



AIRCRAFT COMPONENTS LIFE CYCLE MONITORING AS A TOOL FOR IDENTIFYING INAUTHENTIC AVIATION EQUIPMENT ITEMS

A. Sharypov

The State Scientific Research Institute of Civil Aviation,
Mikhalkovskaya Street, 67, building 1, 125438 Moscow, Russia

V. Brusnikin, S. Koval, G. Glukhov, O. Gubanov

The State Scientific Research Institute of Civil Aviation,
Mikhalkovskaya Street, 67, building 1, 125438 Moscow, Russia

ABSTRACT

The article discusses the aircraft components life cycle monitoring issues as a tool for identifying inauthentic aviation equipment items. The issues of solving the civil aircraft components authenticity both abroad and in the Russian Federation have been considered, definitions and concepts of an inauthentic aircraft component have been provided. The experience of solving this problem in FSUE “The State Scientific and Research Institute of Civil Aviation” which is based on obtaining the updated information about technical state of aircraft components and comparing it with reference information delivered by manufacturers of such aviation items. The solution of this problem is based on the works assessing authenticity of aircraft components in accordance with technology and procedures of “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 aircraft component life cycle monitoring information analysis system (ACCLCMIAS) developed by FSUE “The State Scientific and Research Institute of Civil Aviation” as an operating mechanism for carrying out the aircraft component life cycle monitoring have been specified.

Key words: civil aviation, authenticity, components, aircraft, monitoring, life cycle, aviation equipment, airworthiness, state supervision.

Cite this Article: A. Sharypov, V. Brusnikin, S. Koval, G. Glukhov, O. Gubanov, Aircraft Components Life Cycle Monitoring as a Tool for Identifying Inauthentic Aviation Equipment Items, *International Journal of Mechanical Engineering and Technology* 9(7), 2018, pp. 612–620.

<http://www.iaeme.com/IJMET/issues.asp?JType=IJMET&VType=9&IType=7>

1. INTRODUCTION

The problem of maintaining airworthiness of aircraft fleet is not a new problem for Russia and for the world civil aviation, and not only aviation authorities but also the Russia's top leadership pay attention to its solution. In recent decrees of the President of the Russian Federation on activities on suppression of illegal trafficking of 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 of industrial products, including counterfeit products.

In particular, for aviation industry it is noted that there is the problem of timely identification of aircraft components (units and spare parts with unconfirmed life cycle) the use of which in aircraft may constitute a flight safety hazard during operation. The requirements to ensure operation of only approved AC components are contained in the Guidelines of ICAO (DOC 9760-AN/967 "Airworthiness Manual", Edition 3, 2014., Ch. 9. "Continuing airworthiness of aircraft", Par. 9.10. "Authenticity and serviceability of aircraft parts" [2].

It should be noted that using the term "counterfeit" for aviation equipment items is not quite correct. According to the Civil Code of the Russian Federation, "counterfeit" refers to "goods, labels, packing of such goods on which the trademark or a confusingly similar designation is applied". It means that no counterfeit products (in the traditional meaning) can exist in the civil aviation due to their production feasibility issues.

In accordance with the above mentioned ICAO guidelines and "Methodology of assessing authenticity of AC components" (Edition 2) No. 24.10-966ГА carried into effect by Order of the State Service of Civil Aviation No. 24.10-35ГА dated 19/03/2004 and approved by the Aviation Industry Department of the Federal Industry Agency on 23/11/2005 [3], and other regulatory documents of the Russian Federation [4], currently such items are termed as inauthentic ("unapproved" in ICAO terms) AC components, i.e. AC components which do not comply with the registry state requirements.

They include:

- AC components provided for operation by an organization which is not authorized for that;
- AC components subjected to maintenance or repair and admitted for further operation by organization not authorized for that;
- AC components which were serviced or repaired not according to the requirements of the applicable documentation;
- AC components which have reached their service life limit including, whenever necessary, storage life.

As applied to Russian civil aviation, taking into account the existing specific features, one more criterion has been added:

- AC component which has unapproved accompanying documents and maintenance records and log books, i.e. those executed with deviation from the requirements of normative technical documents.

