1.10.29. EMA TESTING OF "PROTON" ROCKET HULL THICKNESS

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One of the quality requirements providing a high-level reliability of sophisticated items produced by space rocket industry enterprises is the testing of hull thickness and other elements of rocket vehicles.

Formidable volumes of testing and increased requirements for thickness measurement precision of shrouds and panels walls designed for hull plating of "PROTON" rocket required development of conceptually new method and apparatus providing necessary performance and accuracy of measurements. In order to resolve this problem, a magneto-acoustic (EMA) thickness meter A1270 was developed (fig. 1). in JSC "NIIIN MSIA "Spectrum" according to technical requirements of the State space research and production center (GKNPC) n. a. Khrunichev M.V. By virtue of application of an EMA transducer featuring excitation and reception of rotational ultrasonic horizontally polarized waves with radial and linear polarization and longitudinal within the bandwidth from 2.5 to 5 MHz (fig. 2), testing of alloys derived and processed with different technologies is possible. Testing of items can be performed in any dimensional position and from a surface of any curve (convex and concave) with a minimal radius as of 50 mm, since the thickness measurement procedure is not connected with the acoustic contact influence. EMA thickness meter provides thickness measuring of items made of aluminum alloys over the range of 0.5 – 100 mm by echo-method with 0.01 mm discretion in the thickness range from 0.5 to 25 mm and 0.1 mm when measuring thicknesses over 25 mm. The conceptual difference of the A1270 thickness meter from its predecessors is the application of co-relational signal processing which made it possible to nearly eliminate the influence of form and amplitude change on accuracy of measurements.

Fig. 1.

Availability of a processor and a graphics display in the EMA thickness meter increases informativity of measurements and gives an opportunity to save minimal thickness values and the software selection of a measurement method extends capabilities for measuring of items thickness with a damaged surface. The increased accuracy of thickness measurements was provided by a capability for real-time correction of ultrasonic waves velocity. Application of EMA thickness meter at the space rocket plant GKNPC n. a. Khrunichev M.V. has significantly simplified technology of measurements and increased their performance and production culture (fig. 3). Results achieved during continuous operation of A1270 thickness meters allowed to determine the range of ultrasonic velocity oscillations dispersion in aluminum alloys either of different grades and consignments or within a single raw blank. Real-time thickness measurement of panel walls allows interacting with the whole technological process of critical structures production.

Fig. 2.

Fig. 3.

Actions taken for improvement of energy consumption efficiency of the EMA thickness meter (application of novolatile permanent magnets in EMA transducers, automatic power shutdown after a continuous pause in measurements) provide stable operation of a thickness meter throughout a shift.