

THE AS/EN 9100 IMPLEMENTATION GUIDE

**A Practical Reference for Building,
Auditing, and Sustaining a Quality
Management System in Aerospace**



PLAN



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JORDAN COOPER

The AS/EN 9100 Implementation Guide

A Practical Reference for Building, Auditing, and
Sustaining a Quality Management System in Aerospace

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A Practical Reference for Building, Auditing, and Sustaining a Quality Management System in Aerospace

About this book: This comprehensive guide takes you from foundational understanding to full implementation of an AS/EN 9100-compliant Quality Management System in aerospace. Written for executives, quality managers, aerospace engineers, auditors, consultants, and compliance professionals, it explains what the standard requires, how to plan and execute implementation, how to prepare for and maintain certification, and how to integrate aerospace quality management into everyday operations. Every chapter draws on authoritative sources from IAQG, SAE International, ASD-STAN, and ISO, and provides practical guidance with real aerospace industry context. This is not a summary of the standard text, and it is not an audit checklist. It is a working reference for anyone responsible for aerospace quality management today.

Introduction: The Safety Imperative and the Quality Standard

Why Aerospace Quality Is Different

Every industry makes mistakes. Some make mistakes with check marks and corrected paperwork, some make mistakes that cost money, and a few make mistakes that kill people. The aerospace industry is one of those few. A missing torque value on a fastener, a misidentified heat lot on a titanium bar, a counterfeit connector routed into an avionics harness, a skipped inspection step during rush production, any one of these seemingly small failures can travel through a supply chain and appear in a place where there is no margin for recovery.

This reality drives everything about AS/EN 9100. The standard exists not as a bureaucratic exercise but as a response to the fact that in aerospace, product quality is inseparable from human safety and from the reliability of mission-critical systems. When a commercial airliner, a military aircraft, a launch vehicle, or a satellite performs its function, it depends on thousands of components and processes controlled by organizations that may never have met the end user, may operate in different countries, and may be separated by multiple tiers of the supply chain. Quality management in this environment cannot be left to individual organizations to interpret loosely or inconsistently. A common framework is essential.

That framework is AS/EN 9100, the quality management system standard for aviation, space, and defense organizations. It is maintained by the International Aerospace Quality Group (IAQG), an international cooperative of the industry's largest manufacturers, primes, and government agencies. The standard is technically identical across regions, published as AS 9100 by SAE International in the Americas, as EN 9100 by ASD-STAN/CEN in Europe, and as JISQ 9100 in Japan. The naming varies, the requirements do not [1,2,3].

The Real Cost of Failure: Lessons from the Field

The aerospace industry has learned its quality requirements through hard experience. Early in the 1990s, before a unified standard existed, major manufacturers imposed their own quality requirements on suppliers, each with different terminology, different procedures, and different expectations. Boeing ran its D1-9000 program, Airbus maintained its own specifications, Pratt and Whitney had its own quality standards. A supplier serving multiple primes faced an impossible burden of compliance, which often led to confusion, inconsistent implementation, and gaps that could be exploited by human error or malicious intent.

This fragmented system contributed to high-profile quality incidents that reshaped industry thinking. In 1996, a Boeing 767 crash in Guam was traced to maintenance documentation errors that led to incorrect repair procedures, a failure that could have been prevented through better control of processes and records. Throughout the 2000s and 2010s, counterfeit electronic components repeatedly surfaced in defense and commercial aerospace programs, sometimes appearing so convincing that they passed initial inspection, with consequences including in-flight failures and costly fleet-wide investigations [4,5].

These events underscore a fundamental truth: in aerospace, quality is not merely about meeting dimensional tolerances or cosmetic specifications. It is about controlling every variable that could affect whether a product performs its intended function without causing harm. AS/EN 9100 was created to institutionalize this understanding across the entire supply chain.

What AS/EN 9100 Does and Does Not Do

AS/EN 9100 is sometimes misunderstood as a certification that guarantees product quality or as a regulatory requirement imposed by governments. Neither is entirely accurate, and confusing what the standard is and what it is not leads to poor implementation.

