

Applications
Brochure

WET HYDROGEN SULFIDE (H₂S) DAMAGE

The phased array ultrasonic solution that keeps you on ahead of the curve.

Discover the all-inclusive package delivering actionable data.

THE BEYOND CURRENT SOLUTION

Eddyfi Technologies offers a wide array of innovative phased array ultrasonic testing (PAUT) inspection solutions, which use non-intrusive techniques primarily on a test component's external surface. These solutions provide plan view, cross-sectional, and 3D imagery, visually indicating material integrity variations in easily interpretable graphics.

- One-stop shop solutions driven by technical expertise
- Streamlined workflow for setup, acquisition, and reporting
- Full support for ultrasonic testing (UT) methods including PAUT, time-of-flight diffraction (TOFD), conventional UT, full matrix capture (FMC)/total focusing method (TFM), plane wave imaging (PWI) and phase coherence imaging (PCI)
- Standard and custom probes designed in-house by our technical experts
- High-resolution TFM imaging

At Eddyfi Technologies, our advanced technical experts lead the way in guiding you with dedicated packages for both industry-typical and niche inspection applications. We deliver highly optimized solution kits driven by our market-leading instruments, packed with software features that enhance efficiency and user experience.

UNDERSTANDING THE THREAT

In process environments containing wet hydrogen sulfide (H_2S), commonly referred to as sour service, assets have the potential for exposure to several damage mechanisms, which can result in catastrophic failure. These damage mechanisms generally affect carbon and low-alloy steels, particularly in the oil and gas industry, although H_2S can also be present in other process environments. Failure to detect or monitor these damage mechanisms can lead to loss of containment and loss of life.

The most common wet H_2S damage mechanisms are hydrogen induced cracking (HIC), stress oriented hydrogen cracking (SOHIC), sulfide stress cracking (SSC), and hydrogen blistering.

The H_2S and H_2O contained in crude oil interact with the iron (Fe) of the steel wall releasing hydrogen (H) into oil stream. The hydrogen diffuses into the steel and comes together to form molecular hydrogen at discontinuities. Over time, more and more hydrogen becomes trapped building up pressure and therefore stress in the steel leading to local failure.

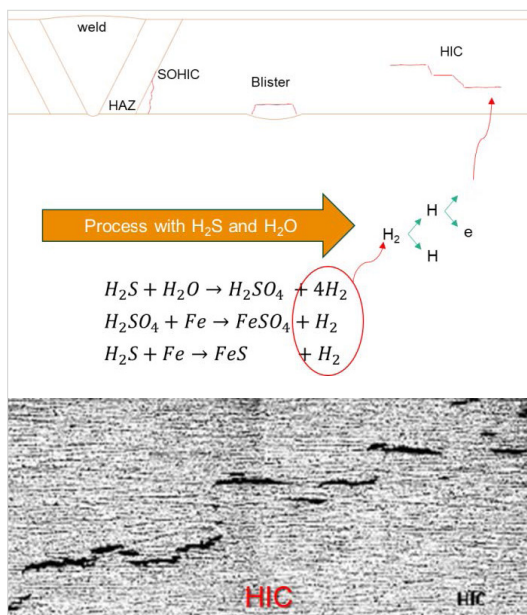


Figure 1: Example of associated flaws.

High stresses cause laminations that are usually parallel to the wall surface, leading to more hydrogen entering and increased pressure.

- Stresses cause cracks which tend to join laminations together. This is known as HIC or stepwise cracking.
- If the lamination occurs near the surface, we end up with a blister rising from the steel surface.
- SOHIC appears as arrays of cracks stacked on top of each other resulting in a through-thickness crack around the heat affected zones (HAZ).
- SSC is a form of hydrogen embrittlement that occurs in high-strength steels and in localized hard zones in weldment of susceptible materials such as HAZ.

INSPECTION TECHNIQUES

Eddyfi Technologies offers portable PAUT systems, Mantis™, Gekko®, and TOPAZ®, which provide all ultrasonic techniques in one box, enabling inspectors to deploy the test methods with full capability.

FAST SCREENING TOOLS: TOFD

Time-of-flight diffraction (TOFD) is used as a fast screening tool before indications are confirmed by other techniques. TOFD is mostly used for fast screening of welds to determine the presence of HIC/SOHIC but it can also be used for the base material.

