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Technological expert diagnostic system of aircraft

The systems for diagnosing the quality of aircraft and its components on the basis of nondestructive testing (NDT)

Technical diagnostics based on methods of inspection - a reliable indicator of quality. Getting data about the characteristics, material properties and characteristics associated with object of control a lot of information. In world practice, distinguished expert systems for maintenance which minimizes the volume of information and the probability of correct decisions increases.

Consider trends and prospects evaluate the technical condition of aircraft structures in the process of maintenance, repair and operation. Development of such systems are divided into five main areas.

The first - the creation of nondestructive testing of elements, parts, components, systems Sun

Second - development methodology physical NDT methods of stress- strain state of diagnosis objects.

Third - the creation of methods of diagnosing test design Sun , based on NDT methods.

Fourth - building monitoring systems based on development of methods and tools for specific products.

Fifth - substantiation of principles evaluation for certification of NDT of aircraft and its components.

Let us consider each of these areas.

1. Justified methodology for the selection of NDT methods parts and assemblies Sun The technique is based on identifying the critical crack size and definition of the shape parameter of the defect, which lay in the control samples, and processing signals from sensors primary information of NDT.

Given that in the testing of aircraft typically use manual control, use a method and apparatus that provide documentation of the origin and size of detected defects and computer processing of the results.

2. Taking into account and study the factors affecting the stress-strain state and fatigue, as well as to develop effective methods and means to identify them. Structural heterogeneity effect on the stress concentration, strength, corrosion resistance, plasticity, impermeability, wears, etc. Defects in welds play a role cuts weaken section creates stress concentration and volume stress. Found that when vibration loads, even small defects have a significant influence on the fatigue strength of the material. Defect is the more dangerous, less than the radius of curvature of its verticals and more than its size. The ductility of the material is sufficient to stop the growth stresses in the areas of their concentration up until the average voltage in the weakened section does not reach the limit point. Studies have shown that the increased brittleness of steel may be due to the aging process of

deformation in tension at a temperature of 100...500°C. Hardening and aging caused by it greatly increases the brittleness of steel and shifts the threshold of the nominal strength to positive temperatures. Additional causes damage at operating voltages are residual stresses arising during welding and assembly due to the uneven distribution of temperature and force action on the metal expands when heated by the surrounding cooler metal. At a certain combination of non-uniform temperature distribution and the stiffness of the object developing mechanical stress reaches the yield stress of the material that is accompanied by plastic deformation. Residual stresses also affect the tendency of the material and welds to brittle fracture. However, a compressive stress is a barrier to crack moving. Nature of the stress distribution is possible to establish the following methods: optical polarization, brittle coatings, magneto- elastic, eddy current methods. For this purpose, a range of indicators and instruments of the stress- strain state. Physical and mechanical properties of the surface of the steel product austenitic and austenitic- ferrite grades determined using eddy current devices operating at high frequencies (100...400 MHz).

Based on years of experience in conducting inspection of welded joints and determining the stress- strain state of welded structures, as well as a theoretical generalization about stress patterns of defects in welded joints depending on their location in the weld seam and elastic characteristics of the base metal and in various types of loading a methodology of determining the coefficients stress concentration at the inverting of defects according to the results of nondestructive testing of tubular structures, vessels and vehicles. The principle of stress concentration factors based on the use of quantitative criteria for assessing defects - a critical crack size and the shape parameter of the defect , as well as correlations between the amount of stress concentration factor and the parameters (amplitude, phase, etc.) signals, which give non-destructive control.

Implementation of analytic methods for predicting the durability of diagnosis objects is possible with the experimental data on the real state of the control object.

3. The aim of the third direction is the development of methods of diagnosing test products in their operation. The methodology put requirements of technical standards, correlations between stress condition, size and kind of defects. Developed system test diagnostics includes the following blocks: the characteristics of the object of diagnosis, formalized model of the object; formalized model of defects; mathematical model of the system and algorithm diagnosis; hardware system software. Quantify the indicators used in the assessment of technical condition, carry out a comprehensive system of control established for the diagnosis of a specific object. For example, for a vessel , the state of the base metal and weld metal , corrosion and corrosion - erosion damage ; housing dimensions and wall thickness , the presence of leaks, the magnitude and nature of the distribution of the stress- strain state , cracks within the sensitivity of controls. Mathematical model of processing of diagnostic data is based on the basic matrix. Its elements are a number of signs and identifiers stresses and defects, ranked according to the hierarchical structure of the vessel code designations elements.

When constructing algorithms of the system of technical diagnostics specific

problem mostly use deterministic logic and diagnostic features. Methodological principles of diagnosis are to collect data on failures in the operation, registration and routings of diagnostic parameters in the process of diagnosing the object with the specified mode of loading. These data are obtained by means of built-in control or during periodic surveys penetrate testing, visual- optical inspection and measurement indicators determine the technical state of structural elements after the withdrawal of its technological cycle processing of the received information, analysis and decision making. Identification of defects and damages is based on the requirements of regulatory documents.

4. Technical inspection of mechanical systems operating in harsh environments provides a two-tier system of monitoring. The basis for monitoring takes a test to diagnose the stage of manufacture and operation of the system. Given the functional relationships between the structural parts of the system formalized model has the form "Mechanical system - module - node - element". This four-level model allows adequately monitors in accordance with the structural and hierarchical scheme. All components of the vectors condition of the system are grouped into 4 parameters and 18 sub-parameters, which are determined by means of NDT flaw during the survey are converted using the formulas in the signs and computer processing is done in accordance with the developed algorithm. Using statistical values calculated separately indicators of the units constituting the system and compare them with the preliminary regulatory admissible (nominal) or the highest values. The magnitude of the deviations of this comparison is necessary to predict the residual life, based on the criteria of fracture toughness, strength, corrosion resistance, changes in the geometry, etc. After calculating and comparing the performance features make the decision to eliminate the negative changes in the elements, the volume of repair works of the mechanical system. To automate surveillance operations and operational management of remedial hold the following sequence of construction: development of a formalized and mathematical model of the system, the development of an algorithm diagnosis, control of hardware. Its use in the production is presented as a workstation Mechanics (operator) region.

5. With the transition to a market economy has arisen a need for product certification and quality systems. One feature of the business is the quality of technical diagnostics. To carry out certification of quality systems and certification of personnel for technical diagnostics create independent bodies - certification and centers of expertise. Certification of specialists is carried out in accordance with European standards.

Considered approaches implemented in aviation rules and successfully applied during the certification work in enterprises producing, operating, servicing and repairing aviation equipment.

Conclusions. Based on the studies, the principles of quality assessment, develop programs and certification procedures and regulations, accreditation divisions NDT and technical diagnostics. Principles of valuation and technical diagnostics NDT are in check : normative and technical documentation on all types (methods) that are used in the enterprise; organizational structure control services; degree of participation of designers and engineers in the selection and appointment

of monitoring and diagnosis; applied technologies and their changes, skills and responsibilities of radiographers; metrological provision of control; availability of documentation in the workplace; acceptance criteria (rejection) clearance testing results; state jobs and control plots based on standards ISO 17024 and 9712.

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