The standard does the following:

- Provides a comprehensive, internationally harmonized Quality Management System (QMS) framework that all aerospace supply chain organizations can use

- Incorporates all requirements of ISO 9001 and adds over 100 aerospace-specific requirements addressing product safety, counterfeit parts prevention, configuration management, traceability, risk management, special processes, supplier control, and more
- Establishes common terminology and expectations so that organizations across different countries and supply tiers can communicate about quality in a shared language
- Creates a certification scheme, administered by IAQG through accredited certification bodies, that provides visibility and trust through the OASIS database
- Requires organizations to demonstrate not only that they have written procedures but that those procedures are effectively implemented and continuously improved

The standard does not do the following:

- Replace regulatory requirements from aviation authorities such as the FAA, EASA, or military procurement agencies
- Substitute for product-specific engineering requirements or customer-specific quality agreements
- Guarantee that a certified organization will never produce a defect
- Mandate any specific software, tool, or organizational structure beyond what is necessary to meet the requirements

AS/EN 9100 is a management system standard, not a product standard, and it operates at the level of processes and controls rather than individual parts. An AS/EN 9100-certified organization is one that has established a systematic approach to identifying requirements, planning operations, managing risk, controlling processes, monitoring performance, and driving improvement. That does not mean the organization is immune to problems, but it means the organization has structures in place to detect problems early, contain their effects, and prevent recurrence [6,7].

How to Use This Book

This book is organized to take you progressively from understanding to implementation to mastery. It assumes you are a professional in the aerospace

industry, possibly with existing familiarity with quality management or ISO 9001, but not necessarily a quality management specialist.

The first section establishes the foundation: what AS/EN 9100 is, how it evolved, its relationship with ISO 9001, its structure, and the principles that underlie it. You will see how the standard fits into the broader aerospace quality landscape and what misconceptions often derail implementation efforts.

The second section walks through the standard's requirements clause by clause, explaining the intent behind each section, what practical implementation looks like, and how aerospace organizations address the specific challenges posed by each requirement. This is where you will find guidance on risk-based thinking, product safety, configuration management, counterfeit parts prevention, supplier control, traceability, special processes, and more.

The third section provides a step-by-step implementation roadmap, describing what should be done at each stage of implementation, who should be responsible, what resources are needed, what evidence should be generated, and what common problems typically arise and how they can be addressed. This section is intended for anyone planning or leading an AS/EN 9100 implementation project.

The fourth section examines implementation in context: how to adapt the standard for small businesses versus large organizations, for manufacturers versus maintenance or engineering-only organizations, for multinational companies, and for organizations that already hold ISO 9001 certification or operate integrated management systems.

The fifth section offers a balanced assessment of the strengths, limitations, and risks associated with AS/EN 9100 implementation, including cost considerations, organizational barriers, and the difference between what the standard actually requires and what organizations sometimes do in the name of best practice.

Throughout the book, you will find practical examples, tables summarizing key points, checklists for common implementation tasks, and references to authoritative sources. Citations appear inline as numbered references linked to the full source list at the end of the book.

You can read this book from start to finish, or you can treat it as a reference, consulting specific chapters as needed depending on your role and responsibilities. If you are an executive evaluating certification, focus on the introduction, chapters on implementation strategy and benefits, and the roadmap. If you are

a quality manager leading implementation, read the entire book with particular attention to the clause-by-clause analysis and implementation chapters. If you are an auditor or consultant, the sections on requirements, common findings, and audit preparation will be most useful.

The Reader Journey: From Awareness to Certification to Continual Improvement

AS/EN 9100 implementation is not an event, it is a transformation. Organizations that treat certification as a project with a fixed end date, after which the system can run on autopilot, typically struggle to maintain compliance during surveillance audits and fail to realize the operational benefits the standard is designed to deliver.

The journey begins with awareness and understanding. Before any procedures are written or audits are scheduled, leadership must grasp what the standard requires, why it matters for the organization's customers and for safety, and what commitment will be needed to implement it successfully. This book's early chapters are designed to support that understanding.

Next comes the work of assessment and planning. Organizations evaluate their current state against AS/EN 9100 requirements, identify gaps, and develop a realistic implementation plan with defined responsibilities, timelines, and resources. The implementation roadmap chapter walks through this phase in detail.

The implementation phase itself involves designing and documenting processes, training personnel, deploying controls, and running the system long enough to generate evidence of its effectiveness. This is where most of the work takes place, and it is where careful planning pays dividends.

After implementation, organizations must demonstrate readiness through internal audits and management reviews, then invite external auditors to conduct the formal certification audit, which occurs in two stages: a document and readiness review followed by a full compliance audit on site.

