



AF 9100:2026

Aerospace Quality Management System

TECHNICAL PROFILE BOOK

Sustainability, Human Factors and Responsible Innovation — Technical Application Book

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Publication identity and application

Control	Publication value
Title	Sustainability, Human Factors and Responsible Innovation — Technical Application Book
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Use and document-control boundary

This companion implements the supplied AF 9100 requirement basis without changing the original standard. Its process allocation, examples, checklists and record design are authored implementation material. Actual mission or product limits, specialist procedures, permissions and genuine observations must be completed before consequential use. Applicable source minima and independent decision conditions cannot be reduced by this companion.

The printed edition date identifies the companion series; it is not evidence that later preparation, review or operational decisions occurred on that date. New support codes in this set are proposed allocations for controlled registration. Established AF-IG-9100-001, AF-FAQ-9100-001 and AF-TR-9100-001 identities are retained; earlier files, the corporate master list and ASTRA codes are not overwritten.

Equivalent combined or digital records are permitted when all required fields, relationships, authority and history remain intact. A completed PDF field or typed name is not evidence of an authenticated approval. Blank records in this delivery contain no invented applicant, signature, event or result.

Contents and reading route

Publication identity and application	2
Contents and reading route	3
1 Scope, responsibility and source priority	4
2 Technical profile and prospective parameter completion	4
3 Subject-by-subject implementation	4
4 Representative evaluation and adverse evidence	6
5 Interface records, decisions and continuing use	6
Appendix A — Controlling source and evidence	7
Source tables — complete field and decision payloads	10
Appendix B — Local implementation and release	11

Select actual scope → complete application criteria → use the applicable procedure and technical book → capture authentic evidence → evaluate every applicable condition → obtain the required independent decision. Document availability does not establish implementation or conformity.

1 Scope, responsibility and source priority

Lifecycle impacts and credible quantitative claims, resource recovery, human-system validation, worker interfaces and bounded emerging technology.

Boundary	Required implementation decision
Object and route	Identify ORG, PRD, SVC, PRC, PER, SUB or CAB separately. Combined records do not merge outcomes.
Activity	Apply source technical modules by performed or retained responsibility, including relevant outsourced work.
Authority	Technical release, employer task permission, independent attestation and statutory authorization remain distinct.
Source priority	AF 9100:2026 and all compatible binding obligations control. This companion does not import ASTRA programme rules or external normative schemes.

2 Technical profile and prospective parameter completion

Functional unit; lifecycle boundary; factor identity; allocation; uncertainty; user/task population; essential response; actual demonstration state

Parameter record	Content required before evaluating results
Identity and trigger	Stable criterion ID, source anchor, owner, actual object, phase, mode and reason it applies.
Limit or attribute	Value/range with compatible units and boundary convention, or an observable state with every essential step.
Technical basis	Actual environment, duty, consequence, derivation, qualified evidence and relevant approval.
Method and representation	Inspection, analysis, demonstration or test; method version, article/population, configuration and validity limits.
Uncertainty and decision	Corrections, model, covariance, coverage, pre-agreed rule, sample/scoring logic and hold conditions.
Authority and change	Technical and independent approvals, actual effectivity, preserved earlier basis and reopening triggers.

The fields above are completed for the actual application. A blank limit, undefined domain or unvalidated method prevents the dependent claim; the book deliberately does not invent one severity, tolerance or task threshold for unrelated applications.

3 Subject-by-subject implementation

20.1 — Lifecycle environmental responsibilities

Source p. 38; complete conditions reproduced in Appendix A.

Implementation record: Lifecycle aspect register; obligations; action plans; integrated change assessments.

Application check: Check material qualification, remaining life, contamination and protective consequences of repair, reuse or environmental improvement. A low-carbon claim does not establish technical interchangeability.

Review boundary: An omitted material category, failed essential human task or unqualified reused input blocks the related claim or release. Record each source condition separately in the linked checklist and preserve approved exclusions.

20.2 — Quantification and credible environmental claims

Source p. 38; complete conditions reproduced in Appendix A.

Implementation record: Inventory model; data sources; factors and editions; uncertainty; claim review and verification status.

Application check: Check material qualification, remaining life, contamination and protective consequences of repair, reuse or environmental improvement. A low-carbon claim does not establish technical interchangeability.

