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RESEARCH & INNOVATION

ECA on Carbon Steel weld in lieu of PT

KINT - Samenwerken aan de kwaliteit van Inspectie en NDO

Congres 15/04/2026

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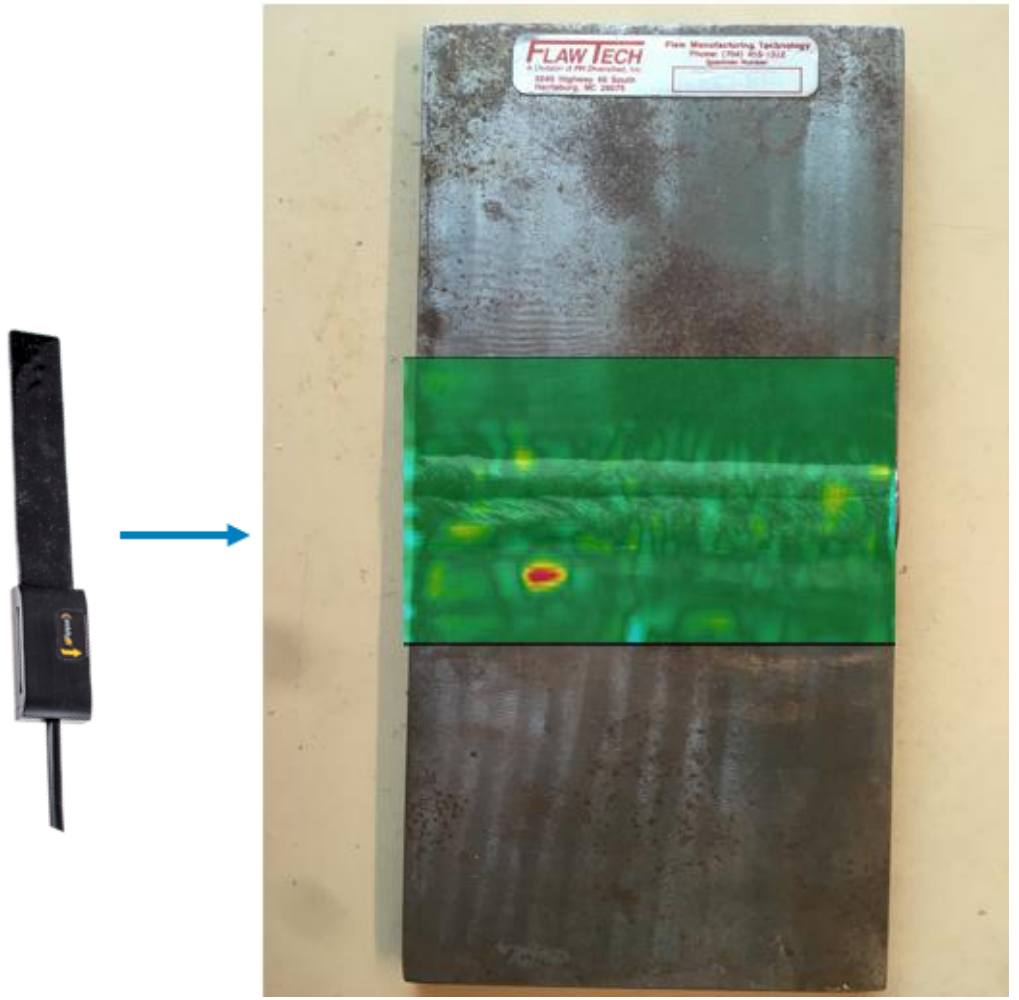
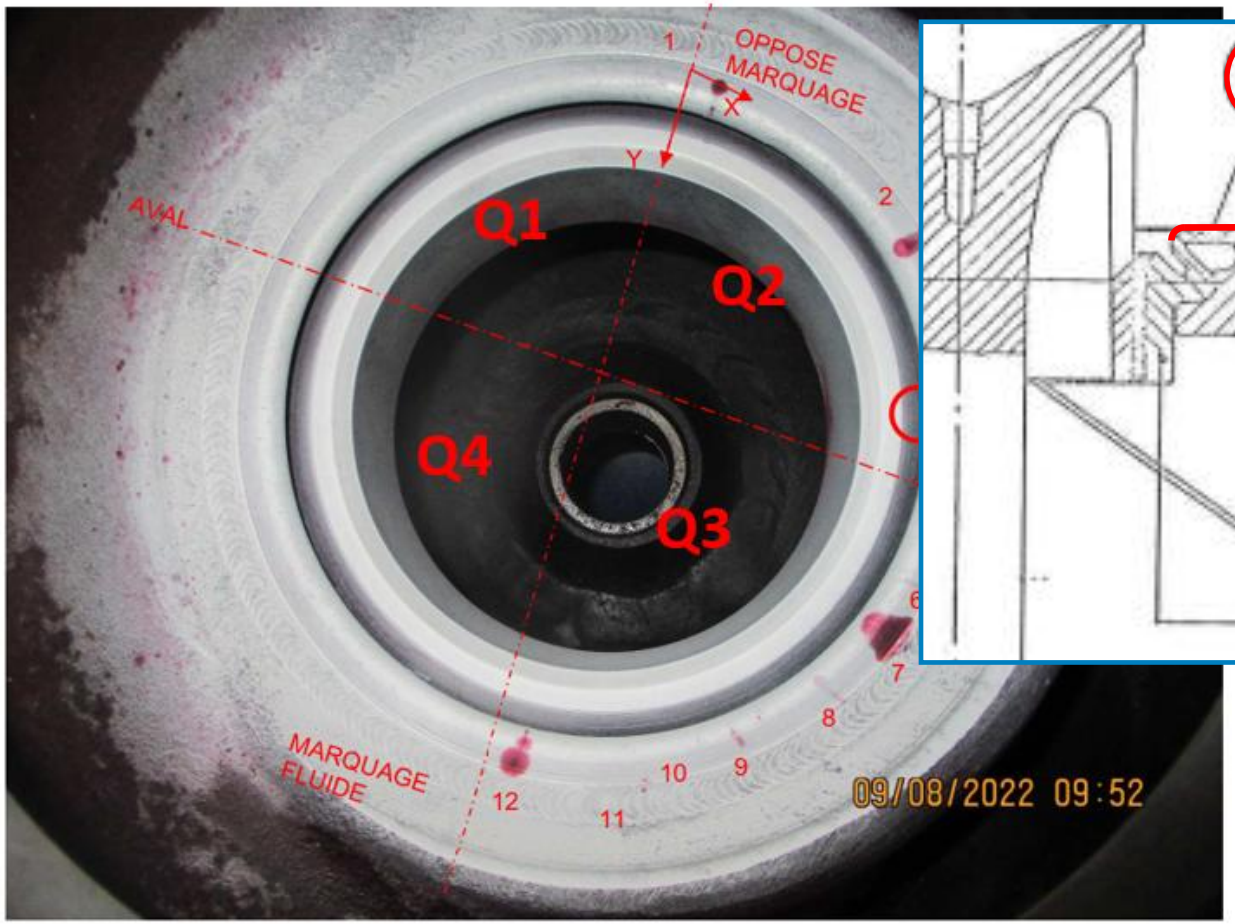
Why ECA in lieu of PT?

