Pipeline Inspection Ultilizing Ultrasound Technology: On the Issue of Resolution

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In-Line Inspection

- Today a standard procedure,
- Major task: Provide accurate data regarding length, depth, width, circumferential orientation and location of flaws,
- Analyzed data will provide geometric information needed for integrity assessment and fitness-for-purpose studies,
- Free swimming tools: pumped through pipelines, fully autonomous: energy, data acquisition,
- Cable operated tools: use a cable for data transfer and/or energy transfer and/or drive,
- Major flaw categories: geometric flaws, leaks, metal loss and cracks.

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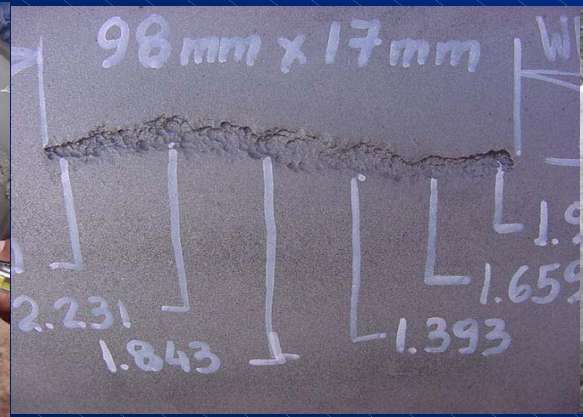
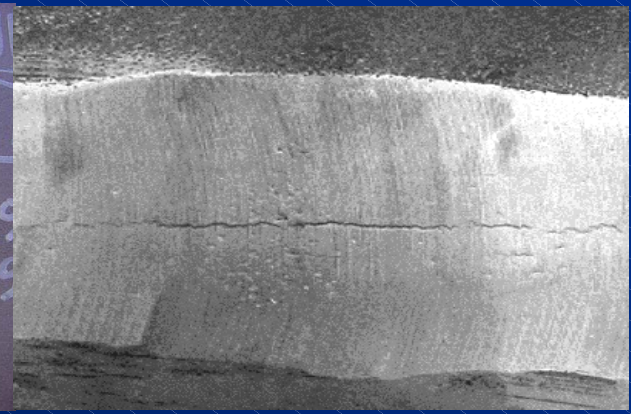
NDT-Principles

- Magnetic Flux Leakage
- Eddy Current Technology
- Ultrasound Technology

General Corrosion



Narrow axial extended corrosion (NAEC)



Crack in weld zone

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Modular Concept

Crack Inspection

Combined Inspection

Wall Thickness Measurement

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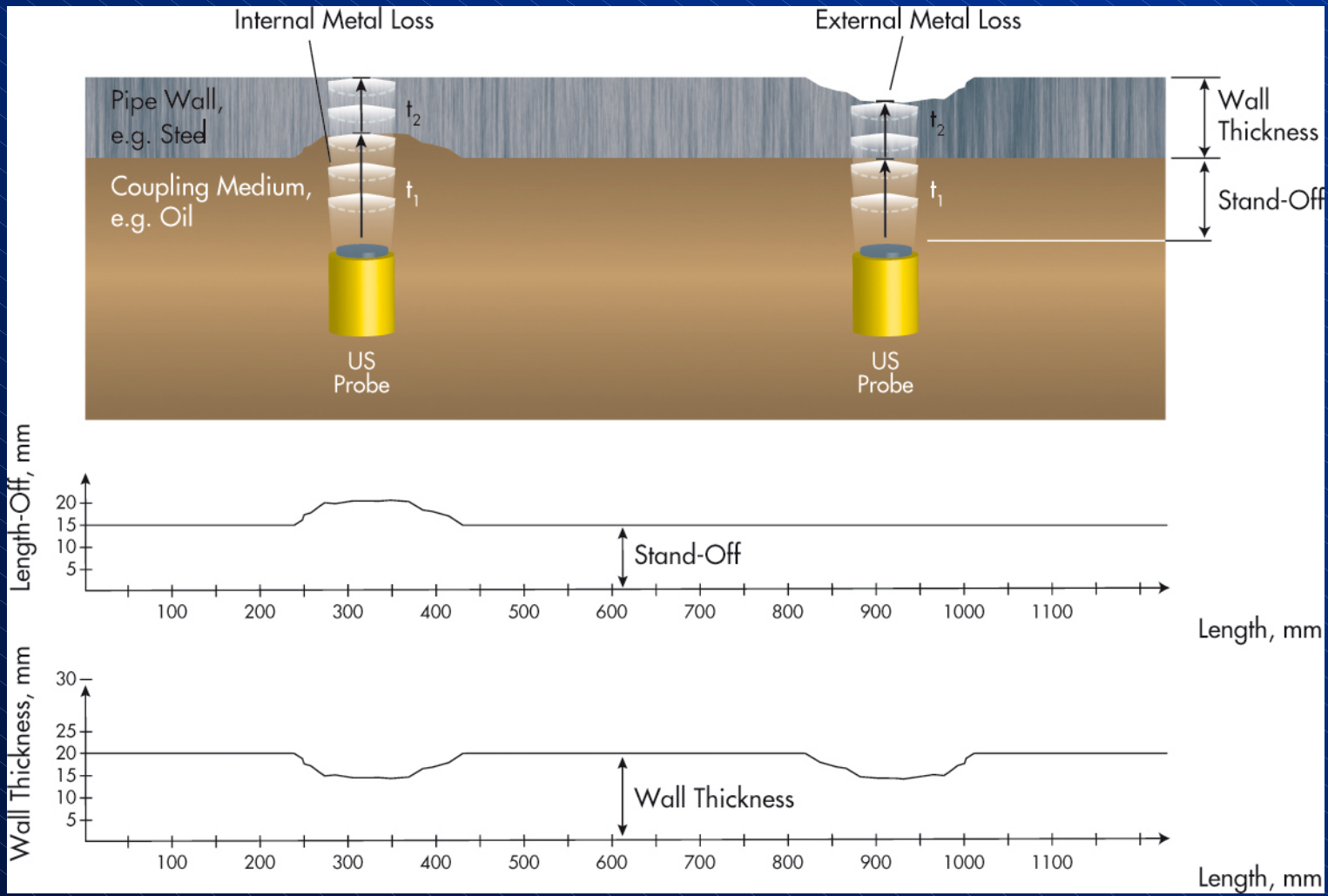
UT-Principle: Wall Thickness Measurement



