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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.

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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 Numerical use, validity and interpretation

This report independently recalculates the source's synthetic examples and explains their decision boundaries. Values are educational, not mission inputs, statutory thresholds or qualification limits. Every actual acceptance calculation requires its own verified inputs, physical model, units, uncertainty, source profile and responsible approval.

Numerical labels Q01-Q25 organize this companion; they do not replace equation identifiers in the unchanged source. The calculations separate evidence validity from conformity and planning metrics from actual release. The internal production checks below are computational checks, not completed laboratory or field validation.

Topic	Method
Q01	Measurement model and combined uncertainty
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2 Detailed worked calculations

Q01 — Measurement model and combined uncertainty

Source anchors: 7.7; H.1-H.2; AD.2

Combine justified uncertainty contributions for the actual reported result.

Calculation element	Controlled method and interpretation
Equation	$u_c^2 = \sum(c_i^2 u_i^2) + 2 \sum(i < j)(c_i c_j \text{cov}(x_i, x_j))$; $U = k u_c$
Variables and units	u_i : standard uncertainties; c_i : sensitivity coefficients; covariance units follow the input quantities; k : justified coverage factor.
Worked synthetic values	For additive independent standard components 0.0012, 0.0015, 0.0010 and 0.0005 mm, $u_c=0.0022226111$ mm. At illustrative $k=2$, $U=0.0044452222$ mm.
Assumptions and validity	Linear approximation and covariance model must be suitable. Correct known significant effects first. $k=2$ is not an exact universal coverage statement.
Decision boundary	Accept the calculation only after model, inputs and intended rule are reviewed. This calculation alone does not accept the item.
Adverse checks	Reject negative/non-finite uncertainty; challenge copied uncertainty from another method and inappropriate division by sample size.

Q02 — Correlation sensitivity

Source anchors: H.4; 7.7

Expose reliance on shared references rather than assume independence.

Calculation element	Controlled method and interpretation
Equation	$\text{cov}(x_i, x_j) = \rho u_i u_j$; $u_{c, \text{corr}} = \sqrt{u_{c, \text{ind}}^2 + 2 \rho u_i u_j}$
Variables and units	ρ : supported correlation; all terms must refer to the same result model.
Worked synthetic values	With $\rho=0.5$ between the 0.0012 and 0.0010 mm components, $u_c=0.0024779023$ mm; the independent result was 0.0022226111 mm.
Assumptions and validity	Do not select correlation to minimize reported uncertainty. Input covariance must be physically justified and mathematically valid.
Decision boundary	Unresolved consequential dependence requires a bounded analysis or more evidence, not an unexplained zero covariance.
Adverse checks	Compare positive and negative plausible dependence and ensure the complete covariance matrix is valid.

Q03 — DR-A interval decisions and exact equality

Source anchors: AD.2-AD.6; H.3

Classify conformity, proven nonconformity and unresolved overlap using valid evidence.

Calculation element	Controlled method and interpretation
Equation	$a=y-U$; $b=y+U$. PASS: $a \geq L$ AND $b \leq H$. FAIL: $b < L$ OR $a > H$. Otherwise HOLD.
Variables and units	L, H : inclusive limits in the same units as corrected result y ; U : non-negative justified expanded uncertainty. For asymmetric coverage use actual endpoints.

Calculation element	Controlled method and interpretation
Worked synthetic values	Using illustrative $L=49.970$ mm, $H=50.030$ mm and explicitly rounded $U=0.00444522$ mm: $y=50.024 \rightarrow$ PASS; $50.028 \rightarrow$ HOLD; $50.036 \rightarrow$ FAIL; $50.02555478 \rightarrow$ PASS at exact upper equality; $50.02555479 \rightarrow$ HOLD.
Assumptions and validity	This example fixes its decimal U explicitly; an actual calculation uses the retained unrounded uncertainty. Do not use a numeric closeness tolerance to move a real result inside a limit.
Decision boundary	HOLD does not prove a physical defect. Rule selection and alternative approval follow AD; it is not acceptable to change rules after seeing a failure.
Adverse checks	Negative uncertainty, reversed limits, missing or non-finite input all produce HOLD; a zero uncertainty still requires a valid technical basis.

Q04 — Dependence and common-cause reasoning

Source anchors: E.3-E.4; 6.1; 11.5

Check whether a favorable redundancy result depends on unsupported independence.

Calculation element	Controlled method and interpretation
Equation	$P(A \text{ union } B) = P(A) + P(B) - P(A \text{ intersection } B)$. Illustrative combined loss $= q + (1-q)p_A p_B$.
Variables and units	All probabilities use the same exposure. In the common-cause example, p_A and p_B are conditional on no common-cause event.
Worked synthetic values	Independent marginals 0.002 and 0.003 give union 0.004994 and intersection 0.000006. With $q=0.001$ and conditional independent channel probabilities 0.002 and 0.003, total loss is 0.001005994.
Assumptions and validity	The second model is a separate synthetic conditional construction, not a consequence of the first marginals. Shared software, power or environment may invalidate independent multiplication.
Decision boundary	Require evidence for common causes and conditional assumptions before using the numerical claim.
Adverse checks	Challenge a backup relying on the same unassessed service and a multiplication performed on incomparable time windows.

Q05 — Exponential mission reliability

Source anchors: F.1; 11.4

Calculate a point prediction under a constant-rate model.

Calculation element	Controlled method and interpretation
Equation	$R(t) = \exp(-\lambda t)$; $\theta = 1/\lambda$
Variables and units	λ : constant failure rate in h^{-1} ; t : compatible operating time in h ; θ : mean life under the applicable model.
Worked synthetic values	For assumed $\lambda = 0.00002 \text{ h}^{-1}$, $R(1000) = 0.9801986733$ and $R(5000) = 0.9048374180$.
Assumptions and validity	Does not model wear-out, changing stress, systematic software defects or repair effects unless separately justified. Prediction is not a confidence bound.
Decision boundary	Compare only with a prospectively defined mission and acceptance basis; no universal reliability target is prescribed.
Adverse checks	Challenge time-unit mismatch, changing duty, unmodeled degradation and a claim that a positive prediction proves safe operation.

Q06 — Series and active-parallel architecture

Source anchors: F.2; 11.4

Calculate a defined system success event from supported component models.

Calculation element	Controlled method and interpretation
Equation	$R_{\text{series}} = \text{product}(R_i); R_{\text{parallel}} = 1 - \text{product}(1 - R_i)$
Variables and units	R_i : probability of the defined component mission success over common conditions and duration.
Worked synthetic values	Series 0.990, 0.995 and 0.998 gives 0.9830799. Two active parallel elements each 0.98 give 0.9996 when either alone is sufficient.
Assumptions and validity	Independence, sufficiency, switching/load effects and harmful interactions must be justified. Do not count a shared resource as two independent paths.
Decision boundary	Unknown common dependencies prevent an unqualified architecture reliability claim.
Adverse checks	Remove an assumed perfect switch or introduce shared power loss and evaluate the changed system model.

Q07 — All-success binomial demonstration

Source anchors: F.3; F-1

Plan independent representative trials for a specified lower confidence bound.