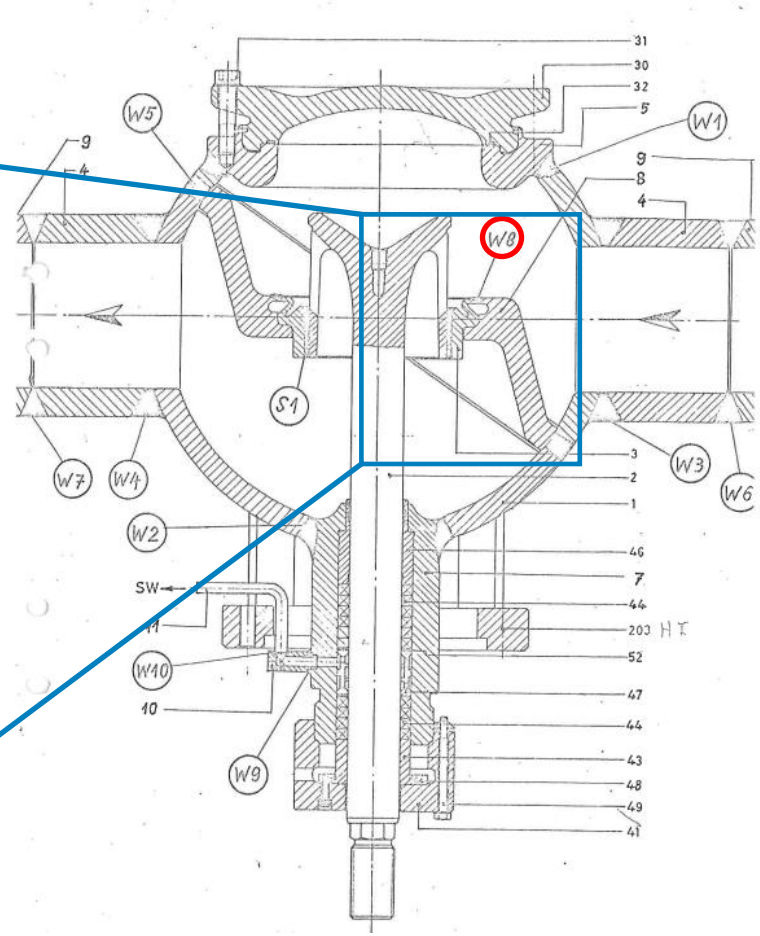
- Less dependent on environmental influences → improved repeatability compared to PT
- Fast to deploy on-site and no chemicals to be applied
- High (theoretical) accuracy
- Detailed data acquisition and post-inspection analysis (traceability)
- Versatile technique with broad variety of stock probes available
- High potential for improvements
  - custom made probes
  - automatization
  - dedicated probe topologies
  - …



Introduction

Findings regular Non-Destructive Testing (NDT): Linear flaws reported by Penetrant Testing (PT) on a Carbon Steel welded seat





Challenges

- Obsolete component
- Poor accessibility
- Non-sized linear flaws
- **How to properly track evolution over time?**

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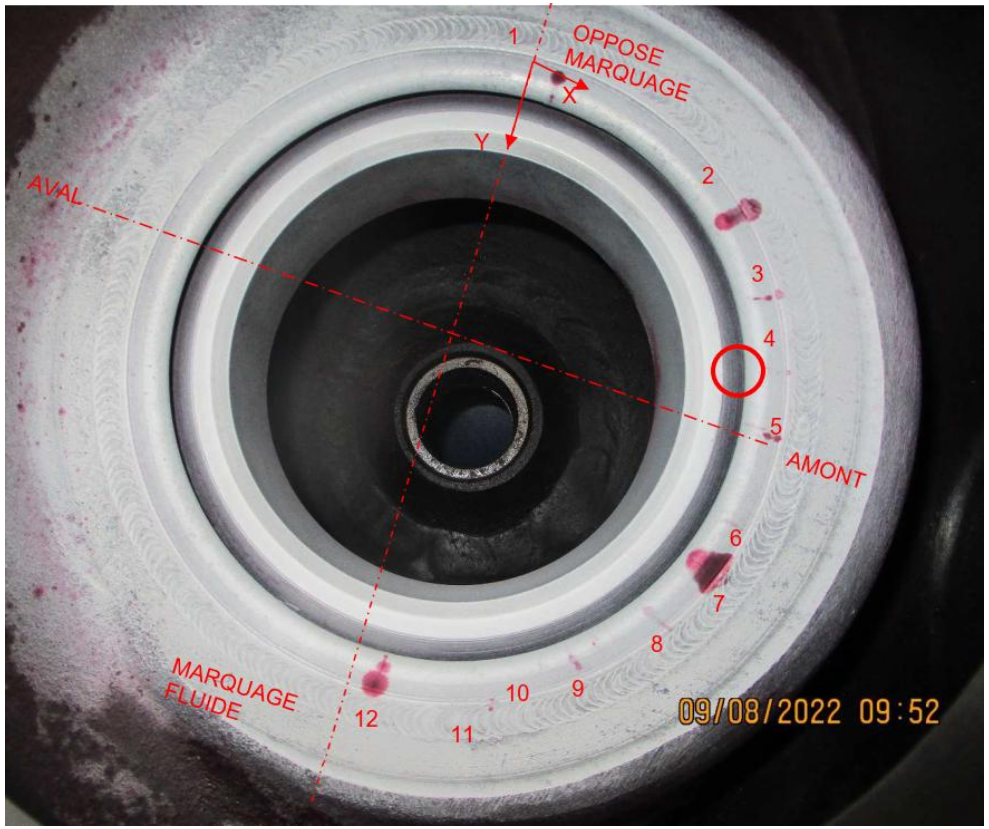
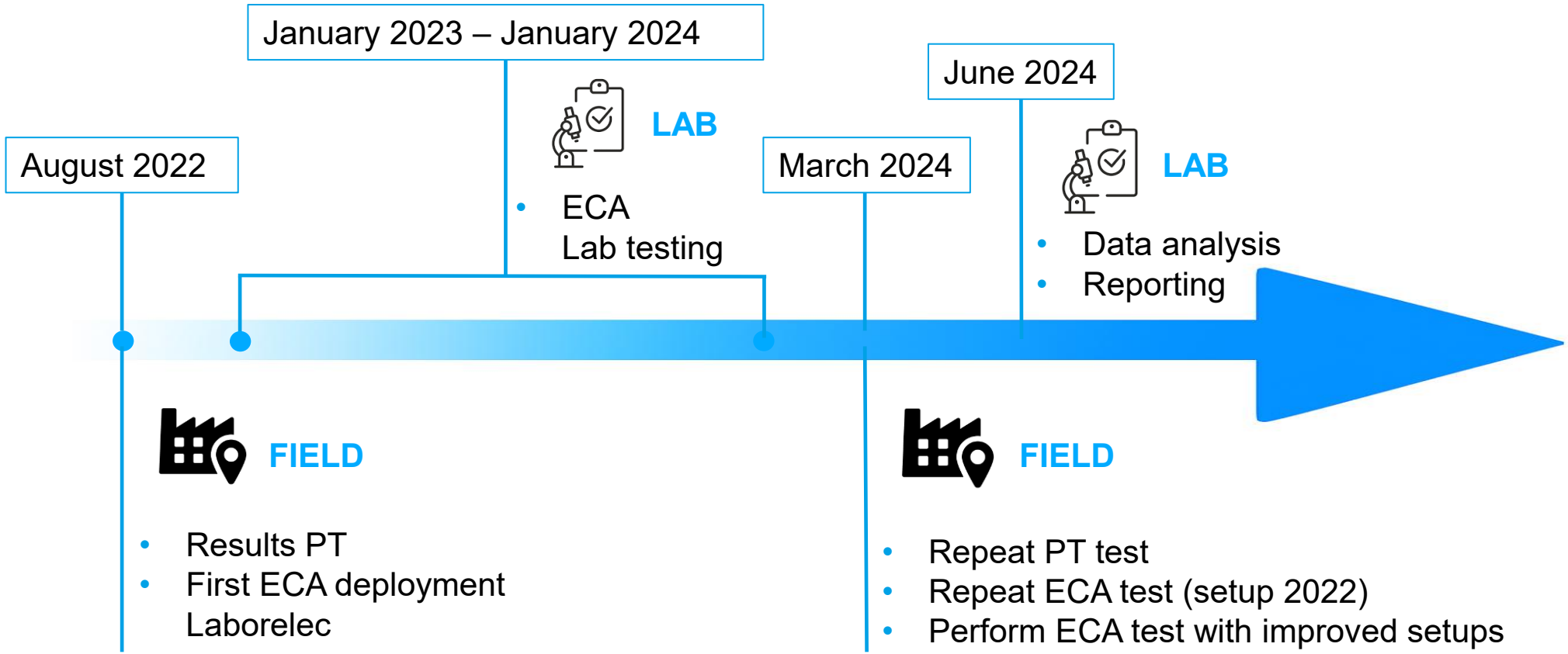
Transversal length sizing by means of **Eddy Current Array**