Review boundary: An omitted material category, failed essential human task or unqualified reused input blocks the related claim or release. Record each source condition separately in the linked checklist and preserve approved exclusions.

20.3 — Circularity, repair and responsible material recovery

Source p. 38; complete conditions reproduced in Appendix A.

Implementation record: Repair and recovery strategy; life-status controls; qualification of reused inputs; secure disposition records.

Application check: Check material qualification, remaining life, contamination and protective consequences of repair, reuse or environmental improvement. A low-carbon claim does not establish technical interchangeability.

Review boundary: An omitted material category, failed essential human task or unqualified reused input blocks the related claim or release. Record each source condition separately in the linked checklist and preserve approved exclusions.

20.4 — Human-system integration and ergonomics

Source p. 39; complete conditions reproduced in Appendix A.

Implementation record: Human-system requirements; representative evaluations; workload and error analyses; design decisions.

Application check: Check material qualification, remaining life, contamination and protective consequences of repair, reuse or environmental improvement. A low-carbon claim does not establish technical interchangeability.

Review boundary: An omitted material category, failed essential human task or unqualified reused input blocks the related claim or release. Record each source condition separately in the linked checklist and preserve approved exclusions.

20.5 — Worker competence, health and safe work interfaces

Source p. 39; complete conditions reproduced in Appendix A.

Implementation record: Work-risk interfaces; competence and contractor controls; incident learning; emergency arrangements.

Application check: Check material qualification, remaining life, contamination and protective consequences of repair, reuse or environmental improvement. A low-carbon claim does not establish technical interchangeability.

Review boundary: An omitted material category, failed essential human task or unqualified reused input blocks the related claim or release. Record each source condition separately in the linked checklist and preserve approved exclusions.

20.6 — Responsible innovation and future-technology review

Source p. 39; complete conditions reproduced in Appendix A.

Implementation record: Responsible-innovation review; evidence gap assessment; bounded-deployment plan; claim approval.

Application check: Check material qualification, remaining life, contamination and protective consequences of repair, reuse or environmental improvement. A low-carbon claim does not establish technical interchangeability.

Review boundary: An omitted material category, failed essential human task or unqualified reused input blocks the related claim or release. Record each source condition separately in the linked checklist and preserve approved exclusions.

4 Representative evaluation and adverse evidence

Environmental Claims, Human Factors and Responsible Innovation

Witness or trace: Use representative users, conditions, workload, access, language, alarms and errors. Identify essential protective tasks and demonstrate actual feasible intervention, not merely a warning or nominal approval button.

Synthetic challenge: A partial manufacturing inventory is advertised as the full lifecycle footprint. Correct the boundary and wording and add required use and end-of-life evidence before any full-lifecycle claim. Uncertainty arithmetic does not account for omitted stages.

Objectives, Opportunities and Improvement Portfolio

Witness or trace: Retain source population and configuration. Reconcile dashboards to actual records, including missing data and failed outcomes. Do not retrospectively change a denominator to meet the target.

Synthetic challenge: On-time delivery rises after overdue orders are removed from the report. Reinstate the due-order population and apply the prospective cancellation rule. Report the corrected result and investigate data governance rather than advertise an unsupported improvement.

5 Interface records, decisions and continuing use

Record	Required implementation purpose
AF-FR-9100-030	Environmental, Resource and Human-System Evidence
AF-FR-9100-027	Metrics, Reliability and Customer Performance
AF-FR-9100-014	Risk, Hazard, Criticality and Residual Decision

Qualification, instance acceptance, current operating capability and independent attestation retain separate evidence and decisions. A new site, material, supplier, digital load, use environment or duty requires a relevant difference and requalification review. No previous result transfers automatically because the name is unchanged.

Appendix A — Controlling source and evidence

Source: AF 9100:2026, Aerospace Quality Management System, FIRST EDITION, 29 September 2026; supplied 131-page PDF. Source page references below locate the original publication. These excerpts are read with the complete applicable standard; local implementation sequences do not replace it.

20.1 Lifecycle environmental responsibilities

SOURCE p. 38 | Normative when applicable

20.1(a) The organization shall identify environmental aspects and obligations relevant to its products, services and operations, including resource use, emissions, noise, hazardous substances, waste and end-of-life effects. The assessment shall consider the declared lifecycle boundary and significant upstream or downstream dependencies.

