

## AEROSPACE QUALITY MANAGEMENT SYSTEM ACCORDING TO SELECTED QUALITY STANDARDS

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### **Abstract:**

The quality is one of the sources of competitive advantage in today's business. Quality in aviation is linked to the wider security. Actions for improvement of manufactured products or the provision of services should be systematic. This article presents the issues of the quality management system in the airline industry. It Shows the selected quality standards which determine the basis to build such a system. The first part of the article contains basic information about universal in applying standards ISO 9000, the second concerns standards developed for the aerospace industry AS 9100C.

*Keywords: aerospace quality management system,*

## 1. INTRODUCTION

The turbulent environment forces modern companies the constant search for the sources of competitive advantage. To succeed they should meet the needs and expectations of its clients, which requires management to take appropriate action in respect of the quality of offered products.

In aviation quality is linked to the wide range of security issues and no other production industry raises such a big interest of observers, as the aviation industry does. (Maksymowicz, p. 209.)

Companies supplying aerospace equipment besides requirements included in certain provisions of aerospace industry may also meet the guidelines adapted from other quality standards in the application of universal ones.

Actions aimed at improving the safety of products in the aerospace industry must be comprehensive, in this connection it is required to use quality management systems based on specific quality standards, first of all on the specific aerospace regulations. This may be mandatory codes, as well as voluntary. Yet another group of standards constitute the guidelines contained in the ISO 9000 standards, the use of which is also voluntary, but is not limited to a specific industry sector.

The purpose of this study is to present selected quality standards (ISO 9000, AS 9100C), on the basis of which the quality management systems are being built in the aerospace industry.

## 2. QUALITY MANAGEMENT SYSTEM IN THE CONTEXT OF ISO 9000 STANDARD

ISO standards from 9000 series belong to the group of international standards relating to implementation of the quality management system in organizations from different sectors diversified in respect of largeness. These standards are characterized by: versatility and elasticity in usage, compatibility with other standards, objectivity in relation to evaluation of quality system. Moreover, they were updated several times- amendments made in 2000 being the most significant.

Currently ISO 9000 standards family consists of:

- ISO 9000:2005 Quality management systems – Fundamentals and vocabulary,
- ISO 9001:2008 Quality management systems – Requirements,
- ISO 9004: 2009 Managing for the sustained success of an organization – A quality management approach,
- ISO 19011:2011 Guidelines for auditing management systems.

Preparation and implementation of the quality management system require a certain terminology, therefore ISO 9000:2005 standard includes basic definitions and describes basic rules, on which a system should be based. These rules include:

- Defining the needs and expectations of clients,
- creating a vision and developing a policy which helps to put it into practice,
- identifying primary and secondary processes, measuring and improving,
- managing interrelated processes and activities,
- constant research about new ways of improving the functioning of the organization and quality system,
- making decisions on a basis of gathered data and information,
- establishing partner relations with clients (PN-EN ISO 9000, 2006, p. 7-9).

ISO 9000:2008 standard includes requirements towards quality management system. They are divided into 5 chapters and relate to:

- general requirements towards system, which should be based on a systemic approach and developed as well as supervised documentation, which should consist of: quality policy, a quality manual, documented procedures and notes as well as other documents essential for effective management of processes,

- management's responsibility for: engagement in a creation of a system, determining requirements of organization clients, realization of the quality policy, planning processes, determining rights and responsibilities, reviewing of a management,
- managing of the organization's resources including: human resources, infrastructure and work environment,
- managing of processes essential for realization of a product related to: clients, purchases, production or delivering services, supervision of the equipment for monitoring,
- doing measurements, analyses and improvements by: monitoring of client's satisfaction, conducting internal audits, performing supervision over products, which do not meet requirements, conducting corrective and preventive activities (PN-EN ISO 9001:2009, p. 15-39).

Only ISO 9001 standard is underlined to certificate a system that is to determine by the independent unit that the system is compatible with the standard's requirements.

ISO 9004:2009 standard indicates recommendations for achieving permanent success in constantly changing environment. Presented recommendations emphasize a need to consider client's and other parties interested in organization requirements and stress the importance of studying in the process of improvement.

The last standard: ISO 19011:2011 relates to problems connected with conducting audits and includes information concerning rules of auditing, managing programs of audits as well as guidelines for evaluation of competences of people engaged in realization of audits.