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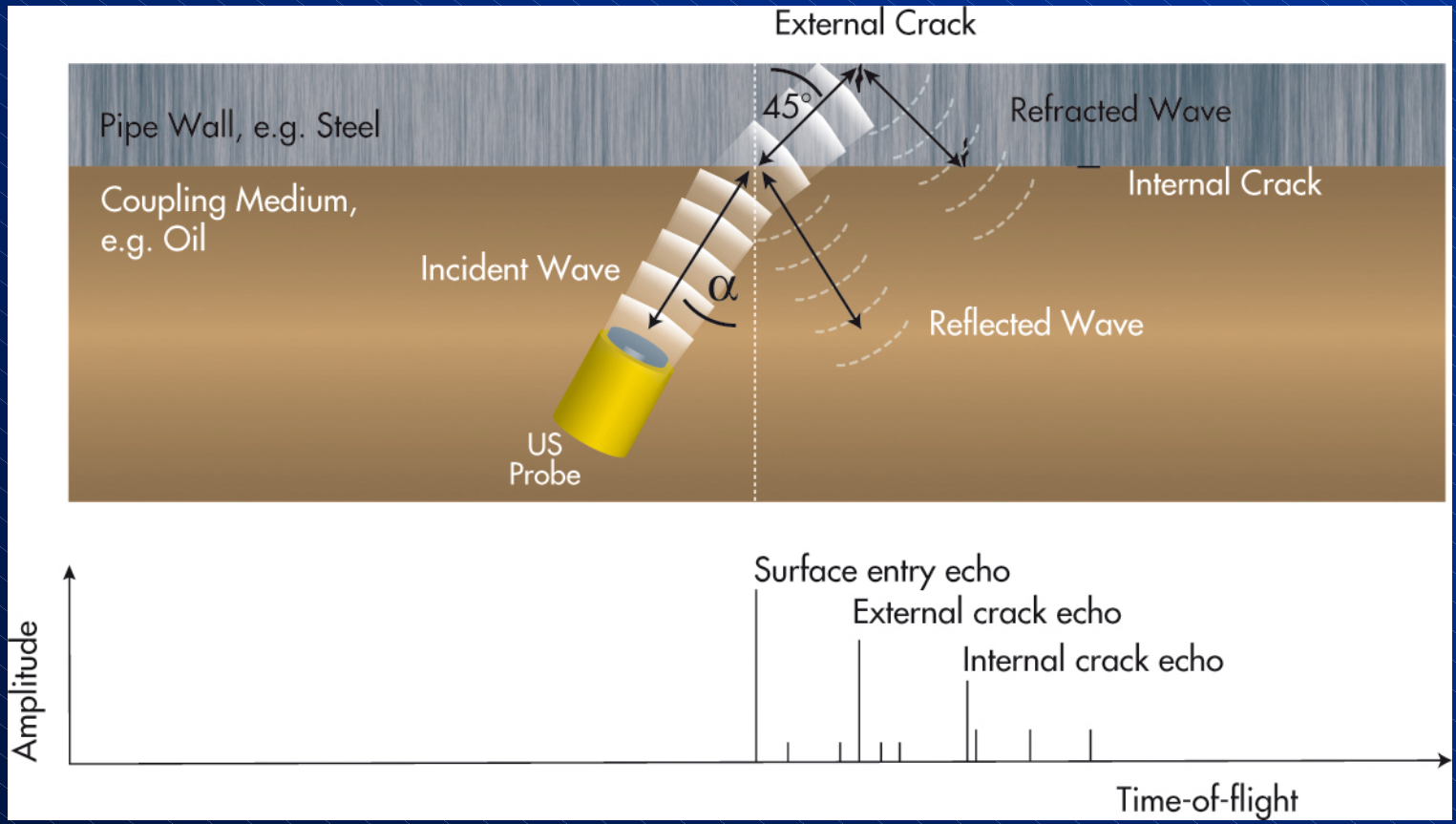
UT-Principle: Crack Detection



