Inspection

This Note outlines techniques for four different examinations:

- compensating for coating thickness
- uncoated welds
- welds with non-metallic coatings
- welds with metallic coatings

It provides the basis for the development of procedures for specific inspection tasks.

Before carrying out any examination it is necessary to define the task to be carried out. The following information should be collated:

- parent material specification
- weld metal specification
- heat treatment condition
- surface finish
- joint geometry
- coating specification
- nominal coating thickness
- acceptance standards

WeldScan probes only detect flaws that are oriented at right angles to the scanning direction. Care must be taken when developing inspection procedures to ensure that sufficient scans are specified to detect all likely types of flaw.

This size of flaw that can be detected depends on the surface condition of the weld. Rough surfaces create ‘noise’ which mask the flaw signal. As a result only flaws deeper than 1mm can be detected. Shallower surface flaws can be detected in welds that have been dressed.

The depth of flaws can be assessed up to 4.5mm deep. Above this depth the signal response levels out. Care needs to be taken as crack branching can give an indication that a flaw is deeper than it actually is.

Compensating for Coating Thickness

This technique applies only to non-conductive coatings. Coating thickness is measured by comparing the signal from the component under examination with the signals received from a test block of similar material with coatings of varying thickness.

This test requires the use of a calibration test block plus four 0.5mm thick plastic shims (e.g. WeldScan test block 31A008) and an absolute pencil probe (such as 130P3) with a probe cable compatible with the instrument to be used. The calibration test block material should be similar to the material to be examined.

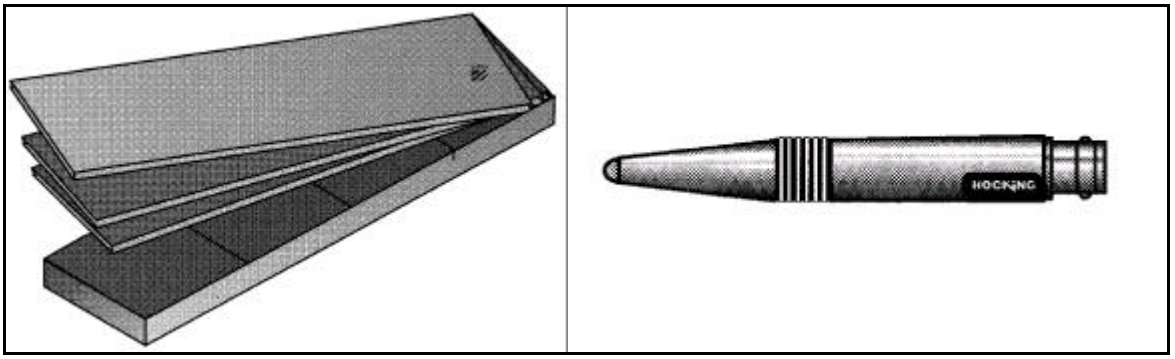

Figure 1 - Test Block 31A008 with0.5, 1 & 2 mm notches plus 4 x 0.5 mm shims and absolute pencil probe.

There are three stages to this procedure:

- balance the probe on the test block without the shims
- record the lift off signal produced when examining the test block through the shims
- examine the component to be tested and compare the signal produced with that produced from the test block plus known shims.

1) Place the probe on the bare calibration block and balance. Adjust the phase angle until the movement of the spot is horizontal.

2) Place the probe over 0.5mm, 1mm, 1.5mm and 2mm thick shims in turn. In each case record the position of the spot on the screen.

3) Place the probe over the component to be examined. The coating thickness can be estimated by comparing the signal from the area under examination with those produced by the examination of the test block through the shims.

Examining Uncoated Welds

Examination of welds includes examination of the surrounding parent material; heat affected zone as well as the weld.

The examination is carried out as follows:

1) Using a test block of similar material to that under examination, calibrate the equipment. Note or record the deflections obtained from the 0.5mm, 1mm and 2mm slots in the calibration block.

2) Place the WeldScan probe on the parent material at least twice the material thickness from the weld. Balance the probe. This will ensure that particular effects due to the fabrication process that apply to the whole component will not be picked up during the examination. Adjust the display settings to obtain the most useable display.

3) Examine the parent material and heat affected zone. This involves two scans on each side of the weld. In each case hold the probe so that it is at right angles to the material surface. This may mean tipping the probe when scanning along the weld toe. For the first scan move the probe in a zigzag pattern parallel to the length of the weld. See Fig 2. The second scan is known as the ‘Single Pass Technique’. Run the probe along the weld toe on each side of the weld.