Calculation element	Controlled method and interpretation
Equation	$n = \text{ceil}(\ln(\alpha) / \ln(R_0)); R_L = \alpha^{(1/n)}$
Variables and units	$0 < \alpha < 1$; confidence = $1 - \alpha$; $0 < R_0 < 1$; n is a positive integer of all-success independent trials.
Worked synthetic values	At 95% confidence the illustrative targets 0.90, 0.95, 0.99, 0.999 and 0.9999 need 29, 59, 299, 2995 and 29956 all-success trials. For 300 successes, $R_L = 0.9900639181$.
Assumptions and validity	Trials must be independent, representative and identically distributed under the chosen model. Repeating the same dependent observation does not create new independent information.
Decision boundary	The bound must meet the pre-approved claim; no small failure-free test set proves zero risk.
Adverse checks	Reject $R_0 = 1$ or α outside (0,1); preserve failed attempts and changed configurations.

Q08 — No failures during accumulated exposure

Source anchors: F.4

Bound a constant failure rate from valid exposure with no observed failures.

Calculation element	Controlled method and interpretation
Equation	$\lambda_{\text{U}} = -\ln(\alpha) / T; \theta_{\text{L}} = T / (-\ln(\alpha))$
Variables and units	T : positive total valid item-hours; α : one-sided tail probability; all pooled exposure uses a justified common rate model.
Worked synthetic values	$T = 60000$ item-hours and 95% confidence give $\lambda_{\text{U}} = 4.992887123 \times 10^{-5} \text{ h}^{-1}$ and $\theta_{\text{L}} = 20028.492042 \text{ h}$.
Assumptions and validity	Parallel testing reduces elapsed test calendar, not the required exposure. Total item-hours do not establish one item's wear-out life.

Calculation element	Controlled method and interpretation
Decision boundary	Check censoring, interruptions and mechanism consistency before accepting the rate bound.
Adverse checks	Reject zero exposure; challenge mixing incompatible versions or deleting exposure and failures selectively.

Q09 — Exposure with observed failures

Source anchors: F.5

Compute a one-sided upper rate bound for a fixed-time Poisson/HPP model.

Calculation element	Controlled method and interpretation
Equation	$\lambda_U = \chi^2_{\text{quantile}(1-\alpha, 2r+2)} / (2T)$
Variables and units	r: non-negative integer failure count; T: valid exposure; quantile is the lower-tail probability quantile, not an upper-tail table label.
Worked synthetic values	For r=3 failures, T=100000 h and 95% confidence: $\lambda_U = 7.753656528e-05 \text{ h}^{-1}$; reciprocal lower mean interval=12897.140806 h.
Assumptions and validity	A changed rate, reliability growth, redesign or unreported repair may require another model. Define the failure and stopping rules before testing.
Decision boundary	Accept only within a validated rate and sampling basis; the interval is not a service-life authorization.
Adverse checks	Challenge a non-integer failure count, undocumented censoring and an upper-tail/lower-tail quantile mix-up.

Q10 — Weibull reliability and B10 life

Source anchors: F.6

Explain a parametric life-distribution calculation without inventing fitted performance.

Calculation element	Controlled method and interpretation
Equation	$R(t) = \exp(-(t/\eta)^\beta)$; $B_p = \eta[-\ln(1-p)]^{1/\beta}$
Variables and units	$\eta > 0$: time scale; $\beta > 0$: dimensionless shape; $0 < p < 1$: cumulative failed fraction. This is a zero-location two-parameter model.
Worked synthetic values	For assumed $\beta = 1.5$ and $\eta = 10000 \text{ h}$, $R(5000 \text{ h}) = 0.7021885013$ and $B_{10} = 2230.755256 \text{ h}$.
Assumptions and validity	Parameters are assumed here, not estimated. Real inference must address censoring, mechanism, representativeness and uncertainty; accelerated extrapolation requires a valid relationship.
Decision boundary	A B10 point estimate alone does not authorize a life limit or extension.
Adverse checks	Challenge unsupported acceleration, absence of confidence treatment and life resets after repair.

Q11 — Availability and restoration boundaries

Source anchors: F.7; O.4; 24.4

Distinguish intrinsic model availability, observed service availability and restored evidence integrity.

Calculation element	Controlled method and interpretation
Equation	$A_i = \text{MTBF} / (\text{MTBF} + \text{MTTR}); A_o = \text{uptime} / (\text{uptime} + \text{downtime})$
Variables and units	Use compatible time units and non-zero total exposure. Define included logistics, administration, scheduled maintenance and external outages.
Worked synthetic values	MTBF=1200 h and active repair=6 h give 99.50248756% intrinsic availability. Observed 960 h available and 40 h unavailable give 96% under a different boundary. A 3.2 h restoration with 45-minute data age meets assumed 4 h/1 h time objectives but not a failed integrity check.
Assumptions and validity	Different downtime boundaries explain the different percentages. Availability does not measure correctness or safety while available.
Decision boundary	Require separate correctness, configuration and relationship checks before assured return.
Adverse checks	Reject a zero observation window and challenge a restored server with missing required records.

Q12 — Rational-subgroup control charts

Source anchors: G.1-G.2; 25.3

Calculate fixed baseline monitoring limits from the source's printed synthetic data.

Calculation element	Controlled method and interpretation
Equation	$s_{\text{within}} = R_{\text{bar}} / d_2$; $X_{\text{bar limits}} = \bar{X}_{\text{doublebar}} \pm A_2 R_{\text{bar}}$; $R_{\text{limits}} = D_3 R_{\text{bar}}, D_4 R_{\text{bar}}$
Variables and units	For subgroup size five only: $d_2=2.326$; $A_2=0.577$; $D_3=0$; $D_4=2.115$. Baseline is 25 subgroups of five.
Worked synthetic values	Recalculation of the 125 printed observations gives mean=50.00215328 mm, $R_{\text{bar}}=0.01354600$ mm, $s_{\text{within}}=0.0058237317$ mm, $X_{\text{bar limits}}$ [49.99433724, 50.00996932] mm and $R_{\text{upper}}=0.02864979$ mm.
Assumptions and validity	Limits describe process behavior, not product requirements. Subsequent monitoring groups do not redefine the baseline to hide a shift.
Decision boundary	Investigate instability and measurement validity before relying on capability or releasing affected production.
Adverse checks	Challenge using $n=5$ constants for another subgroup size and including post-shift samples in the original baseline.

Q13 — Capability versus overall performance

Source anchors: G.3; 25.3

Compare explicitly defined within-subgroup and overall estimators.

Calculation element	Controlled method and interpretation
Equation	$C_p = (\text{USL} - \text{LSL}) / (6s_{\text{within}})$; $C_{pk} = \min((\text{USL} - \text{mean}) / (3s_{\text{within}}), (\text{mean} - \text{LSL}) / (3s_{\text{within}}))$; P_p / P_{pk} use s_{overall} .
Variables and units	$\text{LSL}=49.970$ mm and $\text{USL}=50.030$ mm are synthetic specifications. Overall standard deviation uses $n-1$.
Worked synthetic values	Using the source's printed baseline: $C_p=1.71711206$, $C_{pk}=1.59386463$, $s_{\text{overall}}=0.0060316566$ mm, $P_p=1.65791931$, $P_{pk}=1.53892049$. Minor final-digit differences from displayed source values can follow rounding.
Assumptions and validity	Model, stable sampling, rational grouping and measurement capability must support interpretation. A normal fit is not proof of normality.