Thus, in general terms, inauthentic aircraft components are the components which do not meet the established conditions of manufacture, maintenance, repair and/or have the executed documentation non-compliant with the established requirements.

2. GOALS AND OBJECTIVES

In the already published documents of the top leadership of the Russian Federation: the Decree of the President of the Russian Federation and Strategy, the solution of this problem is closely connected with the development of illegal industrial product trafficking issue suppression as applied to the civil aviation - it is provision of monitoring and surveillance of aviation equipment items trafficking.

One of the main objectives of developing the aviation equipment items trafficking monitoring and surveillance system is “the improvement of the industry statistic information acquisition and processing based on the up-to-date information technologies, assurance of fidelity of the industry statistics”. The legislative basis for implementing the state resolutions in the field of creation of the information system and airworthiness check is the Air Code of the Russian Federation (Article 37, Par. 8). A practical embodiment of this problem is creation, development and implementation of the aircraft components life cycle monitoring information analysis system.

3. METHODS AND MATERIALS

Such an approach to organization of the aircraft component life cycle state monitoring is implemented in Information Analysis Center of the Federal Unitary Enterprise “The State Scientific Research Institute of Civil Aviation” (FSUE SSRICA) as a part of Aircraft Airworthiness Monitoring Information Analysis System (AAMIAS) [5, 12].

This system is based on the principle of integration of all stakeholders of aviation equipment operation process into the unified information space. The unified AAMIAS information space stakeholders are the following objects of aviation activity in the Russian Federation:

- aircraft operators;
- maintenance organizations;
- repair organizations;
- aircraft developers/manufacturers;

as well as suppliers of air-technical equipment, leasing companies and aviation administration.

The methodological basis of the system development is the national standard of the Russian Federation - GOST R 54080-2010 “Air transport. Aviation equipment maintenance and repair system. Aircraft airworthiness monitoring information analysis system” [5].

The system includes the following basic components:

- Analytical Center.
- Hardware and software system.
- A network of regional IT modules.
- Information system.
- A set of normative technical documentation (regulations, manuals, guidelines, algorithms).

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In addition, AAMIAS performs also some other functions aimed at increasing the efficiency of flight safety and aviation security

It should be noted that the problem of aircraft components life cycle monitoring is topical for civil aviation all over the world.

Russia, being a party to Convention on International Civil Aviation and an ICAO member, shall comply with the requirements and guidelines of ICAO documents concerning the aircraft airworthiness maintenance. In accordance with ICAO guidelines, “the registry state shall be responsible for maintaining each aircraft listed in the registry of this state in airworth state...” [6, 7, 8]. It is achieved by developing an efficient aircraft airworthiness maintenance system comprising the aircraft components life cycle monitoring system. The ICAO guidelines determine that the state shall organize “The Service Difficulty Reporting System - SDR” aimed at assurance of an acceptable flight safety level by:

- facilitating the item improvement;
- detecting tendencies of their change (rather than individual cases);
- assessing reliability of component parts;
- providing more detailed guidelines for AC operators (Doc 9760 Attachment B to Ch. 8), based on the analysis data and further, “it is essential that for the purposes of continuing airworthiness a system of control exists which ensures that only parts meeting the approved design data applicable to a particular aircraft are installed on that aircraft”. (DOC 9760 Ch. 9, Par. 9.10).

The main tool for the state supervision of inauthentic aircraft components trafficking for prevention of installation thereof on aircraft shall be the aircraft components life cycle monitoring with performance of works for assessing authenticity of the components during supplies and operation.

Currently the AC components authenticity assessment in the system of the state supervision of the AC airworthiness in civil aviation is performed not systematically, but as one-time inspections appointed after any incidents related to flight safety. Uncoordinated operation of all civil aviation and aviation industry entities (aviation equipment developers and manufacturers, maintenance and repair organizations and airlines’ continuous airworthiness managements), as well as suppliers of air technical materials involved in this process is due to the lack of objective information on the problem and, consequently, absence of programs for developing system activities.

The urgency of AC components authenticity problem solution is due to the existing difficult situation in the civil aviation of the Russian Federation related to continuous detection of operated AC components with doubtful maintenance records and log books and, consequently, with implicit life cycle which may result in grave consequences.

