Ultrasonic HTHA Inspection Solutions

Dual Linear Array™ (DLA) and Total Focusing Method (TFM) Probes

Multitechnology HTHA Probes Help Maintain Asset Safety

Optimum HTHA detection on thicknesses ranging from 4 mm up to 95 mm using high-frequency, high-sensitivity small element probes.

Angle-beam DLA probe (A28)

- High-resolution 10 MHz dual 32-element arrays
- Cover more of the weld and HAZ with high beam-steering capability
- Increased POD offered by a longer focal range due to its patented pivoting housing

Zero-degree integrated wedge DLA probes (REX1)

- 10 MHz dual 64-element arrays
- Faster scanning with beam width coverage up to 30 mm
- Adjustable stabilization and wear protection system

TFM probes

- High frequencies with multiple smaller elements unleash the potential of TFM for HTHA detection

Leading-Edge Technology Optimized for Efficient HTHA Detection

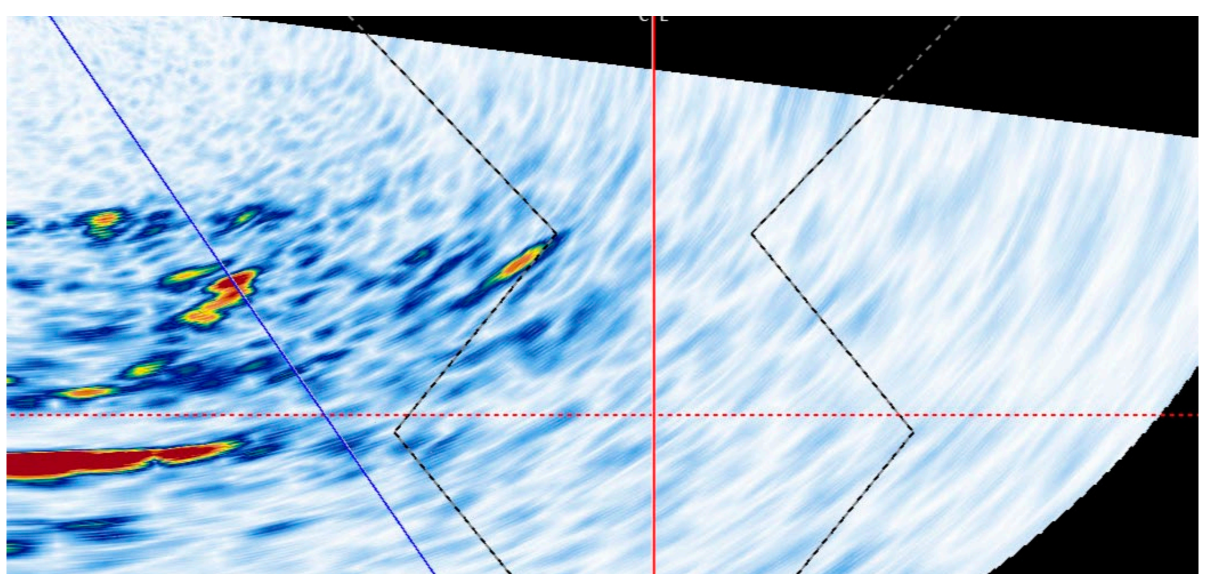
Early detection of high-temperature hydrogen attack (HTHA) damage can help oil, gas, and petrochemical facilities avoid catastrophic failures of critical high-pressure assets. While it is essential to evaluate the equipment's condition, HTHA is challenging to detect and assess, including for ultrasonic testing (UT). For this reason, Olympus created probes specifically designed to detect HTHA-induced damage at an earlier stage. The solution comprises Dual Linear Array™ (DLA) probes that are used to perform the pitch-catch technique, as well as phased array (PA) probes that are fine-tuned for the total focusing method (TFM). These methods, combined with TOFD screening, are used as part of a complete multitechnology inspection strategy.

Detect and Define Smaller HTHA Voids with Dual Array Probes

The high-frequency capacity of Olympus' Dual Linear Array™ (DLA) probes increases the resolution, which helps improve the probability of detection (POD) for small indications such as HTHA. DLA probes use the pitch-catch technique. They feature two distinct and acoustically isolated element arrays, one for transmitting and one for receiving. This configuration enables higher gain to be used without the adverse echoes commonly experienced with the pulse-echo technique. The high number of small elements in the dual arrays helps ensure optimal focusing and sensitivity in the region of interest.