Certification is valid for three years, subject to annual surveillance audits. But the real measure of success is not maintaining a certificate on the wall, it is building a quality culture in which everyone understands their contribution to product safety, in which problems are investigated thoroughly and fixed at

their root, in which risk is managed proactively, and in which improvement is continuous rather than reactive.

This book is designed to support you at every step of that journey and to remain a useful reference throughout the lifecycle of your quality management system.

Chapter 1: Foundations of AS/EN 9100

What Is AS/EN 9100: Definition and Purpose

AS/EN 9100 is the quality management system standard developed specifically for organizations that design, manufacture, service, or distribute products for the aviation, space, and defense industries. It is not a generic quality standard adapted for aerospace, it is a standard written by the aerospace industry for the aerospace industry, based on input from the world's major airframe manufacturers, engine producers, defense contractors, government agencies, and quality professionals.

Formally, the standard is titled “Quality Management Systems - Requirements for Aviation, Space and Defense Organizations.” It specifies requirements for a Quality Management System (QMS) that an organization needs to demonstrate its ability to consistently provide products and services that meet customer requirements, applicable statutory and regulatory requirements, and the unique safety and reliability expectations of the aerospace sector [8,9].

The purpose of AS/EN 9100 can be stated simply: to standardize quality management requirements to the greatest extent possible across the global aerospace supply chain, reducing or eliminating organization-unique requirements, improving quality, schedule, and cost performance, and increasing confidence among customers that certified suppliers are capable of delivering safe, reliable products [10].

The standard applies to organizations of any size that perform aerospace-related activities, from large primes building complete aircraft to small machine shops producing precision components to engineering firms performing design work and maintenance organizations servicing aircraft. The specific application varies based on the organization's activities, but the underlying principles remain the same.

AS/EN 9100 is a requirements-based standard, not a guidance document. It uses the word “shall” to indicate requirements that must be met, and it does not provide options for organizations to pick and choose which elements to imple-

ment. The certification audit verifies conformity with these requirements, not with a subjective notion of good quality practices.

The Relationship Between AS 9100 and EN 9100

The dual naming of AS/EN 9100 reflects the standard's global harmonization, not a fundamental difference in content. The standard is developed collaboratively by the International Aerospace Quality Group (IAQG), which operates across three geographic sectors: the Americas, Europe, and the Asia-Pacific region.

In the Americas, the standard is published as AS 9100 by SAE International, using the "AS" prefix that designates aerospace standards under SAE's numbering system. In Europe, the same standard is published as EN 9100 by CEN/ASD-STAN, using the "EN" designation for European standards. In Japan and parts of the Asia-Pacific, it appears as JISQ 9100 under the Japanese industrial standards system [11,12].

All three versions are technically identical in their requirements. The IAQG has made this harmonization explicit and intentional, ensuring that an organization certified to AS 9100 in North America meets the same requirements as an organization certified to EN 9100 in Europe. This harmonization is a core feature of the standard's design and a key benefit for global supply chains.

Practically, this means that:

- The clause numbering, structure, and requirements are the same across all versions
- Certification under one regional designation is recognized under the others
- Organizations operating in multiple regions do not need separate quality systems for different markets
- The IAQG's Online Aerospace Supplier Information System (OASIS) database lists certified organizations regardless of the regional designation under which they hold certification [13]

The most recent version, Rev D, was issued in September 2016 and aligned with ISO 9001:2015. EN 9100:2018 is the European publication of this same revision, with the date reflecting its formal adoption process in Europe rather than a substantive difference in content.

Looking forward, the IAQG is preparing a comprehensive revision that will be published under a new designation: IA9100, where “IA” stands for International Aerospace. This revision, expected around late 2026, is designed to further consolidate the global identity of the standard and align it with the upcoming ISO 9001:2026 revision [14,15].

Key Principles of the Standard

AS/EN 9100 embodies several foundational principles that shape how it is structured and how it should be implemented:

Customer focus and satisfaction. The standard begins with the requirement that organizations understand and meet customer requirements, including requirements for quality, delivery, cost, and regulatory compliance. In aerospace, customer requirements are often extensive, flowing down from prime contractors through multiple tiers of suppliers, and they frequently include safety and airworthiness considerations beyond simple product specifications.

