

The Ultimate Technical Guide to AS9110 Rev C: Quality Management Systems for Aviation Maintenance Organizations

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In the high-stakes environment of the aerospace industry, precision, reliability, and safety are not merely objectives—they are absolute prerequisites for operational existence. While the **AS9100** standard is widely recognized as the benchmark for aerospace design and manufacturing, the **AS9110** standard (specifically the current **Revision C**) serves a distinct and vital sector: the Maintenance, Repair, and Overhaul (MRO) of aerospace components and aircraft. For organizations operating within the civil and military aviation spheres, adhering to **AS9110 Rev C** is the cornerstone of ensuring that returned-to-service products meet the highest possible standards of airworthiness.

Understanding the Genesis and Scope of AS9110 Rev C

AS9110 was developed by the **International Aerospace Quality Group (IAQG)** to address the specific needs of maintenance organizations that were not fully met by the broader AS9100 manufacturing standard. While AS9100 focuses on the production of new parts, AS9110 is tailored to the complexities of maintaining existing hardware, managing technical data from Original Equipment Manufacturers (OEMs), and navigating the rigorous regulatory frameworks established by authorities such as the **Federal Aviation Administration (FAA)** and the **European Union Aviation Safety Agency (EASA)**.

AS9110 Rev C, published in 2016, represents a significant evolution in the standard. It incorporates the high-level structure (HLS) of **ISO 9001:2015**, which facilitates easier integration with other management systems. However, it adds over 100 additional requirements specifically focused on aerospace maintenance. These additions target critical areas such as **human factors**, **product safety**, **counterfeit parts prevention**, and **configuration management**.

The Core Differences: AS9100 vs. AS9110 vs. AS9120

It is common for organizations to wonder which standard in the AS91XX series applies to their operations. The following table provides a technical breakdown of the focus areas for each standard, highlighting why AS9110 is the definitive choice for MRO providers.

Feature / Standard	AS9100 (Design & Manufacturing)	AS9110 (Maintenance & Repair)	AS9120 (Distribution & Logistics)
Primary Target	OEMs and Parts Manufacturers	MRO Stations and Repair Facilities	Distributors and Stockists
Key Focus	Design control and production consistency	Maintenance programs and technical data adherence	Chain of custody and traceability
Human Factors	Minimal emphasis	Critical requirement for maintenance tasks	Not applicable
Technical Data	Creation of technical specifications	Access and control of OEM data/manuals	Pass-through of data only
Release Authority	Certificate of Conformity (CoC)	Approval for Return to Service (e.g., FAA 8130-3)	Traceability documentation

Technical Framework: The Pillars of AS9110 Rev C

The architecture of **AS9110 Rev C** is built upon the Annex SL structure, but its technical depth lies in the aerospace-specific additions. To achieve **AS9110 certification**, an organization must demonstrate a robust mastery of several core mechanics.

1. Human Factors (Clause 7.1.6 and 10.2.1)

One of the most significant inclusions in Revision C is the explicit focus on **Human Factors**. In an MRO environment, the majority of failures are traced back to human error rather than mechanical failure. AS9110 requires organizations to consider the interactions between people and their environment, tools, and processes. This involves training staff to recognize the "Dirty Dozen"—twelve common human error preconditions such as fatigue, stress, lack of communication, and complacency.

2. Product Safety (Clause 8.1.3)

Product safety is treated as a distinct process within the QMS. Organizations must maintain processes that ensure safety throughout the product lifecycle. This includes the management of **operational risks**, the analysis of safety-related data, and the communication of safety hazards to stakeholders. In a maintenance context, this translates to the rigorous verification that any repair does not negatively impact the structural integrity or functional safety of the aircraft.

3. Prevention of Counterfeit Parts (Clause 8.1.4)

The aerospace supply chain is global and complex, making it vulnerable to the entry of unapproved or counterfeit parts. AS9110 Rev C mandates a formal program to prevent the use of counterfeit components. This includes rigorous supplier evaluation, training in the detection of counterfeit parts, and a defined process for the quarantine and reporting of suspect items to prevent them from re-entering the supply chain.

The Operational Heart: Clause 8 Breakdown

Clause 8, "Operation," is where the technical requirements for maintenance are codified. For an MRO organization, this is the most critical section of the **AS9110 Quality Manual**.

Operational Planning and Control

Maintenance organizations must plan the processes needed for product realization. This includes the determination of requirements for the products and services, the establishment of criteria for processes and product acceptance, and the determination of resources needed. Under AS9110, this specifically includes **Configuration Management**—a process for establishing and maintaining consistency of a product's performance, functional, and physical attributes with its requirements and design throughout its life.

Control of Nonconforming Outputs

In aerospace maintenance, the handling of nonconforming parts is governed by strict safety protocols. If a part is found to be non-airworthy and cannot be repaired within the scope of authorized technical data, it must be clearly identified and controlled. AS9110 Rev C requires that nonconforming products be rendered unusable if they are being scrapped, ensuring they cannot be inadvertently salvaged and used in an aircraft.

Maintenance Process Mechanics

The maintenance process itself is subject to specific technical requirements:

- **Technical Data:** The organization must ensure that it has the most current versions of Maintenance Manuals, Service Bulletins (SB), and Airworthiness Directives (AD).
- **Ground Support Equipment (GSE):** Tools and equipment used for maintenance must be calibrated and maintained to ensure they do not introduce errors into the maintenance process.
- **Work Packages:** Maintenance must be performed according to a documented work package that provides clear instructions and allows for the recording of all tasks performed.