In FSUE SSRICA a system for assessing the aircraft components authenticity was developed. It enables, inter alia, electronic monitoring of the life cycle of aviation equipment items and their compliance with the established requirements of the registry state. Performance of works for assessing the aircraft components authenticity is one of the most important elements of maintaining aircraft airworthiness solved within the whole complex of tasks aimed at assurance of flight safety [9, 10].

Actually, it was the first attempt to coordinate the activity of assessing authenticity of aircraft components of all organizations involved in the aircraft airworthiness maintenance.

Essentially, this system was used for adjustment and practical approbation of the basic ideas and software for implementing the aircraft components life cycle monitoring information analysis system. The efficiency, practical significance and feasibility of the project have been proved.

The basic stages of the aircraft components authenticity assessment works are:

- analysis of aircraft components maintenance records and log books;
- analysis of identification characteristics of aircraft component;
- electronic check of maintenance records and log books with aviation equipment manufacturers (repair organizations);
- analysis of supply sources;
- engineering and technical analysis of possibility (impossibility) to accept an aircraft component for operation, its influence on operation safety, assessment of possibility to permit flights within the aircraft system as a whole;
- database maintenance.

Basic tasks tackled by the system:

- information analytical support of aviation enterprises and suppliers of air technical materials on the aircraft components authenticity assessment issues;
- monitoring of technical and service life state of aircraft components.

Currently the aircraft component authenticity assessment operations are performed by the Information Analysis Center of FSUE “The State Scientific and Research Institute of Civil Aviation” in accordance with “Methodology of assessing authenticity of AC components” (Edition 2) No. 24.10-966ΓA [3], as well as GOST R 55256-2012 “Air transport. Aviation equipment maintenance and repair system. Procedures of works for civil aviation aircraft components authenticity assessment. General requirements” [4].

The goal of the works performed in accordance with this Methodology is verification of aircraft component life cycle, including checking for compliance of each inspected AC component with the established requirements of the applicable normative technical documentation and verification of its delivery from an approved source of air technical materials supplies.

The methodology was successfully used during works for increasing endurance and service life of an aircraft and during works for assessing technical state of an aircraft specimen for issuance of its airworthiness certificate.

Since the time of the aircraft components authenticity work commencement the FSUE “The State Scientific and Research Institute of Civil Aviation” experts have checked over 3800 aircraft, over 50% of the checked AC being included into the central database into which information about more than 2 mln aircraft components has also been included, and about 5200 inauthentic components influencing the flight safety were identified and rejected, such as aircraft engines, rotor blades, swash plates, tail rotor blades, hydraulic system units, alighting gears, navigation equipment, etc. [11].

The results of the aircraft components life cycle monitoring works carried out by FSUE “The State Scientific and Research Institute of Civil Aviation” vividly characterize the overall situation with authenticity assessment in Russian civil aviation.

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However, the aircraft components authenticity assessment works does not achieve the potentially achievable level due to imperfection of the regulatory framework for obligatoriness of carrying out such works during certification of an aircraft specimen, its repair, or during increase of aircraft endurance and service life.

It should be noted that the aircraft components authenticity assessment is only a part of activities carried out by FSUE “The State Scientific and Research Institute of Civil Aviation” for several years and aimed at the development of efficient methods of maintaining airworthiness of both aging and new prospective aircraft brought into operation. This whole scope of works enabled creating and approving in some airlines the aircraft components life cycle monitoring information analysis system (ACCLCMIAS) as a part of the general aircraft airworthiness monitoring information analysis system. ACCLCMIAS is a mechanism of continuous monitoring of updated information about service life and technical state of aircraft components by FSUE “The State Scientific and Research Institute of Civil Aviation”

The aircraft components life cycle monitoring is a scheduled and purposeful check of parameters and processes influencing the technical state of the aircraft components and implemented during manufacture, operation, repair and service support of aviation equipment operation. The main goal of such monitoring is increasing the efficiency of decision-making in the field of aviation equipment operation supported, in particular, by the results of the aircraft components inspection.

The aircraft component life cycle is a complex of interconnected processes of sequential change of the investigated component state. The general diagram of aircraft components life cycle, i.e. the whole chain of the components trafficking and over all entities on its route (manufacturer, supplier, operator, repair organization, again operator, etc.) can be shown as follows (Fig. 1).

