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Measurement surface preparation

Increasing measurement accuracy by preparing your test piece contact surface

Overview

The Ionix HS582i dual element transducer is suitable for testing on several different materials, surfaces and applications, however the surface condition of the test piece or asset being measured, needs to be able to transmit sound energy through the contact surface. As with conventional transducers, preparing the contact surface and using appropriate couplant will increase the signal amplitude and accuracy of your measurements.

An example of surface corrosion on a pipe

The problem with poor surface conditions

The surface of the test piece, or asset that a thickness measurement is required from, needs to be in contact with the front face of the transducer to allow the ultrasonic energy to pass between the test object and the probe. Poor surface condition from corrosion, erosion, scale or loose attached layers such as plating, paint, enamels or other coatings may impede the ultrasonic signals by scattering or absorption of the layers themselves, or reverberations in the uneven couplant layer, reducing the amplitude and accuracy of your measurements. Resultant ultrasonic thickness measurements cannot be more accurate than the surface condition or roughness present.

Surface preparation recommendations

Ultrasonic procedures and standards often call for a minimum level of surface preparation for reliable thickness measurements, as often, measurements are required from in-service assets which will have corroded surfaces or protective coatings that have been built up or applied during their lifetime. To allow as much sound energy as possible to pass from the transducer into the test piece, the couplant layer between the two must be thin and equal along the duration of the tip diameter. The following describes example surface preparation methods taken from the standards referenced at the end of this document.

Surfaces should first be visually inspected to understand the appropriate method of preparation required before an ultrasonic inspection can take place. After assessing the condition of the surface use the following steps as

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guidance to combat any issues with your measurements, preparing an area at least twice the area of the probe diameter.

1. Removing loose coatings

Ensure that loose scale, corrosion, dirt, paint, or other coatings are removed using a stiff bristled or wire brush. Thoroughly work from left to right on the surface making sure no area is missed that an inspection is planned for and prepare an area at least two times the probe diameter.

To speed up this process a rotary tool is recommended, however confirm this is suitable for the asset prior to use.

A corroded surface pre-preparation

2. Bonded layers

Often surface roughness is unavoidable or uncontrollable, for example from mild corrosion that is firmly 'bonded' to the surface or functional thin paint layers, respectively. These types of surface pose no issues for ultrasonic testing and a thicker gel couplant can be used to fill up any pits that may exist. In some circumstances, this surface oxidation is often unavoidable, especially in high temperature environments (100 - 550 °C), where steel will rapidly oxidise whilst preparation is taking place. A bit of common sense is important here.

Where adhesion is good in these layers the measurement can be made through the coating using measurement mode 3 (multiple echo) to remove the additional thickness of the coating layer. If only a single echo can be detected due to surface roughness or irregular surface of the backwall, the layer thickness will need to be subtracted from the measurement or the layer removed.

3. Surface finish

For surfaces that are more heavily corroded, or with a rough/damaged coating further work is required before a measurement can be taken.

- Using a file, remove the majority of the corrosion so that the area is smooth and free of any debris that could cause an issue for the sound energy to pass through. A file can remove large amounts of material at a time, so caution is advised during this step to avoid causing more damage to the surface. From this point a finer abrasive paper can be used to ensure it is as smooth as possible with no undulations. This will also help to improve the life of the transducer and reduce the frequency of resurfacing between measurements.
- For extreme corrosion/pitting it may be a good idea to avoid these areas and calculate the thickness either side then inspect the worse areas separately to get an accurate measurement.

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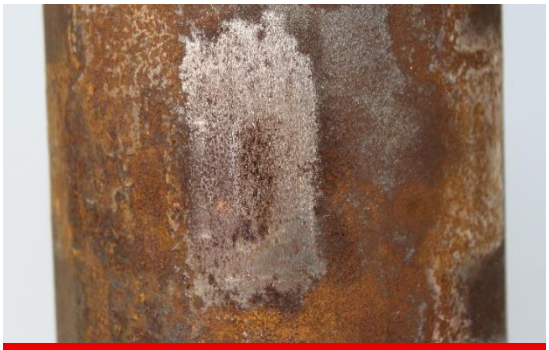
- After preparing the surface use an appropriate degreaser (temperature dependant) on the pipe to remove any residue that may react with the couplant during testing.
- Ionix can recommend a range of couplants which are tested for their corrosion inhibiting properties.
- Measurements on the pitting itself can also be completed but using only the first back wall echo.
- Multiple measurements on the same point will provide a more accurate representation of the condition of your test piece, however you may find measurements are challenging, making it difficult to get an accurate thickness even after meticulous preparation of the surface. If this occurs the issue may be internal to the test piece, with the reflection either being dispersed away from the 'return' element of the transducer, or it is out of the transducers test range (2.5 – 50 mm Echo-Echo/Mode 3). If you think this may be the case, another method of measuring to differentiate between inclusions and pitting such as a 45°-angle-beam probe may be suitable.

It is recommended to prepare a metal surface to achieve SA 2.5 'near white metal finish' (ISO 8501) or to an ideal surface roughness of Ra = 0.8 µm. Lesser surface roughness is more realistic and will still achieve coupling but take caution as the poorer surface may impact the accuracy of your measurements. Care should be taken not to significantly reduce the thickness or to pass below the minimum acceptable thickness value of the asset.



A prepared surface to ~SA2.5 near white metal

4. Check your measurement mode

Measurements taken on a rough or irregular surface can necessitate the use of a thicker couplant layer and can lead to distortion of the ultrasound path. When taking measurements in Mode 1 or 2 this can lead to increased measurement uncertainty as the couplant layer is included in the thickness measurement. Due to the slow speed of sound of couplant, this could appear to be 3 to 4 times thicker in the UT set than the actual layer thickness used. Mode 3 removes the effect of couplant thickness by comparing subsequent backwall reflections but may be difficult to resolve in rough or irregular surfaces, or corroded backwalls.

For further guidance, see

ISO 16809 Non-destructive testing – Ultrasonic thickness measurement