Calculation element	Controlled method and interpretation
Decision boundary	The actual profile sets required capability and confidence; no 1.33 or 1.67 threshold is prescribed here.
Adverse checks	Challenge pooling different products, data dependence, low sample size and a shifted process whose historical Cpk looked favorable.

Q14 — Measurement-variation component example

Source anchors: G.6

Combine two independent variation components without presenting the result as a complete gauge study.

Calculation element	Controlled method and interpretation
Equation	$s_{\text{gauge}} = \sqrt{s_{\text{repeat}}^2 + s_{\text{reproduce}}^2}$; $\text{ratio} = s_{\text{gauge}} / s_{\text{total}}$
Variables and units	Standard deviations refer to compatible study quantities; independence is an explicit assumption.
Worked synthetic values	0.0015 and 0.0010 mm combine to 0.0018027756 mm. Against 0.0060 mm observed total variation the ratio is 30.046261%.
Assumptions and validity	This is not a full crossed or nested gauge study. Parts, operators, interactions, design and uncertainty require actual evaluation.
Decision boundary	No universal acceptance percentage is inferred; decide fitness for the intended measurement.
Adverse checks	Challenge a missing interaction term and confusion of standard-deviation ratio with variance contribution.

Q15 — Binomial sampling and operating characteristics

Source anchors: I.1-I.2; AD.6

Describe the acceptance behavior of a pre-approved lot plan.

Calculation element	Controlled method and interpretation
Equation	$P_{\text{accept}}(p) = \sum_{k=0..c} \binom{n}{k} p^k (1-p)^{(n-k)}$; $\text{producer risk} = 1 - P_{\text{accept}}(p_A)$; $\text{consumer risk} = P_{\text{accept}}(p_L)$
Variables and units	n: positive sample size; $0 \leq c \leq n$ integer acceptance count; p: defective fraction under independent homogeneous Bernoulli model.
Worked synthetic values	For $n=105, c=2$: producer risk at $p_A=0.005$ is 1.60531611% and consumer risk at $p_L=0.05$ is 9.91872625%. These meet the synthetic 5%/10% constraints. $n=80, c=0$ rejects about 33.0352% of lots at $p=0.005$.
Assumptions and validity	Random representative selection, lot integrity and valid inspection classification are assumed. A plan's OC is not an estimate of a particular lot's actual defect count.
Decision boundary	Known defective units still require disposition; critical-characteristic obligations are not waived by the lot rule.
Adverse checks	Challenge repeated resampling until pass, mixed lots and false-negative inspection.

Q16 — Finite-lot sampling without replacement

Source anchors: I.3

Use the finite-population model where its conditions apply.

Calculation element	Controlled method and interpretation
Equation	$P_{\text{accept}} = \sum_{k=0..c} \text{choose}(D, k) \text{choose}(N-D, n-k) / \text{choose}(N, n)$
Variables and units	N: lot size; D: hypothetical defective items; n: sample size; c: acceptance number. Impossible combinations contribute zero.
Worked synthetic values	For N=1000, n=105, c=2, hypothetical D=50 gives 0.0869621588; D=5 gives 0.9903796061.
Assumptions and validity	These describe plan behavior at hypothetical lot states; D is not discovered from acceptance. Without-replacement sampling differs from the binomial approximation.
Decision boundary	Use the approved prospective model and do not substitute an approximation without assessing its effect.
Adverse checks	Reject $n > N$, negative counts and non-integer population inputs.

Q17 — Zero observed defects is not zero population risk

Source anchors: I.4

Calculate an exact one-sided upper defective-probability bound.

Calculation element	Controlled method and interpretation
Equation	$p_{\text{upper}} = 1 - \alpha^{(1/n)}$
Variables and units	n independent observations with zero defect detections; alpha is the one-sided tail probability.
Worked synthetic values	At n=80 and 95% confidence, $p_{\text{upper}} = 0.0367541978$, or 3.67541978%.
Assumptions and validity	The model assumes valid independent detection. It cannot quantify unseen defects that the method systematically misses.
Decision boundary	The bound supports only its stated population and model, not a universal defect-free claim.
Adverse checks	Challenge converting lack of reported failure into infinite-life reliability or resetting n after an adverse observation.

Q18 — AI confusion-matrix metrics

Source anchors: N.4; 12.5

Report separate error quantities and denominators rather than a single assurance score.

Calculation element	Controlled method and interpretation
Equation	Precision = $TP / (TP + FP)$; Recall = $TP / (TP + FN)$; Specificity = $TN / (TN + FP)$; Accuracy = $(TP + TN) / N$; $F1 = 2TP / (2TP + FP + FN)$
Variables and units	Positive means the defect class. TP/FP/FN/TN are non-negative counts from a defined independent evaluation population.
Worked synthetic values	TP=190, FP=15, FN=10, TN=785: precision=92.682927%, recall=95.000000%, specificity=98.125000%, accuracy=97.500000%, F1=0.938271605.
Assumptions and validity	Zero denominators are undefined, not favorable defaults. Relevant critical scenarios and labeling error require separate assessment.
Decision boundary	Each pre-approved essential criterion must be met; high accuracy does not cancel the 10 missed defects.
Adverse checks	Challenge training/evaluation overlap, changing thresholds on evaluation data and a metric that treats missing output as correct.

Q19 — Exact intervals and an independent challenge population

Source anchors: N.5

Show that rare or difficult scenarios retain their own uncertainty and decision.

Calculation element	Controlled method and interpretation
Equation	For $0 < x < n$: two-sided exact endpoints $\text{beta_quantile}(\alpha/2, x, n-x+1)$ and $\text{beta_quantile}(1-\alpha/2, x+1, n-x)$; boundary cases need their proper 0/1 endpoint.
Variables and units	x: observed successes; n: relevant trials; $\alpha=0.05$ for the displayed two-sided 95% procedure.
Worked synthetic values	190/200 recall: [90.997246%, 97.576583%]. Separate difficult-defect set 38/50: recall 76%, interval [61.830925%, 86.939008%].
Assumptions and validity	The second set is not a subgroup within the 1000-case set. Sampling intervals do not cover all labeling, distribution-shift or missing-scenario uncertainty.
Decision boundary	Evaluate the relevant independently approved scenario criterion; do not hide weak challenge results by pooling incompatible datasets.
Adverse checks	Challenge $x > n$, negative counts, wrong interval tail and automatic extrapolation to other material or lighting conditions.

Q20 — Partial environmental inventory and uncertainty

Source anchors: 20.2; U.1-U.2

Reconcile quantities, compatible factors and claim boundaries.

