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**Information support of aftersale support of aircraft gas turbine engines in real operation**

*The questions of information systems for assessing the technical condition of aircraft engines in the system of maintaining the flight worthiness of aircraft are considered. The main tasks of monitoring the technical condition of engines during their maintenance and the overall structure of control and diagnosis of engines during operation stage have been proposed.*

The operation of aircraft engines requires the creation of an information system that would ensure the maximum use of the full potential of the information fund at all stages of their operation, as well as the automation of information exchange processes at the level of operating units, aviation enterprise, factories and scientific organizations. The information system should provide the publication of operational information on the current technical condition of products, the level of reliability of both individual systems and objects, and complex of their elements of the same type [1].

In order to improve the efficiency of engine use, the grounds for regulatory equal reliability, optimization of methods and modes of maintenance, testing of other methodological and organizational issues – the development of programs to ensure the reliability of aircraft engines.

An integral part of the management system of engine reliability is information support, in connection with which special centers and systems for collecting and processing information on the basis of electronic computers are currently being created. The most important source of information is statistical data on operating results. Mathematical processing of operational information and its analysis can solve a wide range of problems that contribute to the reliability of engines and ensure aviation safety.

System, registering, accumulating and summing up the volumes of information on the technical condition (TC) of the engines, should ensure their integrated use to optimize established levels of the controlled parameters, means of control and diagnostics, evaluation of the effectiveness of the carried out improvements of engines and prediction of their TC with the purpose of effective management of volumes of spare parts and service planning [2].

An important role in the organization and conduct of maintenance is played by the conditions of the maintenance process, training and experience of the maintenance personnel, the quality of operational and technological documentation and informative and automated support.

The fig. 1 demonstrates the main components of information support of engines in operation.

The main attention should be paid to the implementation of new directions in technical diagnostics and non-destructive testing methods [3].

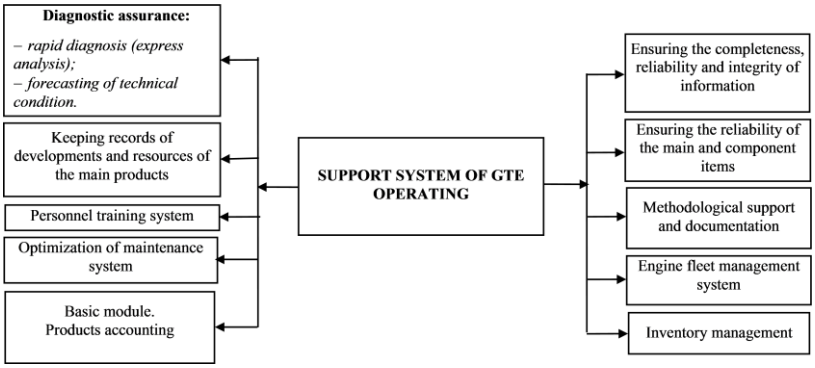


Fig. 1 The main components of the engine tracking system in operation

The fig. 2 shows the main information flows of TC monitoring of the gas turbine engine (GTE) in real operation. The operational properties of parts and components of GTE products significantly depend on the quality of their surfaces and surface layer, which are determined by geometric (macro-deflection, waviness, stiffness) and physical and mechanical (microhardness, residual stress, structure) characteristics.

The success of solving the problems of developing maintenance programs depends on the developed methodological support for the formation of programs and created necessary information resources. Formation of optimal control modes of objects of operation is carried out on the basis of solving the problem of random process control. This determined the need to solve problems in conditions of high uncertainty of the initial information [3, 4, 5].

Analysis of the world experience in the field of product support service of modern aviation equipment allows us to draw the following conclusions:

– firstly, the leaders of the world aircraft industry no longer sell "just the aircrafts" and "related services". They offer customers an integrated and functionally complete set of the most modern tools, technologies and services for business in the field of air transport;

– secondly, today information systems and technologies are no longer just tools and become the basic system-forming platforms for the effective operation and maintenance of modern aircraft. These technologies form the basis of product support services of the world's leading aircraft corporations.

In domestic practice, according to most experts, to achieve the strategic goal of penetration into the world market of civil aircraft and capture its significant share of the formal copy of foreign experience in the field of product support services at the level of individual developers of aircraft products, such as SE "ANTONOV" and Zaporizhzhia machine-building construction department "Progress" and aircraft and engine plants is clearly not enough today. We need disruptive strategic solutions that determine the shape of the integrated system of product support services of aircraft of the future. Whereas, for the development and further implementation of such solutions, the consolidation of all available resources of the service profile is required. They still operate separately, and therefore ineffective.