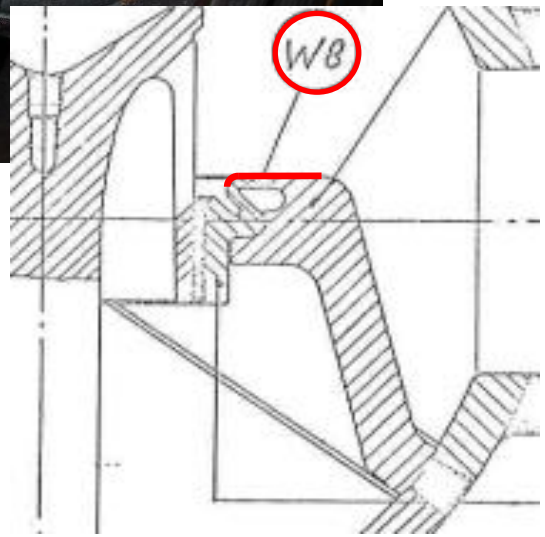
Timeline

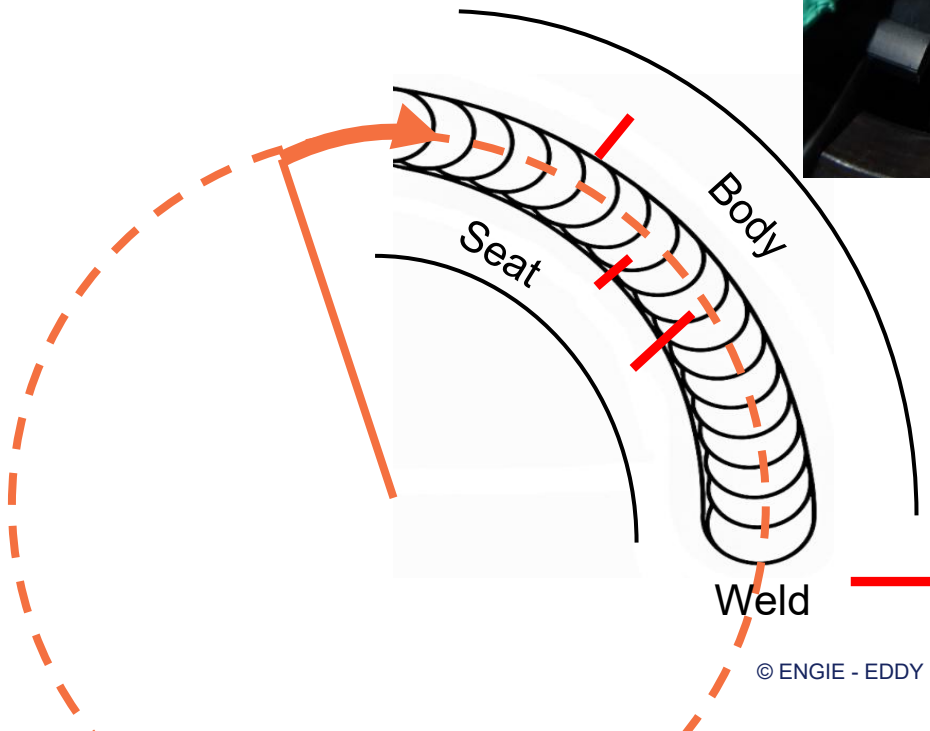


Field – On-site testing 2022

Various challenges were faced

- Short notice intervention prior to start-up
- First of a kind → no procedures available (= expertise mode)
- Lack of reference pieces – transversal flaw orientation
- Geometry
  - Limited accessibility
  - 360° manual scanning
  - Curved surface

