

**DYNAMIC INSPECTION OF COMPOSITE TO METAL BOND WITH AIR COUPLED AND SQUIRTER ULTRASONIC SYSTEM**



Advances in composite manufacturing technology have led to the widespread application of composites owing to their very less weight to strength ratio compared to metals. They are used as substitutes for metals like in aircraft wings, casings as in satellites, and a variety of other applications. One of the important applications of composites is in thermal insulation as in the case of rockets and missiles. The motor tube which encloses the propulsion motor or the fuel is lined with a composite layer to give protection as well as thermal insulation. In this case, the steel motor tube is lined with a sheet of high silica cloth and phenolic resin

which is baked in an autoclave for a perfect bonding of the composite to the metal. Due to several variables like poor vacuuming, poor mixing of composites, temperature and pressure variations, etc., there are chances of improper bonding leading to a dis-bond between the metal and composites. The interface between the metal and lining is inspected in pulse-echo as well as through transmission modes using Squirter Pulse-Echo UT and air-coupled Through Transmission UT. Two air-coupled transducers scan the sample through transmission mode while an immersion probe scans the sample in a squirter mode where

water is continuously pumped in between the probe and sample.

After the inspection, the data is subjected to an automatic defect reporting algorithm according to the party's acceptance criteria resulting in complete computer-generated reports.

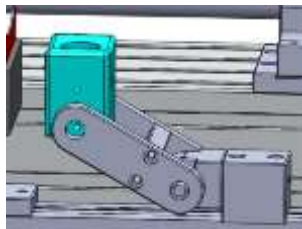
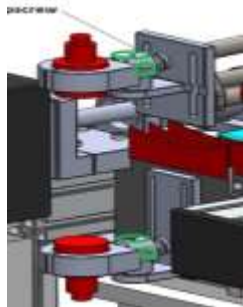
UT Transducers used	
Air Coupled UT	225kHz transducers
Squirter UT	5 MHz transducers

Both the inspections are carried out simultaneously with the air-coupled inspection leading the squirter mechanism, without any water drops falling onto the Air-coupled transducer surface, as the



presence of water on the surface may result in variations with the air-coupled readings.

Air coupled TT probes (red)



Squirter PE UT probe (blue)

The cycle time for one barrel is 30 minutes. The system used for the inspection is **SHRUTI**<sup>®</sup>. Scanning High-Resolution Ultrasonic Inspection System is indigenously developed and is a customizable, automated, multi-axis robotic scanner. Along with an ultrasonic probe, advanced data analysis (*extut*<sup>®</sup>), and image analysis package (*imagine*<sup>®</sup> & *SimScan*<sup>®</sup>), SHRUTI facilitates easy inspection of samples and components. **SHRUTI**<sup>®</sup> offers very high-resolution images of the test coupon with very high scanning speeds. The complete instrument

control is through the software. Skelton of the system is being built from lightweight aluminum extrusions which are upgraded to Stainless Steel for heavy-duty applications. All the electrical connections are rugged and properly routed following industrial standards offering very durable and reliable running. The system employs rugged servo motors for motion requirements and had industrial standard safety interlocks.



System with sample

The system employs a centralized lubrication system to cater to the lubrication requirements, centering rollers, pendent mechanism, and auto cycle to reduce human intervention. The system can run 24x7 with minimal human intervention. Both the pulser-receivers are synchronized and interfaced with a central computer that controls the pulser-receiver electronics and motion

hardware at the same time and records the data to a central repository.



ULTRASONIC TEST REPORT  
(Through Transmission Technique)

App's Agency Name:	Customer: Microtube Ltd.							
Lot No. / Tube No. / Subcontractor:	Page: 08/26							
Tube Dimensions: ID 203mm, OD 284mm, Length 1400mm	Control: 40							
Ref used:	Apparatus: SHTRC 0705 0000							
Probe: 200KHZ, Diameter: 38mm	Ref. Scan Settings: 70 dB							
Defect Identification:								
Control								
	A	B	C	D	E	F	G	H
1	*	*	*	*	*	*	*	*
2								
3								
4								
5								
6								
7								
8								
9								
10	*	*	*	*	*	*	*	*
11								
12								

100% of scans logged  
\* 50% of scans logged

Revised:	Pages: 01
DISPATCH AUTHORITY	
DATE	
APPROVING AUTHORITY	
DATE	

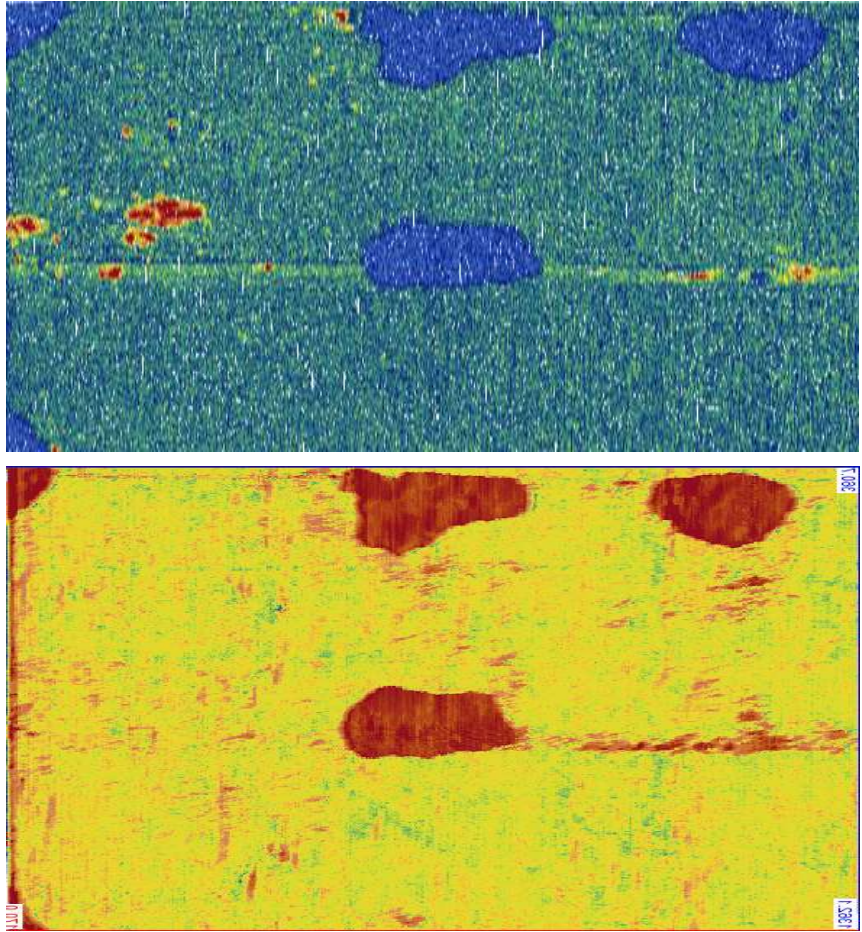
Sample Inspection report

The machine is calibrated with a reference sample that has simulated defects using Teflon inserts. The baseline data obtained from the reference sample is fed to the reporting algorithm for automatic defect identification.

# Dynamic Inspection of composite to metal bond with air- coupled and Squirter Ultrasonic system - Application Note

A Dhvani Research  
Application Note

Chennai, INDIA



Air coupled Thru-Transmission (above) and squirter Pulse-Echo (below) UT C Scan images. The lengthier portion is along the horizontal axis and the width is along the circumference.

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