A28 DLA Probe for Angle Beam Inspection

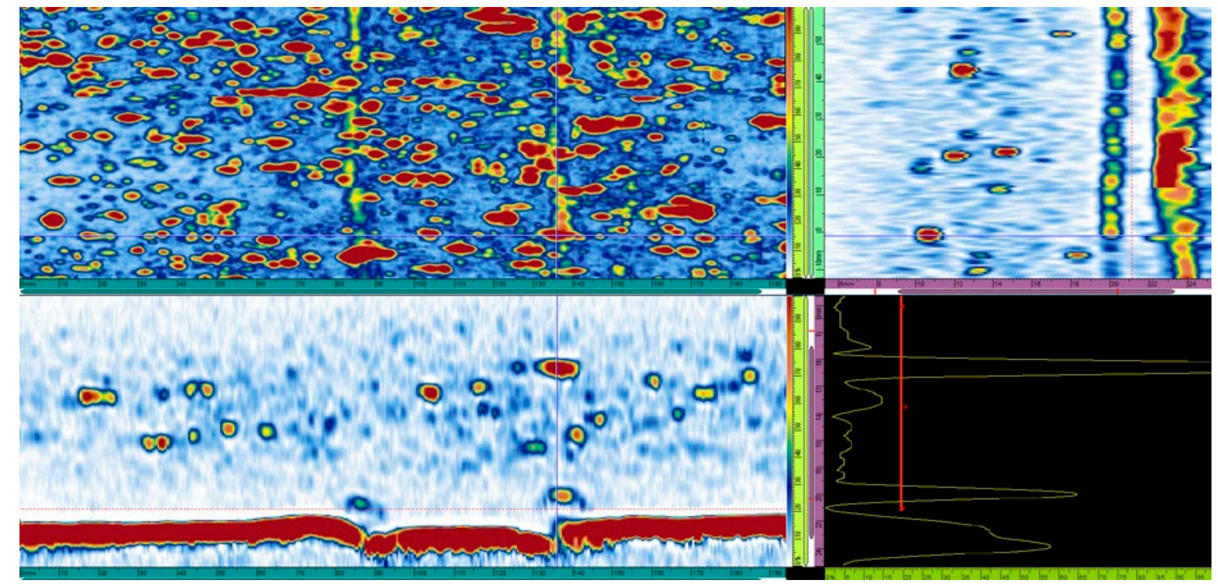
Multiple small elements (dual 32-element arrays) contribute to the A28 probe's increased beam steering capacity, enabling it to cover a larger portion of the volume of the weld and heat-affected zone (HAZ). The probe features a patented pivoting hinge system that enables the transmitting and receiving elements to be as close as possible to expand the thickness range at which the beam can be electronically focused. The pivoting system also conforms the two arrays to the wedge roof angles.



0–80 degree sectorial scan showing HTHA damage in the weld and heat-affected zone (HAZ)

REX1 DLA Probes for Fast Zero-Degree Inspection

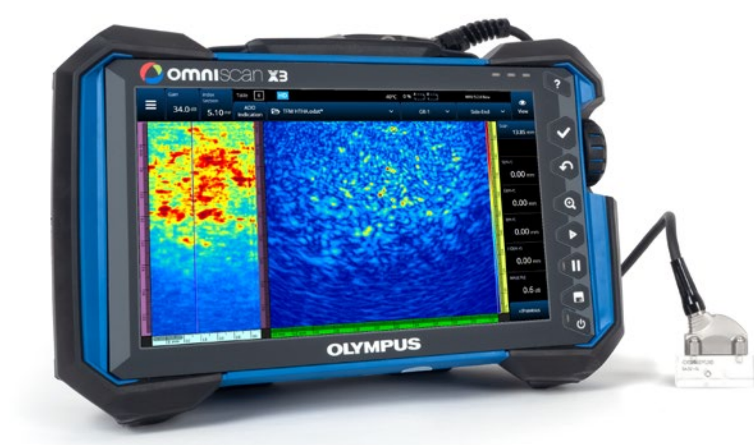
These dual 64-element probes are used at 0 degrees to cover a 30 mm (1.18 in.) wide area for fast scanning and clear C-scan images when used with an encoder or scanner. Dual phased array technology enables focusing at different depths for improved detection and definition. Users can further increase the signal response in the region of interest by choosing the number of elements used for focusing the beam directly in their OmniScan™ X3 flaw detector. The innovative wear-resistant probe stabilization system fits to the surfaces of pipes as small as 4 inches (101.6 mm) OD.