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Comparison UT-MFL

Feature	UT	MFL
Confidence Level	90-95%	80%
Depth threshold Eg. For 15 mm wt For 25.4 mm (1")	0.7 - 1 mm 0.7 - 1 mm 0.7 - 1 mm	Appr. 0.1 wt 1.5 mm 2.54 mm
Depth sizing accuracy	± 0.2 mm	appr. ± 10% wt
Metal loss measurement	Quantitative	Qualitative
Crack detection	Yes	no

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Key Points

Major Advantages UT:

- True quantitative measurement (e.g. actual wall thickness measurment)
- High accuracy (wall thickness reported to ± 0.4 mm)
- No material dependance
- Can be used in ferritic and austenitic material
- High sensitivity, low threshold (min. depth 0.2 mm, resolution 0.06 mm)
- Very good repeatability (i.e. corrosion growth assessment)
- Crack detection and sizing capabilities

Disadvantages:

- Needs a liquid couplant (i.e. batch in a gas pipeline)
- Max. speed with full specs limited to 2.5 m/s.

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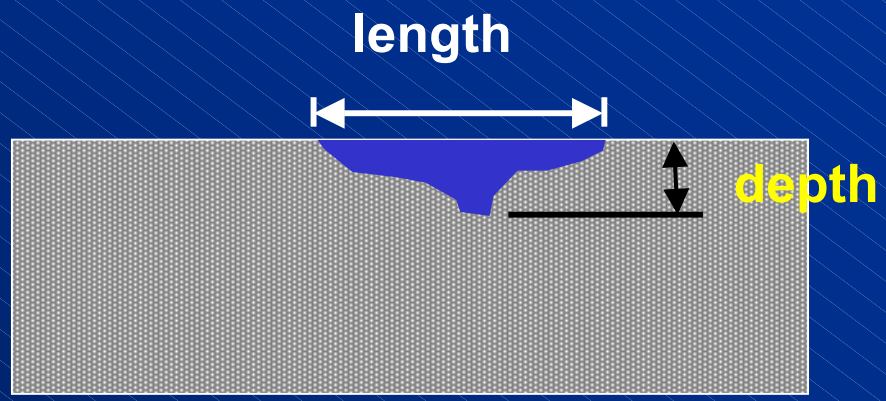
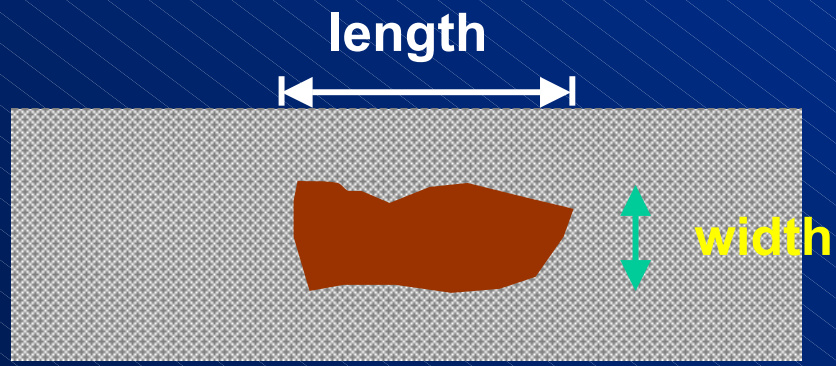
Three Dimensions of Resolution

