

Aircraft Components Life Cycle Monitoring System as an Element of the State Control of Aviation Equipment Operation Maintenance

V. Yu. Brusnikin¹, A.N. Sharypov², G. E. Glukhov³, A.G. Karapetyan⁴, S.V. Koval⁵, P. E. Chernikov⁶
^{1, 2, 3, 4, 5, 6}The State Scientific Research Institute of Civil Aviation,
Ministry of Transport of the Russian Federation Russian Federation,
Moscow, Mikhalkovskaya Street, 67, building 1

Article Info

Volume 82

Page Number: 14535 - 14545

Publication Issue:

January-February 2020

Abstract:

The article reviews issues of the aircraft components life cycle monitoring as a tool for identifying inauthentic aviation equipment items. It reviews also the issues of problem-solving with regard to the civil aircraft components authenticity both abroad and in the Russian Federation, gives definitions and concepts of an inauthentic aircraft component, and includes the experience of solving this problem in the “State Research Institute of Civil Aviation” Federal State Unitary Enterprise (hereinafter referred to as “the State Research Institute of Civil Aviation”), which is based on obtaining the updated information about technical condition of aircraft components and comparing it with reference information delivered by manufacturers of such aviation items. The solution of this problem is based on performance of works on assessment of aircraft components authenticity in accordance with the technology and procedures given in the “Methodology of assessing authenticity of AC components” (Edition 2) No. 24.10-966ΓA at all stages of the component life cycle. The goals, objectives, structure and functionality of the information analysis system of aircraft components life cycle monitoring (IAS ACLCM), developed by the State Research Institute of Civil Aviation, as an operating mechanism for monitoring the aircraft component life cycle have been specified. Within the framework of this problem, the solution with regard to development of state control of air technical materials supply to the civil airlines with use of the Voluntary Certification System of Civil Aviation Objects developed by the State Research Institute of Civil Aviation has been reviewed.

Article History

Article Received: 18 May 2019

Revised: 14 July 2019

Accepted: 22 December 2019

Publication: 28 February 2020

Keywords: civil aviation, state control, operation, information analysis system, user module, aircraft components authenticity, monitoring, aviation equipment, approved and unapproved aircraft components, air technical materials, state control of aviation equipment supply.

I INTRODUCTION

The problem of maintaining airworthiness of aircraft fleet is not a new problem for Russia and for the world civil aviation. Not only aviation authorities but also the top leadership of the Russian Federation pay attention to its solution. In the Decree of the President of the Russian Federation on activities on suppression of illegal trafficking in industrial products and “Strategy for Suppression of Illegal Trafficking of Industrial

Products in the Russian Federation for the Period Till 2020 and Scheduled Period Till 2025” approved by the Decree of the Government of the Russian Federation [1] the priority industries have been determined for monitoring and taking measures to suppress the illegal trafficking in industrial products, including counterfeit products.

In the already published documents of the top leadership of the Russian Federation: in the Decree of the President of the Russian Federation

and Strategy the solution of this problem is closely connected with the development of suppression issues in illegal trafficking of industrial products as applied to the civil aviation - it is a monitoring and state control of aviation equipment operation maintenance, including control of aviation equipment items trade.

The previous article reviewed the issues of the aircraft components life cycle monitoring as a tool for identifying inauthentic aviation equipment items [2]. Availability of such tool does not mean yet a system solution of the problem. It can be specific solutions of the problems related with identifying inauthentic aviation equipment items by any participants of monitoring process and at any stage of aircraft operation. Such works are only a part of common elements of the state control over aircraft components trade that is required for maintaining operation of civil aircrafts [3-7]. For qualitative solution of the problem at issue it is necessary to make monitoring a compulsory element of the common state control system of aviation equipment operation maintenance, which is able to maintain a required level of aircraft airworthiness and flight safety.

It is a problem not only for Russia. It is a topical issue for the world aviation community with regard to aircraft airworthiness control [8, 9].

