str. 4D, Kyiv, 01135, Ukraine

This is to certify that the Requirements of the above organisation has been assessed 2014/34/EU Directive by Pyramid Certifications LLP applicable to following products for

ATEX

Product : Low Frequency Signaller AAU.S Series with Low-Frequency Detector AAU.D Series. (Degree of Protection of Casing-IP68 Under Pressure 12 MPa)

Certificate No. : IATINT159121
Initial Certificate Date : 23.09.2021
Certificate Date : 23.09.2021
Valid Until : 22.09.2024

Ex II 2G Ex pxb ib IIB T4 Gb

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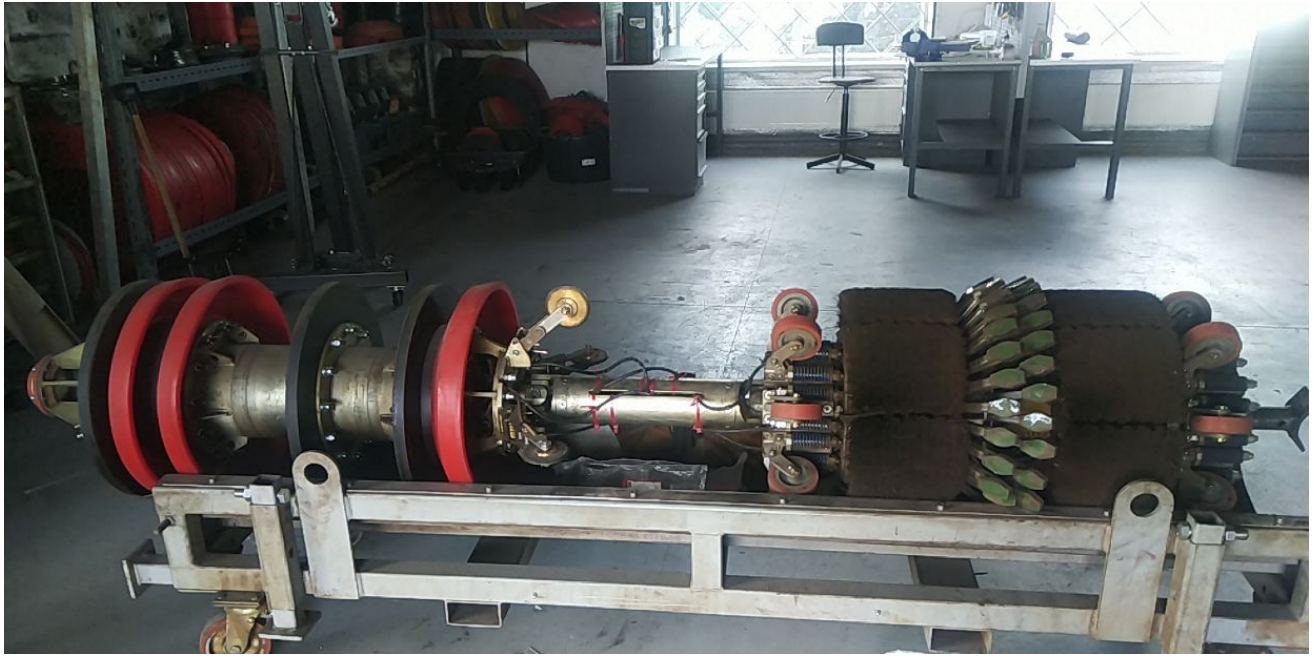
All equipment is certified according to ATEX norms

XYZ option
In-line precision pipeline route mapping and strain analysis

Communication over Wi-Fi and USB3, option to disatach data storage unit from the tool body

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