20.1(b) Environmental actions shall be integrated with safety, quality and mission requirements. A change intended to reduce environmental impact shall undergo technical assurance. The organization shall not trade an unassessed safety risk for a favorable environmental metric.

Required evidence: Lifecycle aspect register; obligations; action plans; integrated change assessments.

20.2 Quantification and credible environmental claims

SOURCE p. 38 | Normative when applicable

20.2(a) Quantified claims shall state functional unit, boundary, time period, activity data, factors, allocation, uncertainty and exclusions. Different scenarios shall be compared on a consistent basis. Avoided emissions, offsets and direct inventory reductions shall be reported separately.

20.2(b) Data quality and supplier information shall be assessed. Estimates shall be distinguished from measurements and independently verified claims from self-declarations. Annex U provides a synthetic calculation example; its factors are not prescribed real-world emission factors.

Required evidence: Inventory model; data sources; factors and editions; uncertainty; claim review and verification status.

20.3 Circularity, repair and responsible material recovery

SOURCE p. 38 | Normative when applicable

20.3(a) Design and support planning shall consider repairability, reusable resources, remanufacture and recovery where compatible with technical and legal obligations. Reused material or components shall retain sufficient identity, life status and suitability evidence.

20.3(b) Life-limited or safety-critical items shall not be returned to service solely because they pass a superficial inspection. End-of-life disposition shall prevent counterfeit re-entry and protect sensitive information. Claims of recyclability shall identify actual material streams and relevant limitations.

Required evidence: Repair and recovery strategy; life-status controls; qualification of reused inputs; secure disposition records.

20.4 Human-system integration and ergonomics

SOURCE p. 39 | Normative when applicable

20.4(a) The organization shall incorporate human capabilities, limitations and reasonably foreseeable behavior into design and validation. Interfaces shall consider workload, physical access, visibility, language, training, alarms, accessibility and error recovery.

20.4(b) Validation shall use representative users and relevant operating conditions where practicable. The organization shall identify limitations of simulation or non-representative participants. A warning label shall not be the sole mitigation when a feasible design control is necessary to address a serious hazard.

Required evidence: Human-system requirements; representative evaluations; workload and error analyses; design decisions.

20.5 Worker competence, health and safe work interfaces

SOURCE p. 39 | Normative when applicable

20.5(a) The organization shall identify work-related hazards that can affect people or conformity, including fatigue, exposure, access, lifting, hazardous energy and emergency conditions. Applicable workplace obligations shall be identified and addressed through competent arrangements.

20.5(b) Contractors and temporary personnel shall be included in relevant communication and controls. Quality investigations shall consider whether work design or unsafe conditions contributed to the event. This standard does not replace a complete occupational health and safety management framework where one is required.

Required evidence: Work-risk interfaces; competence and contractor controls; incident learning; emergency arrangements.

20.6 Responsible innovation and future-technology review

SOURCE p. 39 | Normative when applicable

20.6(a) Before deployment of materially novel technology, the organization shall examine intended benefit, foreseeable harm, distribution of consequences, security, misuse, human authority and evidence gaps. The review shall include relevant technical and non-technical expertise without replacing required legal decisions.

20.6(b) Claims about future capability shall distinguish demonstration, planned development and validated operational performance. Experimental deployments shall be bounded, monitored and reversible where possible. An experimental designation shall not remove obligations to protect affected people and systems.

Required evidence: Responsible-innovation review; evidence gap assessment; bounded-deployment plan; claim approval.

U.1 Boundary and functional unit

SOURCE p. 85 | Definition, explanation or informative example; no new universal limit

U.1(a) The example concerns 1,000 manufactured assemblies in one reporting period. The illustrative boundary includes purchased electricity, a fuel input, a material input and inbound transport. It excludes product use and end-of-life. Consequently the result is a partial production inventory, not a complete product lifecycle footprint.

U.1(b) Before a real comparison, specify the functional unit, system boundary, time and geography, allocation, data quality and excluded activities. An aircraft, vehicle or spacecraft should not be compared with another merely per unit when their useful functions, capacity or service life differ.