The Federal Aviation Administration of the USA (FAA) and the European Aviation Safety Agency (EASA) do the best to deal with this issue and have reached a certain success [1-19].

The methods of controlling used by FAA and EASA differ considerably: having a lot of regional representatives, FAA takes measures to detect counterfeit parts at sites and issues the directives in the form of "Unapproved Parts Repots", which describe the causes of each specific case and warn the aircraft owners, operators, aviation equipment maintenance and repair organizations, and distributors about possible availability of counterfeit parts and components.

The complex of measures taken by the USA includes also development of the voluntary accreditation program for dealers and intermediaries involving in aviation components supply process. With regard to this problem, FAA has issued Advisory Circular AC 00-56A, etc. [10].

Thus, it can be said that all these measures indicate that the state control of aviation equipment operation exists in the USA and in Western Europe.

In the article we show that the developments the State Research Institute of Civil Aviation in the field of aircraft components life cycle monitoring are one of the elements of the state control system of aviation equipment operation maintenance in the Russian Federation. The State Research Institute of Civil Aviation continues the works on system creation [11-14].

II GOALS AND OBJECTIVES

One of the objectives of development of the state control system of aviation equipment operation maintenance is availability of updated information about technical condition of the operational aircraft fleet. For receiving such information, it is necessary "to improve the industry statistic information acquisition and processing system based on the up-to-date information technologies, and to assure certainty of industry statistics".

The legislative basis for implementing the state resolutions in the field of creation of the state information system and airworthiness control is the Air Code of the Russian Federation (Article 37, Par.8). On a practical level, the solution of this problem is realized as creation, development and implementation of the integrated state system based on existing developments of aviation equipment items control methods and procedures in combination with corresponding organizational decisions on control over activities of all entities participating in civil aircraft operation.

The system must provide information analytical support of aviation equipment operation at all stages of aviation equipment items life cycle. It is focused on solving applied problems with regard to aviation equipment operation support, namely:

- state control of aircraft airworthiness;
- control of the aircraft equipment items supply system;
- support of operational documents;
- information support and production process automation of civil aviation entities and organizations.

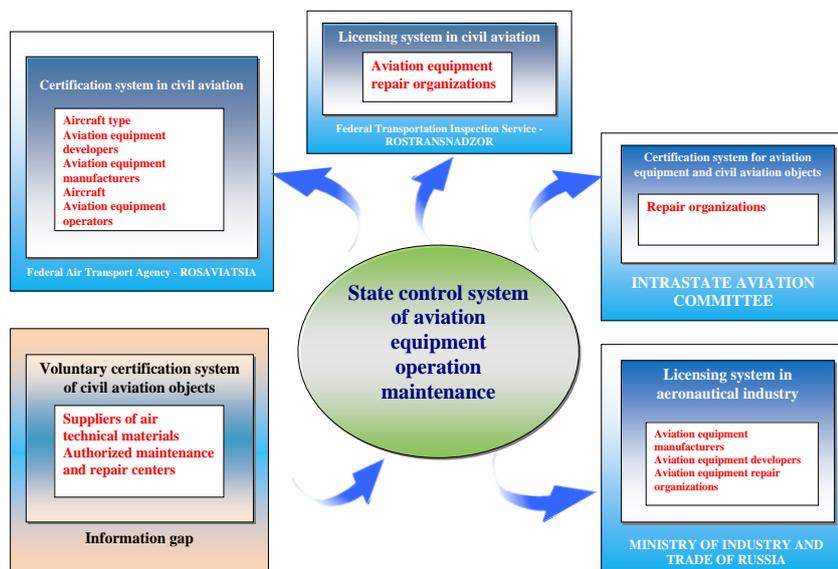
A part of these objectives has been realized during development of the Information Analysis System of Aircraft Components Life Cycle Monitoring. We described the results of the developments in the previous article [2].