Quality management system built on a basis of requirements and recommendations included in ISO 9000 standard can be implemented in every organization regardless of its profile of action. This system can be characterized as: "management system for leading an organization and its supervision in relation to quality". Terms used in this definition mean:

- management system: system for establishing organization's aims and their realization,
- quality: degree in which a group of inherent (permanent) properties fulfill the requirements (PN-EN ISO 9000:2006, p. 25,27).

Implementation of a system should begin by establishing by the management of the organization its scope and field of implementation. It is relevant to conduct an analysis first and evaluate current status of management. Consecutive activities concentrate on identification of processes and preparing systemic documentation. It is also necessary to conduct trainings among employers and undertake corrective and preventive activities, which improve system.

### **3. AS 9100C AS THE BASIS OF THE AEROSPACE QUALITY MANAGEMENT SYSTEM**

European Union has released some of the most important documents forming the basis for a kind of air law among the members of the design and production of the EU aviation products. The most important document is a regulation of the European Parliament and of the Council of the European Community No 216/2008 on common rules in the field of civil aviation and establishing a European aviation safety agency here in after referred to in the industry as the Basic Regulation. The document was modified, and the latest version was founded in January 2013, creating a regulation (EC) No 6/2013 (Commission Regulation (EU) no 6/2013).

This regulation approves two other documents of the European Commission, namely:-Commission Regulation (EC) 1702/2003 of 24 September 2003 laying down implementing rules for the certification of aircraft and related products, parts and appliances in terms of airworthiness and environmental protection, as well as for the certification of design and production organizations. Annex 1 to the document provides a series of rules known as PART-21. After changes - Regulation (EC) No 7/2013 – Commission Regulation (EC) 2042/2003 of 20 November 2003 on common rules in the field of civil aviation and establishing aviation safety agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36. Annex 1 to the regulation constitutes provisions of PART-M, annex 2 is rule PART-145, annex 3 provides PART-66 and annex 4 deals with the requirements of PART-145. After changes - Regulation (EC) no 593/2012.

The purpose of the implementation of the Basic Regulation was to establish and maintain uniform and high level of civil security in the European Union as well as the protection of the environment. In addition, it aims to facilitate the free movement of persons, goods and services, the promotion of certification, while avoiding duplication of legislation. Dynamic development of the aviation industry has become a motivator to create standards for this sector of the economy, which resulted in building the standards AS 9100 Quality Management Systems-Requirements for Aviation, Space and Defense Organizations. The purpose of this action was to achieve a significant improvement in the quality and safety, and reduce costs by analyzing the values (Łunarski, p. 83).

So far the norm was two renewals to version AS 9100B<sup>1</sup> (now outdated) and current AS 9100C. Aerospace quality standard AS 9100C relates to the quality management system (QMS) and the requirements for aerospace organization (Quality Management Systems - Requirements for Aviation, Space and Defense Organizations). Specifies requirements for a quality system for organizations that are facing the need to demonstrate its ability to provide the aviation product meeting the requirements of the customer. Assumes that the organization where this standard is implemented, aims to enhance customer satisfaction through the effective application of the system of systematically improved and ensuring compliance requirements with the statutory requirements and regulations.

In the framework of the AS 9100C are both ISO 9001: 2008 entries, as well as AS 9100B and topical additions necessary for aeronautical products. In addition, this standard places requirements for the quality management system for the aerospace industry in order to improve the quality and safety while reducing costs due to the elimination or reduction of the exceptional requirements of the organization and the pooling of these variability inherent expectations. AS 9100C, constructed on the basis of ISO 9001: 2008 quality management system certification forms the basis of air companies, without which no organization could not operate in the correct way (AS 9100:2009, p. 4.). However, this is not the only one document to standardize the work of the organization. AS 9100C consists of 8 chapters and the preliminary information that has been presented in table 1. The Committee on rules. Technical standards SAE International shall inform that report AS 9100C is voluntary and used by organizations in order to develop the level of technical and engineering sciences. The organization should be identified and links are managed in such a way that any resources were used to transform input data into output. The advantage of this approach is to ensure that the current supervision of ties between the various processes in the system processes, as well as over their combination and mutual interaction (AS 9100C, pp. 1-3).