Calculation element	Controlled method and interpretation
Equation	$E = \sum(A_i EF_i)$; intensity = E/Q ; independent $u(E) = \sqrt{\sum(u_i^2)}$
Variables and units	Activity and factor units must cancel to compatible emissions units. Q is a defined functional output. Correlation needs covariance terms.
Worked synthetic values	Synthetic contributions $42000 + 15000 + 36000 + 5400 = 98400$ kg CO ₂ e. For 1000 assemblies intensity = 98.4 kg CO ₂ e/assembly. Standard uncertainties 4200, 1200, 7200, 810 give $u(E) = 8460.265953$ kg CO ₂ e.
Assumptions and validity	This example excludes use and end-of-life. Its invented factors must not be used as actual national, supplier or lifecycle factors.
Decision boundary	Uncertainty does not account for an omitted lifecycle stage; boundary accuracy and quantity calculations are separate checks.
Adverse checks	Challenge duplicate upstream stages, missing factor versions and a partial inventory labeled full footprint.

Q21 — Comparable reduction scenario and technical eligibility

Source anchors: 20.1-20.3; U.3-U.4

Separate calculated scenarios, achieved reductions and suitability of reused inputs.

Calculation element	Controlled method and interpretation
Equation	$\Delta_E = \Delta_A EF$; relative reduction = $\Delta_E / E_{\text{base}}$; new intensity = $(E_{\text{base}} - \Delta_E) / Q$
Variables and units	Maintain the same boundary, output and factor assumptions before comparing.
Worked synthetic values	Reducing assumed electricity from 120000 to 108000 kWh gives 4200 kg CO ₂ e less, 4.26829268% of the partial baseline; new intensity = 94.2.

Calculation element	Controlled method and interpretation
Assumptions and validity	A scenario is not measured improvement. Changed production mix, transferred emissions, uncertainty and actual technical performance must be reviewed.
Decision boundary	An environmental benefit never authorizes unqualified material reuse or an unsupported life extension.
Adverse checks	Challenge offset subtraction into gross inventory and repeated counting of the same internal recovered material.

Q22 — Operational and financial metrics without conformity substitution

Source anchors: 6.3; 9.1; Z.1

Calculate measures with explicit populations and distinct interpretations.

Calculation element	Controlled method and interpretation
Equation	FPY=first-pass accepted/input; RTY=product(compatible conditional stage yields); OTD=on-time complete orders/orders due; ppm=defective units/inspected units x 10 ⁶ .
Variables and units	Other metrics retain their own denominators: OEE=availability x performance x quality; CPI=earned/actual; SPI=earned/planned.
Worked synthetic values	Synthetic results: FPY 94%; RTY 94.1094%; OTD 92%; 350 defective units per million; cost-of-poor-quality 45000 or 3% of revenue; OEE 83.79%; CPI 0.9; SPI 0.8.
Assumptions and validity	Do not merge these independent examples into one claimed real organization. Schedule index is not direct calendar delay and OEE is not safety.
Decision boundary	State critical missing evidence separately from completion percentages. No metric passes a failed mandatory condition.
Adverse checks	Challenge changed denominators, defect-versus-defective-unit counts and a maturity average that hides an essential failure.

Q23 — Engineering margins and quantity reconciliation

Source anchors: 11.7; Z.2; T.3

Make denominators and reserve ownership explicit.

Calculation element	Controlled method and interpretation
Equation	Margin_relative_to_demand=(capacity-demand)/demand; unused_fraction=(capacity-demand)/capacity; sum(child quantities)+consumption+remaining=parent quantity.
Variables and units	Capacity and demand refer to the same physical quantity and operating condition. Inventory balances must use compatible units and avoid duplicate allocations.
Worked synthetic values	5 kW capacity versus 4 kW demand gives 25% demand-relative margin and 20% unused capacity. A 500-item source split into 200,200,100 reconciles numerically but still requires identity, condition and recipient links.
Assumptions and validity	Account for degradation, uncertainty, simultaneous peaks and terminal reserve. A positive scalar margin does not establish transient adequacy.
Decision boundary	Accept budgets only with valid inputs, model and protected reserve; quantity closure is not product eligibility.
Adverse checks	Challenge double-counted reserve, a denominator of zero and consumption not deducted from a split-lot balance.

Q24 — Organizational audit time, stages and coverage

Source anchors: AC.1-AC.4; AC.8

Reproduce the source planning minimum without turning it into a quotation or applying it to other routes.

Calculation element	Controlled method and interpretation
Equation	$T_{\text{calc}} = \text{ceil}(2[B K(1+f) + 0.5(S_v - 1) + 0.5H])/2$; $T_1 = \max(0.5, \text{ceil}(2 \times 0.25T)/2)$; $T_2 = T - T_1 \geq 1.5$.
Variables and units	B is the exact effective-personnel band; K follows highest criticality; f adds 0.15 for each of three distinct triggered complexity conditions; S_v actual visited sites; H additional materially different shifts.
Worked synthetic values	N=80, C2, special processing and assured digital acceptance, one site, no extra shift: B=5, K=1.35, f=0.30, raw=8.775, T=9, T1=2.5, T2=6.5. Surveillance floor=4.5 days; renewal=7 days. Review and decision are additional.
Assumptions and validity	Also meet one day per visited site and enough time for real tasks, central functions and witnesses. Increase total if both stage floors cannot be met. An evaluator-day is eight productive hours.
Decision boundary	Use exact source floors plus necessary extra work; technical provider and personnel routes require their actual activity plan, not this ORG formula.
Adverse checks	Test every personnel band boundary, duplicate flags, passive observers, round-down, stage deficiency and omitted mandatory sites.

Q25 — Site sampling and calendar integrity

Source anchors: AC.5; AG.1-AG.6

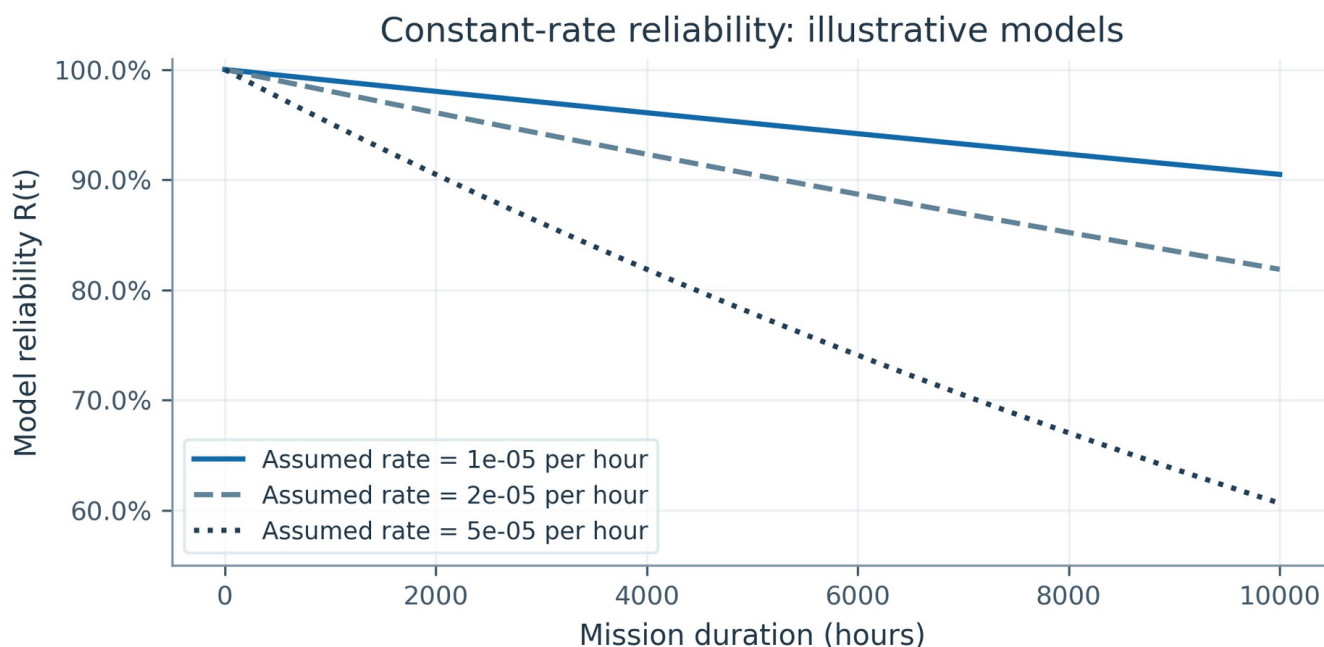
Apply source eligibility, rotation and genuine-event clocks.

