GE
Sensing & Inspection Technologies

Fundamental Principles

Ultrasonic Testing of Seamless Tubes


Ultrasonic tube testing with rotating probe system

Depending on the application and specification, seamless tubes have to be inspected for several types of flaw over their entire circumference and length. The specification to be applied usually describes in detail the flaw sizes, inspection densities (pulse intervals), track widths, test and evaluation methods.

Basically, three different types of tube inspection are possible. In the case of rotating probes, the tube transport movement is linear. In the case of helically transported tubes, the probes are arranged stationary. With stationary rotating tubes, the probes are guided along the tube.

GE imagination at work

The resulting inspection tracks on the tube surface are always helical. The inspection density in the longitudinal tube direction (pitch of scan helices) depends on the speed of the tubes or probes and on the required/preset tube advance. In the circumferential direction of the tube, the inspection density depends on the surface speed and the pulse repetition frequency.

As a rule, scanning is always carried out in both directions when inspecting seamless tubes, i.e. clockwise and counter-clockwise in longitudinal flaw testing; and in the transport direction as well as in the opposite direction in transverse flaw testing.

Transverse flaw testing, which is not required that often, is a more critical method than longitudinal flaw testing from the point of view of ultrasonics. As the tube or probe advance per rotation is smaller than the circumference with most tubes (usually already from a diameter of 10 to 15 mm), the results are more or less steep scan helices. Due to that fact that – to put it simply – at least one test track must definitely detect the flaw, the minimum flaw length chosen should always be a bit larger than the scan helix.

Ultrasonic tube testing with scanneer technique

This can easily be determined on the basis of the advance per rotation in longitudinal flaw inspection, and therefore the test speed normally refers to longitudinal flaw inspection. In transverse flaw inspection, the minimum flaw length depends on the tube diameter (steepness of scan helices) and on a number of single probes arranged around the circumference. It is normally not possible to use probe arrays in this application.

If tubes are to be tested for almost the same flaw lengths, both in longitudinal and in transverse inspection, the transverse flaw testing method limits a possibly faster testing process for longitudinal flaws. Moreover, it is possible to carry out tests for laminar flaws (material separations) and wall thickness measurements; these tests and measurements are carried out using the same straight beam probes. In addition, rotating testing machines allow calculations of the geometry data, such as outside and inside diameters, ovality and eccentricity to be made since the probes are arranged opposite to one another in these machines and they are not guided directly along the tube. These geometric calculations also include the measurement of the distance between probe and tube surface in water.

These measurements can be strongly affected by temperature variations (changes in the sound velocity) of the coupling water. Various measures are taken to compensate for this effect. Random amplitude variations, interferences and measurement failures cannot be totally avoided in dynamic operation. Because of this, the measured time-of-flight values have to be averaged and subjected to interference suppression and verification checks before they are delivered as thickness readings and analysed further.

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