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DIAGNOSING THE TECHNICAL CONDITION OF AIRCRAFT EQUIPMENT

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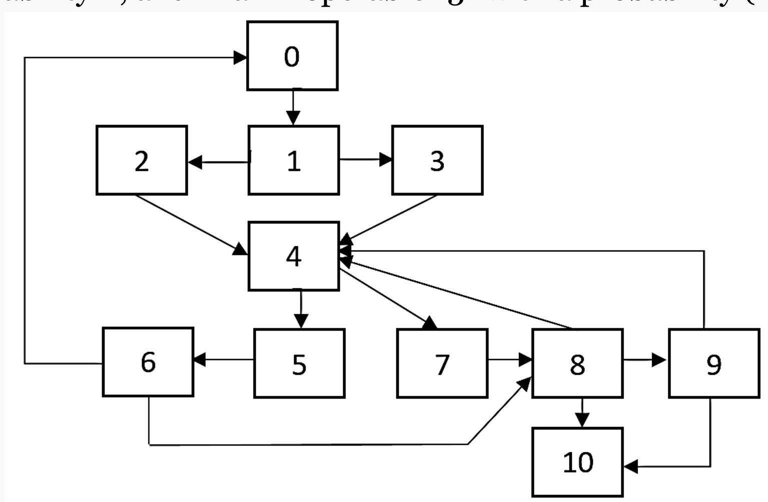
Annotation
The article deals with the issues of diagnosing the technical condition of aviation equipment, the goals and objectives of technical diagnostics, non-destructive methods for monitoring aviation equipment.

Keywords: flight safety, technical condition, diagnostics, non-destructive control methods, composite materials, forecasting, aviation technology.

The operation of modern aircraft must ensure the safety, regularity, economy and efficiency of flights.
In recent years, in solving the problem of ensuring flight safety, there has been a transition from the accumulation and analysis of numerous and disparate data on the causes of aviation accidents to the creation of a general theory of flight safety [1].
To quantify the level of flight safety, statistical and probabilistic indicators are used. Statistical indicators make it possible to take into account all the factors and causes of aviation accidents, since they reflect the level of sophistication of aviation technology, the organization and provision of flights, the degree of training of ground and flight personnel.
The probabilistic indicators of flight safety, which characterize a flight as an event that will be completed without accidents, are influenced by the following factors: aircraft equipment failures, personnel errors, and external conditions [2].
Operational diagnostics is a branch of technical diagnostics - a science that studies the technical condition of objects of technical diagnostics and their manifestations, develops methods and means of technical diagnostics , as well as general principles for the construction and application of technical diagnostics systems . The terms and definitions of the basic concepts of operational diagnostics (technical diagnostics), as well as the procedure and standards adopted in the development and application of technical diagnostic systems, are set out in the relevant standards.
The system of technical diagnostics is understood as a set of objects , means and algorithm for technical diagnostics, as well as the performer (in the case of a manual system), prepared or carrying out technical diagnostics according to the rules established by the ETD.

Each AT product, regardless of complexity and purpose, is equipped with a technical diagnostics system that provides the ability to determine its TS (operability) and search (if necessary) for typical malfunctions (defects) [3]. The development of a technical diagnostics system is usually started at the stage of prototype development of the product, and its final formation occurs during the serial operation of the aircraft. At the stage of serial operation, work is underway to improve the means and algorithm for technical diagnostics , automate the collection and processing of diagnostic information, etc. Depending on the nature of the interaction with the object, the means of technical diagnostics used and the level of work automation, functional and test, general and local, built-in and external, software and hardware, universal and special, automatic and manual systems of technical diagnostics are distinguished .

The structure of technical diagnostics is characterized by the nomenclature of distinguished states and the probabilities of objects falling into them. It depends on the task of technical diagnostics , the probability of finding an object in different vehicles and the reliability of the results of technical diagnostics . Thus, the structure of technical diagnostics when checking the operability of objects with TS prediction, troubleshooting (defects) can be represented as follows (Fig. 1). The object of technical diagnostics, having worked out the next cycle of operation "0" with a duration, enters the state of waiting for verification "1". At the same time, it can be both in a workable "2" with a probability P, and in an inoperable "3" with a probability (1- R) condition.