Length Resolution

Depth Resolution



Width Resolution



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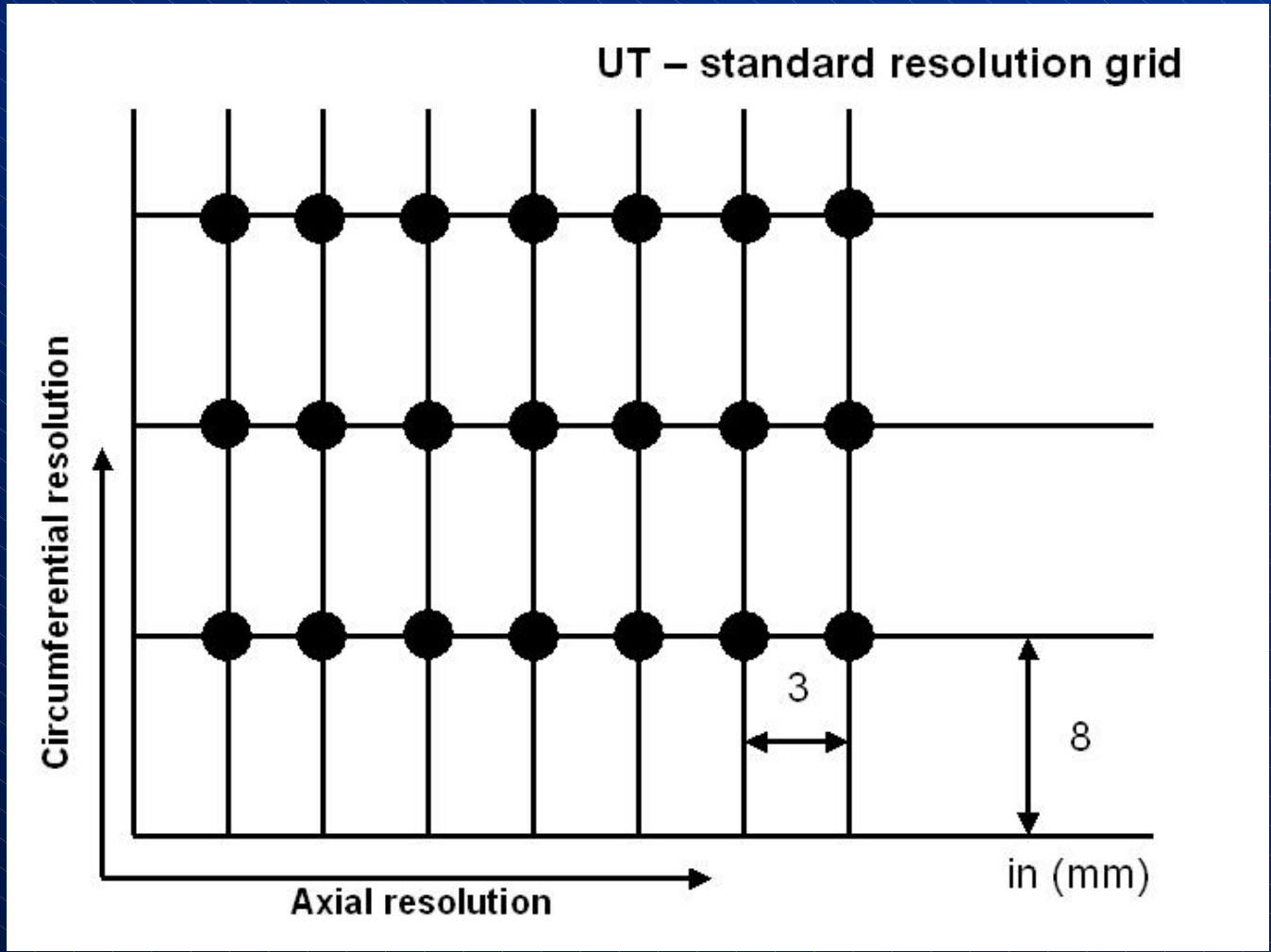
Resolution



