



**ULTRASONIC
TESTING SYSTEM
FOR THE DETECTION
OF HYDROGEN
INDUCED CRACKS
(HIC) ACCORDING TO
NACE STANDARD**



In the oil, gas, and petrochemical industry, there is a huge network of pipelines transporting raw materials. Most of the pipeline structures are made of carbon steel. In these pipes lines, a common damage mechanism is hydrogen-induced cracking (HIC). This failure occurs when the surface is continuously exposed to a wet H₂S atmosphere.

Wet H₂S damage occurs due to the effects of aqueous hydrogen charging of steel in process environments. This process can happen at relatively low temperatures, largely as a result of atomic hydrogen from wet H₂S

which enter the steel and collect at inclusions or impurities within the steel. This happens because the H₂S prevents the hydrogen recombination reaction that would normally occur, forcing the hydrogen atoms into the metal structure, leading to corrosion and weakness.



Specimen with huge hydrogen induced crack

Courtesy: What is piping

These defects are very critical which will grow slowly inside the

material and if not found will lead to catastrophic accidents. Ultrasonic immersion scanning systems are built by Dhvani Research which can evaluate the materials for hydrogen-induced cracks as per NACE TM0284-2016 standard. These systems are used to evaluate the resistance of the manufactured materials like pipes or pipe welds against hydrogen-induced cracks. The samples are obtained from the manufactured products which are made into specimens of the size 100 by 20 by 20 mm in size.

These specimens are then artificially subjected to chemicals

that will accelerate the hydrogen-induced cracks and hence will be an indication of the resistance of the manufactured product to HIC.



Automated multi-channel Immersion ultrasonic testing system with focused transducers.

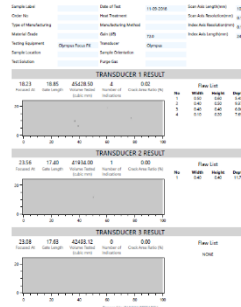
This system is a 3-axis system with 2 motorized axes (X, Y) and 1 manual axis (Z-axis). This system scans a sample using 3 individual probes focused at various depths respectively and genera an automated report mentioning the crack area ratio after inspection. Three probes are connected to the probe holder mounted on the Z-axis. The requirement was more stringent in this particular case where a 0.2 mm FBH was the calibration defect. The accommodation of customizations is one of the features of the systems built by Dhvani R&D.

Salient Features of the machine:

- Multi-Channel Immersion UT
- Custom built single interface (acqUT) for Ultrasound parameters and Motion settings
- Automatic water path calculation function based on the sample

thickness for the probes to focus at respective depths.

Automated single ally Immersion ultrasonic testing with the unfocused transducer.



Automated scanning with all the probes in a single raster scan. Automated customized report generation with calculated defect area percentage. (CAR value as per standard). A special feature that is programmed for this application is the water path calculation function for all the probes and the generation of individual C-scan for each probe channel automatically. The user needs to verify the water path distance and should make a



decision on initiating the scan.

The system is capable of scanning the components at a speed of 500 mm/sec in raster scan mode. There are dedicated sample placement fixtures that ensure that each time the sample is

placed accurately. The scan time for one sample is approximately 2 minutes. One of the customized reports generated by the system:

This system is an automated 3 axis system (X, Y, and Z turn that can accommodate a single unfocused transducer. This immersion tank system is built to scan 72 samples of the standard dimension according to the NACE at a time. All the samples are arranged in a matrix form on a thin sheet with slots to accommodate samples. This sheet is fixed on the bottom of the tank. The system image is shown below

Salient Features of the system:

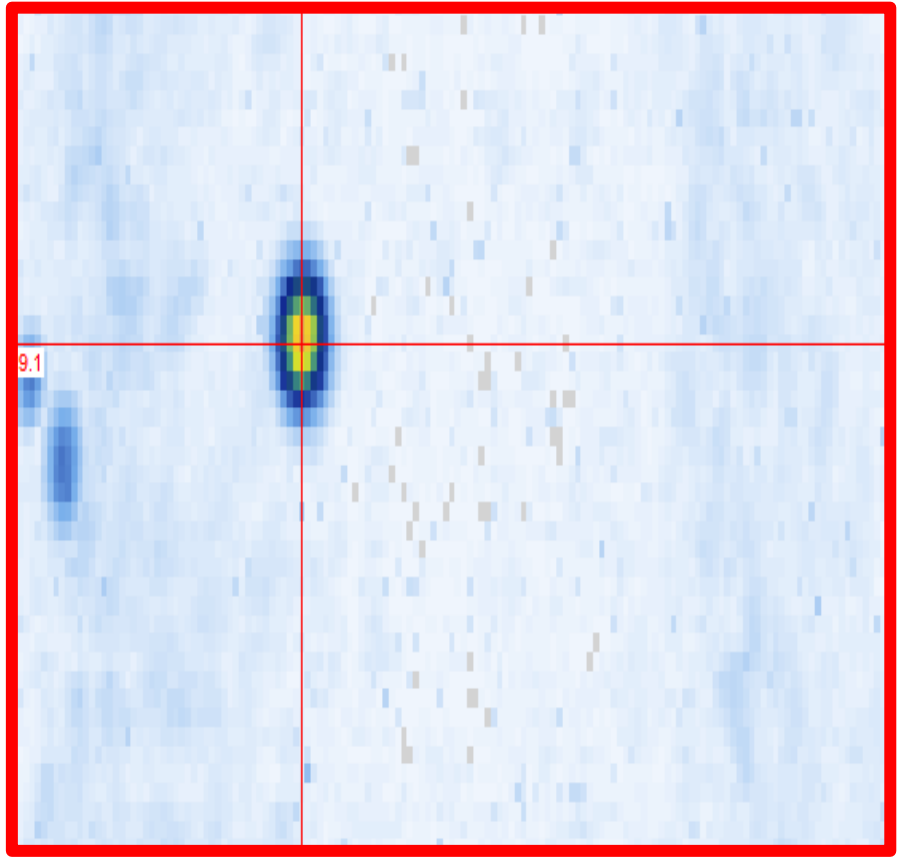
- Custom built single interface (acqUT) for Ultrasound testing and Motion settings
- Automated scanning of 72 samples in one raster scan setup. C-scans of each sample will be generated separately.
- Single sample scan, along with any number less than 72 is also possible.
- Customized automated report generation with respective CAR values as shown below for each sample in the slot.



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A Dhvani Research
Application Note

Chennai, INDIA



C-Scan Image showing the flat bottom holes of the calibration sample

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