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Experimental technique of tests of units of automatic equipment of aircraft

We represent the conception of the engineering method of determination of the initial technical state of components of the automatic equipment of spacecrafts and carrier rockets. The experimental test bench for adjustment of the method is described, the results of adjustment are given. On the basis of experimental data the possibility of using the vibroacoustic method for diagnosis of components of the automatic equipment is estimated.

Design of difficult technical systems to which the modern carrier rocket belongs demands ensuring their high reliability and fail-safety in operation. An exception of emergencies during the work – the major task which has to be solved during creation of new samples of the equipment. One of ways of achievement of the specified purpose is application of diagnosing of technical systems at all stages of their production, including finally assembled product. To reach the necessary level of reliability and safety it is necessary to conduct, first of all, rather full land experimental working off of any created rocket design including for the purpose of working off of manufacturing techniques [1, 2].

The purpose of researches is development of an engineering technique of diagnostics of units of automatic equipment of aircraft allowing quickly, objectively and with minimum financial and to determine by labor costs initial technical condition of the examinee of an object.

Fail-safe tests are the most important and integral part of production of carrier rockets, one of the most difficult components is the pneumatic hydraulic power supply system. A large number of elements, knots, automatic equipment units is its part.

Owing to complexity of a design of system, it passes a number of tests both at an assembly stage, and at the final stage in general. But after final assembly the product goes to the launch pad, and, as a result of transportation and assembly of a product directly on the launch pad in a design there can be malfunctions which can lead further to an emergency outcome.

Development new and improvement of the existing control methods and diagnostics is one of ways of increase in design and technological reliability of products of the aerospace equipment. The certain place is taken by the system of functional diagnostics, her feature is that for her work on the examinee an object no influences from means of the diagnosis move. Use of systems of functional diagnostics at bench and flight tests significantly increases reliability and operability of the missile and space equipment [3, 4].

Diagnosing of a pneumatic hydraulic power supply system of carrier rockets is made for a research of tightness of pipelines and highways, compliance of design parameters of an expense and pressure of components and also for assessment of correctness of assembly of difficult highways. However along with it it is also necessary to make diagnostics of units of automatic equipment of one-time and

reusable action, valves, membranes, the dosing elements, etc. as the operability of these bodies plays an important role at operation of a product.

The purpose of researches is development of a technique of control of a condition of elements of automatic equipment of reusable action, information support and a technique of application in a cycle of technological tests of the carrier rocket.

The task of diagnosing of a condition of elements of automatic equipment – valves, regulators, switches which details at operation make progress with a stop is set. Thereof they publish a short-term (pulse) acoustic signal that allows to apply the methods used in the analysis of shock vibration at measurements of this signal and the subsequent processing.

The basic principle of vibroacoustic diagnostics is assessment of a deviation of parameters of technical condition from norm on parameters of a vibroacoustic signal.

On the basis of statistical data of working off and operation of units of automatic equipment the most characteristic malfunctions are defined: jamming, emergence of scratch, a cracking of sealing elements, hit of foreign debris, incomplete opening and closing, inexact of operation on time. For preliminary experimental working off of a technique the serial normally closed electropneumatic valve of direct action has been chosen. For carrying out researches experimental test bench is developed and mounted.

For tests five identical valves from one party have been selected. All valves have undergone factory control and were in good repair. At the first stage tests of efficient valves were made multi-fold (20 operations). At tests time process lasting 6 ms (300 reference points) was registered. On the basis of these tests average reference values of controlled parameters for serviceable valves (vibroacoustic portraits of serviceable objects) have been received [7].

At the second stage failure conditions of valves were modelled. Concrete characteristic malfunctions were serially artificially brought. For each malfunction the procedure of measurements repeated. Average "portraits of failure conditions of valves" are as a result received.

Further the analysis and processing of the obtained data was carried out. Statistical methods of recognition of images were applied – running start of the measured values of a controlled signal was estimated, comparisons of power indicators of a signal were carried out. It was succeeded with rather high reliability to define some malfunctions which have visually different character of a signal from norm by statistical methods (hit of foreign debris on sealing elements and destruction of sealing elements).

However, for other malfunctions only statistical processing doesn't suffice. Therefore methods of the spectral analysis which have yielded surer results were applied to their identification. Application of the spectral analysis has allowed to allocate informative components of the studied signals. Thanks to it has become possible to identify also other modelled malfunctions that speaks about operability of the offered technique.

Also methods of mathematical modeling which introduction has allowed to confirm working capacity, reliability and informational content of the offered technique were applied to the approval of results of identification.

The complex of information support for support of decision-making in problems of control of pneumatic hydraulic power supply systems and their elements and also recommendations about combined use of this method with others, applied now has been created.

The developed technique with high degree of reliability allows to define technical condition of a subject to diagnosing as serviceable or to reveal existence of characteristic defects

Experimental working off has shown operability of a method. The developed and manufactured experimental stand allows to investigate various types of elements of automatic equipment of pneumatic hydraulic power supply systems.

The received results can be used in other scientific research and also in practical problems of tests of various elements and knots of newly created carrier rockets and aircrafts.

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