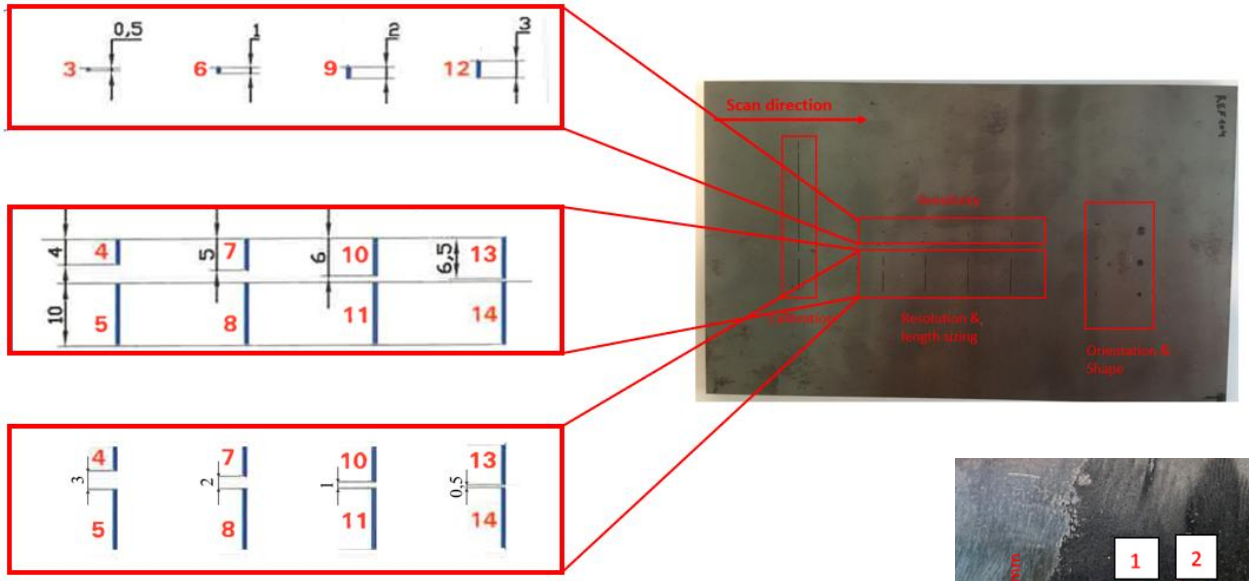


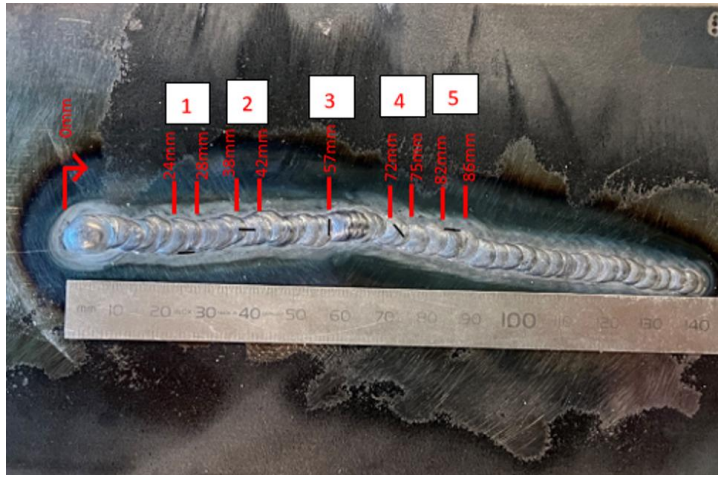


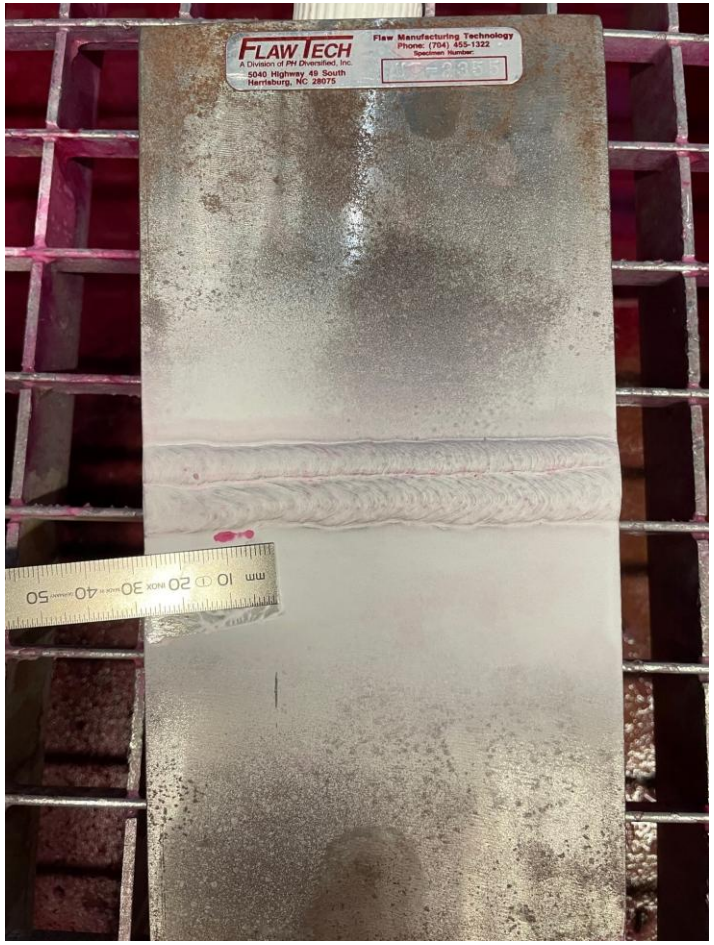
Data acquired successfully

Lab Testing

Selection and fabrication of dedicated reference pieces

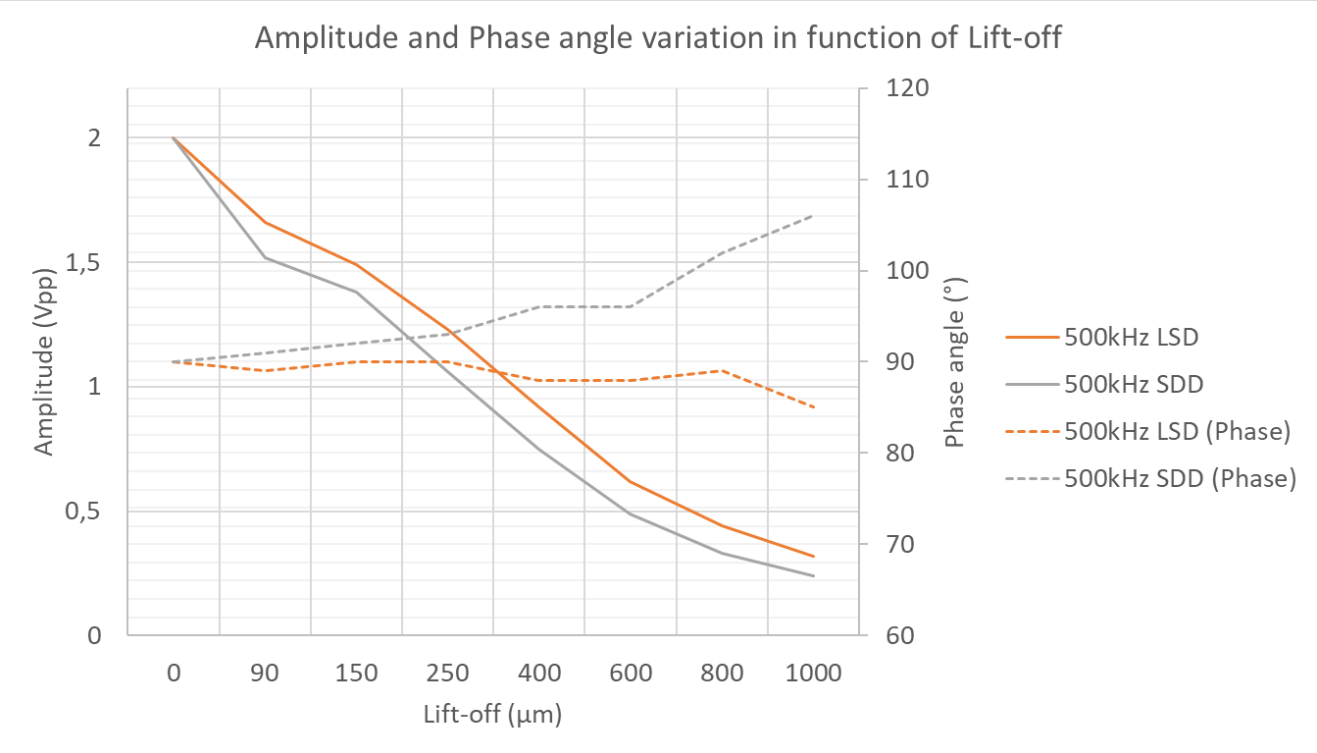






Lab Testing – Study Lift-off influences

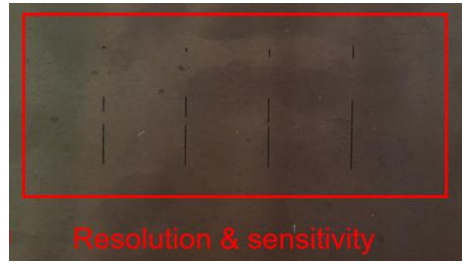
Long Single Drive topology can better withstand lift-off



- **SDD**
  - Strong amplitude decay at low lift-off levels
  - Almost immediate phase perturbation