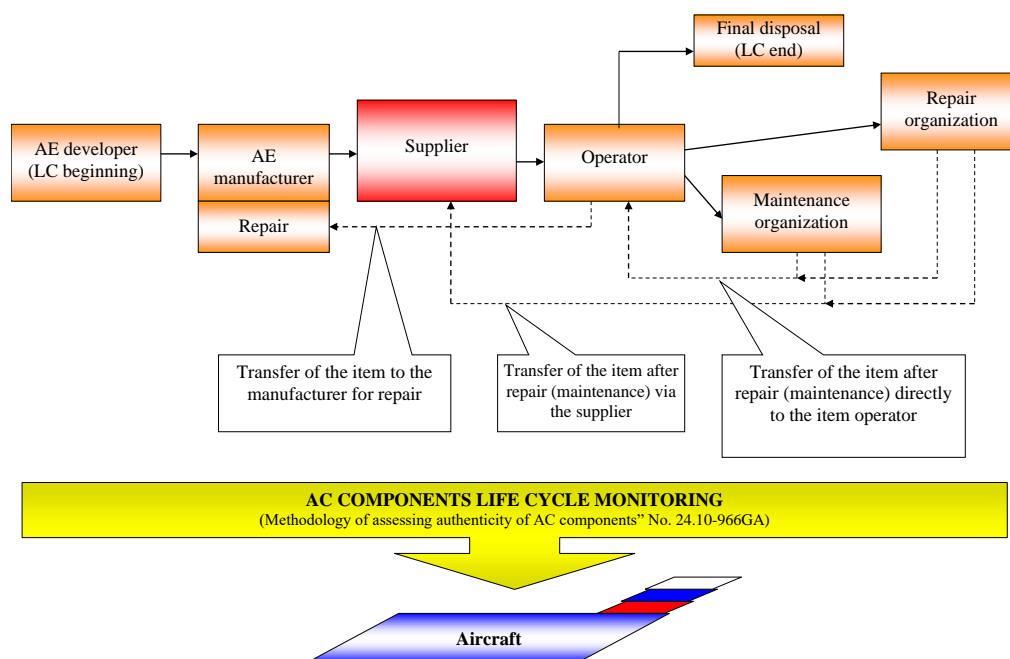


Figure 1 Life cycle of aviation equipment items

The study of sequential change of aircraft components state is supported by the update of the information about the technical state of such components and shall be based on a wide use

of information technologies just like the solution of many other problems in the aircraft airworthiness maintenance system where the main issue is obtaining the trustworthy information about technical state of the aircraft fleet and its components and especially the update of such information as applied to the time when the operation continuation decision is made.

Thus, information support is a key element of the aircraft components life cycle monitoring system. It will allow making qualitative changes in the system of manufacture and operation of Russian aviation equipment items oriented to the requirements and tendencies of development of the global aviation industry system.

The central regulatory and methodological library of the civil aviation - the database of regulatory and operation requirements of the issues of maintaining the life cycle of aircraft and their components is also an element of the information support [13].

However, the analysis of the current situation and the progress of works in the civil aviation currently evidence the extremely slow pace of works in this direction. It may be stated that the whole process is random now, i.e. individual task of this problem are tackled by aviation authorities upon receipt of information within implementation of particular tasks. Such an approach did not allow telling about creation of the Unified Information Space on the basis of which unified algorithms of making decision on the aircraft fleet operation could be made.

The efforts of FSUE “The State Scientific and Research Institute of Civil Aviation” were focused on solution of this problem during the development of the aircraft components life cycle monitoring information analysis system. Using the developed algorithms, each information analysis system stakeholder provides information about his/her contribution into formation of technical state of an aircraft component (Fig. 2).

