How do Ultrasonic NDT Thickness Gauges work?

Capable of non-destructively measuring a wide variety of materials, when only one side is accessible, Ultrasonic Thickness Gauges are ideal for, among other things, monitoring corrosion and erosion, or checking for defects in complex, manufactured components.

Ultrasonic NDT gauges such as the Elcometer MTG Material Thickness Gauges, and the Elcometer PTG Precision Thickness Gauges; are designed to provide accurate, reliable material thickness measurements for a wide range of applications - including pipelines, storage tanks, rubber linings or thin plastic bottles for example.

So, how do they work?

The Elcometer MTG range of ultrasonic material thickness gauges can measure both uncoated materials up to 500mm thick, and coated materials up to 25mm thick, and to do it they use a dual element transducer.

Dual element transducers consist of two independent crystals, separated by an acoustic barrier. The two elements are angled so that when one crystal emits an ultrasonic pulse, the energy path creates a “V” shape, entering the material via ultrasonic couplant, hitting the back-wall of the material, and echoing towards the other crystal, where it is detected. The gauge then uses the speed of the pulse and the time taken to travel from one crystal to another (from pulse to echo), to calculate the thickness of the material - with the acoustic barrier preventing any sound from reaching the receiver directly from the emitter, before the pulse has completed its path.

When it comes to measuring coated materials, in order to ignore the thickness of the coating and measure just the thickness of the material underneath, the gauge is adjusted to measure the time between two echoes. The first echo occurs when the pulse first hits the back-wall of the material, with the second echo occurring when the pulse next hits the back-wall of the material for a second time. The transducer detects both of these echoes and uses the speed of the pulse and time between echoes to calculate the thickness of the material, ignoring the coating above it and any other echo.

Alternatively, the Elcometer PTG range of ultrasonic precision thickness gauges use single element transducers to measure uncoated materials as thin as 0.15mm.

Single element transducers, as the name suggests, consist of one crystal, which both emits and receives the ultrasound pulse. The pulse once again travels between the transducer and the material via ultrasonic couplant.

However, measuring thin materials means that the ultrasonic signal will return to the transducer incredibly quickly, and as a result there is not always enough time between the pulse leaving the element, and the echo returning. This is why, when using an Elcometer PTG, single element transducers use a delay line, to increase the time between the pulse being sent and the echo being received, ensuring more accurate results.

Whilst the energy path from a single element transducer still travels from pulse to echo, in order to remove the length of the delay line from the measurements, and measure just the thickness of the material, the gauge doesn’t time from Pulse to Echo. Instead the Elcometer PTG measures from Interface to Echo – Interface, when the pulse passes between delay line and material; and Echo, when the pulse hits the back-wall of the material, and returns to the element. The time taken, along

with the known speed of the pulse, allows the gauge to disregard the length of delay line, and measure just the thickness of the material.

In order to accurately and reliably measure incredibly thin materials, as little as 0.15mm thick, the Elcometer PTG is adjusted to measure between two echoes. While the gauge still reads the Interface, the point at which the pulse passes between delay line and material, in order to once again remove the delay line from the measurement; the gauge only times between the two subsequent echoes. The first of which occurs when the pulse first hits the back-wall of the material, the second when the pulse hits the back-wall of the material once again. The time between these two subsequent echoes and the speed of the pulse, ensures the Elcometer PTG can measure incredibly thin materials with pinpoint accuracy.

So, that's how the Elcometer MTG and PTG gauges work – for more information on their features and applications make sure you watch our Ultrasonic NDT videos by visiting Elcometer.com, or simply click on one of the links on screen.

And please, don't forget to subscribe to the Elcometer Channel to be notified of any new videos.