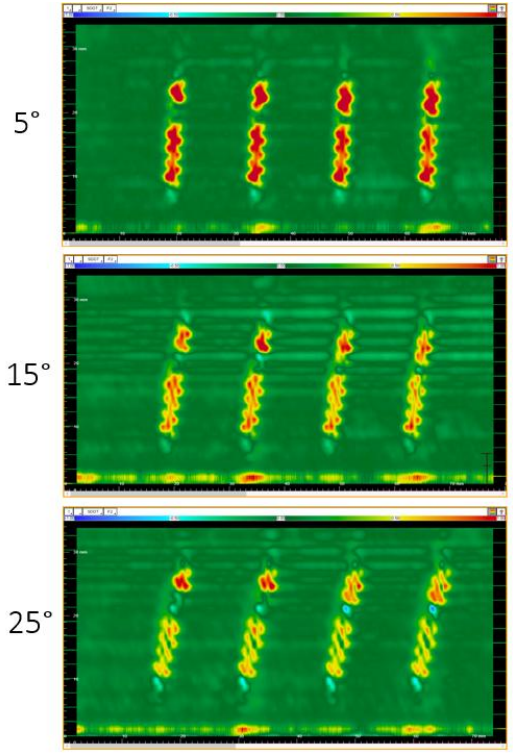
- **LSD**
  - Less amplitude decay observed
  - Phase behaves stable

Lab Testing – Effect of misalignment



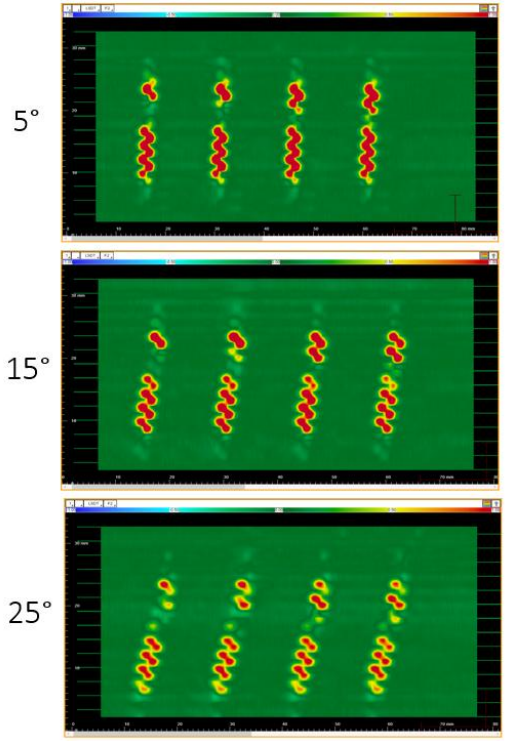
Long Single Drive topology copes better with misalignment

- **SDD**



  - Strong amplitude decay and negative phase rotation at flaw edges

- **LSD**

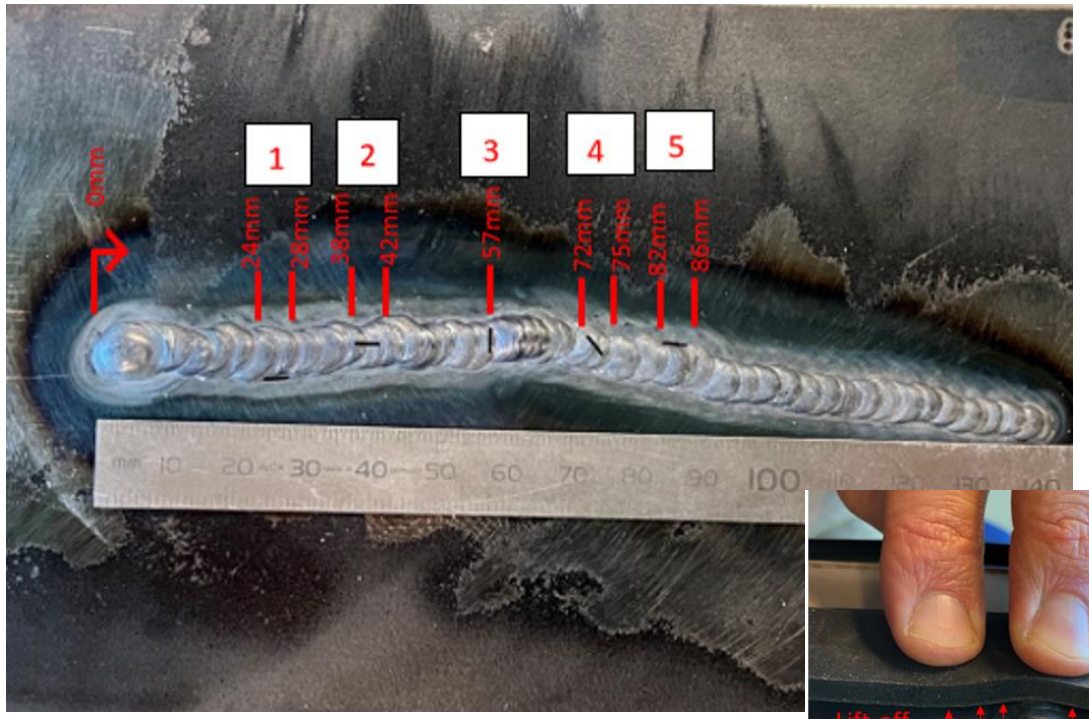


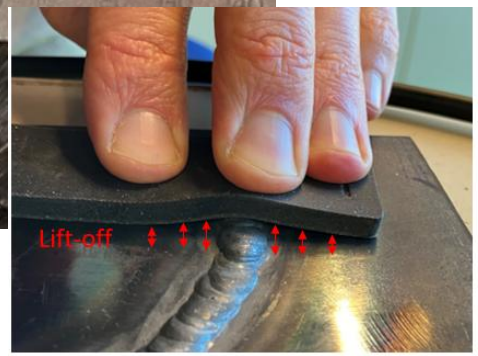
  - Less amplitude decay observed, phase angle at flaw edges remains positive

