Advanced PA UT Probes for TOPAZ64

Application Solution
March 2020
Overview

• Inspection Challenges

• Advanced PA UT Probes:
  – TFM-AL Linear Arrays
  – 2D-Matrix Arrays

• TOPAZ 64 Portable Intelligence

• Benefits of Zetec Solution
Inspection Challenges

• For some inspection configurations and damage mechanisms, standard phased array probe and wedge combinations will not provide the required inspection capability

• Flaws considerably smaller than the ultrasonic wavelength (caused by e.g. HTHA, creep, ...) cannot be reliably detected

• Misoriented or branched cracks can be missed or undersized

• Advanced focusing techniques (e.g. TFM) can improve detection, but also benefit from dedicated probe design
TFM-AL Probes

- Azimuthal, 1D-linear array probes in AL-type housing
- Compatible with standard AL- 55SW and AL-0LW wedges

BENEFITS :

- 64 elements, very small pitch, for maximum effective PA UT steering range and improved TFM imaging
- Curved active element for better focusing and improved lateral resolution in passive plane compared to standard azimuthal probes (AM, 16 or 32 elements) at equal frequency
- Smaller footprint than standard 64 element probes (LM) for better access to weld and HAZ
TFM-AL-5 MHz, DF 15 mm

- Specifically suited for detection of clusters of small voids during detection and assessment of HTHA damage in typical vessels with wall thickness around 1 inch (25 mm)
- Beam dimension of 1 x 1 mm$^2$ (0.04 x 0.04 sq inch)
TFM-AL-5 MHz, DF 15 mm

Example - Welding Flaws (V-bevel, T = 1 inch)

TFM-AL-5 MHz
Better resolution
Better SNR

AM-5 MHz
AL-TFM, 5 MHz, DF 15 mm

Example – HTHA Damage (X-bevel, T = 0.9 inch)

AL-TFM
Better resolution
Better SNR

LM 5 MHz

HTHA Damage

Courtesy of Lavender International
TFM-AL-5 MHz, DF 50 mm

- Suited for detection and characterization of small flaws in components and welds in wall thickness range 25 to 100 mm (1 to 4 inch)
- Beam dimension of $3 \times 2 \text{ mm}^2$ (0.12 x 0.08 sq inch)
<table>
<thead>
<tr>
<th>Probe Name</th>
<th>Frequency</th>
<th>Elements</th>
<th>Pitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT - 7.5 MHz - 16</td>
<td>7.50 MHz</td>
<td>16</td>
<td>0.50 mm</td>
</tr>
<tr>
<td>AT - 7.5 MHz - 32</td>
<td>7.50 MHz</td>
<td>32</td>
<td>0.25 mm</td>
</tr>
<tr>
<td>AT - 10 MHz - 32</td>
<td>10.00 MHz</td>
<td>32</td>
<td>0.25 mm</td>
</tr>
<tr>
<td>AT - 10 MHz - 16</td>
<td>10.00 MHz</td>
<td>16</td>
<td>0.50 mm</td>
</tr>
<tr>
<td>TFM-AL5-DF15</td>
<td>5.00 MHz</td>
<td>64</td>
<td>0.30 mm</td>
</tr>
<tr>
<td>TFM-AL5-DF50</td>
<td>5.00 MHz</td>
<td>64</td>
<td>0.30 mm</td>
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</table>
## TFM-AL Probes - Offering

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Item</th>
<th>Detailed Description</th>
</tr>
</thead>
</table>
| 10058571    | TFM-AL-5MHz DF 15 mm  | ZPA-PB1D-TFM-AL-5MHZ-64E-DF-15MM-REX-3.0M-ZPAC  
1D Linear phased array probe designed for **focused azimuthal scanning and TFM in depth range 5 to 30 mm - 5 MHz** - 64 elements - AL probe casing - Active surface of 19.2 mm x 15.0 mm - Curved in the passive plane - ZPAC connector (TOPAZ) - 3.0 m cable length |
| 10058568    | TFM-AL-5MHz DF 50 mm  | ZPA-PB1D-TFM-AL-5MHZ-64E-DF-50MM-REX-3.0M-ZPAC  
1D Linear phased array probe designed for **focused azimuthal scanning and TFM in depth range 25 to 100 mm - 5 MHz** - 64 elements - AL probe casing - Active surface of 19.2 mm x 15.0 mm - Curved in the passive plane - ZPAC connector (TOPAZ) - 3.0 m cable length |
| 10058574    | TFM-AL-10MHz DF 50 mm | ZPA-PB1D-TFM-AL-10MHZ-64E-DF-50MM-REX-3.0M-ZPAC  
1D Linear phased array probe designed for **focused azimuthal scanning and TFM in depth range 25 to 100 mm - 10 MHz** - 64 elements - AL probe casing - Active surface of 19.2 mm x 15.0 mm - Curved in the passive plane - ZPAC connector (TOPAZ) - 3.0 m cable length |
2D-Matrix Array Probes