III METHODS AND MATERIALS

The analysis of all stages of aviation equipment items life cycle shows that all the stages include the state control of both objects

entities (i.e. the organizations that perform repair operations in accordance with the requirements of the regulatory documents of civil aviation and aeronautical industry). The state control is provided within the framework of any certification or licensing systems for the enterprises of civil aviation and aeronautical industry that maintain aviation equipment operation. Thus, aircraft components life cycle monitoring and making decision to identify inauthentic components are an important part of activity of all these entities as participants of the state aviation equipment items control system [15, 16].

The analysis of aircraft components life cycle, actions of all entities involving in life cycle monitoring shows that operation of all these organizations is controlled by state via various compulsory certification or licensing systems: compulsory certification system in civil aviation, licensing system in civil aviation, licensing system in aeronautical industry, and voluntary and internationally recognized repair entities certification system of the Interstate Aviation



under control (i.e. aircraft components) and

Committee (Figure 1).

Fig. 1. State control systems of aviation equipment operation maintenance

However this well-composed aircraft components control system has a significant gap.

It is suppliers of air technical materials, when the aviation equipment items are transferred by one

entity having the state certificate or license, to the other entity being under state control, via a specific “blackbox”, i.e. via an intermediary supplying aviation equipment items (Figure 2)[20-28].

For eliminating this gap in the control system of aircraft components technical condition, in 2000 the State Research Institute of Civil Aviation developed the Federal Aviation Regulations for Compulsory Certification of the Organizations Supplying Air Technical Materials within the framework of the Air Transport Certification

System applied at that time. These Regulations were approved by the Federal Service.

The Federal Aviation Regulations established the requirements to the suppliers of air technical materials, and the procedures of their certification. The establishment of the Regulations allowed implementation of the state control at all stages of aircraft components supply from manufacturers to operators. Such control was meant to solve the “blackbox” issue with regard to supplies and to regulate the aircraft components life cycle monitoring in this field.