Lab Testing – Coarse weldbead with EDM flaws

Long Single Drive out stands Short Double Drive for flaw detection on a coarse weld bead

Detection of flaws - Ref 107	SDD-*		LSD-*	
	500 kHz		500 kHz	
	*A	*T	*A	*T
Flaw 1	No	No	Yes	No
Flaw 2	Yes	Yes	Yes	Yes
Flaw 3	No	Yes	No	Yes
Flaw 4	Yes	No	Yes	Yes
Flaw 5	No	No	Yes	No



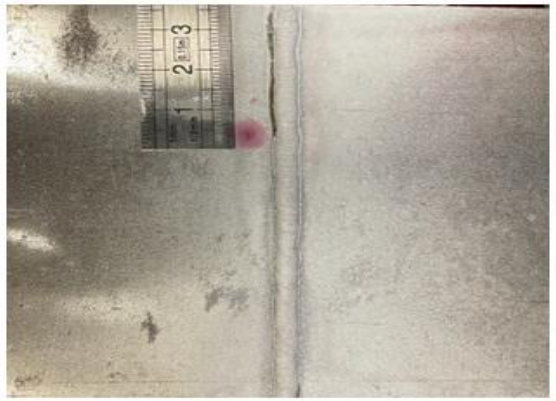


- Flaw 1 & 5 were not detected with SDD topology caused by lift-off
- LSD topology detected all flaws present

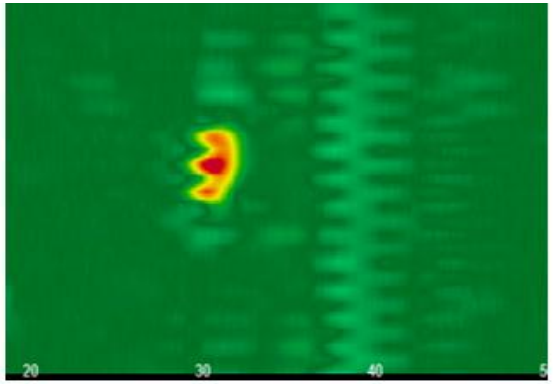
Lab Testing – Comparing PT versus ECA

Assessing and comparing ECA transversal length sizing on realistic cracks in near of welds

PT



ECA (LSD)



- ECA LSD outstands PT

	Specimen Number	UT2359
Indications acc. to Flawtech	**#Flaw Number**	#19
	Length (mm)	8
PT-Contrast	**Detected**	Yes
	Length (mm)	NA
	Visibility	Moderate
ECA (LSDT - Setup 7)	**Detected**	Yes
	Length (mm)	6,1
	Visibility	Good
ECA (SDDT - Setup 6)	**Detected**	No
	Length (mm)	NA
	Visibility	NA

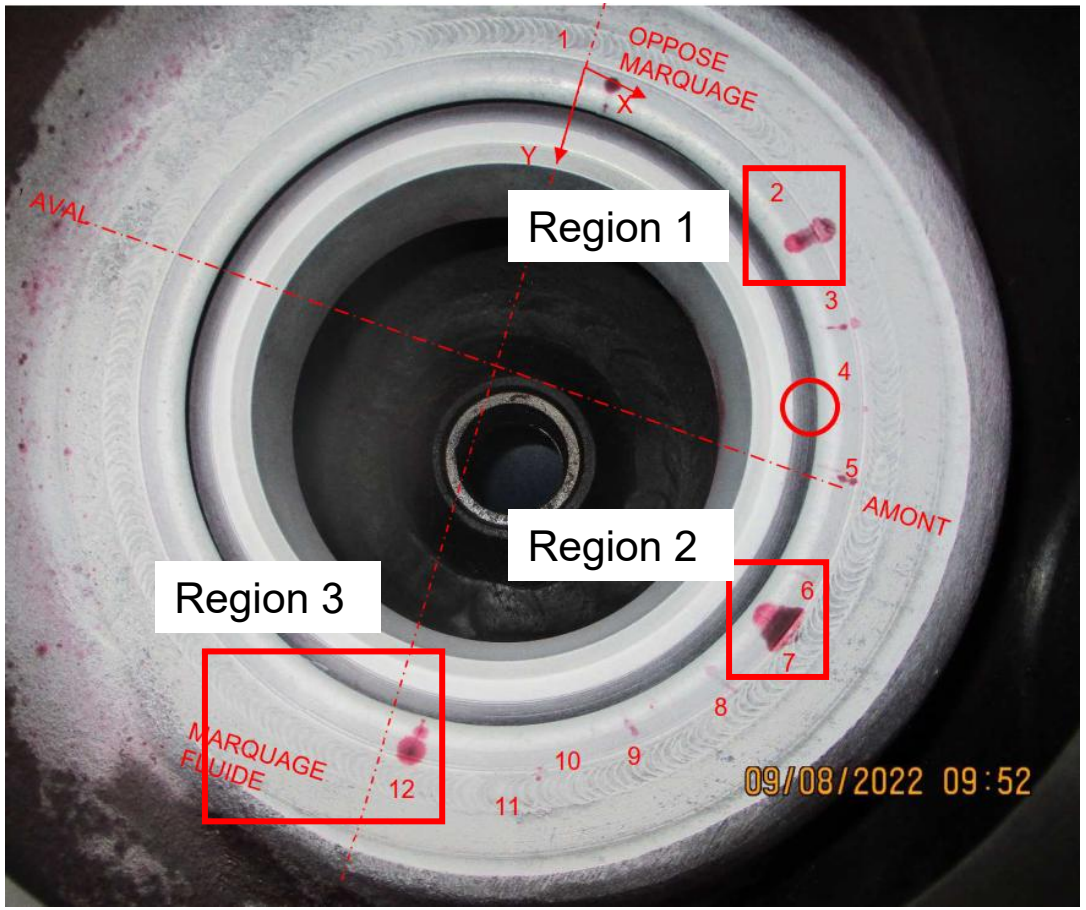
Field – On-site testing 2024

- Tests of 2022 were repeated
- Additional setups were tested
- Geometry
  - Limited accessibility
  - Curved surface
  - 360° manual scanning