Rice. 1. The structure of technical diagnostics during verification facility health

An object from state "2", having passed check "4", enters state "5" ("good"). The probability of a correct diagnosis of "good" in this case will be $P_g = P \cdot (1\text{-}\alpha)$.

From the state "5" the object gets to the prediction of the residual resource "6". With a positive forecast ($t_p > \tau$), the object enters the next cycle of operation "0". With a negative forecast ($t_p < \tau$), the object enters the state of searching for the cause of a possible malfunction (defect) "8".

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After its establishment, the object goes into the defect elimination state "9", from where it returns to the state "4" and then goes according to the previous scheme (4-5-6-0). If it is impossible to eliminate the defect, the object is decommissioned due to the lack of the necessary resource and sent for repair or decommissioning "10".

An object from state "3", having passed check "4", gets into state "7" ("failed"). The probability of a correct diagnosis of "unfit" in this case will be P_g \u003d (1 - P) (1 - β). From state "7" the object goes to state "8" and then to state "9". After the fault is eliminated, the object returns to state "4" and then goes according to the scheme "4-5-6-0" or "4-5-6-8-9-4-5-6-0", or "4-5 -6-8-10". Due to the presence of erroneous diagnoses, the “good” object from state ”3”, having passed the test ”4” with probability (1 - P) · β, falls into state 5, and then into state 6. With a positive resource forecast, which is possible due to the reuse of distorted information, the faulty object falls into the "0" state.

Due to the presence of erroneous diagnoses "failed", the object from state "2", having passed the test with probability P·α, goes to state "7", and then to state "8" to search for a non-existent malfunction. Due to the fact that the malfunction is actually absent , the result of the search will be negative and the object will return to the state “4”, and then it goes according to the pattern “4-5-6-0” or “4-5-6-8-9-4-5-6-0”, or "4-5-6-8-10".

Thus, the presence of erroneous diagnoses "failed" leads to an increase in labor intensity, loss of time and cost of work on TD, which is associated with the need to search for non-existent malfunctions, and the presence of erroneous diagnoses "good" - to the occurrence of failures, since faulty objects get into operation.

During operation, the AT product can be in one of the following states (Figure 2), while the transition from the state to the next state is carried out through a certain event [4].

Serviceable - the state in which the object meets all the requirements established by the technical documentation. These requirements concern both the main output parameters (that is, those that determine the quality of the performance of the specified functions by the object), and secondary, non-basic parameters, on which the performance of the object does not depend on the considered period of time. So, for a voltage regulation system, the main (determining) parameters include the output voltage and load current, generator power, etc. The quality of the locking of the fastening elements, the color of the generator case, etc., can be attributed to minor (secondary) ones [5].

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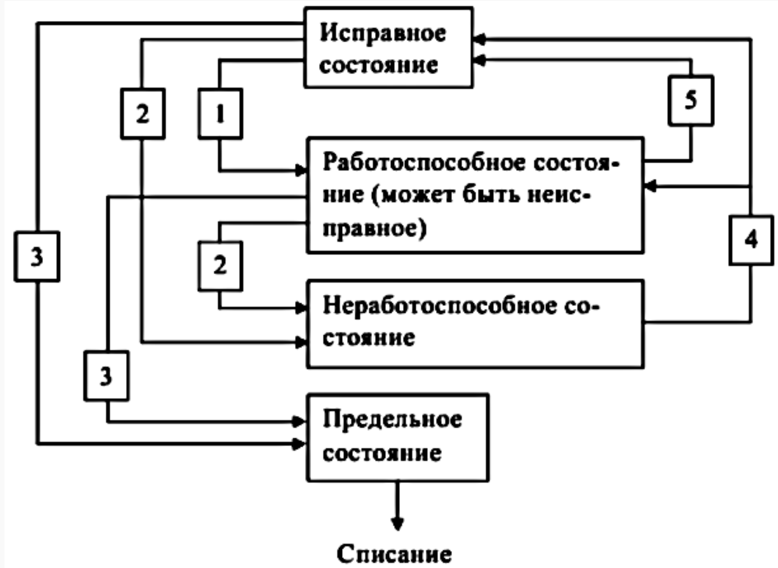

