



**Ultrasonic Technologies, Inc.**

2664 Cypress Ridge Blvd,  
suite. 103 Wesley Chapel,  
Florida, 33544, U.S.A.

[www.ultrasonictech.com](http://www.ultrasonictech.com)

## FLAW DETECTION IN CERAMIC ARMOR PLATES

### Resonance Ultrasonic Vibrations (RUV) Technology

- **High reliability and accuracy**
  - **High throughput**
    - **Real-time**
  - **Non-destructive**
  - **Cost-effective**



#### RUV TECHNOLOGY

The Resonance Ultrasonic Vibrations (RUV) technology was developed for non-destructive detection of **cracks** and **delamination** in composite ceramics used in body armor plates. The RUV technology implements fast measurement of the ultrasonic resonance response in ceramic substrates. Invisible peripheral or bulk cracks or delaminated components are exhibited as deviation of the resonance response between the flawed plate and a standard plate. In addition, the RUV tool allows “health” monitoring of the individual plate integrity during routine maintenance and rotation.

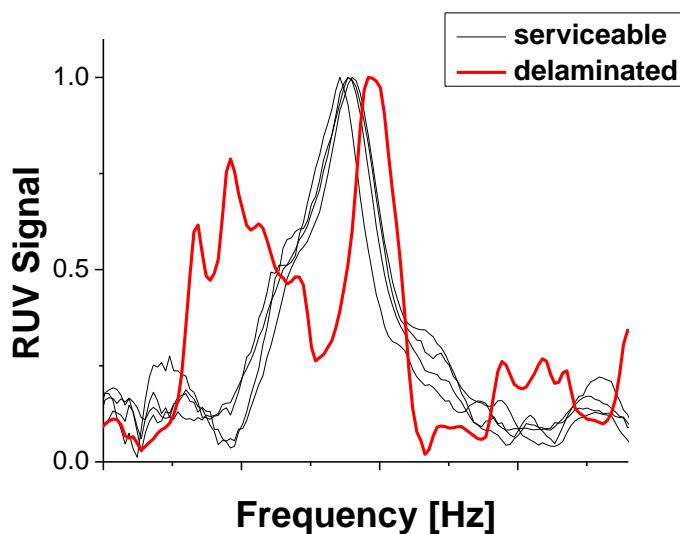
Ceramic substrates used to manufacture armor plates are the primary contributors to the overall performance of the finished product. Quality controls, in regard to cracks and delamination, as well as process controls in production, are two primary aspects that require advanced testing efforts. To ensure that armor plates are not damaged and adhere to performance standards, periodic quality inspection is a mandatory requirement for armor

plates employed in combat and special operations as well as after storage, shipping and transportation. Commercially available the RUV-CP.1 model is used in plate production, while RUV-DBAM model is a deployable portable system.

RUV technology provides (1) within seconds non-destructive inspection of mechanical flaws (**cracks, delamination**) during plate production; (2) detection of these mechanical flaws in fully assembled plates after deployment during periodic quality inspections in the field; and (3) cost-effective solution to quality control and maintenance service. Additionally, the RUV system serves as a process improvement tool that increases yield by eliminating production flaws caused by mechanical defects.

## FREQUENCY CURVE

Through a resonance frequency curve selected from a broad range (20 - 250 kHz) the RUV method enables delam detection in ceramic armor plates with simple quantitative criteria. A delamination of armor plate components alters RUV peak parameters: amplitude, bandwidth and peak position. This is illustrated in Figure 1 by comparing RUV curves measured on standard plates with the identical plate inspected by CT scan with confirmed delamination. Specifically, the delam plate shows split of a primary broad peak on multiple sharp lines. This feature is automatically revealed by RUV software. The RUV approach is based on fast measurement and analysis of a specific resonance peak and rejection of the suspect sample if peak characteristics deviate from similar non-cracked samples.



**Figure 1:** Deviations of the resonance peak caused by delamination in ceramic plate (left). Black lines are good plates, red line is a delaminated plate. RUV quality control tool for body armor plates (right)

The RUV method to inspect delamination is based on a statistical approach. In case studies, the capture rate of RUV method approaches 100%.

For more information, please contact UST at [support@ultrasonictech.com](mailto:support@ultrasonictech.com)