Table 1. AS 9100C Standard structure

Część	Nazwa
Initial informations	Foreword, describe of change, introduction (general provision, process approach)
Quality management system - specifications	1. Range of standard
Quality management system - specifications	2. Reference standard
Quality management system - specifications	3. Terms and definitions
Quality management system - specifications	4. Quality management system
Quality management system - specifications	5. Responsibility of management
Quality management system - specifications	6. Management of resources
Quality management system - specifications	7. Realization of the product
Quality management system - specifications	8. Measuring, analisys, development and improving
Additional information	Bibliography

Source: AS 9100:2009, Rev.C. Quality Management Systems - Requirements for Aviation, Space and Defense Organizations. IAQ, p. 1-2.

All the requirements contained in the standard AS 9100C are general and are intended to be used by the aerospace organizations regardless of their size, type or product produced. If any of the requirements of the standards could not be met by the organization, then the discussion is recommended over the exclusion of such requirements. However, the exemption is not acceptable in the case of the company's efforts to obtain the certificate of conformity with this standard, unless exemptions apply to Chapter 7. The realization of the product, and such exclusions do not affect the

<sup>1</sup> Previous version of AS 9100C standard.

Organization's ability to deliver a product that satisfies the client's requirements and the requirements of applicable legislation (AS 9100C, p. 7).

Acquiring organizations parts, materials and assemblies and engaged in the resale of these products including products and buyers organizations to divide them into smaller parts for sale, should apply in turn the standard developed by the International also AS9120 Aerospace Quality Group (IAQG). As mentioned above, the standard AS 9100 is constructed on the basis of ISO 9001, but complemented the content intended for aerospace organizations. Consequently, among the additions can be found among others. the new definition such as: key property risk, special requirements and critical elements and other content that in a shortened and selective are presented below (AS 9100C, pp. 7-8).

According to the requirements of the standard AS 9100C quality management system should relate to the customer requirements and the requirements of legislative and legislative. All processes of the aerospace industry should be identified along with reciprocal links. In addition, the organization is obliged to determine the criteria and methods for the course and supervise processes, ensure the availability of information and resources necessary for these functions. Essential activities such as: monitoring, measurements, analyze processes and the implementation of the measures necessary to achieve the objectives and continuous improvement. Documentation requirements of the quality management system according to the AS 9100C are the same as in the case of ISO 9001. The highest leadership of the Aviation Organization should ensure the opportunity to measure the compliance of the product and the timeliness of deliveries, and take appropriate action in the event of not achieving planned results. In addition to the objectives relating to the quality of the product, which apply both in ISO 9001, as well as in the internal organization strategy, attention should be paid to aspects such as (AS 9100C, p. 15):

- safety of the product and staff;
- reliability, availability and the ability to operate;
- ability to produce and control;
- the relevance of the components and materials used in the product;
- selection and development of embedded software;
- recycling and final disposal of the product at the end of the period of use.

In the area of project management, organization of traffic in order to meet the requirements for the allowable risk should plan and manage the implementation of the product in a way that is based on the structure and subject to supervision within the framework of the set of resources and schedules. In addition, the Organization has established air, deploy and lead risk management process under the relevant requirements. This process should include:-assigning responsibility for risk management;-to define criteria such as risk. probability, consequences, the acceptability of the risk;-identification, implementation, and management of actions to minimize the risk of exceeding the criteria-admissibility of remaining risks after the debilitating action (AS 9100C, pp.15-16).

The company has established air, deploy and carry out the planning process and oversight of temporary and permanent transfer work. In addition, the requirements associated with the device must include the special requirements. In turn after delivery activities include among others. operation is subject to the provisions of the warranty, contractual obligations, and additional. At the same time the airline organizations are committed to planning, implementation and implementation of configuration management. The Organization, if appropriate, shall enter the Division of design and development work on the extracted steps. For each of these actions, in turn, should be referred to the task, the necessary resources, liability, the scope of the project and the input and output as well as constraints in the planning (AS 9100C, pp. 17-21).

