Inspect every tube every time

Dolphin™ G3

A New Generation In Tube Inspection Technology

10 times faster than traditional NDT technologies!

Hi Tech Testing now has breakthrough technology! Dolphin™ G3 makes heat exchanger tube inspection so fast, easy and reliable that you can test 100% of your tubes at a fraction of the time and cost of your current maintenance inspections. The compact and rugged Dolphin™ G3 is designed for maximum convenience and ease of use in the field. Featuring computer-based signal interpretation and easy-to-read reports, Dolphin™ G3 streamlines and enhances your heat exchanger inspection capabilities:

- Takes less than 9 seconds per tube (regardless of length)
- Ruggedized, lightweight main unit (8 kg)
- Compact, handheld probe (1.1 kg) with LCD screen
- Works with any tube material and configuration (e.g., bends, U-tubes, fintubes, spirals)
- Automatic mapping of tube sheets
- Optimized signal to noise ratio
- Computer based analysis
- Identifies hard-to-detect bulges, end-of-tube erosion, fouling and inward dents
- ***Reduces the likelihood of failure by increasing inspection coverage***
- ***Supports existing NDE methods by identifying tubes with anomalies to test in lieu of arbitrary selections for representative sampling***

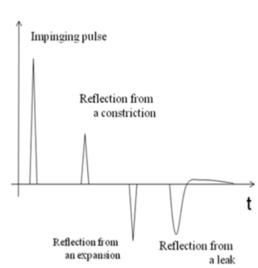
What is APR?

Acoustic Pulse Reflectometry (APR) is based on the measurement of one-dimensional acoustic waves propagating in tubes. Any change in the cross sectional area in the tubular system creates a reflection, which is then recorded and analyzed in order to detect defects.

How Does APR Work?

An acoustic pulse injected into a semi-infinite straight-walled tube will propagate down the tube without generating any reflections. This pulse can be measured by mounting a small microphone with its front surface flush with the internal tube wall, through a hole in this wall. The microphone will measure the pulse once only, as it passes over the microphone diaphragm.

If however, the pulse encounters a discontinuity in cross section, a reflection is created. The amplitude and form of the reflection is determined by the characteristics of the discontinuity: a constriction will create a positive reflection, whereas a dilation (increase in cross section) will create a negative reflection. Neither of these discontinuities will change the shape of the pulse in their vicinity, but the reflection measured by the microphone will be an attenuated and smeared replica of the impinging pulse, due to propagation losses. A hole in the tube wall, on the other hand, will create a reflection having a more complicated shape, affected by the size of the hole and the radiation of acoustic energy to the space outside the tube.



The Tube Inspection Process

The tube inspection process is comprised of the following steps:

1. Mapping of site and generation of work plan
2. Setup of the inspection parameters
3. Measurement of tubes
4. Establishing reference measurement and setup of inspection thresholds
5. Report generation and results analysis

Step 1 - Mapping of site and generation of work plan

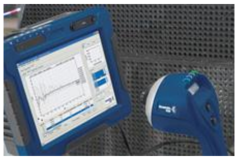
In this stage, a photograph or schematic diagram of the heat exchanger is uploaded to the system in order to create a map of the tube openings. This task is completely automated by sophisticated software. Each of the tube openings is assigned a number. This enables the system to create a graphic representation of the heat exchanger and to keep track of which tubes have already been measured, allowing the technician to work in a systematic manner.

Step 2 - Setup of Inspection Parameters

Using Dolphin's intuitive user interface, the technician sets the inspection parameters related to the physical attributes of the tubes. These parameters include the tube's length, diameter and wall thickness, as well as the probe adaptor's length and diameter.

Step 3 - Taking the Measurements

Using Dolphin's compact handheld probe, the technician begins to inspect the tubes in accordance with the site map and work plan. The probe is applied to each tube opening for approximately 10 seconds. It emits an acoustic pulse and then measures the resulting reflections using APR technology. LEDs on the probe indicate when the measurement is complete and the software guides the technician to the next tube to be measured.



Step 4 – Establish Reference Measurement and Set Inspection Thresholds

Once all of the measurements have been taken, the system calculates a reference measurement based on an intelligent average of the measurements, taking into account statistical deviation and the presence of ambient noise. Any measurement beyond that deviation is a potential flaw. In addition, the system enables the heat exchanger owner to determine thresholds for each type of flaw depending on the sensitivity of the given application (e.g., percentage of wall loss, blockages, etc.). Only those measurements that exceed the defined threshold are reported as flaws.

Step 5 – Generate Report and Analyze Results

This is the stage in which the raw data (i.e., signals) collected by the system is interpreted and presented to the technician for analysis. This entire process is performed automatically by the system software.

Using breakthrough algorithms, the software identifies the different signatures of each type of flaw, allowing the system to automatically identify every defect. It pinpoints the location and determines the severity of every problem in an objective and consistent manner. The precision and sophistication of Dolphin G3's detection algorithms are field-proven to ensure accurate identification of faults, regardless of the presence of background noise or the distance of the fault down the tube.

The system flags all "suspicious" measurements which may indicate a fault and presents them in an easy-to-read online report for verification. The technician can drill down to obtain additional information on each measurement (including the signal graph) as needed before accepting or rejecting each flagged item.

At the conclusion of this process, the system generates a final report (PDF) containing summary information, including tabular reporting and screenshots of the wave forms of the detected flaws. The final report is then presented to the client.

Advantages over Current Technologies

Currently, the most commonly used techniques for inspecting tubes found in heat exchangers are based on invasive testing. Eddy current, magnetic flux leakage, Iris tube inspection and ultrasound-based methods all require a probe to be traversed throughout the entire length of each tube being examined. Over the years, customers have simply become accustomed to the limitations of invasive technology, including:

- **Delays**: Under ideal conditions, invasive technology report inspection times of about 1 minute per tube are often cited, though this rate is very difficult to maintain over an entire shift.
- **Breakdowns**: Probes often get stuck in cases where the tubes have not been cleaned properly, which is difficult to ascertain from prior knowledge. Though some flexible probes are currently available, some bends (e.g., U-tubes) are too tight for such probes. In such cases, the bends are just not inspected.
- **Configuration issues**: Existing NDT-based inspection methods (e.g., ultrasound, eddy current) have difficulty inspecting tubes they cannot traverse due to the configuration or type of material. This is also very costly due to the need for experts to interpret the data and the need to manufacture probes for each specific job.

Dolphin G3, on the other hand, utilizes non-invasive APR technology to create a “virtual probe”, which can navigate bends, coils, elbows, fittings, etc. without difficulty. This technology lets you test any tube from a single point outside the tube in less than 9 seconds, saving considerable time and resources.

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