- Azimuthal, 2D-matrix array probes in AM and AL-type housing
- Compatible with all standard AM and AL wedges, for LW and SW beam generation

BENEFITS:

- 9 x 7 elements, small pitch, for 2-plane steering capability: refracted angle and skew angle can be varied simultaneously, for both LW and SW beams
- Specifically suited for improved detection and characterization of skewed reflectors and misoriented flaws
- Simultaneous multi-skew inspection, no additional inspection sequences required
AM 5MHz 9 x 7 Elements, Wedge 55SW

Acoustic beam simulation, for typical configuration: SW beams with skews ± 15°
AM 5MHz 9 x 7 Elements, Wedge 55SW

Actual weld data: improved flaw characterization

LOF and weld root ONLY detected with nominal skew

Skewed ID Crack BETTER detected and sized with skewed beam
# 2D-Matrix Probes – Typical Working Range

<table>
<thead>
<tr>
<th>Probe</th>
<th>Wedge 55LW</th>
<th>Wedge 55SW</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AM 5 MHz 9x7 elements</strong></td>
<td>25° to 85° LW skew ± 25°</td>
<td>40° to 70° SW skew ± 15°</td>
</tr>
<tr>
<td><strong>AL 2.25 MHz 9x7 elements</strong></td>
<td>10° to 85° LW skew ± 30°</td>
<td>40° to 70° SW skew ± 25°</td>
</tr>
</tbody>
</table>
### 2D-Matrix Probes – UV Database

<table>
<thead>
<tr>
<th>Probe Name</th>
<th>Frequency</th>
<th>Elements</th>
<th>Pitch</th>
</tr>
</thead>
<tbody>
<tr>
<td>00-010781</td>
<td>5.00 MHz</td>
<td>32</td>
<td>0.75 mm</td>
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<tr>
<td>00-010828</td>
<td>5.00 MHz</td>
<td>32</td>
<td>0.75 mm</td>
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<td>TFM-DLA10-DF20</td>
<td>10.00 MHz</td>
<td>64</td>
<td>0.35 mm</td>
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<tr>
<td>AM-5M9x7E9.9-7.7</td>
<td>5.00 MHz</td>
<td>9</td>
<td>1.10 mm</td>
</tr>
<tr>
<td>AL-2.25M9x7E15.8-12.3</td>
<td>2.25 MHz</td>
<td>9</td>
<td>1.75 mm</td>
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<tr>
<td>1.5M8x4E20-12</td>
<td>1.50 MHz</td>
<td>8</td>
<td>2.50 mm</td>
</tr>
</tbody>
</table>
# 2D-Matrix Probes - Offering

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Item</th>
<th>Detailed Description</th>
</tr>
</thead>
</table>
| 10057197    | **AM 5 MHz 9x7 elements** | ZPA-PB2D-AM-5M9x7E9.9-7.7-REX-3.0M-ZPAC  
Generic 2D Matrix Phased Array Probe - 5 MHz - 9 x 7 elements - Active surface of 9.9 mm x 7.7 mm - Impedance matching to rexolite (2.45 Mrayl) - 3.0 m cable length - ZPAC connector |
| 10057198    | **AL 2.25 MHz 9x7 elements** | ZPA-PB2D-AL-2.25M9x7E15.8-12.3-REX-3.0M-ZPAC  
Generic 2D Matrix Phased Array Probe - 2.25 MHz - 9 x 7 elements - Active surface of 15.8 mm x 12.3 mm - Impedance matching to rexolite (2.45 Mrayl) - 3.0 m cable length - ZPAC connector |
TOPAZ 64 - Versatile PA UT Unit

• Fully integrated, portable PA UT unit
• Excellent *64 active element PA UT*
• 2 high-SNR TOFD channels at 200 V
• *12” Hi-Res multi-touch* display
• Support of 2D-matrix arrays
• Best-in class « *live » TFM
• Parallel recording of PA UT & TFM
• *Bipolar pulse (150Vpp)* option
• Driven by *UltraVision Touch*
Benefits of Zetec Solution

• Complete offering of high-quality standard and advanced PA UT probes required for efficient detection and characterization of challenging flaws, e.g. small voids, skewed reflectors, misoriented cracks

• **TOPAZ** portable unit, includes all required tools and features to efficiently set up and deploy advanced PA UT probes and examination techniques, including live TFM

• Advanced data analysis (Volumetric Merge, Indication Table, ... ) and reporting, using on-board **UV Touch™**