Source calculation note: $(U-1) E_{total} = \sum A_i EF_i$; intensity = $E_{total} / \text{functional output}$ A_i is the activity quantity and EF_i is the factor with compatible units. State whether factors include upstream effects and prevent double counting between categories. Figure U-1 — Contributions to the synthetic partial inventory. The illustrative factors and boundary do not support a real environmental claim.

U.2 Uncertainty propagation example

SOURCE p. 85 | Definition, explanation or informative example; no new universal limit

U.2(a) Assume independent relative standard uncertainties of 10%, 8%, 20% and 15% for the four category totals. Their absolute standard uncertainties are 4,200, 1,200, 7,200 and 810 kg CO₂e. Root-sum-of-squares gives 8460.266 kg CO₂e, about 8.598% of the total.

U.2(b) Under suitable distribution assumptions, an illustrative $k=2$ expanded uncertainty is about 16,920.532 kg CO₂e. Shared factors and common measurement sources could create correlation and change the result. Uncertainty does not account for an omitted major lifecycle stage; boundary incompleteness is a separate limitation.

U.3 Improvement scenario and honest comparison

SOURCE p. 85 | Definition, explanation or informative example; no new universal limit

U.3(a) Assume electricity use falls from 120,000 to 108,000 kWh while output, boundary and all assumed factors remain unchanged. The calculated reduction is $12,000 \times 0.35 = 4,200$ kg CO₂e, or 4.2683% of the original partial inventory. New total intensity is 94.2 kg CO₂e per assembly.

U.3(b) This scenario is an arithmetic sensitivity, not an achieved improvement. A real claim would require measured comparable activity, consideration of production mix, uncertainty, leakage outside the boundary and any effect on product quality. Offsets and avoided emissions should not be subtracted invisibly from this inventory.

U.4 Resource efficiency and circularity measures

SOURCE p. 86 | Definition, explanation or informative example; no new universal limit

U.4(a) Useful measures include material yield, energy per functional output, scrap recovery, repair success and verified reuse. Definitions should state whether rework, purchased semifinished material, internal recycling and rejected output are included.

U.4(b) An increase in recycled content should be assessed alongside qualification, contamination, service life and process energy. Circularity percentages do not establish that a safety-critical reused component has valid life or provenance. Technical suitability and environmental benefit require separate evidence.

Source tables — complete field and decision payloads

Table U-1 — Synthetic inventory calculation

Source p. 85 | Illustrative or explanatory source table

Input	Activity	Assumed factor	Calculated result
Electricity	120,000 kWh	0.35 kg CO ₂ e/kWh	42,000 kg CO ₂ e
Fuel	6,000 L	2.50 kg CO ₂ e/L	15,000 kg CO ₂ e
Material	20,000 kg	1.80 kg CO ₂ e/kg	36,000 kg CO ₂ e
Transport	45,000 tonne-km	0.12 kg CO ₂ e/tonne-km	5,400 kg CO ₂ e
Total for stated boundary	1,000 assemblies	No offset or avoided-emission deduction	98,400 kg CO ₂ e
Intensity for stated boundary	Per assembly	98,400 / 1,000	98.4 kg CO ₂ e per assembly

Appendix B — Local implementation and release

Readiness condition	Evidence before consequential use
Authority and responsibility	Actual legal operator, owner, competent technical authority, independent reviewer and permitted result class are recorded.
Scope and criteria	Object, configuration, site, period, trigger, every technical value or observable attribute, units and prospective approval are complete.
Evidence and methods	Original accessible evidence, representative observations, valid methods, uncertainty, adverse cases and limitations support the intended conclusion.
People and independence	Competence is current for each task; genuine conflicts, relevant prior work and needed separation have been checked.
Records and tools	Field meanings, unique IDs, original history, access, retention, recovery and actual deployed workflows have passed local validation.
Decision and public use	All relevant blockers are resolved; required independent decision and written permissions precede the exact public claim.
Continuity and handover	Receiving custody, unresolved duties, corrections and historical decisions survive transfer, retirement or provider closure.

Record the completed local readiness and actual authorization in AF-FR-9100-032 or an equivalent controlled record. Preserve the unchanged source standard and each earlier decision basis. A blocked activity may continue only within a genuinely permitted development boundary, not as a provisional conformity certificate.