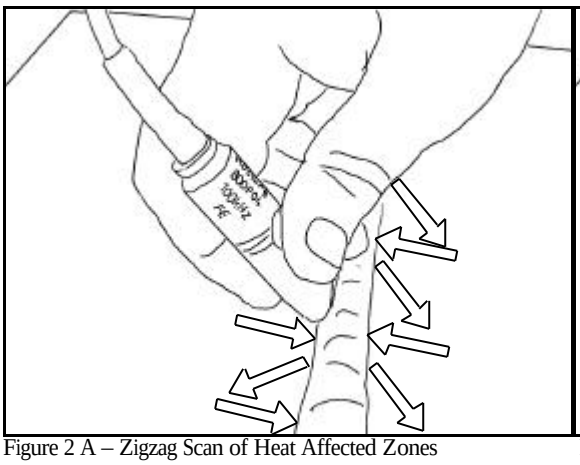

Figure 2 A – Zigzag Scan of Heat Affected Zones

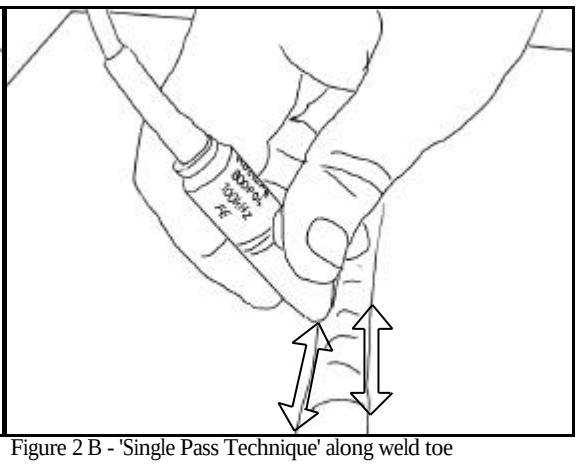

Figure 2 B - 'Single Pass Technique' along weld toe

4) Examine the weld. The number and type of scans required will depend on the size, configuration and surface condition of the weld. The aim is to ensure complete coverage of the surface of the weld. Fig 3 shows three different scans. Scan pattern A covers the entire width of the weld and would be sufficient for a dressed weld. Scan pattern B covers a single weld pass. Scan pattern C covers the toes of individual weld passes.

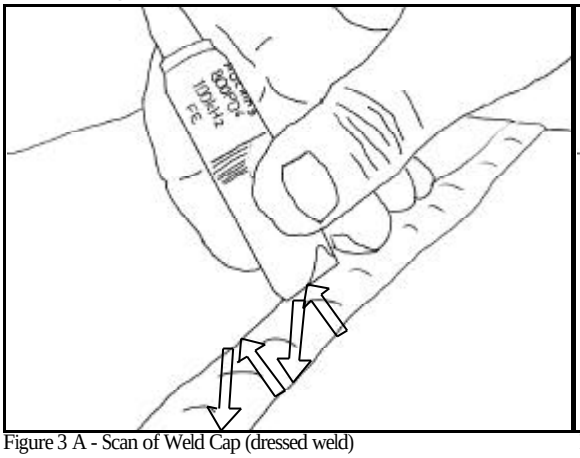

Figure 3 A - Scan of Weld Cap (dressed weld)

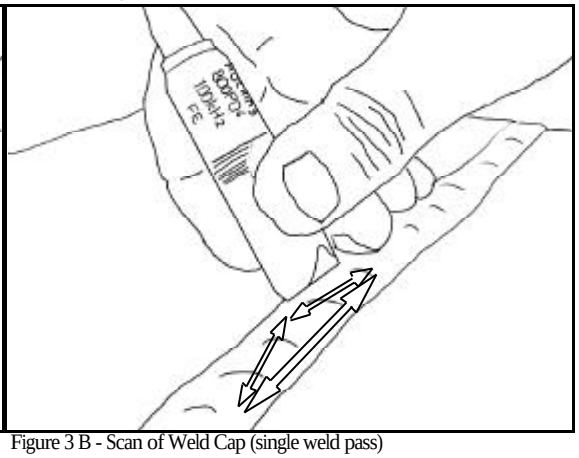

Figure 3 B - Scan of Weld Cap (single weld pass)

