



AF 9100:2026

Aerospace Quality Management System

FORM

Calibration, Method Validity and Uncertainty Budget

AF-FR-9100-018

FIRST EDITION

30 September 2026 | English master text

Publication identity and application

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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.

Interactive fields are blank by default. Save a working copy, use continuation records where necessary and preserve raw supporting evidence outside the PDF through controlled references. Separate issued PDFs are the authoritative interactive copies; the combined reading edition is flattened.

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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 Purpose, source identity and completion rules

This additional implementation form organizes the detailed record needs of the identified AF 9100 provisions. It supplements the twelve source form modules without renumbering them or creating a new assessment route.

Complete the applicable fields with authentic information. Record unknown, unavailable and not-yet-demonstrated conditions explicitly. An exclusion needs an approved applicability rationale. Use linked continuation records for multiple items, sources, tests, people or decisions. Keep source attachments under controlled custody; do not rely on this PDF alone where raw evidence is required.

2 Common identity and record control

Record ID and continuation link

Template/code and controlled version

Case/applicant/asset identity

Route, scope and application profile

Object configuration and relevant period

Actual creation/event time and time zone

Author and role

Reviewer and approval responsibility

Current state and original history

Original evidence and source location

Access classification and permitted recipients

Retention basis, duration and preservation hold**Correction: original value, reason, author and approval****Authenticated approval/workflow reference (typed name is not a signature)**

3 Form-specific evidence and decisions

Method/measurand/range

Object and conditions

Equipment identity/status

Reference chain and uncertainty

Known corrections

Validation criteria fixed in advance

Representative specimens and challenging cases

Bias/precision/detection/robustness

Raw data and processing

Uncertainty components and distributions

Sensitivity/covariance

Coverage interpretation

Decision suitability

Failed comparisons**Previous-output impact****Method approval and revalidation**

4 Detailed continuation record

Use this section for each additional independently testable condition or actual event. A form-level summary cannot remove a required field, earlier failed result or unresolved item.

Parent form and continuation/item ID

Exact object / configuration / performer / event time

Source requirement / approved profile / condition

Numeric criterion with units or observable attribute

Method / validity / uncertainty / essential step

Original evidence and actual result

Conclusion and limitations / rejected or contrary evidence

Required protection / action / responsible owner / actual due event

Reviewer / approval reference / receiving acknowledgement

5 Completeness and receiving review

Check	Required review
Identity and scope	Every record belongs to the actual object, evaluated configuration and relevant period.
Evidence and validity	Required original data, method, actual results and limitations are traceable.
Decision separation	Technical disposition, independent attestation, employer task authority and public permission are not merged.
History and time	Earlier failed states and original notification clocks are preserved; no manufactured observations.
Approval and custody	Actual competent authority and receiving responsibility are established; typed names are not authenticated signatures.

Actual reviewer / conclusion / unresolved items

Authenticated approval instrument or workflow reference

Receiving custodian / access / retention / accepted residual duties

Appendix A — Source requirements and complete field payload

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.

7.6 Measuring equipment and metrological traceability

SOURCE p. 18 | Normative when applicable

7.6(a) Measurement systems used to demonstrate conformity shall be suitable for the measurand, range, environment and decision risk. The organization shall maintain a register containing equipment identity, location, owner, range, calibration or verification method, interval, status and acceptance criteria.

7.6(b) Where traceability is required or necessary for confidence, calibration shall be linked through a documented chain to appropriate measurement references. Where an established reference does not exist, the technical basis of verification shall be documented. Equipment shall be protected from unauthorized adjustment and damage.

7.6(c) Out-of-tolerance, damaged, overdue or otherwise unsuitable equipment shall be removed or restricted from use. The organization shall assess the validity of prior results and trace affected outputs. An equipment recalibration certificate shall not, by itself, resolve the product disposition.

Required evidence: Equipment register; calibration chain; recall system; uncertainty suitability; impact and disposition records.

7.7 Measurement methods, uncertainty and decision rules

SOURCE p. 18 | Normative when applicable

7.7(a) Test and inspection methods shall be validated or verified as appropriate for their intended use. The organization shall establish an uncertainty model and decision rule where measurement uncertainty can affect conformity. Personnel shall understand the distinction between specification limits, instrument resolution, uncertainty and process-control limits.

7.7(b) Automated inspection, machine vision and in-process probing shall be evaluated against representative defects, surfaces, geometries and environmental conditions. False acceptance and false rejection shall be considered. Revalidation shall follow material changes to optics, algorithms, fixtures, software or decision thresholds.

7.7(c) Annex AD shall govern conformity decisions relying on measurement uncertainty. The informative examples in Annex H shall not be used to select favorable acceptance criteria after results become known. The decision rule and treatment of an indeterminate result shall be fixed before evaluation.

Required evidence: Method-validation records; uncertainty budgets; decision rules; automated inspection challenge results.

H.1 Measurement model and components

SOURCE p. 65 | Definition, explanation or informative example; no new universal limit

H.1(a) Consider a corrected measurement y with four independent standard-uncertainty components expressed in millimetres. Known significant systematic effects have already been corrected; the remaining uncertainty of each correction is included. Standard uncertainty is not the same quantity as a known measurement error.