1 - damage; 2 - failure; 3 - transition of the AT product to the limit state due to the irreparable destruction of the structure; 4 - restoration (repair); 5 - recovery
Rice. 2 . Scheme of the main states of the object of operation of aviation equipment

Operable - a state in which the values of all parameters characterizing the ability of an object to perform the specified functions comply with the requirements of technical documentation. At the same time, some of the minor parameters or quality characteristics (locking, coloring, etc.) may not meet the regulatory requirements;
Faulty - a state in which the object does not meet at least one of the requirements of the technical documentation.
Consequently, a serviceable object is always operable, but a faulty object can also be operable;
Inoperable - a state in which the value of at least one parameter characterizing the ability of an object to perform the specified functions does not meet the requirements of technical documentation. An unhealthy state is always a failed state;
Limiting - a state in which the further use of the object for its intended purpose is unacceptable or impractical, or the restoration of its serviceable or operable state is impossible or impractical.
Recoverable (non-recoverable) object - an object for which, in the situation under consideration, restoration of a working state is provided (not provided) in the regulatory and technical and (or) design documentation.
Defect - each individual non-compliance of the object with all the established requirements of the technical documentation.
Damage is an event consisting in violation of the healthy state of an object while maintaining a healthy state.

Failure is an event consisting in a violation of the operable state of an object. In case of failure, one or more of the main parameters of the object go beyond the boundaries of the tolerance fields.

Modern technical diagnostics uses instruments to determine the technical condition of aviation equipment, which make it possible to more objectively determine the state of this equipment, as well as to perceive diagnostic signals emitted by the mechanism, which are inaccessible to perception directly by the human senses. Methods and tools for diagnosing individual units, systems and mechanisms are determined by their design and functions [6].

The volume and technology of control largely depend on the methods of operation of the AT - by resource, by condition and combined.

If the operation is carried out according to the state, then periodic control and verification work is planned, based on the results of which a decision is made on further operation. With the combined method of operation, part of the elements of the object is operated according to the technical condition, the rest - according to the resource. Only from 60 to 75% of units and systems of modern aviation technology can be transferred to operation as it is (the experience of PAN American , Air Canada, etc.). Therefore, the combined method of operation is currently the main one.

The transition to operation according to technical condition and to the combined method of operation contributes to an increase in the level of aircraft reliability due to the introduction of the most thorough control of a significantly larger number of OK parts in operation and repair conditions. At the same time, the proportion of parts, the state of the material of which is determined by the methods of flaw detection, increases significantly.

Conclusion. Periodic maintenance of aircraft systems, engines and electronic equipment is assigned depending on the operating time of the airframe - the aircraft flight time from the start of operation or after repair in accordance with the regulatory and technical or design documentation.

Bibliography

1. Volkova V.N. Theory of Systems, Moscow: Vysshaya Shkola, 2006. 511 p.
2. Mashoshin O.F. Diagnostics of aviation equipment: textbook. allowance. M.: MGTU GA, 2007. 141 p.
3. Makarovsky I.M. Fundamentals of technical operation and diagnostics of aviation equipment. Samara: SGAU, 2004. 118 p.
4. Vorobyov V.G. Reliability and technical diagnostics of aviation equipment: textbook. M.: MGTU GA, 2010. 448 p.
5. Chekryzhev N.V. Development of methods and models for improving the efficiency of maintenance of aircraft and their systems: diss . can . those. Sciences. Samara, 2014. 178 p.
6. Novikov I.A., Meshkov S.A., Agoshkov O.G. Methods and devices for diagnostics of technical systems . Balti ka , 2017. 205 p.