Calculation element	Controlled method and interpretation
Equation	For eligible C0/C1 surveillance pool S: $m = \max(\text{ceil}(\sqrt{S}), \text{ceil}(S/2))$; random portion $\geq \text{ceil}(m/4)$. Calendar due dates use actual trigger plus specified interval.
Variables and units	S excludes separately mandatory sites; central function and critical/new/unique locations are added. Full initial/renewal coverage remains required.
Worked synthetic values	For nine eligible sites m=5 and the random portion is at least two. For calendar-month intervals the same day is used, or target month-end if unavailable. A report issued later does not reset an earlier notified finding.
Assumptions and validity	A site formula does not state statistical confidence. Preserve rotation through the required 24-month window. Payment, appeal and booking do not extend expiry.
Decision boundary	Missed required surveillance triggers affected status action. Restoration alone preserves original expiry and the suspended gap.
Adverse checks	Challenge month-end arithmetic, wrong time zones, earlier notice than report date, expired reprints and repeatedly reset suspension dates.

3 Original analytical figures and their boundaries

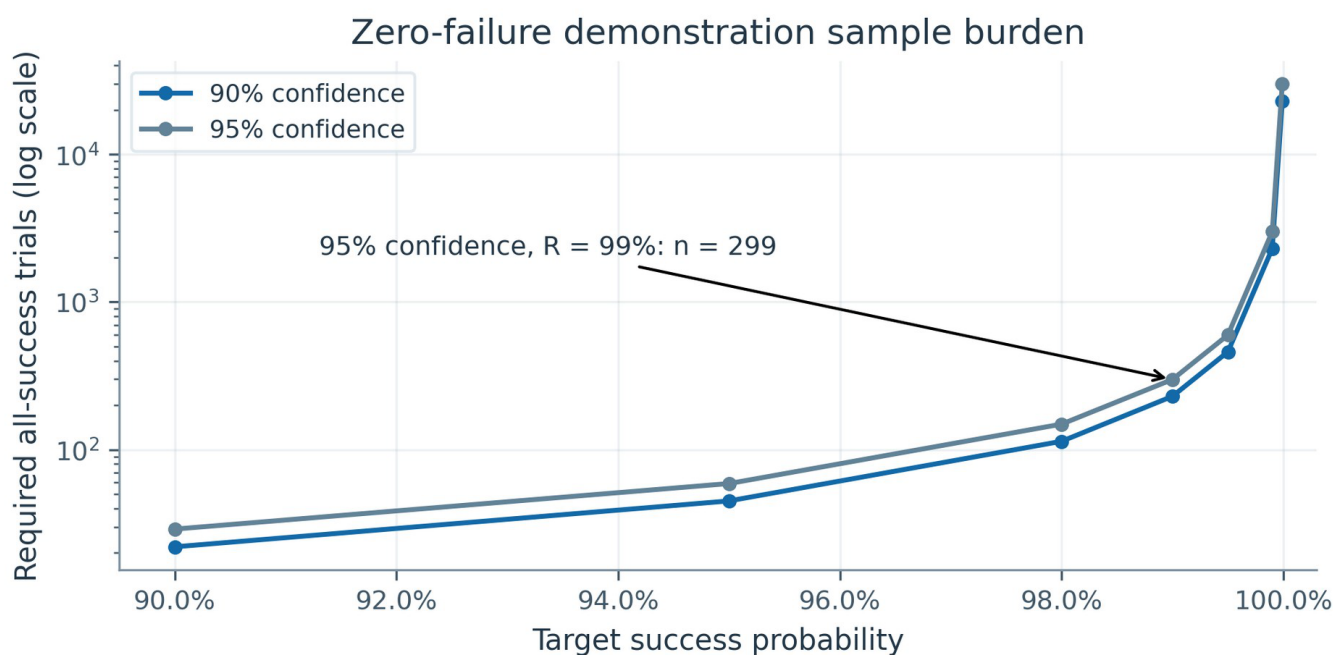
The following nine figures are reproduced from the supplied AF 9100 standard. They retain the source's synthetic nature, axes and assumptions. Their inclusion is illustrative; no newly observed physical performance is claimed.

F-1: Exponential reliability under three assumed constant rates.



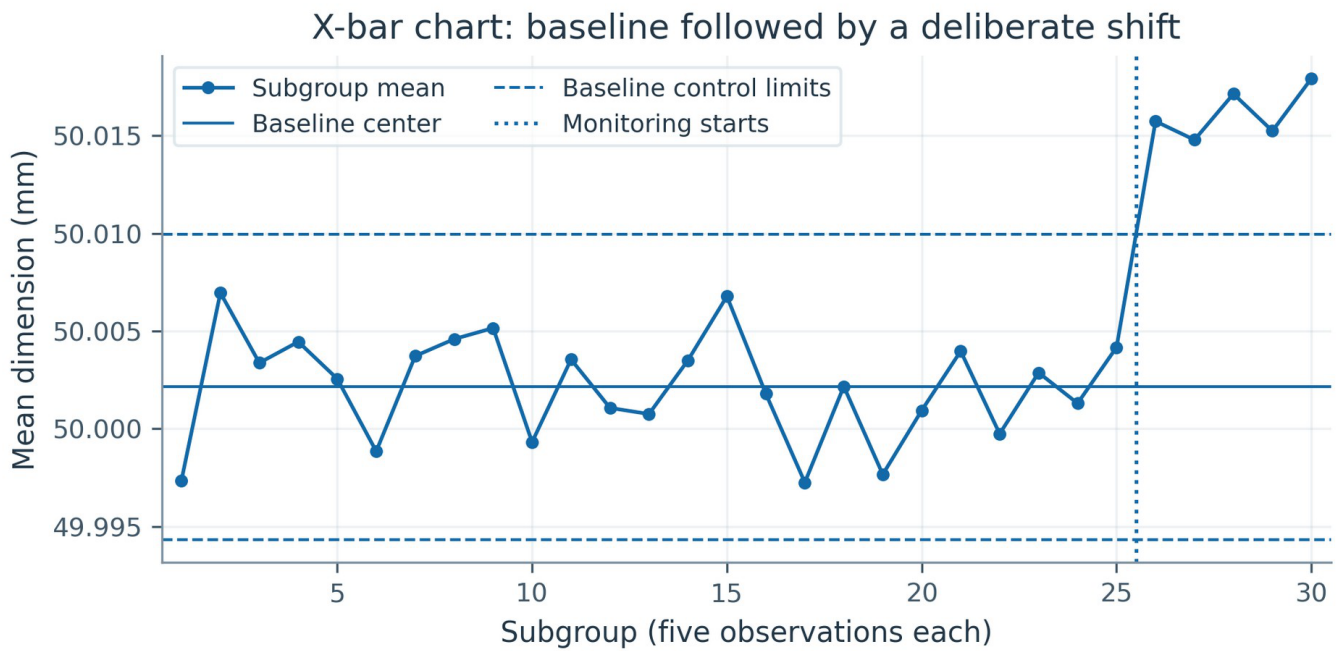
Source AF 9100:2026 p. 59. Read with the full corresponding annex and the worked calculation above.