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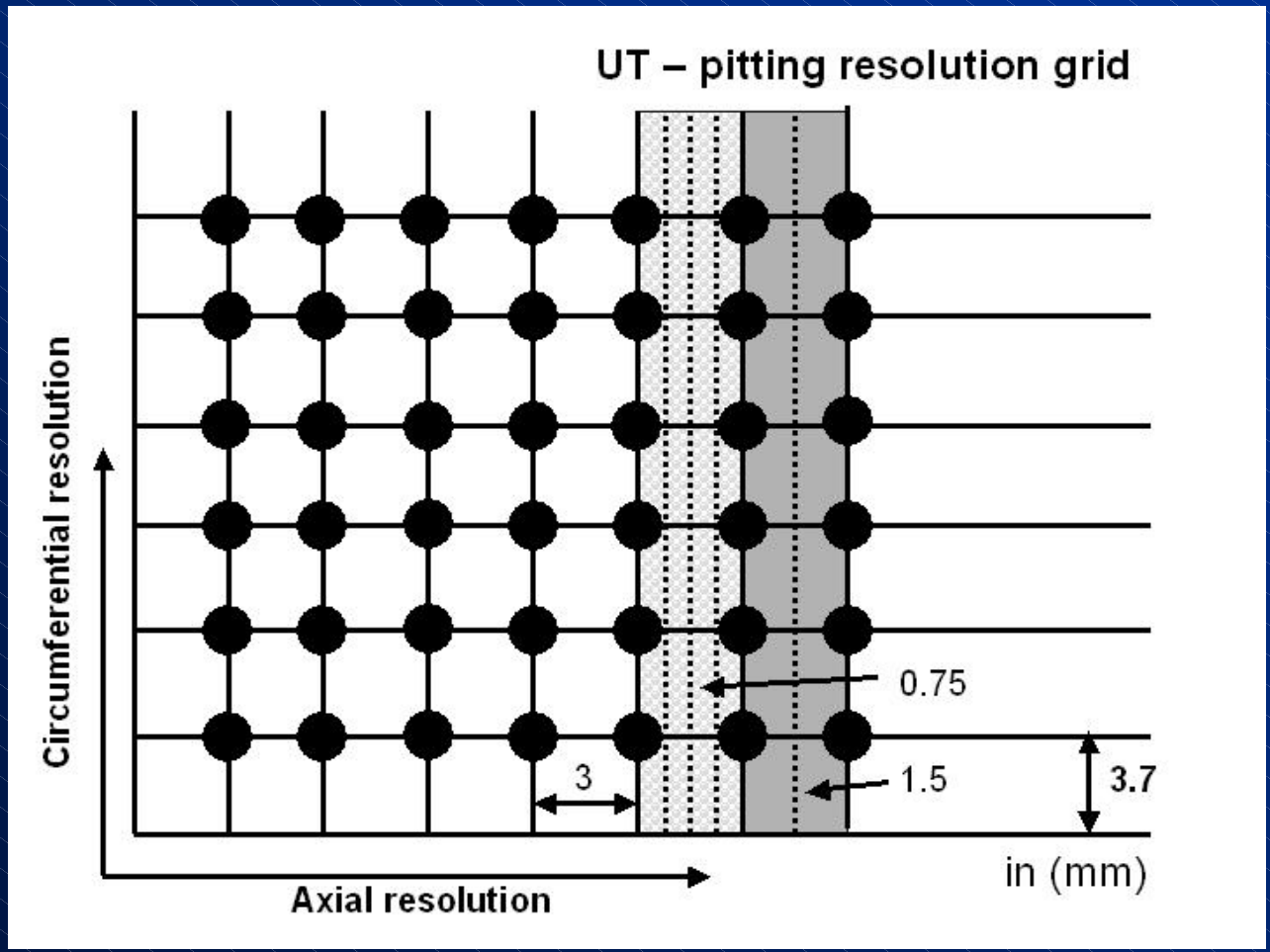
Resolution 2



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Metal Loss and Wall Thickness Measurement

7 steps
⇒ 0.2 mm resolution

22 steps
⇒ 0.06 mm resolution
new

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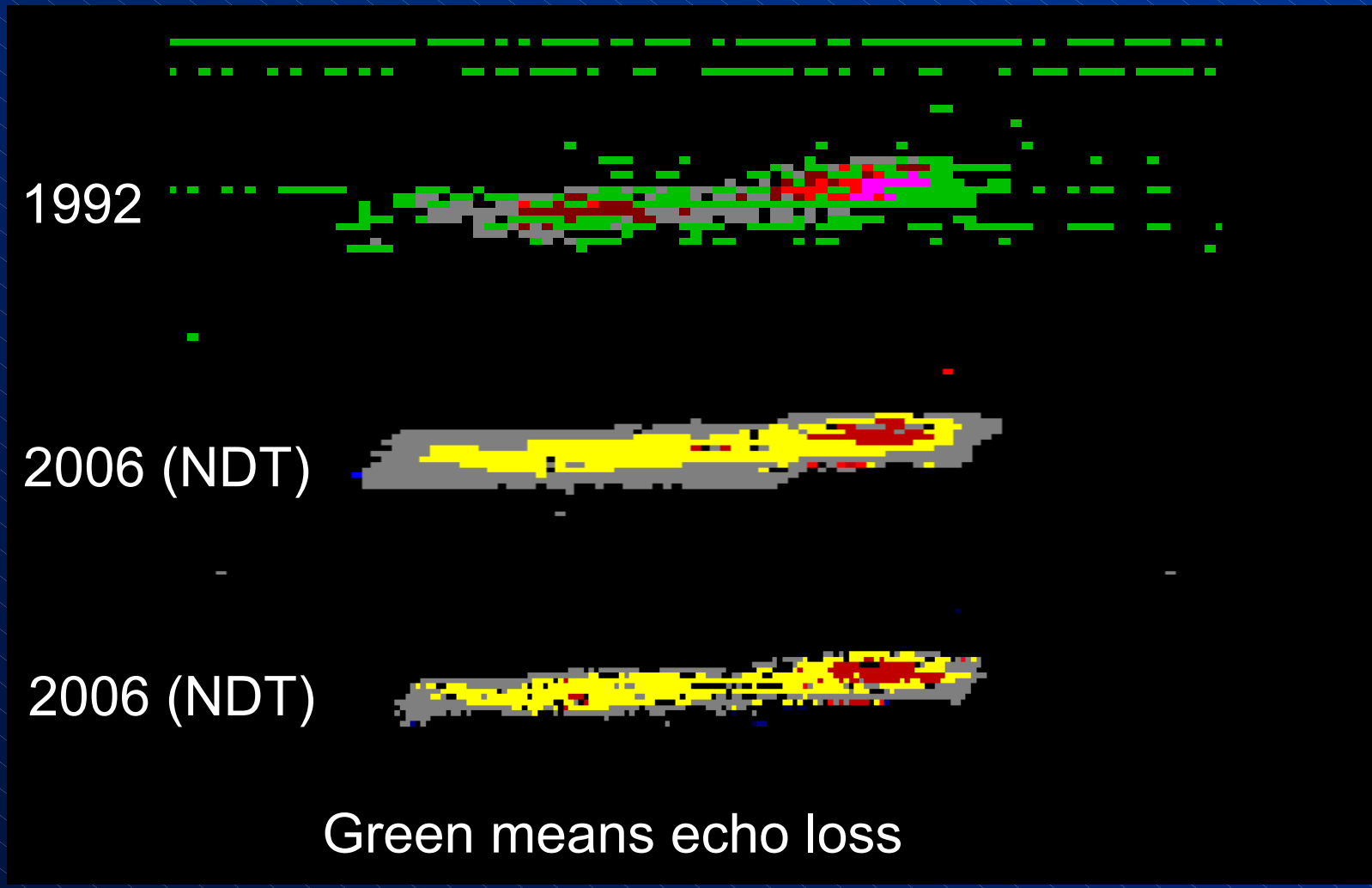
Ultrasonic comparisons