Leadership and accountability. Top management is required to demonstrate active leadership and commitment to the quality management system, not merely endorse it. The standard explicitly requires executives to ensure the QMS is integrated into business processes, to promote customer focus, to communicate the importance of effective quality management, and to ensure the QMS achieves its intended results [16].

Process approach. AS/EN 9100 requires organizations to manage their activities as interconnected processes rather than isolated functions. This means defining process boundaries, understanding how processes interact, identifying inputs and outputs, assigning process owners, establishing controls and performance criteria, and continually evaluating effectiveness. The process approach is fundamental to the standard’s Annex SL structure inherited from ISO 9001:2015 [17].

Risk-based thinking. Unlike previous versions of quality standards that treated risk management as optional or secondary, AS/EN 9100 requires organizations to identify and address risks and opportunities throughout the QMS. This goes beyond a simple risk register and requires integrating risk assessment into planning, operations, supplier management, design, and continual improvement. The aerospace industry’s safety-critical environment makes this requirement especially meaningful [18].

Evidence-based decision making. The standard requires organizations to base decisions on the analysis and evaluation of data and information, not on assumptions or intuition. This means collecting performance data, monitoring processes, conducting audits, analyzing nonconformities, and using that evidence to drive corrective actions and improvements [19].

Continual improvement. AS/EN 9100 does not accept static compliance as an endpoint. It requires organizations to continually improve the suitability, adequacy, and effectiveness of the QMS through corrective actions, preventive measures, innovation, and systematic evaluation. Improvement is built into the standard's final clause and referenced throughout [20].

Product safety throughout the lifecycle. A distinctive feature of AS/EN 9100 compared to generic quality standards is its explicit emphasis on product safety. Organizations are required to identify and manage product safety considerations throughout the entire product lifecycle, from initial design through manufacture, delivery, and use. This reflects the fundamental reality that in aerospace, quality failures can have consequences far beyond financial loss or customer dissatisfaction [21].

How AS/EN 9100 Fits Into the Aerospace Quality Landscape

AS/EN 9100 is one element in a broader ecosystem of aerospace quality standards, regulations, and certification schemes. Understanding where it fits helps organizations avoid confusion and position their quality management system correctly.

The standard is built on ISO 9001, the international baseline quality management standard. AS/EN 9100 fully incorporates all ISO 9001 requirements and adds aerospace-specific additions, meaning that an AS/EN 9100-certified organization is also conforming to ISO 9001, but the reverse is not true [22].

The standard coexists with regulatory frameworks from aviation authorities and defense agencies. The FAA in the United States, EASA in Europe, and defense procurement agencies worldwide maintain their own regulations for aircraft certification, maintenance, and defense acquisition. AS/EN 9100 does not replace these regulations, but it supports compliance with them by establishing disciplined processes for controlling design, production, documentation, and nonconformities. Major aviation regulators recognize and

support AS/EN 9100 as a quality management baseline for their regulated supply chains [23].

The standard is complemented by related standards in the AS/EN 9100 series:

- AS/EN 9110 addresses maintenance, repair, and overhaul (MRO) organizations
- AS/EN 9120 addresses stockists and distributors of aerospace products
- AS/EN 9101 specifies requirements for aerospace auditors
- AS/EN 9102 establishes requirements for First Article Inspection
- AS/EN 9103 covers variation management of key characteristics
- AS/EN 9104 governs certification body requirements
- AS/EN 9145 addresses production part approval processes for aerospace [24,25]

The standard also interfaces with specialized accreditation programs. Nadcap, the industry-managed accreditation program for special processes such as heat treating, plating, and nondestructive testing, requires AS/EN 9100 certification as a prerequisite. Organizations performing special processes typically need both AS/EN 9100 for their management system and Nadcap accreditation for their specific process capabilities [26].

The standard is supported by the IAQG Certification Scheme and the OASIS database. When an organization achieves AS/EN 9100 certification through an accredited certification body, its certification status, scope, and audit results are recorded in OASIS, providing visibility to potential customers across the supply chain. The IAQG scheme is designed to ensure consistency in certification practices worldwide through its Industry Controlled Other Party (ICOP) program [27].

Common Misconceptions About AS/EN 9100

Several misconceptions about AS/EN 9100 persist in the aerospace industry, and they can undermine effective implementation if left uncorrected:

Misconception: AS/EN 9100 certification guarantees product quality. Reality: Certification confirms that an organization has implemented a quality

management system meeting the standard's requirements. It does not guarantee that every product the organization produces will be defect-free. Quality of individual products depends on execution, not just system certification [28].