F-2: Required all-success trials versus reliability target and confidence.



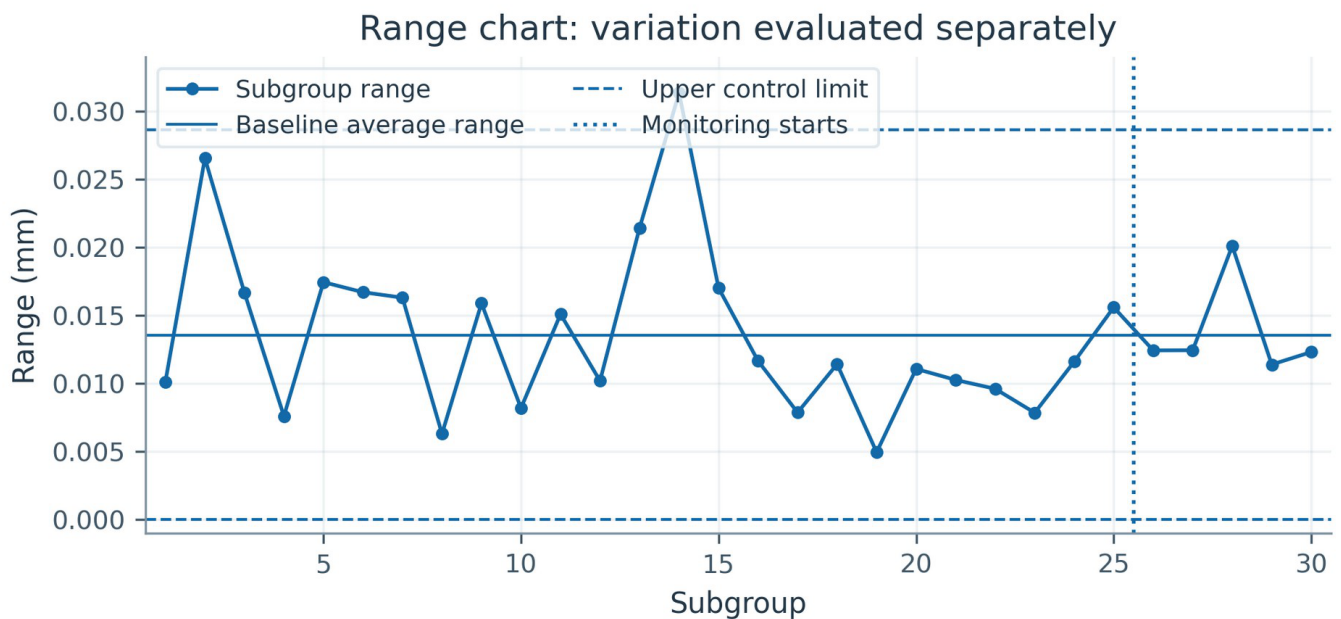
Source AF 9100:2026 p. 60. Read with the full corresponding annex and the worked calculation above.

G-1: Subgroup means with fixed baseline control limits and a later shift.



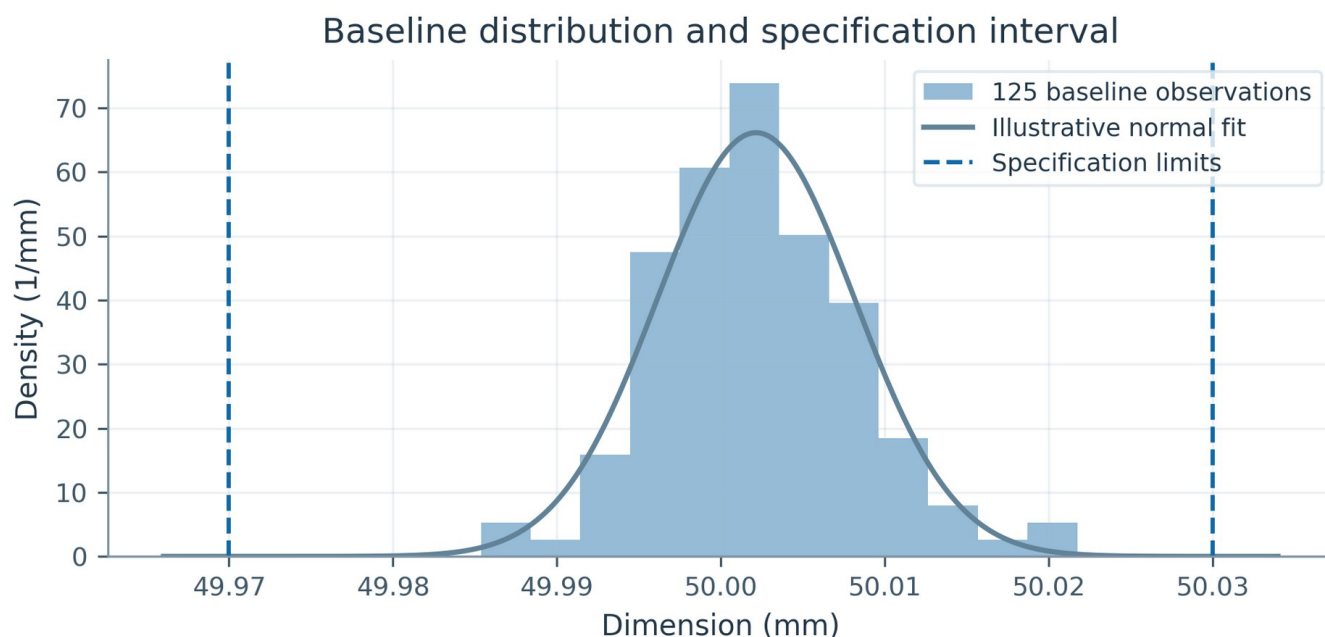
Source AF 9100:2026 p. 63. Read with the full corresponding annex and the worked calculation above.

G-2: Separate range chart; stable spread does not exclude a shifted mean.