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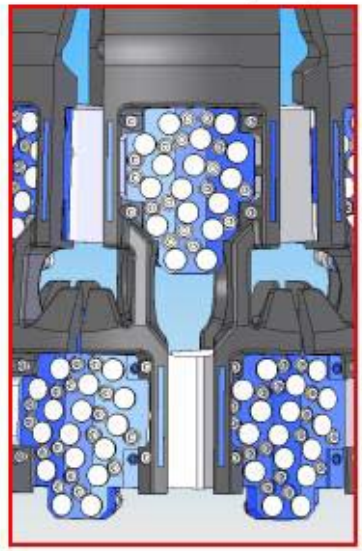
Sensor Plate Layout

8 sensors per plate	12 sensors per plate	16 sensors per plate
		
Standard Resolution	**Enhanced Resolution**	**Pitting Resolution**
	Circumferential Spacing:	
8 mm	5.5 mm **+ 50 %**	3.7 mm **+ 100 %**

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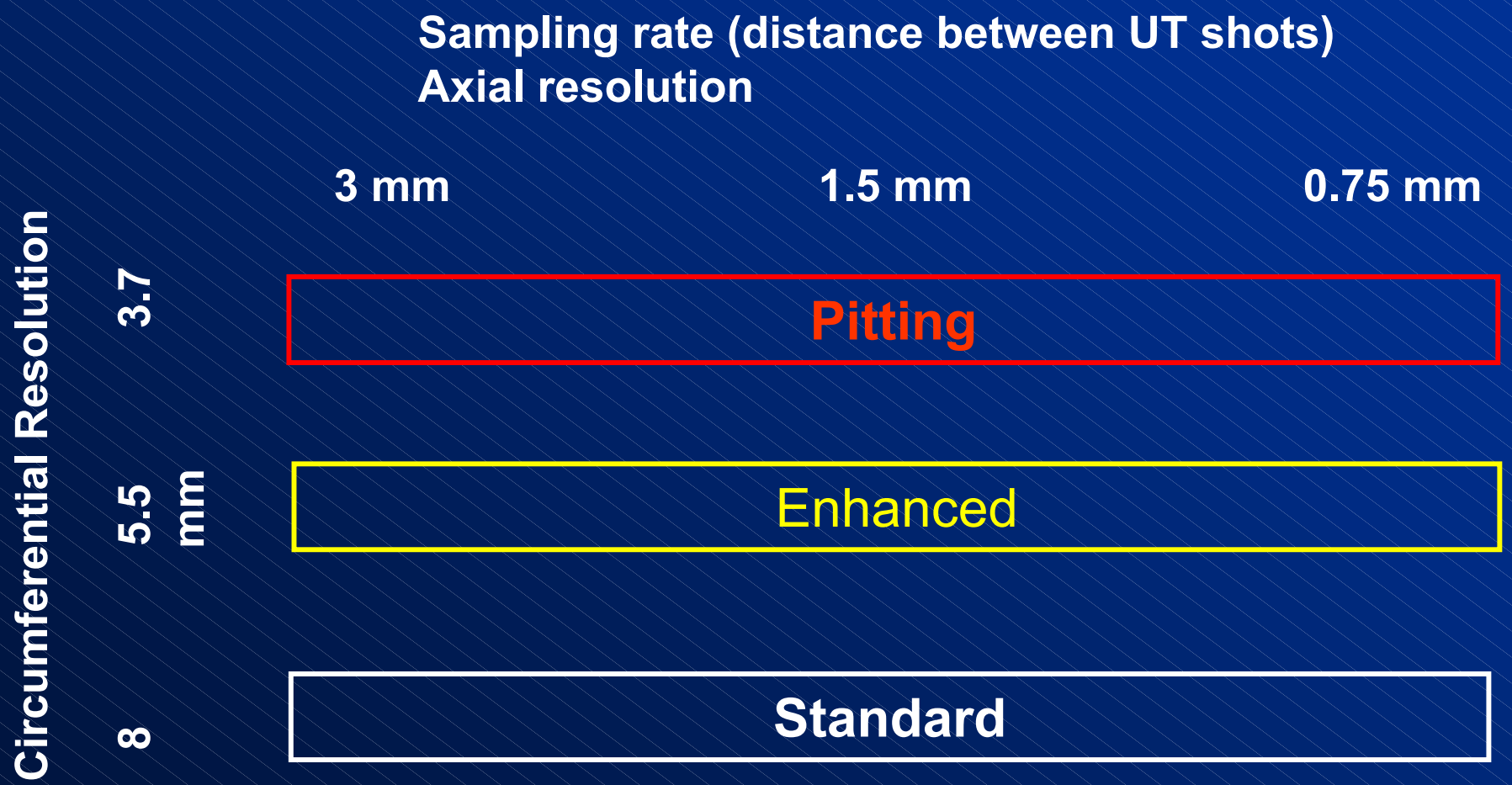
Different Resolutions