Misconception: AS/EN 9100 is a government regulation or a legal requirement. Reality: AS/EN 9100 is a voluntary standard developed by industry, not by government. However, it is frequently specified as a contractual requirement by prime contractors and defense agencies, which makes it effectively mandatory for organizations seeking aerospace supply chain access. Aviation regulators support but do not directly mandate the standard [29].

Misconception: A small organization does not need AS/EN 9100 or can use a simplified version. Reality: The standard applies to organizations of all sizes. There is no scaled-down version for smaller companies. However, the standard explicitly requires processes to be appropriate to the organization's context and activities, meaning smaller organizations can implement proportionate controls without unnecessary bureaucracy [30].

Misconception: Writing procedures is the same as implementing the standard. Reality: Documentation alone does not constitute compliance. The standard requires organizations to implement procedures, follow them consistently, measure their effectiveness, and take corrective action when they do not work. Auditors evaluate implementation, not just paperwork [31].

Misconception: AS/EN 9100 is too complex and burdensome for practical use. Reality: While the standard is more demanding than generic quality standards, its requirements are designed to reflect actual aerospace industry needs. Organizations that implement it properly often find that it reduces confusion by standardizing expectations across customers and improves operational efficiency through better process discipline. Perceived complexity often comes from adding redundant bureaucracy rather than from the standard itself [32].

Misconception: Once certified, the work is done. Reality: Certification is valid for three years with annual surveillance audits, and maintaining compliance requires ongoing effort. The standard's continual improvement requirement means that organizations should be actively enhancing their system, not merely preserving it. Complacency is one of the most common causes of certification loss [33].

Understanding these misconceptions early helps organizations approach AS/EN 9100 implementation with realistic expectations and a focus on genuine

quality improvement rather than superficial compliance.

Chapter 2: Historical Evolution and Current Landscape

Early Aerospace Quality Practices and Lessons Learned

The story of AS/EN 9100 begins long before the standard itself, in the decades after World War II when aerospace manufacturing emerged as one of the most demanding and safety-critical industries in the world. Governments, particularly in the United States, established military specifications and inspection protocols to ensure that defense-related aerospace products met minimum quality levels. Standards such as MIL-Q-9858A for quality systems and MIL-I-45208A for inspection systems provided a framework, but they were prescriptive, process-heavy, and focused more on documentation than on actual quality outcomes [34].

Commercial aviation grew alongside military programs, and the major manufacturers developed their own internal quality standards. Boeing's D1-9000 program, for example, established comprehensive requirements for suppliers, including quality system audits, process controls, and documentation expectations. Airbus, Pratt and Whitney, Rolls-Royce, and other major primes created similar proprietary requirements. Each program had its own terminology, its own audit criteria, and its own forms. Suppliers who worked with multiple primes faced the burden of maintaining separate quality systems for each customer, which was expensive, confusing, and error-prone [35].

Quality incidents during this period reinforced the need for better systems. The 1996 crash of a Korean Air Boeing 767 in Guam, caused by maintenance errors stemming from unclear documentation and procedures, highlighted how failures in quality management could cascade into catastrophic outcomes. Similar incidents, including supply chain failures, counterfeit part introductions, and maintenance oversights, demonstrated that ad hoc or inconsistent quality practices were inadequate for an industry with such high stakes [36].

The aerospace industry recognized that a fragmented approach to quality was unsustainable. Multiple proprietary standards created inefficiency, con-

fusion, and gaps in coverage. A unified, internationally recognized quality standard was needed, one that could be adopted by all major primes and accepted across borders.

The Emergence of AS9000 and Industry Consolidation

The first major step toward standardization came in 1997 with the publication of AS9000, “Quality Systems - Aerospace - Model for Quality Assurance in Design, Development, Production, Installation and Servicing.” AS9000 was developed by the Society of Automotive Engineers (SAE) in the United States and represented an effort to consolidate the divergent quality requirements of major aerospace companies into a single, harmonized standard [37].

AS9000 was based on ASQ 9001:1994 (the American version of ISO 9001:1994) and added 55 aerospace-specific requirements covering areas such as product safety, process controls, supplier management, and inspection. It marked the beginning of a coordinated industry approach, and several major U.S. primes adopted AS9000 as their baseline requirement for suppliers, reducing the need for multiple proprietary standards [38].