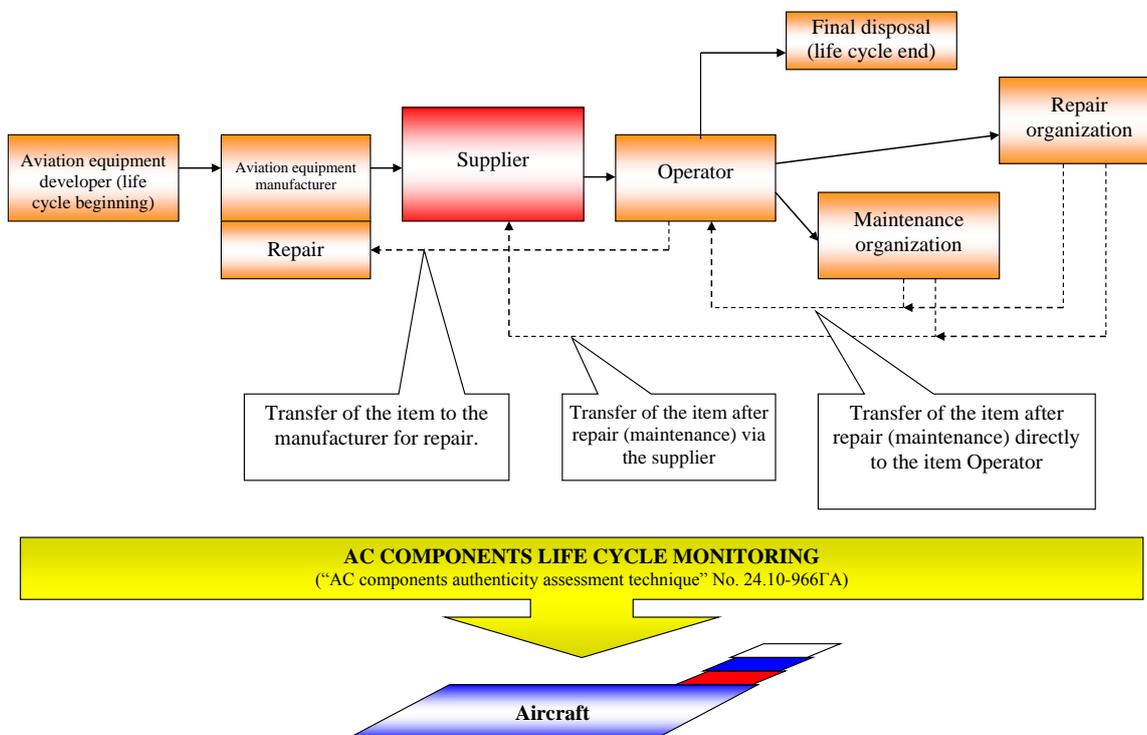


Fig.2. Life cycle of aviation equipment items

The aviation entities and suppliers took a favorable view of the established certification system. For the first time, the aviation entities started to receive the official objective data with regard to the suppliers of air technical materials, a nomenclature of supplied items and additional services provided by the suppliers of air technical materials [29-31].

But due to some internal reasons the State Aviation Civil Service canceled these Federal Aviation Regulations in 2001 by the Decree of the Ministry of Transport of the Russian Federation. Such short-sighted decision affected significantly development of the aircraft airworthiness support and components life cycle control system and provided favorable conditions for further operation of the black market of inauthentic aviation equipment items in Russia.

Unfortunately, up to the present the aviation authorities in Russia have not developed yet standard and regulator documents with regard to this issue although in this period several incidents occurred due to supply and use of the components on the aircrafts, which were received from “implicit supply sources” with unobvious life cycle that was confirmed by the falsified number-specific documents (certificates and labels), which were revealed during estimation of authenticity of such aviation equipment items.

In our opinion, the aviation authorities have a misrepresentation of this problem and their role in this process. Being guided by Article 37 of the Air Code of the Russian Federation and interpreting this article solely with reference to the operator’s responsibility for a full range of issues related to flight safety and continued aircraft airworthiness, the Russian aviation authorities keep themselves actually aloof from solving the issue related to supply of aviation spare parts and monitoring of their compliance with the requirements of applicable regulatory documents.

Of course, an airline is responsible for operation of aircraft components in accordance with the applicable requirements. However the aircraft operation experience over the past ten years shows that the logistical problems are systemic and it is obviously incorrect to shift responsibility for aviation equipment items life cycle monitoring onto an operator and to leave it to face the black market of spare parts on its own.

Such position of the aviation authorities prompts the air entities to create the own stand-alone systems for assessing the suppliers of air technical materials. In such case every air entity will be guided by own requirements to the suppliers, own assessment procedures that will not enable to create a uniform industry register of suppliers of air technical materials, which meet the general certification requirements, and, obviously, will reduce effectiveness of aircraft components life cycle monitoring. It will be

impossible to provide access for all concerned parties to the certification results and receipt of the required information for making a decision on assessment of components authenticity for the operated aircraft.

Besides, it must be noted that being a party to Convention on International Civil Aviation and an ICAO member, Russia shall comply with the requirements of ICAO documents concerning the continued aircraft airworthiness. The Convention speaks that “State is a sole authority, which is responsible for compliance of all important parameters of every aircraft registered in that State with those of the prototype designed and certified in accordance with the airworthiness rule code approved for aircraft of the given type... Although the methods, used for fulfillment of the given liabilities concerning airworthiness by States, can vary and in some cases include transfer of the right to fulfill particular liabilities to authorized organizations or other states, such measures do not make the State, in which aircraft are registered, free from a shared liability” [17].