Advantages:

- Less dependent on defect orientation
- Digital record of the examination
- Accurate through-wall sizing

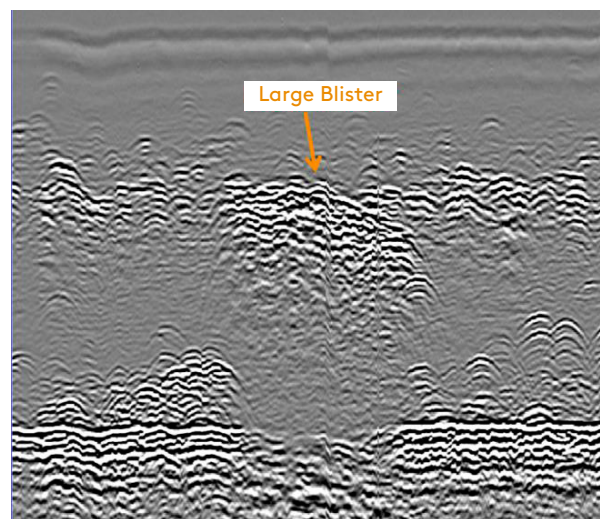


Figure 2: TOFD scan displaying large blisters. Image courtesy of Aker Solutions.

TOTAL FOCUSING METHOD

TFM/FMC is a process that involves two steps. The acquisition part, FMC, consists of firing the elements one by one and recording the data on all receivers each time. This leads to a large beam spread, which becomes more sensitive to connections between laminations. This is very important in the context of wet H_2S , where both morphologies, HIC and blistering, differ significantly in terms of favorability to a 0-degree intersecting beam. TFM focuses the acoustic energy everywhere within a region of interest (ROI) defined by the operator, providing optimum spatial resolution along the active plane. Both Gekko and TOPAZ also offer PWI capability, which is essentially a sectorial scan using the full aperture of the array (64 elements here) combined with TFM reconstruction. The advantage is a gain in productivity and more sensitivity as we fire all the elements rather than one at a time.

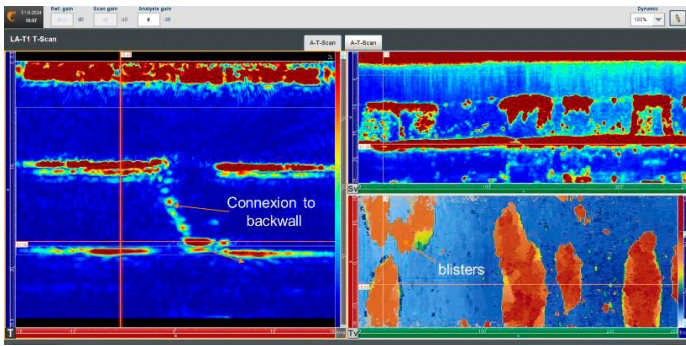


Figure 3: Visible connection between the HIC damage, blister and the backwall (ID).

Explore the following [blog](#) for further details on how to better detect H₂S damage.

INSPECTION SOLUTIONS

Examinations using manually encoded, semi-encoded, or fully motorized (automated) scanners provide 100% coverage of the component, data storage for asset monitoring throughout its lifetime, and offline analysis of the data, contributing to the inspection reliability for this challenging industry problem. Tailor your requirements with our variety of alternative scanners available.

SEMI-AUTOMATED SOLUTION

The handheld **NDT Sweeper** is a highly versatile semi-automated 2D encoded scanner which can virtually replace multiple specialized scanners due to its ability to perform corrosion mapping and weld inspections.

- From 100mm (4in) OD to flat
- 2D mapping – dual encoder
- Omni-wheels
- Versatile
- Integrated breaking system
- Lightweight



Figure 4: Semi-automated NDT Sweeper for corrosion and weld inspections.

AUTOMATED SOLUTION

The automated, robust, field-proven **NAV2** robotic scanner has been successfully deployed on various assets such as storage tanks, pressure vessels, pipelines, and other critical infrastructure.

- From 75mm (3in) OD to flat
- Ultra low profile
- Battery operated and remote controlled
- Max speed 250mm (9.8in)/sec
- Elevated temperatures up to 150°C (302°F)
- Versatile

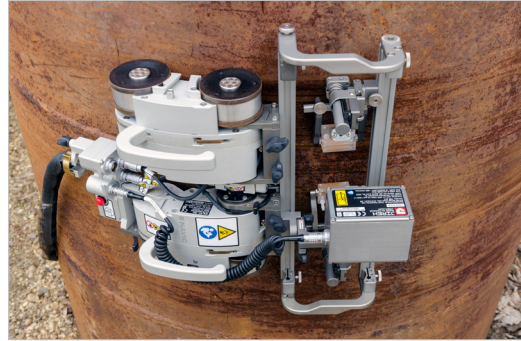


Figure 5 and 6: Automated crawler for corrosion and weld inspection. Handles removable.

PHASED ARRAY PROBES AND WEDGES

We offer a wide range of in-house standard and technique-specific linear array probes and wedges for inspecting H₂S damage. Need something specific? [Contact](#) our team for customized probe and wedge options. While flat-footprint wedges are suggested in the recommended kits below, we can also manufacture AOD and COD contoured wedges upon request, especially for piping applications.

Discover a new era of precision with Eddyfi Technologies' high-quality NDT probes and transducers: [View PAUT Probe Catalog](#)



Figure 7: A12 and TOFD probes.