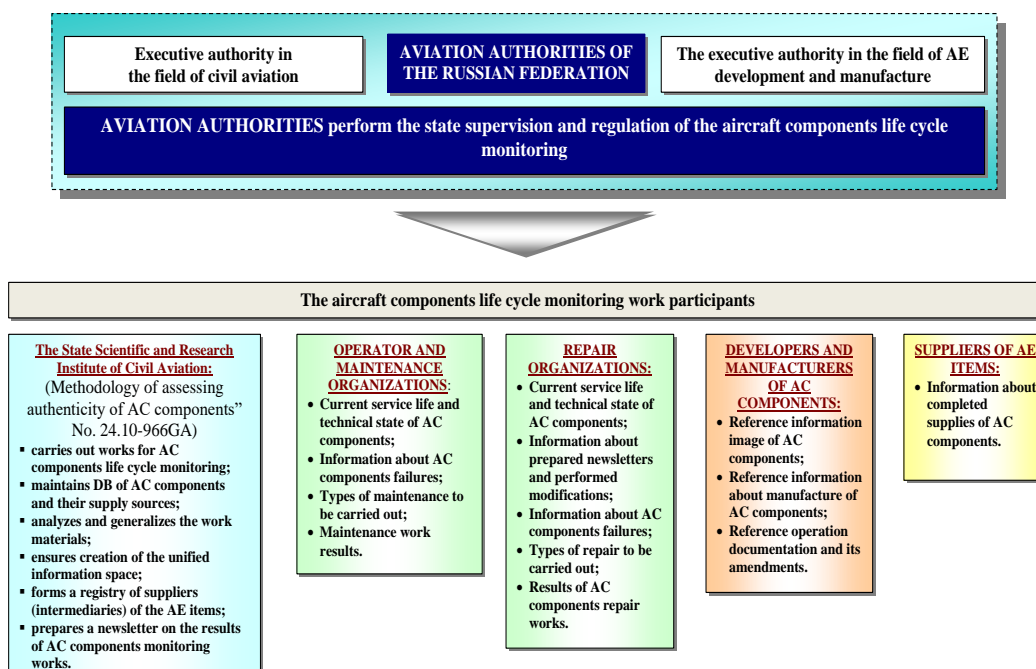


Figure 2 The reference and updated information about aircraft components during monitoring of their life cycle

On the basis of the acquired information the aircraft component information certificate is generated. Complemented with the component photos and visual identification attributes of the component it is stored in the Central database of the information analysis system. Such information certificate is the basic unit in case of detection of any inauthentic components during the aircraft components life cycle monitoring.

The aircraft components life cycle monitoring information analysis system developed in FSUE “The State Scientific and Research Institute of Civil Aviation” is an effective mechanism of checking the aviation equipment items at all stages of their life cycle. It allows providing all stakeholders 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 and ensure the civil aviation authorities’ state supervision of aircraft airworthiness maintenance and flight safety.

The aircraft components life cycle monitoring information analysis system, being one of the basic elements of the Unified Information Space in the field of monitoring and inspection of technical state of aviation equipment items allows using it as a basis for developing the state supervision of the aviation equipment operation maintenance the development of which is in the scope of works performed by FSUE “The State Scientific and Research Institute of Civil Aviation”. The fundamentals and technologies for building such a state system will be detailed in the next article of the same authors.

4. CONCLUSIONS

Thus, the efforts of FSUE “The State Scientific and Research Institute of Civil Aviation” for the development of the aircraft components life cycle monitoring information analysis system have shown that:

- In the civil aviation of the Russian Federation, just like in the civil aviation of other ICAO member countries, there is a problem of operating inauthentic aircraft components and a problem of suppressing their illegal trafficking in operation.
- In the civil aviation of the Russian Federation there is a task to develop an effective mechanism of detecting inauthentic aircraft components.
- In the civil aviation of the Russian Federation there are some unsolved problems in the regulatory framework for performance of works for aircraft components authenticity assessment due to the absence of regulatory provisions on mandatory conduction of such works.
- In FSUE “The State Scientific and Research Institute of Civil Aviation” the aircraft components life cycle monitoring information analysis system (ACCLCMIAS) has been developed as a working mechanism for monitoring the aircraft components life cycle which integrates the work of all stakeholders of such monitoring, both in the field of civil aviation, and in the field of aviation industry.
- Provision of normative technical documentation for the monitoring procedures is performed on the basis of the funds of operating and maintenance documentation of the Central civil aviation regulatory and methodology documentation library.

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