In the area of purchasing, an aerospace organization should be responsible for the quality of the purchased products or semi-finished products, also from the sources indicated by the client. A factor likely to apply when assessing suppliers are its quality data obtained from objective sources. Such organizations include processes and quality management systems certification bodies and Government agencies. The Organization should pay attention to the identification of the products along with outlining the respective releases of specifications and technical data. In addition, it is important to draw attention to the requirements for the design, testing, research, control, verification of the application of statistical techniques to the deliverable of the product and appropriate statements for approval by the Organization, as well as critical elements. Information about purchases should also include requirements for test samples. Requirements including the requirements should be provided in

the supply chain and put to record. The right of access to all devices and objects associated with the device and all the relevant records must receive both the Organization as well as the client and the authorities at every level of the supply chain (AS 9100C, p 21).

Review of the product by the customer at every level of the supply chain may not be for the proof of the effectiveness of quality control and should not exempt the organization from liability to provide acceptable product and comply with all applicable requirements. Verification activities, in turn, may include (AS 9100C, p. 21):

- to obtain objective evidence of product quality on the part of suppliers;
- control and audit on suppliers;
- an overview of required documentation;
- control devices on delivery;
- authorized supplier for verification or certification providers.

If the product is in turn released for use in the production in anticipation of the completion of all the required verification measures, should be identified and described so as to allow its withdrawal and replacement in case of not meeting the requirements. In the event of a transfer verification at the supplier, the Organization should determine the requirements for communication and to maintain the register of transfers.

Conditions of production surveillance shall include (AS 9100C, pp. 22-23):

- the availability of information, which in the case of providers should include drawings, parts lists, processes and material standards;
- the availability of work instructions, which may include process diagrams, documentation of production and documentation control;
- use of proper equipment, including for example. specific equipment;
- settlement during the manufacture of the products documented for all entries;
- involved in the manufacture and control of finished according to plan;
- actions for the prevention, detection and removal of foreign objects;
- monitoring and control of resources such as water, air, energy and chemical products joined in so far as they affect the quality of the product,
- implementation of the quality criteria laid down in a clear and practical way through eg. written standards, representative samples or illustrations;
- and a number of other, familiar with the ISO 9001 standard guidelines.
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In addition, the Organization should use a representative element of the first batch of a new part or Assembly in order to verify the manufacturing process, documentation and Instrumentation in terms of fulfillment of the requirements. These actions are often called control first. In turn, tools, equipment and software used to automate the monitoring and implementation process of the product must be validated before releasing into production and have supported. Information subject to monitoring in order to evaluate the customer satisfaction should include product, promptness, customer complaints and requests for corrective actions, but should not be limited to them. Aviation organizations should implement plans to improve client satisfaction, referring to shortcomings identified by the evaluation and assessing the effectiveness of their effects (AS 9100C, pp. 23, 27).

In determining the appropriate methods for monitoring and measurement of processes, it is desirable, that the Organization has taken into account the nature and extent of monitoring or measurement applied to each of its processes in relation to their impact on the conformity with the requirements for the product and the efficiency of the quality management system. In the event of non-compliance with the process, the Organization should take appropriate corrective actions, assess whether non-compliance process affects the non-conformity of the product, determine whether non-compliance process is limited to a particular case or can affect other processes or product and to identify and oversee the incompatible products. The monitoring and measurement of product was also expanded to include the requirement for the acceptance of measurement device, which should be documented and include acceptance criteria and/or rejection, the order of execution of measurements and tests the required records of the results of measurements and the required type of measuring instruments. If you turn from the organization is required to demonstrate the eligibility of the product, shall provide records that provide evidence of conformity of the product with the requirements of, and upon delivery of all documents should accompany the products (AS 9100C, pp. 28-31).

In the case of monitoring for illegal products, the Organization should protect the reporting process in time, and the actions taken to the effects or potential effects of the non-compliance of the product detected after delivery to the customer should be appropriate to the nature and importance of these effects. Therefore, the Organization should also take preventive measures to reduce the potential consequences of non-compliance for other products and processes. As presented above, the standard aviation AS9100C is the norm, but due to its nature as the necessity of taking care of safety and high quality of the products. On the safety use of aeronautical products is not only the staff, but also (and perhaps above all) organizations involved in designing, producing and renovation of aeronautical products affected by the standard presented. Quality management system based on the standard is complex but at the same time, QMS of AS9100C largely providing high quality equal to the high level of safety of aeronautical products.

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