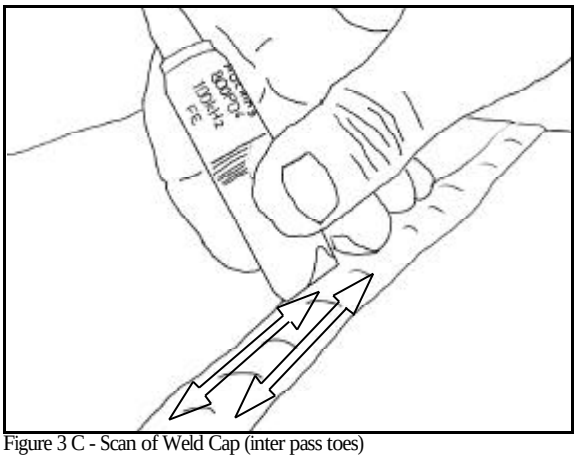

Figure 3 C - Scan of Weld Cap (inter pass toes)

5) If a flaw is detected the area should be subject to additional examinations to determine the extent and orientation of the flaw. A longitudinal scan as illustrated in Fig 4 will determine the length of the defect. A single pass scan as shown in Fig 5 will give the flaw 'signature'. The flaw depth can be estimated by comparing the y axis displacement of the spot on the screen when passing over the flaw, with the signal displacement obtained from the slots in the calibration block.

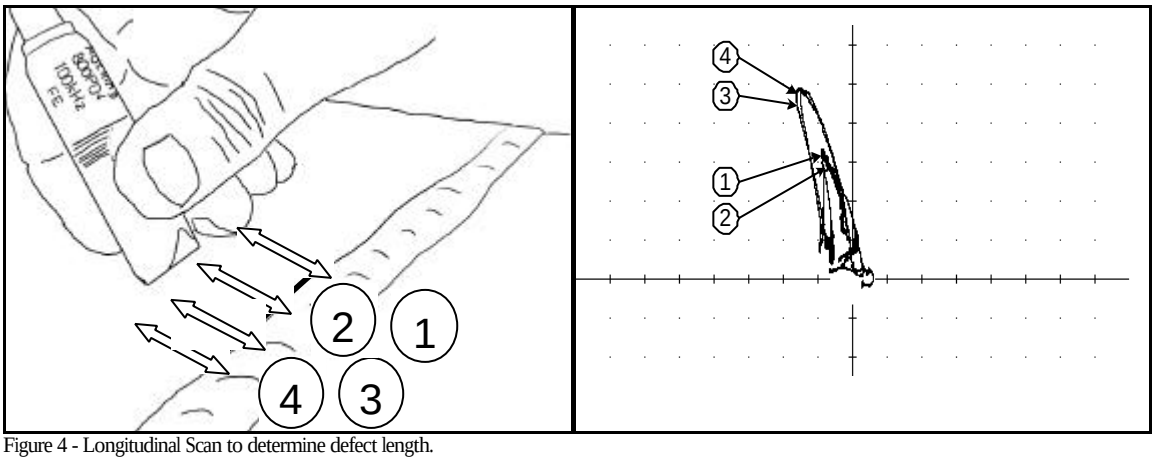

Figure 4 - Longitudinal Scan to determine defect length.

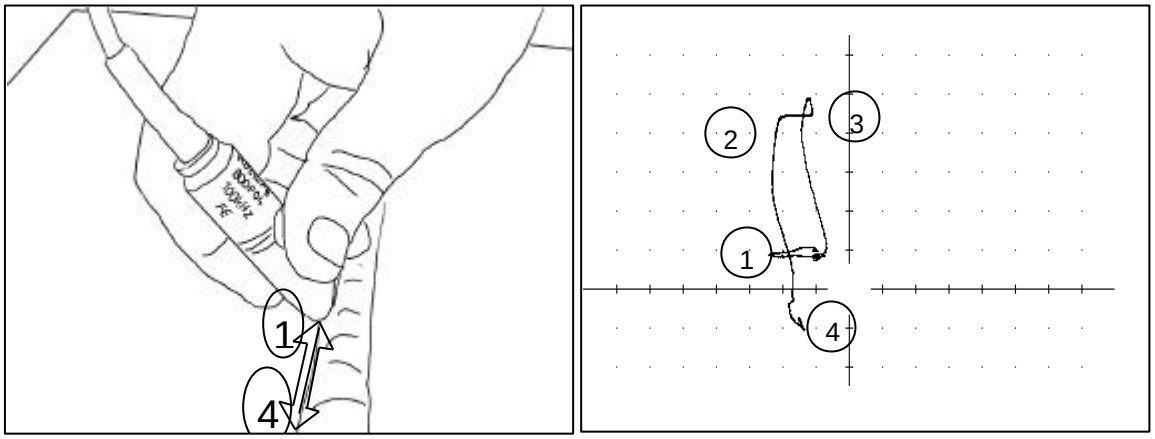

Figure 5 – Single Pass Scan on Heat Affected Zone

Examining Welds with Non-metallic Coatings

WeldScan probes can be used to examine welds covered with non-metallic coatings up to 2mm thick.

