

4.2.27. CFRP INSPECTION BY ULTRASONIC HIGH-FREQUENCY PULSE-ECHO METHOD

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The increased commercial exploitation of fiber/epoxy composites, particularly carbon fiber reinforced plastic (CFRP), in advanced aircraft involves a crucial need for improvement of techniques and equipment for non-destructive testing.

Since 2007 FSUE “VIAM” has been designing the procedures and devices for high-frequency pulse-echo FRP inspection using longitudinal acoustic waves. Over the last two years (2008–2009) the adoption and commercial application of these procedures have revealed some aspects, which could not be taken into consideration earlier. At the same time (2009) another study was carried out. It was aimed at adapting echo method to large-scale CFRP plates of MS-21 that is a promising short-to medium range airliner.

As a cooperative effort by FSUE “VIAM” and FSUE ORPE “Technologiya” a series of investigations was carried out. It covered the research into acoustic properties such as sound attenuation and defect echo in different plates and structures made of VKU-17KE.1 plastic, physical factors responsible for defect echo and loss of back reflection, detectability of different types of inclusions, and test run of various equipment. The research resulted in a new instruction on ultrasonic inspection of MS-21 components. The instructions in force were changed considerably. Particularly, the list of detectors in use was extended. New recommendations on the choice of equipment and scanning index and velocity, the use of electronic distance amplitude compensation and etc., as well as the requirements to standard blocks, examination techniques and coupling liquids were worked out. They were taken into consideration at developing new techniques. The decision to use straight beam wide-band single-element delay line transducers instead of dual element transducers was made. The recommendations on the choice of the central frequencies of the transducer for testing components with different thickness and ultrasound attenuation that allow the minimal size of dead zones were worked out. The 2-nd gate for tracing the amplitude of backwall reflection was installed. The criteria for rejecting the components in the case of the presence of the zones of increased attenuation were worked out. In fact a mirror through transmission method was applied in addition to the echo method.

In 2010 FSUE “VIAM” started to design the procedures for testing CFRP using multiple element transducer (phased arrays). This echo method is widely used abroad and its development allows us to ensure the increase in quality and production rate, informativity and reliability of testing fiber/epoxy composites.