H.1(b) For a general model $y=f(x_1, \dots, x_m)$, use sensitivity coefficients $c_i=\partial f/\partial x_i$ and include covariance terms. The simplified root-sum-of-squares expression is appropriate only when the linear approximation and independence assumptions are suitable.

Source calculation note: $(H-1) u_c^2(y) = \sum c_i^2 u_i^2 + 2\sum(i < j) c_i c_j \text{cov}(x_i, x_j)$ For the additive independent example, all $c_i=1$ and covariance terms are zero. Units remain mm^2 before the square root.

H.2 Calculated combined and expanded uncertainty

SOURCE p. 65 | Definition, explanation or informative example; no new universal limit

H.2(a) The independent-component result is $u_c=\sqrt{0.0012^2+0.0015^2+0.0010^2+0.0005^2}=0.00222261 \text{ mm}$. With illustrative coverage factor $k=2$, expanded uncertainty $U=0.00444522 \text{ mm}$.

H.2(b) The coverage factor must be justified for the distribution, effective information and required coverage. $k=2$ is approximately 95% coverage under suitable normal/large-information conditions; it is not an exact universal 95% confidence rule. For limited degrees of freedom or nonlinear models, use an appropriate alternative analysis.

Source calculation note: (H-2) $U = k u_c$ Report the measurement, units, expanded uncertainty, coverage factor, basis of coverage and decision rule. Rounding must not make the stated uncertainty appear smaller than justified.

H.3 Guard-band example

SOURCE p. 65 | Definition, explanation or informative example; no new universal limit

H.3(a) For specification interval [49.970, 50.030] mm, an illustrative conservative acceptance rule requires $y - U \geq LSL$ and $y + U \leq USL$. The resulting acceptance interval for y is [49.97444522, 50.02555478] mm.

H.3(b) A corrected result of 50.0240 mm has its full stated interval inside specification and passes this particular rule. A result of 50.0280 mm is inside the nominal specification but its uncertainty interval extends beyond the upper limit; conformity is not demonstrated under this rule and the item is held for disposition. This does not prove the item is physically nonconforming.

Source calculation note: (H-3) Accept only if $LSL + U \leq y \leq USL - U$ This is one pre-agreed decision rule, not a universal requirement. A different rule must identify and justify its treatment of false- acceptance and false-rejection risk. Figure H-1 — Two synthetic measurement results with expanded-uncertainty intervals. Dashed specification limits and the narrower acceptance interval illustrate why nominal in-limit results can require further disposition.

H.4 Correlation sensitivity

SOURCE p. 66 | Definition, explanation or informative example; no new universal limit

H.4(a) If the calibration and temperature components have correlation coefficient 0.5, their covariance is $0.5 \times 0.0012 \times 0.0010 \text{ mm}^2$. Adding twice this covariance gives $u_c = 0.00247790 \text{ mm}$, larger than the independent result.

H.4(b) The example shows why shared reference or environmental influences should not be ignored. Correlation should be based on a defensible model or study, not selected to obtain a favorable uncertainty. Sensitivity analysis is useful where the dependence is poorly known.

H.5 Decision-rule report content

SOURCE p. 66 | Definition, explanation or informative example; no new universal limit

H.5(a) A report should identify the measurand, method, corrected result, uncertainty budget, significant assumptions, coverage factor, specification, chosen decision rule and resulting disposition. The rule should be agreed before results are evaluated.

H.5(b) When a decision is indeterminate under the chosen rule, available responses include a better measurement, additional relevant evidence or an authorized technical disposition. Repeated measurement until one reading passes is not a valid resolution unless a predefined statistical method controls that practice.

AH.4 Test and calibration method validity

SOURCE p. 123 | Normative when applicable

AH.4(a) The laboratory shall select methods suitable for the actual measurand, item, range, environment and decision. A new or materially modified method shall be validated; an established method shall be verified for the laboratory's actual implementation. Performance characteristics shall address bias, precision, selectivity, range, detection capability and robustness where relevant.

AH.4(b) Measurement traceability shall use an appropriate documented chain of calibrations, reference materials or other justified references with their uncertainty contributions. Equipment shall be identified, maintained and verified after relevant change. An expired calibration or unsuitable range shall trigger assessment of affected previous results, not only a new calibration.

AH.4(c) Uncertainty shall be evaluated to the extent needed for the report and intended decision. Sampling contributions shall be addressed when sampling belongs to the laboratory's responsibility. Tests reporting qualitative outcomes shall still evaluate the relevant capability to distinguish conditions and avoid false conclusions.

Required evidence: Method validation/verification; measurement traceability; equipment status; uncertainty and detection capability; previous-result impact reviews.

Source tables — complete field and decision payloads

Table H-1 — Synthetic uncertainty budget

Source p. 65 | Illustrative or explanatory source table

Component	Standard uncertainty, mm	Basis and treatment
Calibration correction	0.0012	Assumed standard uncertainty after applying the correction.
Repeatability of reported result	0.0015	Assumed applicable to the actual reported result, not automatically divided by sample size.
Temperature correction	0.0010	Residual standard uncertainty after compensation.
Resolution / quantization	0.0005	Assumed already converted from its distribution to standard uncertainty.