At the same time, in Europe, the European Association of Aerospace Industries (later ASD-STAN) developed a parallel standard, prEN9000-1, which served a similar purpose for the European aerospace supply chain. These two efforts, running in parallel, recognized the same problems and sought similar solutions, setting the stage for eventual global harmonization.

During this period, the International Aerospace Quality Group (IAQG) emerged as the governing body for aerospace quality standards. Originally formed as the Aerospace Quality Steering Committee in the United States, the IAQG expanded into a tri-sector organization with representatives from the Americas, Europe, and Asia-Pacific. Its mission was to establish common quality standards, reduce redundant supplier requirements, and promote continuous improvement across the global aerospace supply chain [39].

The IAQG’s structure reflected the collaborative nature of the effort. Major aerospace manufacturers, government agencies such as NASA and the U.S. Department of Defense, and quality professionals from around the world participated in working groups that developed, reviewed, and maintained aerospace quality standards. This industry-led approach ensured that the standards remained practical and relevant to actual aerospace operations [40].

From AS9002 to AS 9100: The ISO 9001 Alignment

In 1999, the IAQG took the decisive step of creating a single, globally harmonized aerospace quality standard by merging AS9000 and prEN9000-1 into AS9100. This first version of AS9100 was published in October 1999 and represented the culmination of a multiyear effort to align requirements across regions and organizations [41].

AS9100 was based on ISO 9001:1994 and included all of its requirements plus additional aerospace-specific clauses. The standard retained the “AS” designation in the Americas, while the European sector published an equivalent version as EN9100. Japan’s aerospace sector soon adopted a corresponding version as SJAC9100 (later JISQ9100). The result was a single standard with a single set of requirements, published under different designations in different regions, fully harmonized by the IAQG [42].

AS9100’s initial release included 55 aerospace-specific requirements that addressed critical needs such as:

- Configuration management and control of changes
- Control of special processes (processes where output cannot be fully verified by inspection)
- Product safety considerations
- Supplier evaluation and control
- Marking, packaging, preservation, and delivery requirements specific to aerospace
- First article inspection requirements
- Control of nonconforming product with aerospace-specific disposition rules [43]

The standard was well received because it reduced complexity for suppliers, improved consistency across the supply chain, and raised the baseline for aerospace quality management. Many major primes adopted AS9100 as their minimum supplier requirement, effectively phasing out proprietary quality programs and streamlining supplier audits.

The next revision, AS9100A, was released in 2001 to align with the revised ISO 9001:2000 standard, which introduced the process approach and customer focus principles that remain central to quality management today. AS9100A

incorporated the ISO 9001:2000 changes while maintaining the aerospace-specific requirements [44].

AS9100B, released in 2004, was primarily an administrative revision to correct minor inconsistencies and editorial issues from previous versions. It did not introduce significant substantive changes but demonstrated the IAQG's commitment to maintaining and improving the standard [45].

The AS/EN 9100 Revision Cycle and Current Editions

The current edition of the standard, AS/EN 9100 Rev D, was released in September 2016. This revision marked a significant evolution from previous versions, both in its alignment with ISO 9001:2015 and in its expansion of aerospace-specific requirements to address emerging industry challenges [46].

Rev D adopted the Annex SL high-level structure that ISO introduced with ISO 9001:2015, creating a common framework for quality management standards that facilitates integration with other standards such as ISO 14001 for environmental management and ISO 45001 for occupational health and safety. The ten-clause structure of Annex SL (from Scope through Improvement) is now familiar to quality professionals worldwide, and AS/EN 9100 Rev D follows it exactly for the ISO-inherited clauses [47].

Beyond the structural changes, Rev D introduced several significant new requirements:

Product Safety as a dedicated clause (8.1.3): For the first time, product safety received explicit treatment as a standalone requirement, requiring organizations to identify and control product safety considerations throughout the entire product lifecycle. This change reflected growing awareness that aerospace quality management must address not only conformance to specifications but also the potential consequences of product failure [48].

Counterfeit Parts Prevention (8.1.4): The increasing incidence of counterfeit and suspect counterfeit parts in the aerospace supply chain led to the addition of a specific requirement for organizations to plan, implement, and control processes to prevent the use of counterfeit parts. This requirement applies to all supply chain tiers and covers both detection and prevention measures [49].