In Russia Rosaviatsia is such aviation authority. One of the main tasks set by the state is participation in policy making aimed at creation of favorable legal, economic and organizational environment for activity of entities and persons in the field of civil aviation. Creation of such environment will facilitate solving of the tasks that are established in the Decree of the President of the Russian Federation and in the Strategy and are related to issues of suppression of illicit trafficking in industrial products, including counterfeit products, with regard to civil aviation, i.e. interdiction of use of inauthentic aircraft components.

According to these provisions, the aviation authorities must create an environment for activity of air entities and a system of measures and conditions for supplies and use of aircraft components meeting the requirements of the applicable regulatory documents.

One of the implementation ways of such system within the framework of the applicable law is an application of the voluntary certification system for the suppliers of air technical materials, which will enable to detect inauthentic aircraft components at the stage of their supply for use. To our opinion, especially in accordance with the recent legislative amendments in Russia with regard to standardization issues, such solution of the given problem has the prospects for the implementation.

Taking into account the importance of solution for the given problem consisting in illicit trafficking in aviation products and interdiction of use of inauthentic aircraft components, on December 25, 2006 the State Research Institute of Civil Aviation developed and implemented the Voluntary Certification System of Civil Aviation Objects [18,19] in accordance with the Federal Law "On Technical Regulation".

The Voluntary Certification System of Civil Aviation Objects has been registered in the Uniformed Register for Voluntary Certification Systems by the Federal Technical Regulation and Metrology Agency (Registration number POCC RU.B402.04IQA00 dated March 19, 2007). The Voluntary Certification System of Civil Aviation Objects implies assessment of compliance with the certification requirements for 40 civil aviation objects, including the suppliers of air technical materials that are among main participants of aircraft components life cycle.

Relevance of implementation of the Voluntary Certification System of Civil Aviation Objects for compliance assessment of civil aviation objects is confirmed by the Agreements for interaction during certification of civil aviation objects, concluded between the Voluntary Certification System of Civil Aviation Objects and the aviation authorities of the Russian Federation, Rosaviatsia and Rostransnadzor.

The main tool for the state control of inauthentic aircraft components trafficking for

prevention of installation thereof on aircraft in the Voluntary Certification System of Civil Aviation Objects shall be the aircraft components life cycle monitoring with performance of works for assessing authenticity of the components during supplies and operation [2, 20].

As for certification of the suppliers of air technical materials, the Voluntary Certification System of Civil Aviation Objects has a developed mechanism of interaction between the State Research Institute of Civil Aviation and the suppliers of air technical materials relative to their participation in assessing authenticity of supplied aircraft components and monitoring of their life cycle at the stage of supply to air entities. These works performed by a certified supplier of air technical materials allow for inclusion of these entities in the Unified Information Space of air materials use processes that enables to monitor the aircraft components life cycle during the supply process between the manufacturer and civil aviation entities and organizations and prevents supplies of inauthentic air equipment items.

The Compliance Certificate and the fact that a supplier of air technical materials is registered in the Register of the Voluntary Certification System of Civil Aviation Objects, make feel confident that an airline and organization of civil aviation deal with a stable running supplier of air technical materials, which has a corresponding material and technical foundation, qualified specialists and the quality system complying with the ISO-9000 standards. Such organization is able to fulfill all regulatory requirements of civil aviation with regard to maintenance of aircraft components technical condition at all stages of organization activity.

The analysis of the USA Federal Aviation Administration requirements in this sphere shows that FAA uses the similar approaches to assessment of aircraft components market participants, and it is natural as the flight safety requirements are uniform for the whole world

civil aviation irregardless of the state in which aircraft is registered [21].

Assessment of aircraft components authenticity during the monitoring of their life cycle must be performed on a corresponding regulatory base in the field of continued aircraft airworthiness. All participants of monitoring process must always have such regulatory base within reach. This is provided by their connection to the Central Civil Aviation Regulatory and Methodology Documentation Library, which contains the originals of the standard and engineering documentation and is established by the Decision of Rosaviatsia. The State Research Institute of Civil Aviation was selected as a technical operator and a keeper of electronic copies of the standard and engineering documentation for a purpose to provide quick support of air entities and organizations of civil aviation.

