Ultrasonic low-frequency scanner-topograph A1050 PlaneScan

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Introduction
The scanner-topograph A1050 PlaneScan is designed to detect flaws of aircraft’s skin by surface sounding with ultrasonic rolling dry point contact transducers.

12-element linear antenna array of rolling dry point contact (RDPC) transducers provides continuous scanning of large areas of aircraft’s skin without extra preparing operations.

Changing characteristics of the Lamb wave in every point of the object’s surface make it possible to locate corroded sheets with decreased thickness, stratifications in coal-plastic panels and to detect flaws in honeycomb panels.

The main field of application of A1050 PlaneScan is in-process monitoring and in-service inspection of panels, skins and other items of various materials (painted and unpainted aluminum sheets as well as coal-plastics) used in aircraft construction.

Description
Operating principal of the scanner-topograph is based on analyzing parameters of ultrasonic pulses through a small area of the test objects (pulsing base) between every pair of adjacent transducers forming a linear antenna array.

Changes of various parameters of pulses, amplitude of the received echo, form and polarity make it possible to distinguish the echo pulse from aluminum skin of an aircraft from the echo pulse at a flaw area with different thickness and different density.

Pulse processing includes operations on distinguishing an effective echo pulses from noise, measuring or estimating informative parameters and displaying them on the screen of the scanner-topograph in colour coding, handy and easy to understand.

Three informative parameters are saved to memory from every pair of adjacent antenna array elements as a result of analysis of received echo pulses from every point of the tested object’s surface with discreteness of 10 or 5 mm in the scanning direction. Every pair of elements gives a row of dots to the image reflecting information about characteristics of the test zone.

Delay of the effective pulse is displayed on the screen in colour coding. The delay depends on the material of the test object, its thickness, texture (if the material is fibrous) and other characteristics. Short delay time is marked with blue colour and the longest time is coded with red.
The construction of ultrasonic rolling dry point contact transducers is based on the principle of transmitting pulses, normal to the surface, to the object and back through a thin intermediate layer of solid material. It is made on the basis of a brass wheel rim, inside which the active part of the transducer is set.

The inner surface of the rim has a very low roughness (it is polished) to provide a low level of noises in the pulse of the receiving transducer during sliding of the polished contact tip of the transducer active part in the rim surface.

The wheel fork, installed in the body of the electronic unit, with a small (within 10 mm) alternating movement possible, is spring-loaded to create a wheel rim pressure to the surface of the tested object (Pic.1).

Sound pulses in the test object material are emitted with couples of ultrasonic transducers installed at the distance of 20 mm between their centers forming a 12-element antenna array.

The spring provides permanent pressure of the probes to the test object.

The 12-element linear antenna array covers the surface of the test object with a stripe of scanned space consisted of 11 parallel scanning lines in 20 mm from each other. This way general size of the image is 220 mm.

The scanner-topograph is a monoblock comprised of a computer, antenna array, control unit, components to display results and to save them to memory, and an independent battery. (Pic.2)
The antenna array is installed in the lower part of a rectangular case with handles to carry. The handles can be fixed in several positions, so that they can be set in various angles to the face panel. All elements of the antenna array have an independent spring load and can move along their longitudinal axis. It ensures the possibility to perform testing of not only flat areas of the test object, but also of convex areas with radius of curvature of 1400 mm and more, as well as of concave areas with the same minimal radius (Pic.3)
During scanning the monoblock will be borne by four supporting wheels, not by the wheels of the antenna array. Meanwhile the elements will be pressed to the test object surface independently with forces, defined only by inner spring mechanism of the elements. They do not depend on the force of pressure of the monoblock to the test object (Pic.4).

Pic.4. 12-element linear antenna array of rolling dry point contact (RDPC)

One of the pairs of supporting wheels is attached to the case motionlessly. Another pair is installed on an axle and can turn around it a little between limiters, like a balance wheel. This solution provides steady mounting of the monoblock with all four wheels to a test object of cylinder shape along a generatrix or at a sharp angle to it, also to objects of conical, sphere or more complicated shape, but with local curvature radius no less than 1400 mm.

On the front panel of the monoblock there is a display in the center and two keyboards on both sides of it. The quantity of buttons is sufficient for any manipulations to control the monoblock – to view images, to save them to memory and to display saved imaged, to perform analysis and various measurements.

**Conclusion**

It concludes with the main technical characteristics of the system described:

- Transducer frequency range - 50-100 kHz
- Sounding frequency - 200 Hz
- Delay in the probe - 6 µs
- Minimal size of located reflectors - cylinder stratification 30mm in diameter at 1mm depth, longitudinal crack (along the direction of scanning) 5 mm long at 5 mm depth
- Scanning velocity - 100 mm/s
- Ultrasound propagation velocity, not more than - 5000 m/s
- Display type - 5.7” TFT, full colour
- Battery operation time, at least - 8 h
• Connection to PC - USB
• Dimensions, without handles - 420x170x205 mm
• Dimensions, with handles - 465x170x205 mm
• Weight, maximum - 7.5 kg
• Operating temperature range - from – 20 to +50 ºC

**Literature**