Human Factors consideration in corrective action (10.2.1): Rev D explicitly requires organizations to evaluate human factors as potential root causes

of nonconformities. This addition recognized that fatigue, distraction, poor ergonomics, inadequate training, communication errors, and other human performance issues contribute significantly to quality failures and that effective corrective action must address these factors rather than simply blaming individual workers [50].

Enhanced risk-based thinking: While risk management had been present in previous revisions, Rev D elevated it significantly, incorporating the risk-based thinking approach introduced in ISO 9001:2015 and adding specific operational risk requirements for product realization processes. The standard now requires organizations to proactively identify and manage risks at both the strategic and operational levels [51].

Ethics and awareness: The standard added requirements for awareness of ethical behavior within the organization and for training personnel on the importance of product safety and quality. This reflected industry recognition that ethical culture and individual responsibility are critical components of effective quality management in aerospace [52].

Enhanced supplier monitoring: Rev D strengthened supplier management requirements, mandating that organizations evaluate and monitor supplier performance based on objective criteria including quality and delivery performance, and maintain documented evidence of this monitoring [53].

The transition to Rev D was managed by the IAQG with a defined timeline. Organizations certified to previous revisions were required to transition by September 2018, with some flexibility granted for completion by the end of 2019 for organizations facing documented delays. Certification bodies that were not IAQG-accredited faced revocation of their aerospace certification authority if they did not comply with IAQG requirements by the same deadline [54].

Rev D remains the current certified version as of the time of this writing. It is built on ISO 9001:2015, and an amendment to ISO 9001 (AMD1:2024) regarding climate change considerations was incorporated into the standard's context and stakeholder requirements in February 2024 [55].

The International Aerospace Quality Group (IAQG) and Governance

Understanding AS/EN 9100 requires understanding the organization that governs it. The International Aerospace Quality Group (IAQG) is an international

non-profit association registered in Brussels under Belgian law, operating as a cooperative within the aviation, space, and defense industry [56].

The IAQG comprises three geographic sectors:

- The Americas sector, historically led by SAE International and including representatives from Boeing, Lockheed Martin, Pratt and Whitney, General Dynamics, Northrop Grumman, NASA, and the U.S. Department of Defense
- The European sector, coordinated through ASD-STAN and including Airbus, Rolls-Royce, MTU Aero Engines, Safran, and European defense organizations
- The Asia-Pacific sector, including representatives from Japan's aerospace industry, Chinese defense and aerospace organizations, and other Asian aerospace stakeholders [57]

The IAQG's governance structure is designed to balance industry representation with technical expertise. A steering committee provides overall direction, working groups develop and maintain specific standards, and sector committees ensure regional perspectives are represented. Standards development follows a consensus-based process, with drafts reviewed by all sectors before approval [58].

The IAQG does not act as a certification body or a regulator. It does not issue certifications, conduct audits, or enforce compliance. Instead, it performs the following functions:

- Develops and maintains the AS/EN 9100 series of standards through its working groups
- Operates the IAQG Certification Scheme (formerly known as the Aerospace Quality Management System Certification Scheme), which sets requirements for certification bodies that audit aerospace organizations
- Manages the Online Aerospace Supplier Information System (OASIS) database, which records certification status, audit results, and other relevant information for all certified organizations
- Develops guidance materials, training resources, and clarification documents to support implementation of aerospace quality standards
- Coordinates continuous improvement initiatives across the aerospace supply chain [59]

The IAQG's certification scheme is governed by AS/EN 9104 and related standards, which specify requirements for certification bodies, accreditation bodies, and auditors involved in aerospace quality certification. These requirements are more stringent than generic ISO 17021 requirements because of the critical nature of aerospace quality assurance [60].

Looking forward, the IAQG is overseeing a comprehensive revision of the 9100 series that will be published under the new "IA" prefix (IA9100, IA9110, IA9120). This rebranding is designed to better reflect the international character of the standards and to consolidate the naming under a single global identity. The revision is aligned with the upcoming ISO 9001:2026 update and is expected to be published in late 2026, with a transition window of two to three years for certified organizations [61,62].

The IAQG's governance model and its commitment to industry consensus, technical rigor, and global harmonization have been critical factors in the success and widespread adoption of AS/EN 9100 across the aerospace supply chain.

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Phase 5: Training, Competence, and Awareness

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