The funds of the Central Civil Aviation Regulatory and Methodology Documentation Library are divided into sections according to the corresponding activities of civil aviation entities, the common database of which amounts to more than 30 thousands of industry documents. As for the issues reviewed in the given article, our main concern is operating and maintenance documentation, which is a base of the library (42% of the library volume). Thus, the important feature of the aircraft components life cycle monitoring system developed by the State Research Institute of Civil Aviation consists in ability of the institute to provide the regulatory environment, assessment of aircraft components authenticity for all its participants, including enterprises of aeronautical industry, based on the funds of the Central Civil Aviation Regulatory and Methodology Documentation Library [22].

Technologically the aircraft components life cycle monitoring system is based on user

modules, developed by the State Research Institute of Civil Aviation, according to the corresponding functionality of preparation, presentation and analysis of the information about aviation equipment items condition for all participants included in the Unified Information Space of Aircraft Components Life Cycle Monitoring (Figure 3). Such structure allows for detection and eradication of the illicit trafficking in inauthentic aviation equipment items at all stages of their life cycle.

The central software module (CSM) is a set of software and hardware tools and organizational measures of the operator of IAS ACLCM, which provide solving of component monitoring tasks. The central software module is installed and operates in the State Research Institute of Civil Aviation.

The “Developer” user module provides information support of developer’s supervision of aviation equipment operation.

The “Manufacturer” user module provides manufacturer’s information support for after-sale maintenance processes of aviation equipment operation.

The “Supervision” user module provides information support for the authority’s works in the field of civil aviation with regard to inspection of aircraft airworthiness and involved organizations.

The “Operator” user module provides information support for management of production environment and processes of the aircraft operator, covering a set of required managerial functions of the airline.

The “Maintenance and Repair” user module provides automation and information support for aviation equipment maintenance and repair processes in the aviation equipment maintenance and repair organizations and in the aircraft repair enterprises.