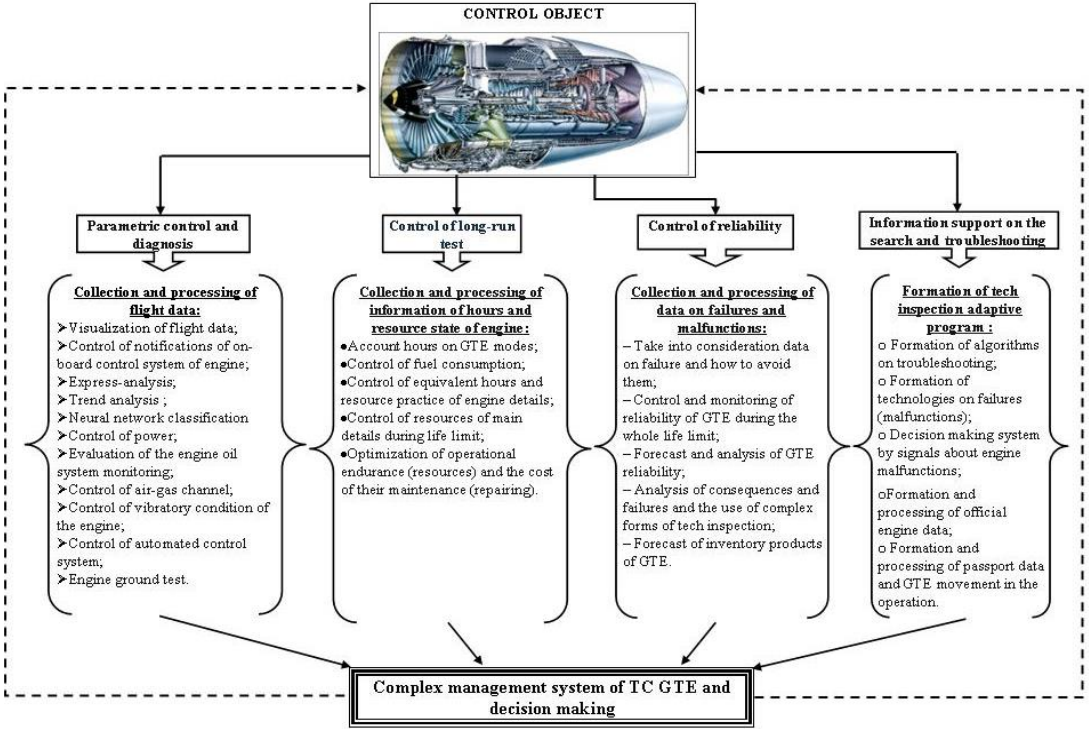


Fig. 2.The main information flows in the monitoring of the TC of the GTE

It should be noted that it is the use of automated means of control and diagnosis of engines during the aftersale support that allows to solve the problems of maintaining the reliability of engines and the power plant (PP) on the whole, ensuring the efficiency of spare parts management [2].

Integrated application of information and diagnostic systems allows to solve the following:

– check the reliability of the control results obtained by the on-board automated control system and troubleshooting in the system itself;

– diagnosis of the engine or PP as a part of the aircraft, taking into account the accumulated databases on the TC of the engine fleet, for the entire previous period of their operation;

– adjustment of electronic units to work with specific engines, as well as actuators of PP control systems and aircraft after their replacement;

– periodic inspection and calibration of measuring channels of engine and aircraft control systems;

– collection of information and formation of databases on the TC of the engine during the entire period of its operation;

– process databases to solve the problems of predicting the state of a particular engine (aircraft) to ensure its operation through its TC;

– information support of decision-making on engine maintenance work based on the results of TC monitoring.

Control of the state of the engine, as the most complex technical object is carried out continuously during its maintenance on the basis of integrated processing of diagnostic information coming from the information-measuring system of the aircraft.

The tasks of the information and diagnostic system of information assurance of the effective functioning of the system to maintain the reliability of the engine and maintain the airworthiness of the aircraft as a whole should include:

– automated maintenance of records and reports on the results of control and maintenance works;

– automated formation and use of expert knowledge bases on methods of search and elimination of failures and malfunctions;

– information support of decision-making on the results of control, diagnosis and forecasting of TC;

– information support of planning and accounting of maintenance works and improvement of the engine (aircraft) operation system;

– information support of the processes of training and retraining of the technical staff of the operator or the organization of tech inspection;

– information exchange with other means of integrated logistics support of the aircraft tech inspection with the help of network tools and removable storage devices.

## Conclusions

Implementation of the above-mentioned tasks at the stage of operation (aftersale support) will allow continuous monitoring of the TC of the engine. At the same time, the information and diagnostic system for monitoring the technical condition of the engine should take into account the following:

– parametric control and diagnosis;

– resource state control;

– reliability control;

– information support for troubleshooting and failures.

In turn, the use of the method of parametric diagnosis in the automated system should take into account and implement the following main tasks:

– the express analysis of the GTE TC for the given level of testability for flight information;

– the software for processing and analysis of racing engine;

– system of complex diagnostics of GTE by measured parameters of operating procedure (trend analysis of integrated, model and specific parameters and failures, neural network classification in recognition of a failed node of the engine in case of mutually damaged nodes);

– expert decision-making system of the vehicle, the search of failures and malfunctions and their elimination technology;

– accounting and control of current and the equivalent hours of GTE and the actual practice of the resource;

– overview and visualization of flight information;

– thermodynamic engine model;

– fuel consumption control program;

– evaluation of the engine oil system monitoring;

– the program of calculation of power;

– control of the vibration state of the PP;

– formation and maintenance of passport data and movement of engines during operation;

– formation and filling official data of GTE.

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