ORDERING INFORMATION

TYPE	ITEM	DESCRIPTION
Solution kit is compatible with the following instruments: Gekko®32-TFM64, Gekko®64-TFM64, TOPAZ®64-TFM, Emerald, Panther™		
Linear array probe	5L64-A12-38.4X10-2.5-IPEX	64-element linear array probe – 5MHz - Active aperture of 38.4mm x 10mm - Pitch: 0.60mm - Elevation: 10mm - A12 casing - 2.5m cable - IPEX connector
	WSA12-0L-FLAT-20mm	Standard wedge for A12 phased array probe - Designed for linear scanning at 0 degree using LW - 0deg LW nominal angle - 20mm delay
	WSA12-IHC-Ring	IHC Ring, ported wedge ring with wear pins
TOFD probe	TOFD5-6-ST1-LEMO00	TOFD Piezo Composite Transducer, 5MHz, 6mm crystal diameter, ST1 casing, Lemo00 connector – (2 QTY required)
	Wedge-ToFD-60LW-ST1-IHC	TOFD wedge for ST1 type TOFD probe - 60-degree LW nominal angle in carbon steel - Irrigation channels and probe holder fixtures – (2 QTY required)
	TOFD-CBL-LEMO00toLEMO00-PAIR-5M	Coaxial cables for TOFD - LEMO00 male to LEMO00 male - 5 meters long - Includes one double cable
Scanner	SCAN-SWEEPER-LE*	NDT Sweeper is a 2D manual scanner designed with poly wheels for easy movement in the scan and index direction. The NDT SWEEPER features 1 individual probe suspension that can be fixed axially or laterally. Compatible with Mantis/Gekko
	SCAN-ACC-SWEEPER-FRKBTN-KIT	Sweeper option for 1 probe suspensions – Ø5.0mm button, Ø8.0mm button and long arms option (77mm from back to center of fixing points)
Accessories	COUPLANT-GLYCERIN-90ML	Couplant, liquid. Blue color. No air bubble. Quantity: 90ml - bottle
	SCAN-MANUAL-PUMP-4MM	Manual water pump - 7.9 L - with 4mm tubing and fittings for ROTIX, STIX or LYNCS scanners. Automated pump available.

*NOTE: DE15 encoder cable and ZPAC probe connectors also available. Various options for TOFD to be deployed with - Not compatible with Sweeper.

Manually Encoded

ITEM	DESCRIPTION
SCAN-ODI-1PA-LE	ODI scanner - 1 probe - LEMO 16 Encoder connector - Cable length 2.5m - Max Clamp Width: 55mm
SCAN-ODI-2PA-LE	ODI II scanner - 2 probes - LEMO 16 Encoder connector - Cable length 2.5m - Max Wedge Width: 45mm

*NOTE: DE15 encoder cable and ZPAC probe connectors also available.

Automated

ITEM	DESCRIPTION
NAV2-SYSTEM-15M*	Automated, battery operated and remotely controlled crawler system – Includes base crawler, control box, 2 x batteries, umbilical, irrigation, cable management, joystick plus accessories. For diameters 3”+.
AUTO-WELD-KIT-2TP-STD**	Standard kit for Weld Inspection. Includes: Pivot frame – 20cm (9.8in), 4 x Toolposts compatible with NAVIC2.
AUTO-RASTER-ARM-300MM	Motorized raster arm for Navic2 system - 300mm option – Predominately for zero degree
AUTO-SPARE-HEAVYDUTY-TP-W	Heavy duty vertical probe holder - wide, designed to carry larger probes on the raster arm, such as the Aqualock cart or Linear Array Probes such as A12 with IHC Ring. Supplied with 8mm pins.
NAV2-WELD-OPT-GUIDE	Battery powered optical guide for weld Inspection
NAVIC2-MOTORIZED-PUMP	The motorized couplant pump is a powered pumping unit used for supplying couplant fluid to the scanning surface. North American power cord.

*Available in 5m (16.4ft)/15m (49.2ft)/30m (98.4ft) Lengths - Add Medium temperature kit for surface temperatures above 50°C (122°F).

**Other variants available - recommended to add SCAN-PIVOT-BTN-KIT

Please note that although they still bear the Zetec logo and branding, the ultrasound instruments and software products are manufactured by Eddyfi Technologies, whereas Zetec branded EC and SG products are manufactured by Zetec Inc. Although affiliated to Eddyfi Technologies, Zetec Inc. remains an independently managed company because of contractual obligations with the US government as a key supplier for classified business. The information in this document is accurate as of its publication. Actual products may differ from those presented herein. © 2024 Eddyfi UK Ltd. Eddyfi Technologies, Eddyfi, Gekko, Mantis, TOPAZ, and their associated logos are trademarks or registered trademarks of Eddyfi Technologies (wholly owned subsidiary of Eddyfi NDT, Inc.) in Canada and/or other countries. Eddyfi Technologies reserves the right to change product offerings and specifications without notice. Eddyfi Technologies is a Previa Business Unit.