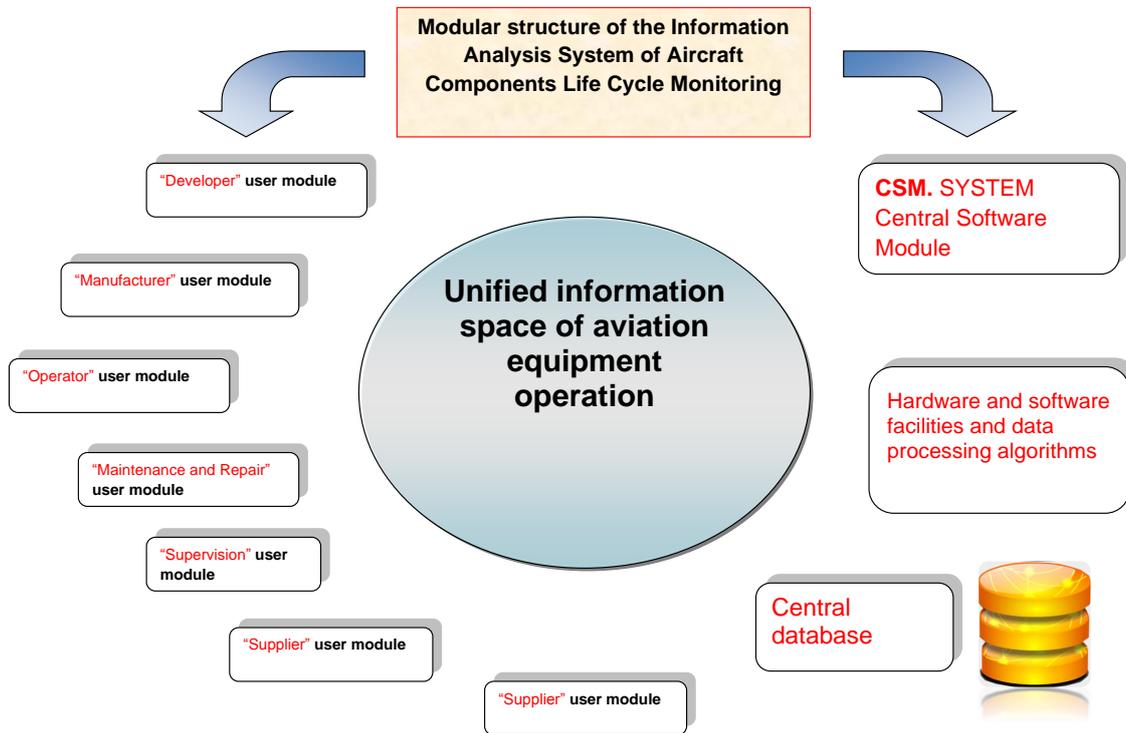


Fig.3. User modules of the Information Analysis System of Aircraft Components Life Cycle Monitoring

The “Supplier” user module automates the information support processes of aircraft components supply processes.

The “Leasing” user module automates the information support processes of aviation equipment leasing with regard to service support of aviation equipment operation in aeronautical lease companies.

The reference and updated information about components condition of operated aircraft fleet, arriving by means of the user modules into the Information Analysis Center of the State Research Institute of Civil Aviation, is used for generation of the Central Database of IAS ACLCM that contains also visual information about every component registered in this system. The developed algorithms and software analyze the given information and generate a conclusion whether the analyzed aircraft component is authentic or inauthentic. The system operation allows for assessment of the condition of every component and to provide this assessment for civil

aviation authorities in order to make a decision on rejection of use of such items [23], [24], [25].

Thus, the information analysis system of aircraft components life cycle monitoring developed in the State Research Institute of Civil Aviation is an effective mechanism of checking the aviation equipment items at all stages of their life cycle, and one of information tools of the general aviation equipment operation maintenance system. IAS ACLCM allows providing all participants of the unified information space with the results of the operated aircraft fleet components authenticity assessment works depending on the type of activity on the use of such components that makes a substantial contribution in ensuring the civil aviation authorities’ state control of continued aircraft airworthiness and flight safety.

IV CONCLUSIONS

Thus, the efforts of the State Research Institute of Civil Aviation for the development of the

Information Analysis System of Aircraft Components Life Cycle Monitoring as the aviation equipment operation maintenance state control tool have shown that:

1. In the State Research Institute of Civil Aviation the Information Analysis System of Aircraft Components Life Cycle Monitoring (IAS ACLCM) has been developed as a working mechanism for monitoring the aircraft components life cycle, which integrates the work of all participants of such monitoring, both in the field of civil aviation and in the field of aviation industry.

2. Taking into account that in the aircraft components market there are suppliers (intermediaries) of air technical materials, which operate out of the industry field of civil aviation and aeronautical industry, IAS ACLCM allows their inclusion into the state control system of aviation equipment operation maintenance by means of their certification in the Voluntary Certification System of Civil Aviation Objects.

3. The modular structure of IAS ACLCM based on user modules developed for every participant of the aircraft components life cycle monitoring system enables to integrate their activity in this sphere and to be a basis for developing the state control tool of aviation equipment operation maintenance.

4. Provision of normative technical documentation for the aviation equipment operation maintenance procedures is performed on the basis of the funds of operating and maintenance documentation of the Central Civil Aviation Regulatory and Methodology Documentation Library.

5. IAS ACLCM controls movement of aviation equipment items at all stages of their life cycle and is a tool for state control of aviation equipment operation maintenance. This system makes it possible to provide the results of aircraft components life cycle monitoring works for all participants of the unified information space. It is

able to provide the state control over continued aircraft airworthiness and flight safety by civil aviation authorities.

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