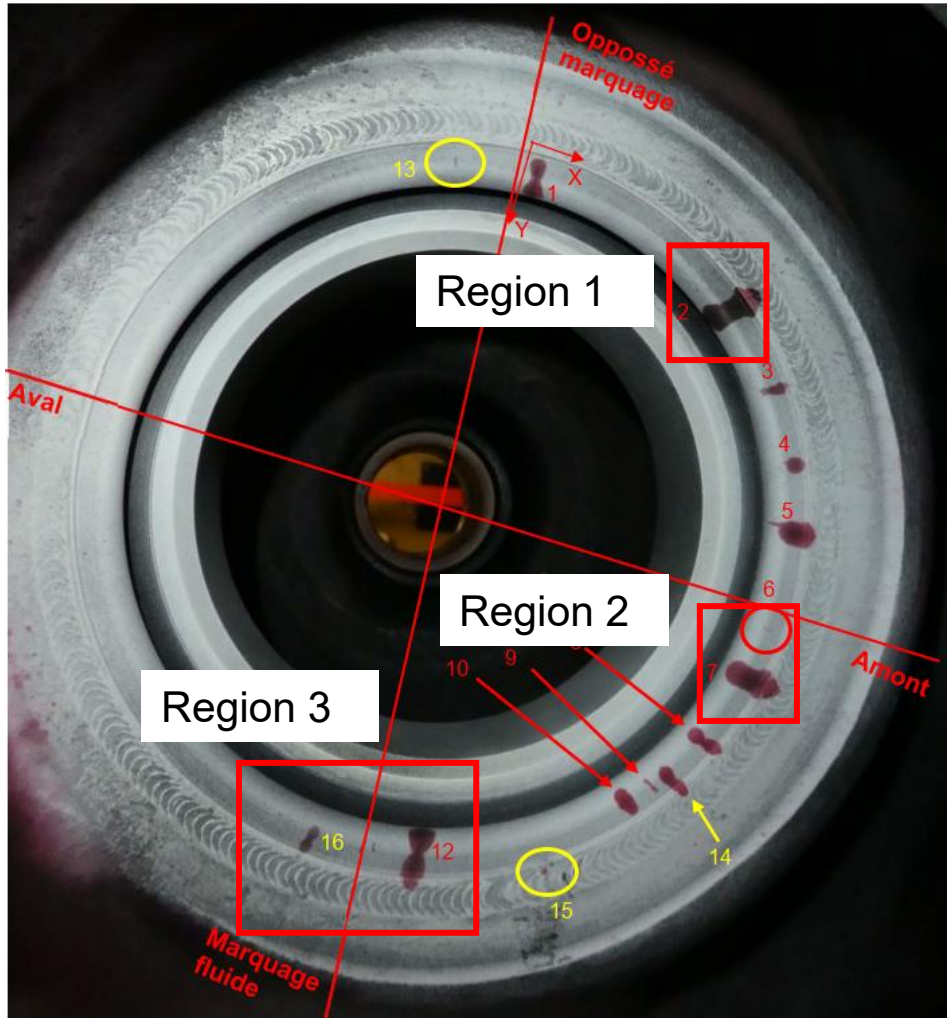
Comparable data acquired + new ECA insights obtained

Field – PT results & selection of interesting flaws

PT 2022



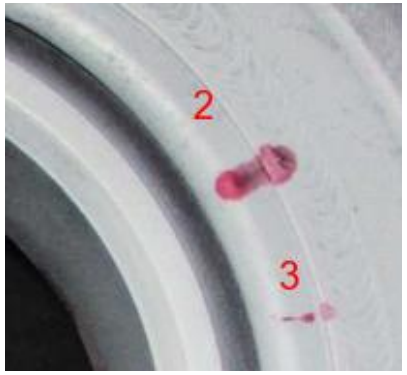
PT 2024



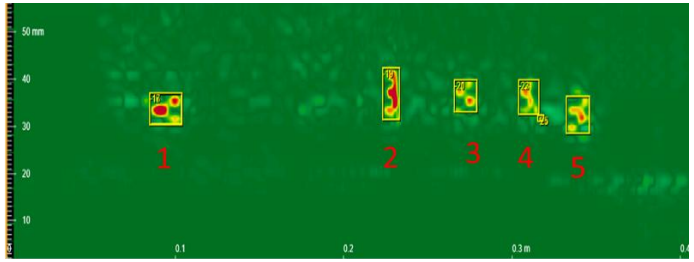
Lab – Data analysis and Reporting

Region 1 - ECA proves increased resolution (flaw 2)

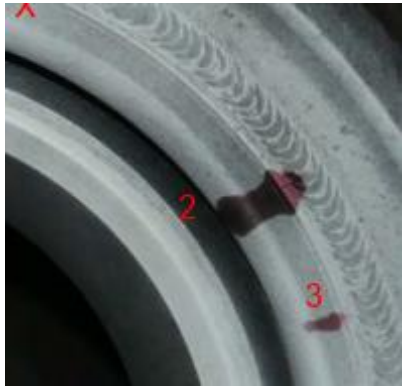
PT 2022



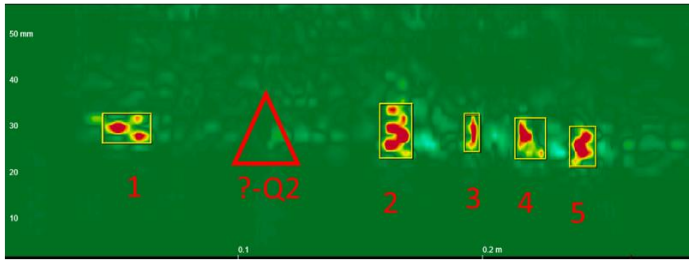
ECA 2022



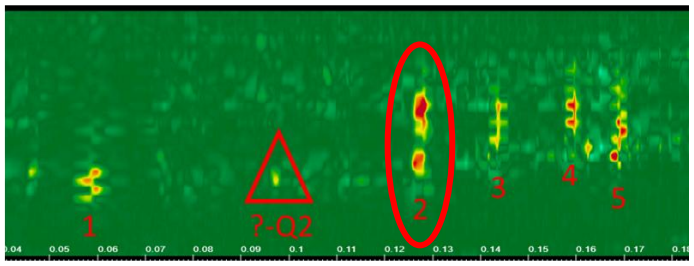
PT 2024



ECA 2024
Iflex 250



ECA 2024
Iflex 500HR

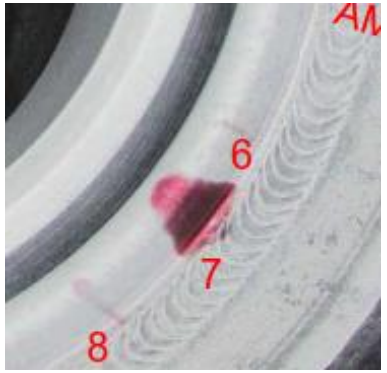


- **PT:**
  - Flaw detected and characterized as linear during both outages
  - Evolution seems to be observed based on length
- **ECA:**
  - Flaw detected and characterized as linear during both outages
  - No growth evolution observed
  - In 2024 ECA HR SDD revealed a discontinued indication