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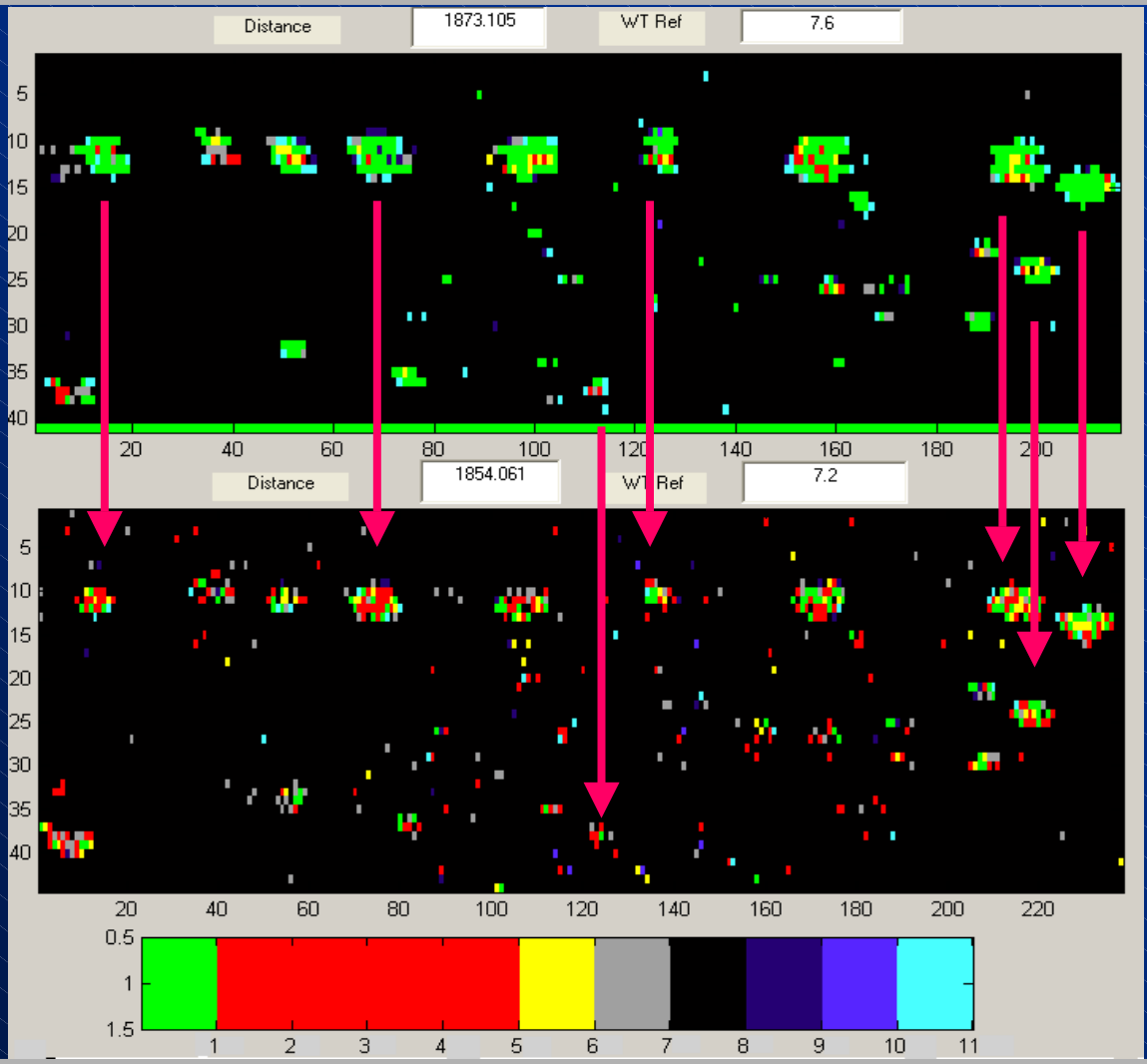
Internal Pitting

1995

Green means echo loss !