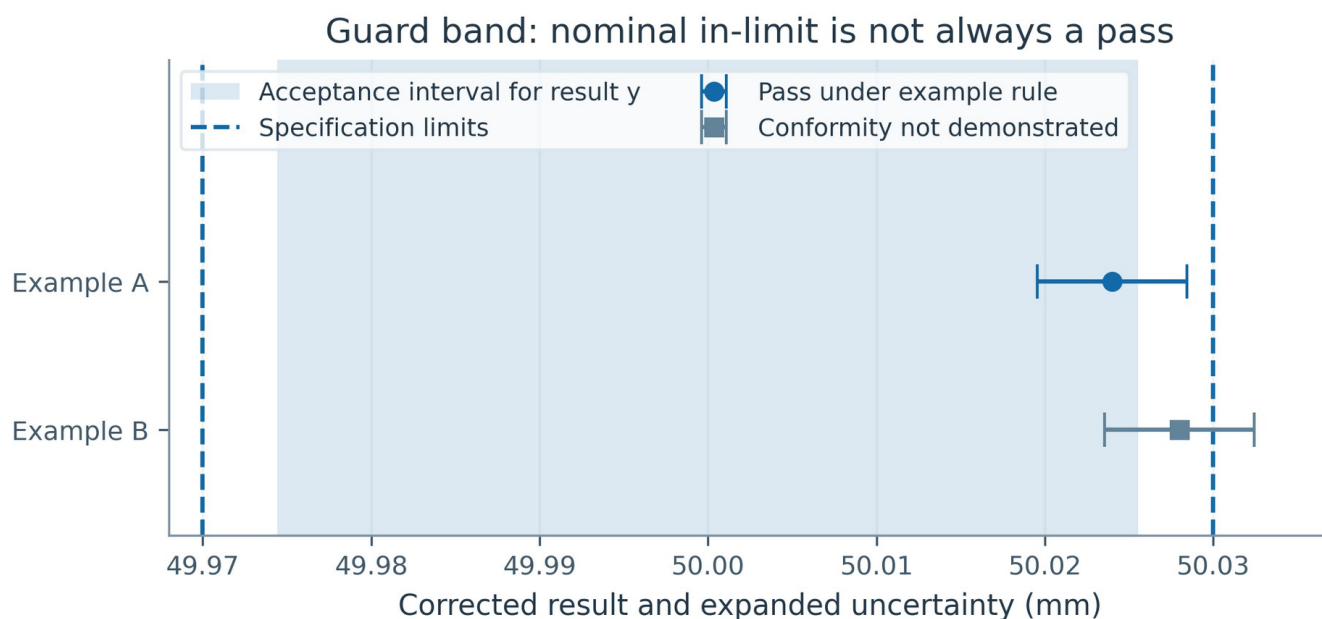
Source AF 9100:2026 p. 63. Read with the full corresponding annex and the worked calculation above.

G-3: Printed baseline histogram and illustrative normal density, not proof of normality.



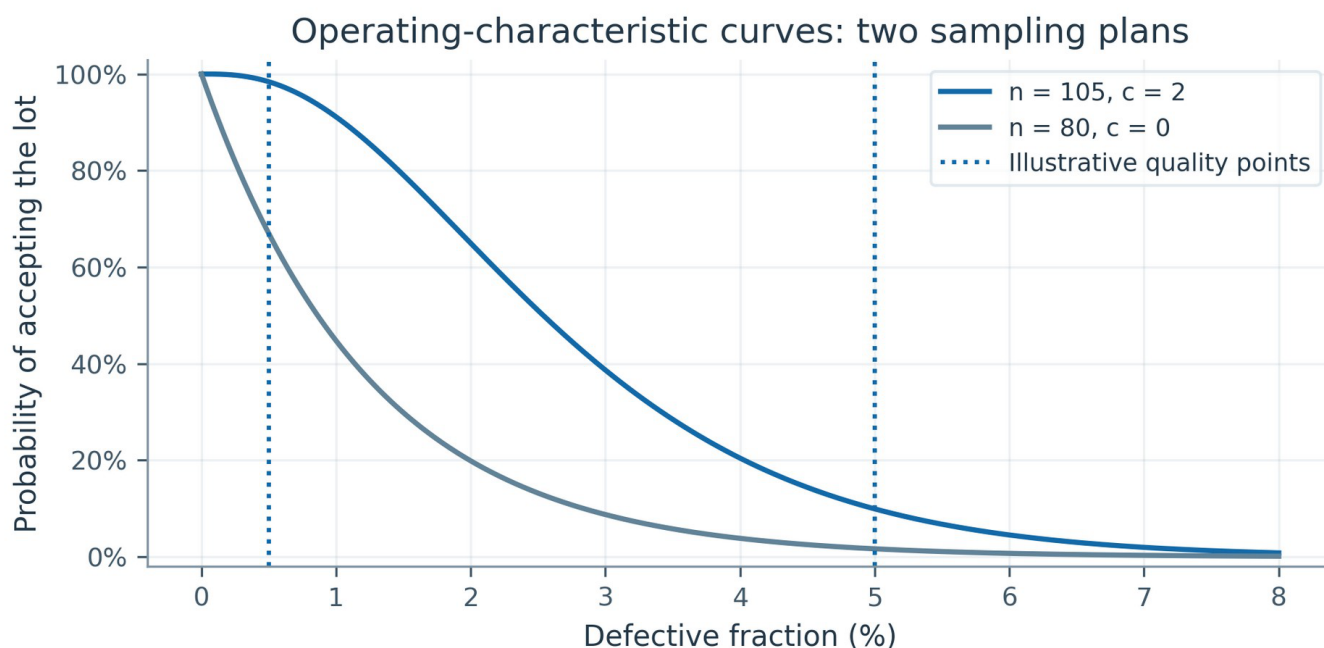
Source AF 9100:2026 p. 64. Read with the full corresponding annex and the worked calculation above.

H-1: Measurement intervals against specification and guarded acceptance.



