

Introduction

Increasingly, due to their ease of use, adhesives are being utilised to join metals or composite structures. Testing of a single adhesive bond is not always a straight forward task using a simple A-Scan. It can be a challenging inspection, and if there are multiple layers then satisfactory reflections cannot always be relied upon, especially if the construction is complicated and/or a variety of materials are involved.

Unlike aluminium or other homogenized metals, adhesives are often not evenly applied, and usually show high level of signal attenuation. Testing of polyurethane bond material requires a lower probe frequency than most common inspection, since the material composition is not homogenized, and its grain structure is significantly larger in comparison to aluminium. Beside the ultrasound transmission issues, the geometry of the part (foam core for example), surface condition and probe access are also significant factors to be considered.

The current best solution is the through transmission shadow technique, using ultrasound penetration through a pitch and catch probe pair. The limitation of this technique being that access is required to both sides of the material. A dual or single element probe could be utilised and, in all cases, Sonatest recommends selecting a probe with a low damped piezoelectric crystal, having narrow band response, due to its higher sensitivity.

Go/No Go Implementation and Performance; Sonatest WAVE has a specifically designed feature for bond testing. A simple application pre-set can be programmed in the instrument with short-cuts for a more efficient operation. Furthermore, utilising the powerful pulsing capability and the wide band receiver to inspect less homogenised material makes WAVE a versatile tool for difficult inspection scenarios.



Figure 1 – Overview of the inspection

Industries

- Aerospace Aeronautical Inspection
- Aerospace Astronautical Inspection
- Rail Sector
- Military Sector
- Automotive Industry

Application

- Corrosion / Thickness measurement
- Composite Material Inspection
- Material Bonding Inspection

Typical Parts

- Aircraft frame panel joints
- Aircraft frame support structure joints.
- Vehicle structure and body bonding
- Laminate and composite structure bonding

Inspection Techniques

- Manual UT – Shadow technique
- Manual UT – Back Wall Monitoring
- Manual UT – Echo pattern monitoring

Features and Benefits

- Wide band input
- Extra narrow band filters for low damped probes
- High resolution on-screen A-Scan reference
- Quick reference scan options
- Alarm options set on singularities.
- Built-in inspection interface

Inspection Methods

The below methods show how this inspection can be carried out.

Pitch-Catch probe technique

The key to this technique is the shadow effect as shown in figure 2. One transducer is transmitting and on the opposite side of the material another probe is receiving. If the ultrasound encounters a highly attenuative bond resulting from say, poor adhesion then the signal will be absorbed or reflected and the signal caught by the receiving probe will be reduced thereby identifying the problem. The A-scan is typically fully rectified, and a negative alarm gate is used for a go/no-go call.

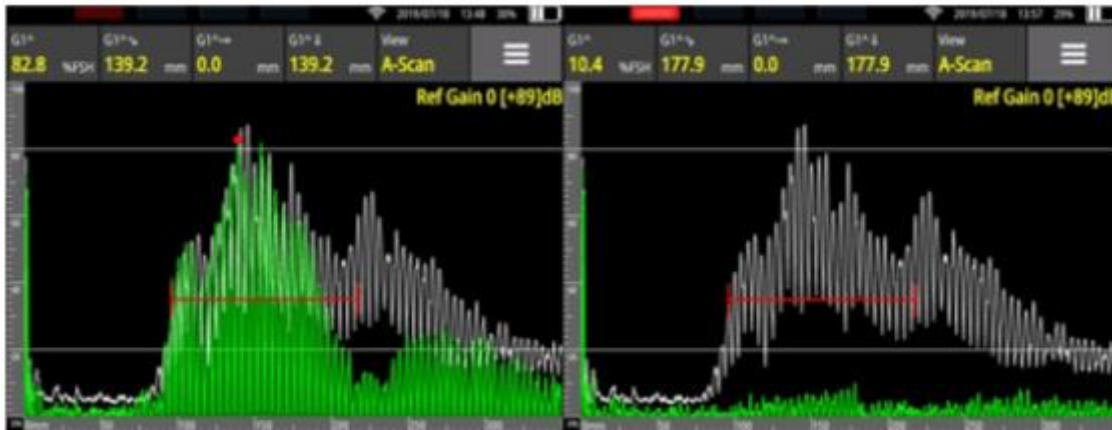


Figure 2 – Pitch-Catch example showing an acceptable signal on the left matching the white reference line, and a reject signal on the right showing a very low amplitude signal and the red alarm bar at the top.

Pulse-Echo single probe technique

This is backwall echo attenuation monitoring combined with the bond line signal checking using a single element probe on the outer surface of the material. The unit should be set in RF mode, so the A-Scan shows the full polarity of the signal to spot the acoustic impedance changes. It is also possible to set a negative gate alarm, so the light indicates a defective zone when the signal is dropped. A typical flaw will indicate a low back wall percentage FSH and the bond line echo will increase in parallel.

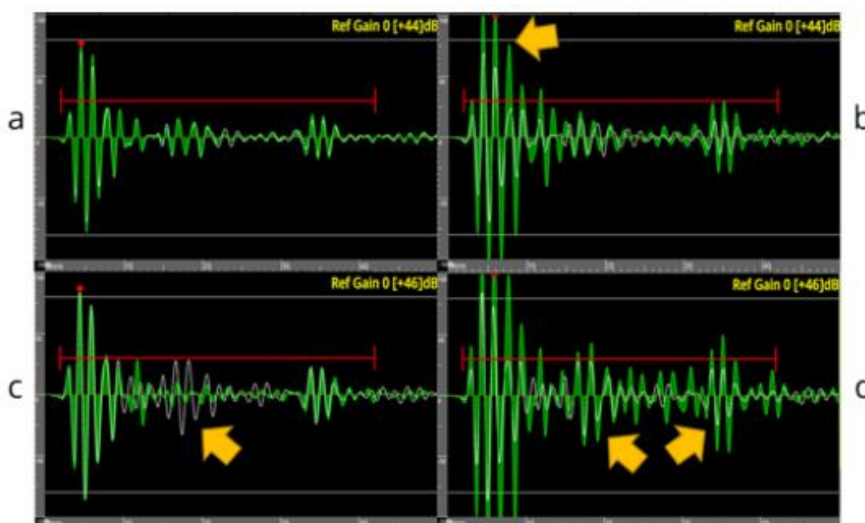


Figure 3 - Shows a series of identified flaws in a two layer aluminium assembly with polyurethane bonding. a) Good bonding, b) Thin line, c) First layer is pulled off, d) Absence of glue

Dual crystal single probe technique

For difficult applications where the first layer is creating undesired echoes, the dual crystal probe can help. This is especially useful when dealing with thinner layers (less than 2 mm or 0.079 inch), the interface amplitude will improve the signal signature in the adhesive (bond material) to make it an easier go/no-go decision. If the incoming farthest echo is strong enough, it indicates that the signal is going through all the layers and with good bonding between the layers, a fair reference A-Scan and the lack of returning waves will be spotted efficiently.

For further information or support, please contact the Sonatest Applications Team: applications@sonatest.com

Recommended Tool Package

Category	Part #	Description
Acquisition Unit	WAVE	Interactive flaw detector with scan plan capabilities to aid in defect detection
Probe	STP Probe series STARC Probe series TSTARC Probe series	Through transmission, 0° single and Twin transducers for these inspections

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