NDT 2006

Sizing of pits possible



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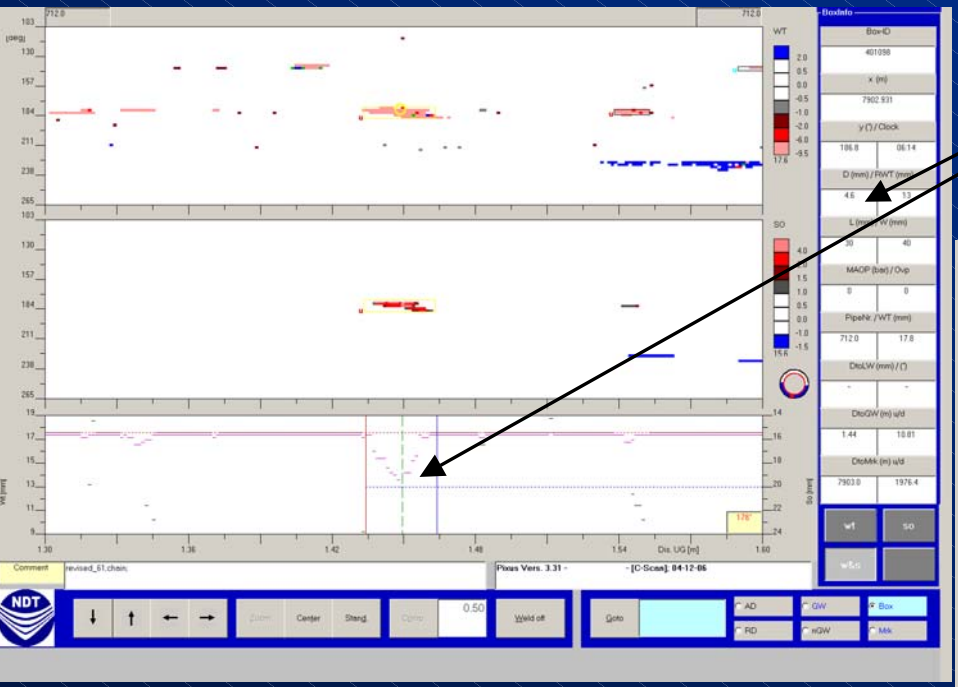
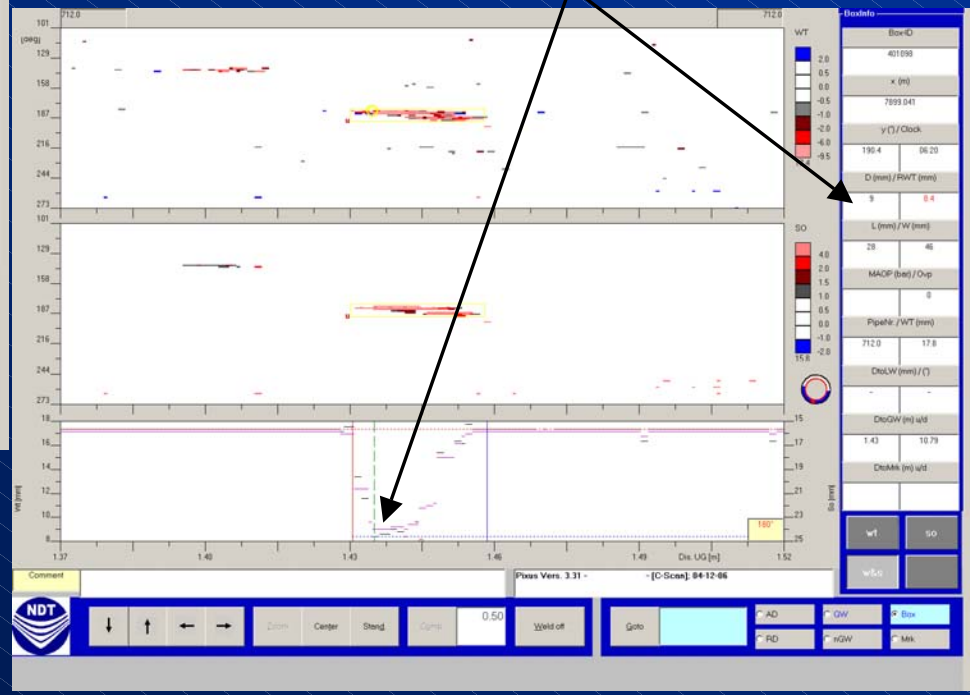
Defect Comparison

Test Results *16“* UMs / UMh



UMs Depth: 4,6 mm

UMh Depth: 9,0 mm



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Thank You For Your Attention !

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