The examination follows the same procedure as that for uncoated welds with the addition of one step that takes into account the effect of the coating.

1) Carry out the calibration as described in Step 1 above, noting or recording the signal caused by the slots in the calibration block.
2) Place plastic shims equivalent to the thickness of the coating on the component to be examined on the calibration piece. Run the probe across the plastic shims and over the slots in the calibration blocks. Note or record the signal caused by the slots. The coating will reduce the signal amplitude. Increase the gain until the signal due to the slots has been restored to the level obtained from the uncoated block.
3) Carry out the examination as described in Steps 2-5 above.

Examining Welds with Metallic Coatings

Special WeldScan probes can be used to examine welds through metallic coatings up to 0.5mm thick. The probes can also be used to measure coating thickness. There are three stages to the inspection procedure:

- calibrate the equipment using a calibration block with a metallic coating of varying thicknesses
- measure the thickness of the metallic coating
- examine the weld

1) To calibrate the equipment, balance the probe in air. Next move the probe to the surface of a steel calibration block with metallic coatings of varying thicknesses. The coating thickness is indicated by the signal angle as shown in Fig 5.

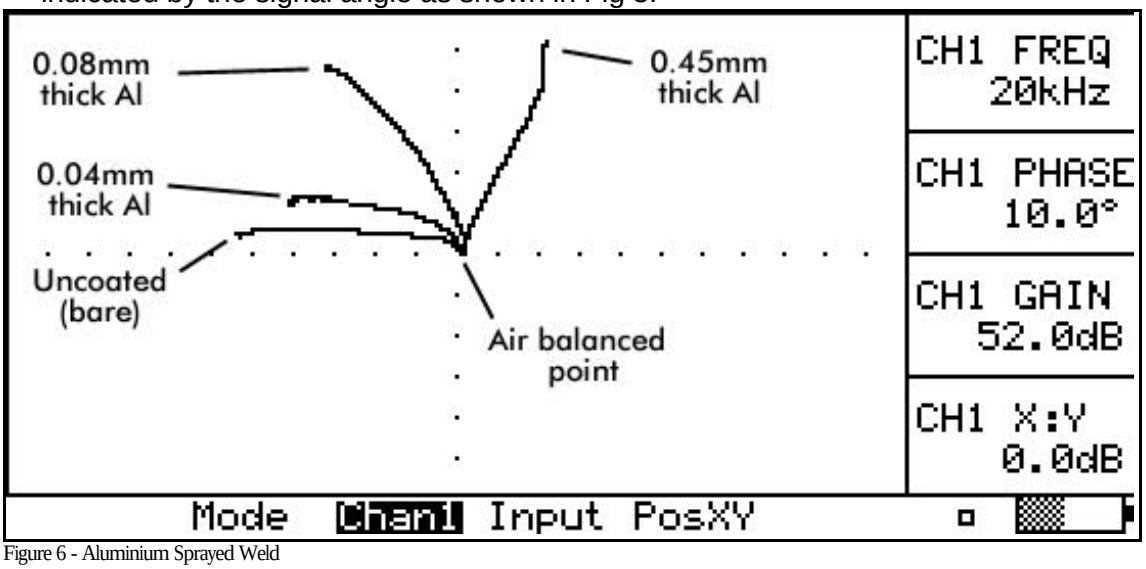

Figure 6 - Aluminium Sprayed Weld

2) Place the probe on the component to be examined. The coating thickness can be estimated from the signal angle.

3) To check a weld for flaws, return the probe to the calibration block and scan over cracks of a known size. Adjust the display such that the signals from the flaws are vertical. Adjust the gain to give a suitably sized signal for a known flaw. Place the probe on the weld to be examined. Scan using the patterns given for uncoated welds.

Inspection Standards

The British and European Standard BS EN 1711:2000 covers the use of WeldScan inspection.