Step-by-Step Implementation: The Road to Certification

Achieving **AS9110 Rev C certification** is a rigorous process that requires systematic planning. Below is a procedural workflow for implementing an AS9110-compliant QMS.

Phase 1: Gap Analysis and Planning

The first step is a comprehensive **Gap Analysis**. This involves comparing the organization's existing processes against the 100+ requirements of AS9110 Rev C. The output of this phase is a detailed project plan that identifies resource requirements, timelines, and key performance indicators (KPIs).

Phase 2: Documentation Development

AS9110 requires a hierarchy of documentation. While the 2015-based HLS is less prescriptive about a physical "Quality Manual" than previous versions, most aerospace organizations still utilize a **Quality Manual** as a high-level roadmap. Key documents include:

- **Quality Procedures:** Detailed documents defining *how* specific requirements (like risk management or internal audits) are met.
- **Work Instructions:** Step-by-step guides for technical tasks at the shop floor level.
- **Forms and Records:** The objective evidence that the system is functioning as intended.

Phase 3: Training and Cultural Integration

Certification cannot be achieved by the quality department alone. Every technician and staff member must be trained on the aspects of the QMS that affect their work. Specialized training on **Human Factors** and **Product Safety** is essential for compliance.

Phase 4: Internal Audit and Management Review

Before the external registrars arrive, the organization must conduct a full cycle of **Internal Audits**. This is the process of checking the QMS against itself. Findings from the audit are presented to top management in a formal **Management Review** to ensure the system's continued suitability and effectiveness.

Comparison of AS9110 Certification Requirements

To better understand the depth of the **AS9110 Rev C Quality Manual and Procedure Package**, it is useful to look at the specific deliverables required for a successful audit.

Requirement Area	Mandatory Documentation / Evidence	Typical Technical Challenge
Risk Management	Risk Register, FMEA (Failure Mode and Effects Analysis)	Quantifying operational risks beyond just financial risks.
Configuration Management	Configuration Management Plan, Status Accounting Records	Tracking part revisions across long-term maintenance cycles.
Traceability	Material Certs, Batch Records, Technician Stamps	Ensuring 100% traceability for small hardware (nuts/bolts).
Internal Audit	Audit Schedule, Non-Conformance Reports (NCR)	Maintaining objectivity when auditing specialized technical tasks.
Supplier Control	Approved Vendor List (AVL), Scorecards	Managing sub-tier suppliers in remote locations.

Case Study: Addressing Human Factors in MRO Operations

Consider a hypothetical Part 145 repair station seeking **AS9110 Rev C certification**. During the implementation phase, the organization identified a trend of "mis-torqued" fasteners in engine assemblies. Under a standard ISO 9001 system, the solution might simply be to retrain the technician. However, under the **AS9110 Human Factors** framework, a deeper technical analysis is required.

The Technical Analysis (RCA)

Using **Root Cause Analysis (RCA)**, the organization discovered that the errors occurred primarily during the night shift. Further investigation revealed that the lighting in the specific hangar bay was insufficient for reading torque wrench scales accurately, and technicians were experiencing fatigue at the 10-hour mark of their shift.

The Solution

The organization implemented several changes aligned with AS9110 requirements:

1. Environmental Controls: Installed high-intensity LED lighting in the assembly area.
2. Tooling Upgrade: Transitioned to digital torque wrenches with audible and haptic feedback to minimize reliance on visual scale reading.
3. Fatigue Management: Revised shift schedules to include mandatory rest periods and implemented a "second-set-of-eyes" verification for critical torque tasks during late-night hours.

This holistic approach not only resolved the technical non-conformance but also demonstrated the "Human Factors" compliance required by AS9110, ultimately leading to a successful certification audit.

The Strategic Value of AS9110 Certification

Implementing **AS9110 Rev C** is an investment that yields significant dividends. Beyond the obvious benefit of regulatory compliance, the standard provides a framework for operational excellence. By focusing on **Risk Management**, organizations can anticipate failures before they occur, reducing the costs associated with rework and warranty claims.

Furthermore, **AS9110 certification** is often a prerequisite for bidding on lucrative defense and commercial aerospace contracts. It serves as a global signal of quality, providing customers with the assurance that the

organization has the technical competence and the systemic rigor to handle critical flight hardware.

Future-Proofing through Revision C

As the aerospace industry moves toward greater digitalization (Industry 4.0), the **AS9110** framework is evolving to accommodate data-driven maintenance. Concepts such as **Predictive Maintenance** and **Digital Twins** fit seamlessly into the "Performance Evaluation" and "Improvement" clauses of the standard. Organizations that master the fundamentals of Revision C today are positioning themselves to lead the technological transformations of tomorrow.

The journey toward AS9110 compliance requires a cultural shift from "fixing parts" to "managing quality systems." By integrating the technical requirements of the standard into the daily heartbeat of the maintenance shop, organizations do more than just pass an audit—they contribute to the safety and reliability of the entire aviation ecosystem. The rigorous documentation, the focus on human error prevention, and the commitment to airworthiness inherent in AS9110 Rev C ensure that when an aircraft returns to the skies, it does so with the highest possible margin of safety.

Tags: #AS9110 #AS9110 Rev C #Aerospace Maintenance #ISO 9001 2015 #Aviation Quality Management #MRO Standards

