Bond Scanner
for glue line and seam inspection
Gluing becomes more and more important as a joining technology for automotive body panels because of the benefit it provides. This trend is driven by advancing weight reduction in vehicle manufacturing where glues are used for sealing as well as for increasing structural stability. In modern car designs, the total accumulated length of glue lines can reach hundreds of meters. However, similar to other production processes, gluing does not provide a 100% process reliability. To identify areas with lack of adhesive as well as misaligned bond lines destructive or non-destructive tests are necessary. Although the solution was developed for the automotive sector, the same technology can potentially be applied in all industry sectors where similar glue lines have to be assessed.

**Bond Scanner**

GE Inspection Technologies’ Bond Scanner is usually simply clamped on two body panels joined by a seam bond. The innovative array design (patent pending) enables the array to adopt also to contoured parts as commonly used in automobile designs and covering bond lines up to 32 mm width. Since the spring-loaded encoder wheel is located on the other side of the plate combination a firm and stable position of the array can be realized. The specially designed protection foil reduces the needed couplant to a minimum and enables a manual, one-handed scanning. Complete sections of car body bond seams (e.g. on hoods, doors or other mounted parts) can be inspected in just one scan.

**Features**

- Flexible, adaptive 10 MHz array
- 64 elements, 0.5 mm pitch for 32 mm coverage
- Spring loaded and sealed encoder for optimal positioning
- Protective foil for reducing wear and couplant need
- Ergonomic handling, smooth scanning operation
- Silicone oil free

**Operating Information**

Ultrasound is being reflected at interfaces between materials of different acoustical impedances whereas the magnitude of reflection is determined by difference of acoustical impedances of adjoining parts. In the given application that means that the reflection at the back side of the top plate will be different depending on whether there is adhesive present or not. The difference in the reflected ultrasound is then being positional recorded and evaluated and the quality of the bond line can be assessed over its complete length.

GE Inspection Technologies’ Bond Scanner incorporates a linear array that is orientated perpendicularly to the scan direction. Only few elements of the array are bundled together to an active aperture which can be electronically moved over the array by switching through elements. In this way glue lines of typical width can be covered while ensuring a good spatial resolution. The amplitude of the reflected ultrasound is then color-coded mapped, first over the array and then over the scanned area to form what is called a C-scan. This C-scan basically represents a map of the presence of adhesive.
Thanks to this technology, the operator is not only able to evaluate the overall width of his bond seam, but can also identify areas with lack of adhesive. He can give immediate feedback to the dispense robots’ operators in case of meander-shaped imperfections, or areas where adhesive is lacking over the complete width.

**UT Results Analysis**

Wherever adhesive is missing on the back side of the top plate, the ultrasound is reflected almost completely. These areas are shown in red (high amplitude) whereas areas where sound is reflected a lot less are shown in blue. Since adhesive is applied in an amount such that it forms a predefined bond seam, the width of this bond seam is also of interest. It can be easily read from the data since the border of the seam coincides with the shift from blue to red on the top part of the picture.

Moreover, also isolated red areas can be identified in the C-scan, representing meander-shaped areas that lack adhesive.

**Complex Geometries**

Complex geometries such as corrugations and curvatures are becoming more popular in modern car designs. They are not only decorative but also increase structural strength where plate thickness is being reduced in light-weight constructions. GE Inspection Technologies’ innovative array design is convexly pre-bent and can adopt its shape to concave geometry because of its flexibility. The array can adopt to concave and convex curvatures with a bending radius of approximately 80 mm.
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GEIT-20075EN (04/16)

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Imagination at work

Schematic of a typical bond seam in a flange. A plate A is flanged around a plate B. The spacing in between is sealed with an adhesive for structural strength and to prevent corrosion. When ultrasound transmits into plate A, the amplitude of the reflected sound at the backside of plate A depends on the presence of adhesive. When ultrasound transmits into the adhesive the amount of reflected ultrasound is less compared to a situation where no adhesive is present.

Krautkramer USM Vision+

Paired with the new Phased Array ultrasonic flaw detector USM Vision+, the complete solution enables phased array glue line inspection of automobile parts even with complex geometries.

• Modern, state-of-the-art Phased Array Flaw Detector
• 16/128 channels
• Rugged housing, IP 54
• Online measurement functionality for quick inspection data assessment
• Data storage as raw data (DICONDE format) or in JPG format

Scanner Packages

<table>
<thead>
<tr>
<th>Complete Bond Seam Solution Package</th>
<th>0680006</th>
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<tr>
<td>Provides the complete solution and a spare scanner plus sufficient spare parts ensuring maximum productivity. The package includes the following parts:</td>
<td></td>
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<tr>
<td>0037510 USM Vision+ UT Phased Array Instrument</td>
<td></td>
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<tr>
<td>0600180 x 2 Two Bond Scanners (PA probes are integrated with scanners)</td>
<td></td>
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<tr>
<td>0600199 x 3 3 spare protection foils</td>
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<tr>
<th>Basic Bond Seam Solution Package</th>
<th>0680005</th>
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<tr>
<td>Provides the basic package to conduct bond seam inspection operations. The package includes the following parts</td>
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<td>0037510 USM Vision+ UT Phased Array Instrument</td>
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<td>0600199 1 spare protection foil</td>
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