AFFORDABLE UT TRAINING

SOUND REFLECTIONS

"Sound Reflections" is a free monthly newsletter presenting basic UT math & theory plus inspection tips for anyone wishing to gain more insight into applied ultrasonic inspection. We hope that your UT problem solving curiosity will help you develop more UT knowledge.

In this first issue of Sound reflections, I decided to present a "pet peeve' of mine. The most basic concept of pulse echo ultrasonic inspection is that a pulse burst of sound energy is transmitted repeatedly and between each transmission, time is allocated to wait for any return echoes from a reflector. The reflector could be any kind of discontinuity: a flaw, a back echo, or some kind of geometric reflector. The condition that you must "wait" for the echo implies there is sound travel time involved. Ironically, most ultrasonic training text books do not include the basic relationship of:

"distance = (speed of sound) X time."

Go ahead, grab your favorite UT training text, most likely, you will not find this simple principle discussed. My view is that this principle should be placed right in the beginning chapter of any UT Nondestructive Testing training text book.

"Pet Peeve"

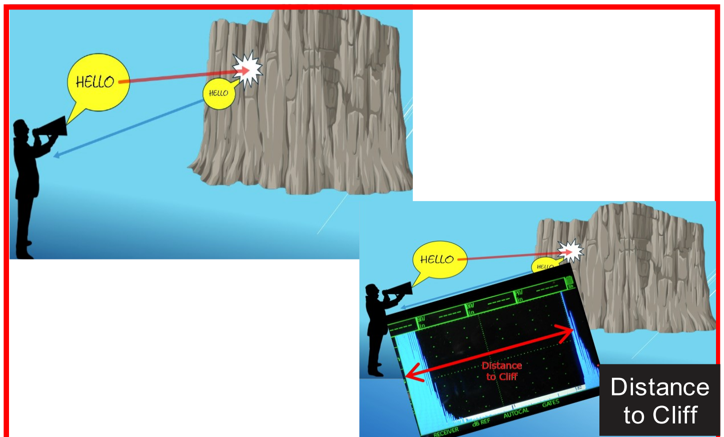
The adjacent figures above show a simple analogy for sound beam energy travel time based on person shouting "Hello" through a bull horn and waiting for the echo to return to his ears. If the cliff wall is 500 yds (18,000 in.) away, the sound travel time through the air, to and from the cliff, is approximately:

time= (2 x dist)/(speed of sound in air)=

(2x18000 in)/(13110 in/sec)=2.75 secs.

Note, since the sound must travel to and from the cliff, the distance covered is actually twice the distance that sound has traveled. Therefore the true distance between the man and the cliff is 1/2 the distance the reflected sound has traveled or 18,000 inches.

Let's use one more example. This time, we will apply the sound energy to measure the distance to a reflector inside an aluminum block. The speed of sound energy in aluminum is about time 2.5 x 10^5 inches/second. The reflecting target is 4 inches from the front surface of the block, while the back surface is 8 inches from the front surface. Refer to the adjacent diagram.



time to reflector=

time= (2 x dist)/(speed of sound in AL)=

(2x4 in)/(2.5 x 10^5 in/sec)=3.2 x 10^-5 sec.=32 µsec.

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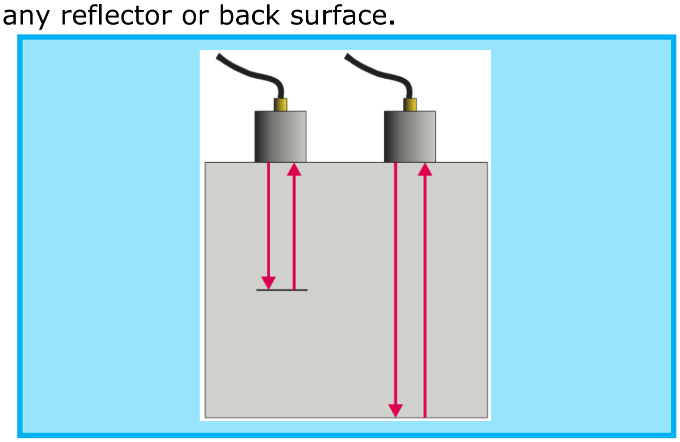
time to back surface=

time= (2 x dist)/(speed of sound in AL)=

(2x8 in)/(2.5 x 10^5 in/sec)=6.4 x 10^-5 sec =64 µsec.

Note that your A-Scan instrument measures the round trip time which is always twice the distance, since it is the time required for sound energy to travel "to and from" the reflector or the back surface. Therefore, your A-Scan instrument always automatically divides the Pulse Echo time measurements by 2 to give you the actual distance to any reflector or back surface.



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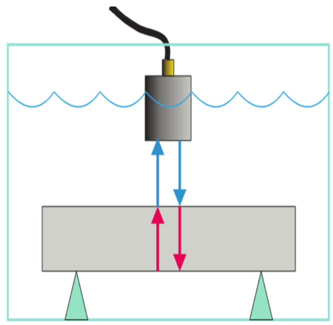
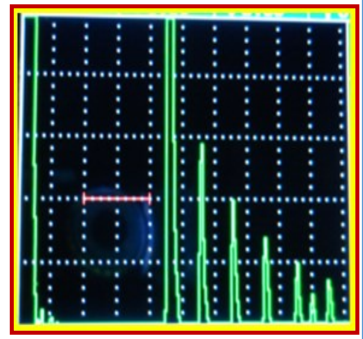
"UT PUZZLES"

"R U A UT MATH PRO?" You are inspecting a 1 inch thick aluminum plate through a water path using an A-Scan instrument calibrated with the sound velocity in aluminum. The distance of the water path read on the screen graticule, initial pulse to interface echo, is 4.5 inches. The velocity of sound in Aluminum is 2.5 x 10^5 IPS and the velocity of sound in water is 0.585 x 10^5 IPS.





What is the actual or true distance of the water path?

See solution in next issue

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