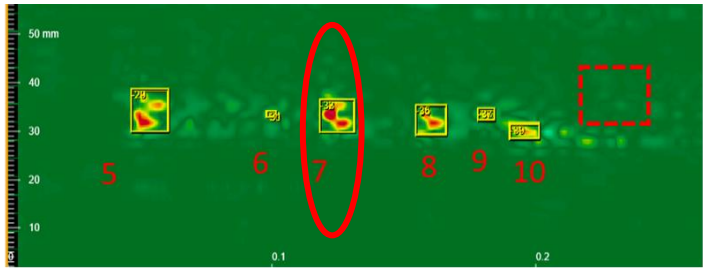
Lab – Data analysis and Reporting

Region 2 - ECA confirms linear nature of flaw (flaw 7)

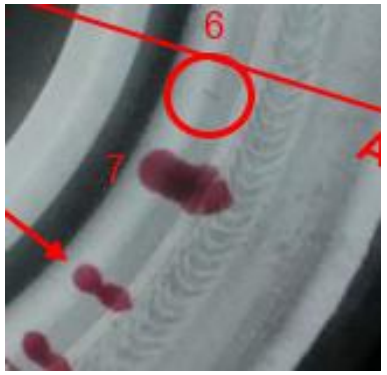
PT 2022



ECA 2022



PT 2024



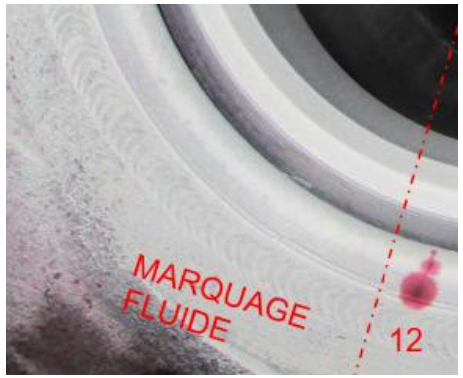
ECA 2024

- **PT:**
  - Ambiguity with regards to shape → indicates evolution of flaw?
- **ECA:**
  - Linear shape confirmed
  - No evolution to be noted

Lab – Data analysis and Reporting

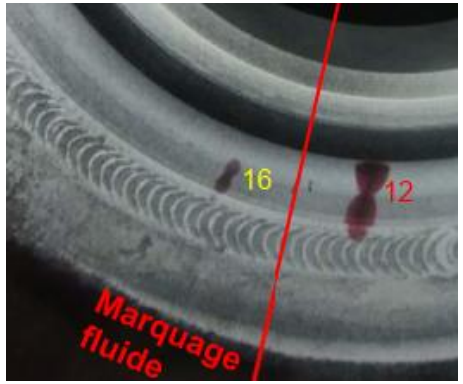
Region 3 - ECA demonstrates enhanced sensitivity (Flaws 12, 16 & 17)

PT 2022



ECA 2022

PT 2024



ECA 2024

- **PT:**
  - 1 flaw reported in 2022
  - 1 new flaw appeared over time
  - Flaw 12 seems to evolve over time
- **ECA:**
  - 2 flaws reported in 2022
  - 3 flaws reported in 2024
  - Flaw 12 remained stable over time

Lab – Data analysis and Reporting

Limited evolutions are observed – automated sizing (=amplitude based) is preferred

- Delta of reported lengths – 2024-2022

Delta of flaw lengths: 2024-2022	SDD Transversal channel (Setup V169_2022-2024) Automated Procedure B 500 kHz Length (mm)
Flaw 1	-0,5
Flaw 2	0
Flaw 3	0
Flaw 4	-0,5
Flaw 5	-1,6
Flaw 6	-0,1
Flaw 7	0
Flaw 8	-1,6
Flaw 9	1,7
Flaw 14	Not detected - 2022
Flaw 10	1
Flaw 11/15	Pseudo flaw
Flaw 12	0
Flaw 13	Not detected - 2022
Flaw 16	0,5
Flaw 17	Not detected - 2022

- Positive length evolution observed on 2 flaws
- 3 new flaws appeared
- Negative “growth” caused by:
  - Data-acquisition quality
  - Non-optimized 2022 setup

= within defined tolerance of Iflex 250 probe

Conclusion

- **Enhanced observations:** transversal flaw detection and evolution of # indications present could effectively be observed. Moreover, the ECA technique revealed high resolution which led to optimized flaw characterisation
- **Sizing capabilities:** sizing was possible however improvements with regards to data quality should be considered (e.g.: encoded scanning, automatized scanning, custom probe, sizing procedure…)
- **Valuable inspection data**: ECA data is available at all time and can be consulted for future purposes / requests

- **Topologies**: clear differences were identified between the tested topologies, each with their own strengths and weaknesses
  - **LSD Topology**: better withstands the effects of coarse/irregular (welded) surfaces, however system sensitivity is partially sacrificed
  - **SDD Topology**: exhibited high sensitivity, capable of detecting very short flaws (e.g., 0.5mm) on smooth surfaces

Next steps

- **Automatization solutions:** investigate conceptual solutions for automation
- **TECA performance comparison:** compare the performance of TECA on CS against ECA (ax. length sizing)

- **ECA driving topologies**
  - **Sizing Procedures**: develop specific sizing procedures for the Long Single Drive topology.
  - **Performance Assessment**: evaluate the performance of Impedance and Short Single Drive topologies

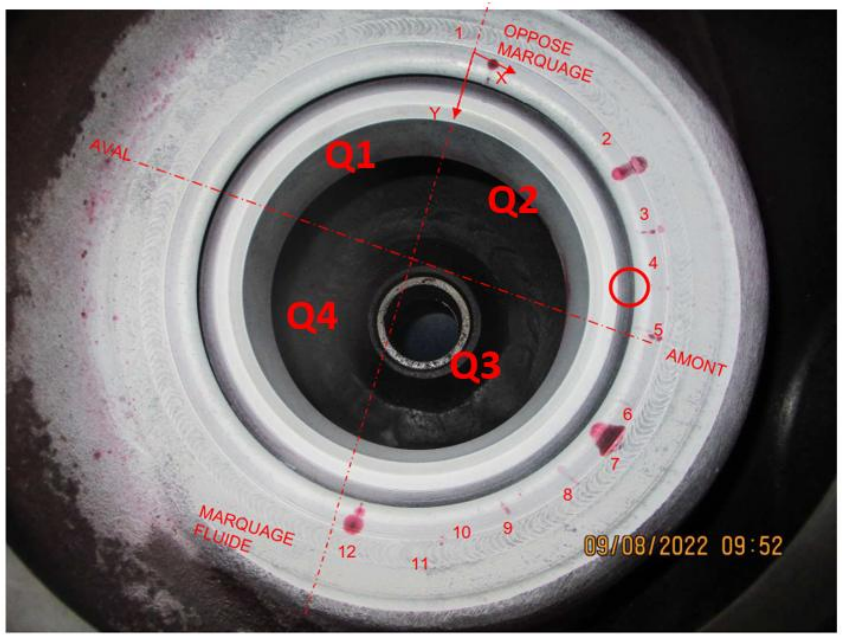
- **Non-Ferro Materials:** examine ECA performance on non-ferrous materials (**project on-going**)

Q&A

Thanks for your attention!

Q&A

Thanks for your attention!



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