Non-Destructive Testing – UT Series No 1.

Ocean Rain

Ultrasonic Testing (UT) thickness checks are baked into the foundation of the integrity systems of most modern industrial operations (or at least the ones that give 3/5ths of a rusty monkey about safety). There's a bit more to it than just the number produced at the end, in this article we'll look at:

- The equipment
- The carbon based lifeform operating it
- The basics of operation

We're going to take a look at the equipment and basic principles of operation - this article isn't intended to be mega in depth (there's much better people to do that than me). If you get too deep in the weeds you'll find that UT is a bit of a dry subject (like when you're using DCUT, EMATs or GWUT, that's an inside inspection joke - see, told you it was a struggle bus effort).

The idea of an ultrasonic "Flaw Detecting and Measuring Device" was patented in the May of 1940 in the US. Which was probably pretty timely as there was a war going on and plenty of equipment was getting panned by flying foreign objects at high velocities. This was improved upon in July 1966 with the invention of "Ultrasonic Testing Apparatus and Method". Although there have been equipment improvements since the basic components of a modern system are strikingly unchanged.

So, before the Beatles had played their last scheduled concert in Candlestick Park we had something that we would recognise as a UT set. So what is in it and how does it work?

The basics of UT thickness checking gear:

- UT Instrument: this is what generates the signals and then displays the returned signals
- Probe Cables: this is what carries the signals between the UT instrument and the probe
- Probe/Flaw Detector: this is the piezoelectric crystal that generates the sound and receives the reflected sound from the part being inspected

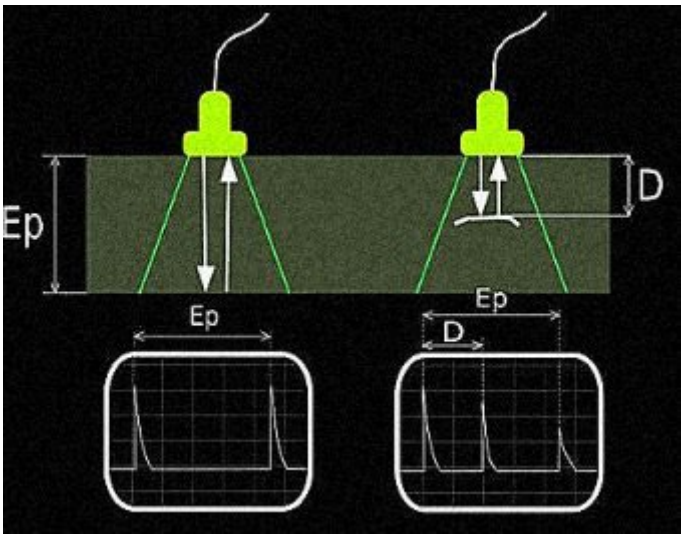
In addition to these you'll also need a liquid couplant (except for specific circumstances outside the scope of this article). There are commercially available liquid couplants but I've seen wall paper paste, green oil and seawater etc. used. If it's wet it'll do in a pinch.

Now that you've got all the kit together, you need to check that it actually produces the results you think it does - enter the calibration block. The calibration block is exactly that, a block of material of known dimensions so that we can check that the readings we expect to get are what we're achieving.

You're also going to need a procedure for the inspection which will be written by someone with a minimum level 2 qualification in the technique being used and signed off by a level 3.

So we've gathered up the gear, how does it actually work? Again, I'm not going to go too far so you don't need to dust off the secondary school physics class knowledge.

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The basic operating principle:

- The crystal in the probe rings (generates sound) due to the voltage applied by the UT instrument
- When the sound from the probe hits a change in material, some of the sound is reflected back to the probe
- The probe then converts this sound into a voltage and sends it to the UT instrument which displays it as a "peak" on the screen

In the above image you've got a probe on the left inspecting a piece of steel and what you see is:

1) An initial peak when the sound from the probe hits the front of the steel and is reflected
2) A second peak when the sound hits the back wall and is reflected to the probe

How do we then turn that into a thickness reading? Just like driving a car - if we drive at 60mph for 30 minutes then we've gone 30 miles. In physics class you will have used the equation Distance = speed x time well, same same here.

We know the speed of sound in steel, we know the time between the echoes and therefore we can determine the thickness.

Ready to go smash out some ultrasonics? Not so fast, who's that SPOF* operating the gear?! There are several accreditation systems for personnel that meet ISO9712 (check the latest edition) and broadly it's either SNT or PCN but there is also CSWIP. SNT is an employer based qualification whereas PCN and CSWIP are administered by an external body. There are three levels to accreditation:

- **Level I:** Possess basic skills, can follow written instructions, and perform basic calibrations under supervision
- **Level II:** Can work independently, calibrate equipment, interpret results, and prepare written instructions
- **Level III:** Can establish techniques, interpret codes, and train and examine Level I and II personnel

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*SPOF means Single Point of Failure i.e. the thing/person/situation that can and will inevitably cause your workscope to explode into flames and get you chewed out by the client.

Right - so we've got the gear and it's calibrated, we've got the human and he/she has a procedure so they know what they are doing. Lets finally bang some sound into the object - easy tiger, gotta check the surface first.

Ultrasonics is (in general) very dependent upon the quality of the surface being inspected. This means any loose or flaking coating will need to be removed, some coatings may need to be removed entirely even if they're in good nick and for bare metal it needs to be prepped to make sure its not going to prevent sound getting into the part being inspected. Some coatings can remain in place - if in doubt get a coated sample and validate.

Your inspector gathers the information, writes a draft report, it gets secondary checked, signed off and then makes its way into a final report incorporating client comments. Engineers will then use this information to make assessments about the object being inspected.

In sum: there's a bit more to taking a thickness check than just slapping a probe on a pipe and getting "the number". It's done every day and is foundational to the safety of industry so we should tip our (metaphorical) hat to it.

To your continued safe operation and successful scope execution



Mike Killeen

Contact Me

The title is from Echo and The Bunnymen's 1984 album