

Automated Phased Array Immersion Ultrasonic Testing System for Inspection of GUN Barrel, Breech Ring and Casings



A gun barrel assembly is a crucial part of gun-type ranged weapons. It is a straight-shooting tube, usually made of rigid high strength metal, through which a contained rapid expansion of high-pressure gas is introduced via propellant combustion behind a projectile to propel it out of the front end (muzzle) at a high velocity.

A gun barrel must be able to stay intact during the expansion produced by the propellants to ensure that optimum muzzle velocity is attained by the projectile as it is being pushed out. If the barrel material cannot cope with the pressure within the bore,

the barrel itself might suffer catastrophic failure and explode, which will not only destroy the gun but also present a life-threatening danger to people nearby. The presence of any defects also leads to the failure of the barrel operation in service. So, a complete volumetric inspection of the barrel needs to be done as a quality evaluation standard. An automated-phased array ultrasonic testing system which is one of the advanced non-invasive testing procedures is discussed here for detecting the defects in the barrel components.

Automated phased array ultrasonic inspection solution for barrel inspection

Automated Phased Array Ultrasonic Inspection System for Barrels, Breech Ring and casing is an immersion ultrasonic system designed to scan for defects using phased array ultrasonic technology. The entire system consists of a material handling gantry, immersion tank, ultrasound gantry, and control system. The subsystems are

1. Material Handling gantry
2. Immersion tank
3. Ultrasound gantry



1. Material Handling Gantry:

The UT immersion plant handles barrels of length up to 10 meters and up to 0.45 m diameter and of different geometric designs weighing up to 8 tons. This gantry can accommodate a range of samples.

2. Immersion Tank:

The stainless-steel immersion tank is the key structural component in the whole system supporting the entire weight of the inspection component and the material handling gantry. The immersion tank holds the drive mechanism for rotating the barrels, their associated motors, and gearboxes.

3. Ultrasound Gantry:

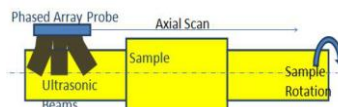
This gantry system is used for the scanning of the samples in different orientations and modes. This gantry houses the UT equipment and the phased array probe. The complete system is shown as below:

Salient Features of the system:

- Production line Phased array automatic inspection plant.
- Scans barrels of length up to 10 m and diameter up to 0.45 m.
- Scans cuboid components of dimensions up to 0.8x0.8x2 m.

- Capable of handling jobs up to 8 tonnes.
- Linear speeds up to 250 mm/s and rotary up to 50 rpm.
- Sophisticated fixture to accommodate barrels of different designs.
- Control system with contour following capability.
- 3D visualization of acquired data.
- Automatic job sentencing at the end of the inspection.

Inspection procedure:



As the components have defects with different orientations, inspection needs to be carried out using both longitudinal and shear waves. The advantage of the phased array inspection is that it can perform all the required modes of inspection simultaneously as shown in the below image. This can make the inspection faster compared to conventional inspection.

The scanning will be performed in a helical path where the sample keeps rotating at a predefined speed and the probe will be moved from one end to another. The scan results of all the individual focal laws will be presented separately. The system

will be calibrated using the standard block with defects.

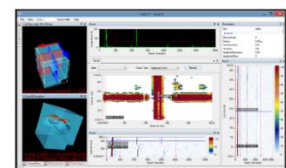
Automated Inspection:

The working procedure is completely automated. The user needs to choose the component serial no from the control panel switch and the inspection needs to be initiated. Once the inspection completes, the system gives an alarm if the sample is defective. The system can also work in manual mode.

Data Visualization:

The visualizer next screen is designed to visualize the following:

- A-scan, B-scan, C-scan, and D-scan as 2D Plots.
- B-Scan, C-Scan, and D-scan mapped on 3D Object.
- CAD geometry with panes that show the point at which A scan is displayed.
- UT Parameters window which shows the acquisition parameters.
- Display Settings window to control the display features.

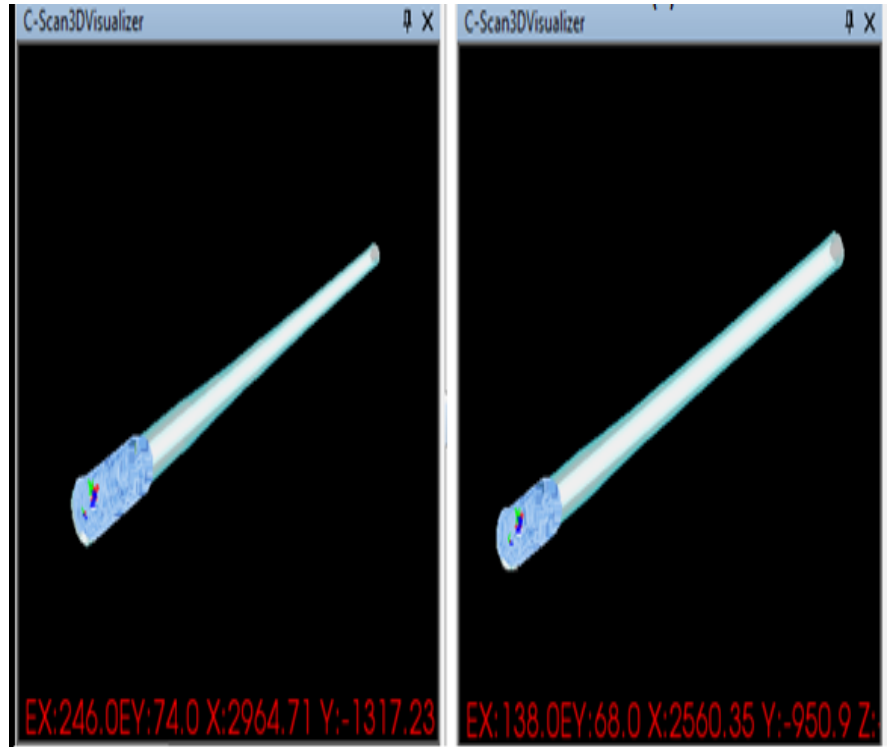


All the scan data can be visualized by mapping them in the 3D CAD model for a better understanding of the defect propagation.

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Application Note

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