C-B-D-A-scans showing HTHA indications

TFM Probes Optimized for HTHA

While TFM imaging provides a larger focused area than conventional PAUT, the focusing capability is still influenced by the probe element quantity, frequency, bandwidth, and effective aperture size. Using higher quantities of smaller elements, further improve the focusing effect and therefore the response to HTHA flaws. Moreover, to increase detection of smaller defect, a shorter wavelength is necessary, hence the use of higher frequency.

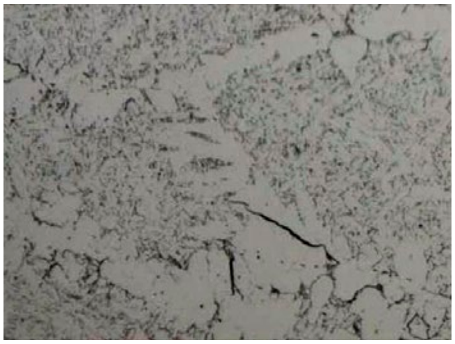


OmniScan X3 unit showing HTHA indications acquired with TFM

OmniScan™ X3 Phased Array Flaw Detector with TFM

Detecting HTHA as early as possible is so critical that multiple inspection methods are often used to increase the chance of detection. Time-of-flight diffraction (TOFD), full matrix capture (FMC), and Dual Linear Array (DLA) have demonstrated to be especially effective acquisition methods for this inspection application. The OmniScan X3 flaw detector fully supports these methods, and its innovative total focusing method (TFM) imaging and software tools can ease your setup and analysis. With its integrated DLA probe configuration, live TFM envelope, high-resolution TFM image (up to 1,024 × 1,024 points), and 64-element TFM extended aperture, the OmniScan X3 flaw detector is the instrument of choice to combine with these optimized probes to form a complete HTHA solution.

Challenges of Early HTHA Detection


Micrography image of HTHA damage

HTHA occurs in high-temperature, high-pressure hydrogen environments, such as heat exchangers, piping, and pressure vessels, mainly in the weld's heat-affected zone (HAZ). Free hydrogen can seep in between the grains of steel alloys and bind with the carbon contents, eventually creating decarburization and methane pockets. If HTHA is not detected early enough, the number of pockets can increase and join, ultimately forming cracks. To avoid potential equipment failure, it is important to detect HTHA before these cracks form. At an early stage, HTHA pockets are so small that standard ultrasonic probes cannot detect them. UT inspectors need to use higher frequencies, stronger focusing, and higher gain with an optimal signal-to-noise ratio (SNR). The Olympus HTHA solution addresses these challenges.

Ordering Information

Part Number	Item Number	Frequency (MHz)	Element Configuration	# of Elements	Pitch (mm)	Active Aperture (mm)	Elevation (mm)	Roof Angle	Thickness Range (mm)
10DL32-9.6X5-A28	Q3301742	10	Dual 32	64	0,31	9,6	5	Set by wedge	Set by wedge
10DL64-32X5-1DEG-REX1-PR	Q3301737	10	Dual 64	128	0,5	32	5	1	30–95
10DL64-32X5-5DEG-REX1-PR	Q3301733	10	Dual 64	128	0,5	32	5	5	4–30
10L64-19.84X10-A31	Q3301607	10	Linear	64	0,31	19.84	10		3–60
10L64-32X10-A32	Q3300429	10	Linear	64	0,5	32	10		8–95
Fork to mount SA28 wedges on HSMT scanners	Q7750200								

Important note: Using phased array probes in direct contact with a surface during inspection can lead to permanent damage. A wedge should always be used.
Although all Dual Linear Array probes are manufactured with 10 MHz piezo-composite, the tested center frequency specification of the REX1 models shifts down to ~9.0 MHz because of attenuation occurring in the integrated wedge.
These probes come standard with an OmniScan™ connector and a 2.5 m (8.2 ft) cable or can be specially fitted with other connectors and cable lengths.

Wedges for the A28 Probe

The angle beam wedge series is optimized for weld volume and heat-affected zone inspection. The wedge angle is set to generate L-waves at a 65-degree nominal incident angle in steel. They feature a roof angle calculated for each AOD diameter to achieve the focus depth called for by the wedge series.

SA28 wedges are available in two focus depths to cover a wide range of thicknesses:

- SA28-N65L-FD25: Optimized for part thicknesses ranging from 4 mm to 45 mm
- SA28-N65L-FD60: Optimized for part thicknesses ranging from 45 mm to 95 mm

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