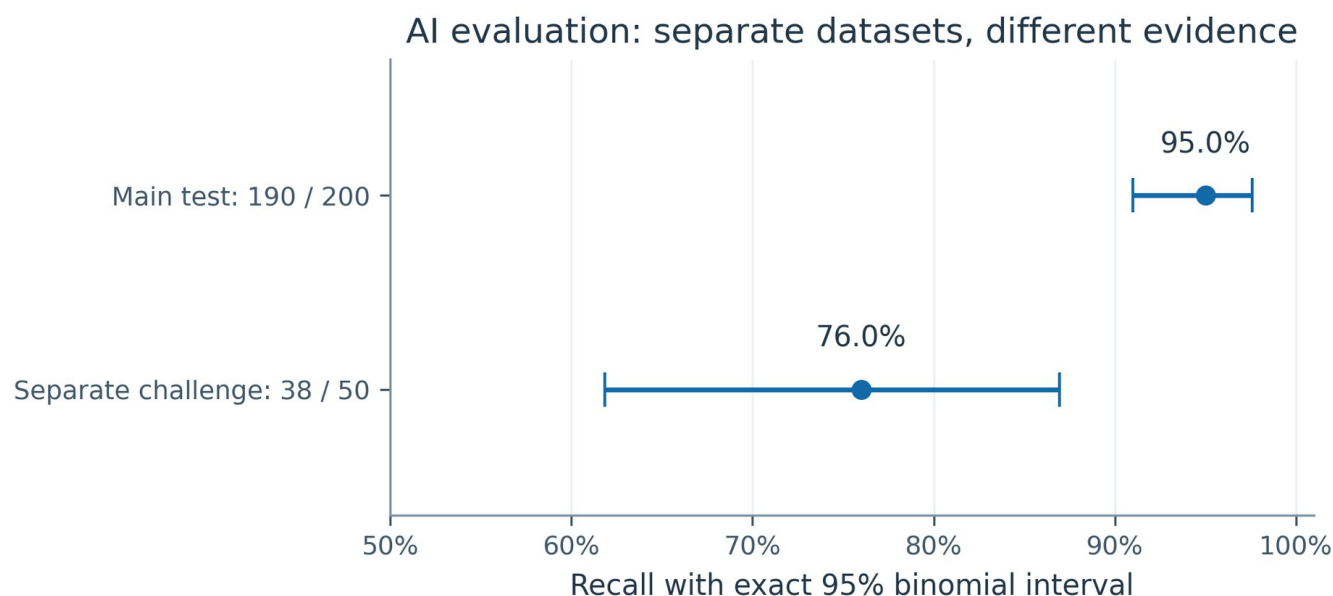
Source AF 9100:2026 p. 66. Read with the full corresponding annex and the worked calculation above.

I-1: Binomial operating characteristics of two different illustrative sampling plans.



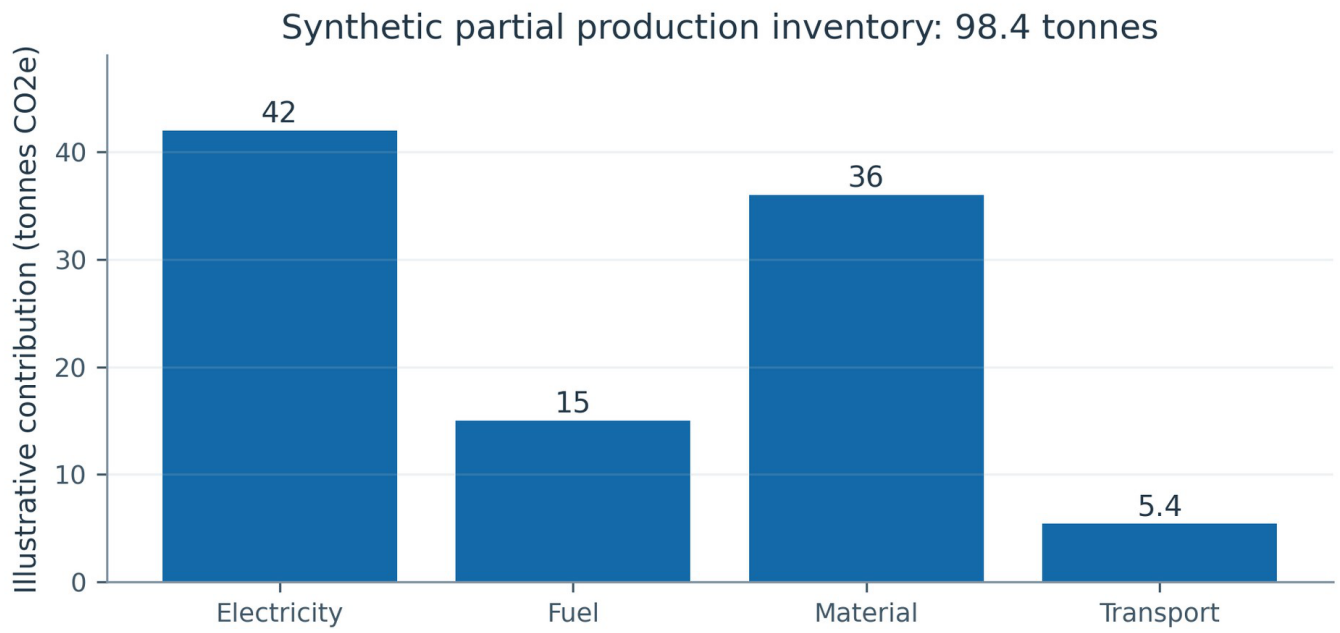
Source AF 9100:2026 p. 67. Read with the full corresponding annex and the worked calculation above.

N-1: Recall intervals for independent main and challenge populations.



Source AF 9100:2026 p. 76. Read with the full corresponding annex and the worked calculation above.

U-1: Contributions to a partial synthetic environmental inventory.



Source AF 9100:2026 p. 85. Read with the full corresponding annex and the worked calculation above.

4 Printed source dataset for reproducibility

The 25-by-five baseline below is the source Table G-1 as printed. It supports the recalculated subgroup and capability examples; later monitoring data are not silently pooled into this baseline.

Group	x1	x2	x3	x4	x5
1	50.00360	49.99847	49.99553	49.99564	49.99348
2	50.00608	50.01104	49.99296	50.01950	50.00521
3	50.01358	49.99691	50.00846	50.00043	49.99748
4	50.00472	50.00662	49.99983	50.00743	50.00366
5	49.99772	49.99707	50.00542	49.99806	50.01451
6	49.99882	50.00341	50.00199	49.98671	50.00330
7	50.00215	49.99646	50.00545	50.01276	50.00179
8	50.00699	50.00468	50.00162	50.00792	50.00174
9	49.99533	50.00905	50.01122	50.00081	50.00936
10	50.00073	49.99843	50.00226	50.00110	49.99407
11	50.00426	50.00845	49.99463	50.00068	50.00972
12	49.99867	49.99745	50.00764	49.99987	50.00170
13	50.00493	50.00357	49.98537	50.00312	50.00678
14	50.00594	50.02176	50.00760	49.99043	49.99179
15	50.01139	50.00160	50.00324	50.00033	50.01734
16	50.00121	50.00414	50.00671	49.99506	50.00182
17	50.00084	49.99297	50.00002	49.99796	49.99446
18	50.00212	50.00970	49.99828	49.99881	50.00194
19	49.99487	49.99982	49.99708	49.99695	49.99959
20	50.00436	49.99617	50.00586	50.00352	49.99479
21	50.00206	49.99973	50.00537	50.00999	50.00272
22	49.99839	49.99820	50.00605	49.99644	49.99962
23	50.00754	49.99969	50.00422	50.00166	50.00125
24	50.00307	49.99512	49.99926	50.00234	50.00672
25	50.00799	49.99657	49.99980	50.00433	50.01216

5 Arithmetic and boundary check record

91 programmed arithmetic and boundary checks were executed in preparing this report. Expected values are source-derived or independently specified boundary outcomes. Success here does not validate actual mission assumptions or a local operational software deployment.

Check	Calculated / observed	Expected	Result
DR-A (49.97, 50.03, 50.024, 0.00444522)	PASS	PASS	PASS
DR-A (49.97, 50.03, 50.028, 0.00444522)	HOLD	HOLD	PASS
DR-A (49.97, 50.03, 50.036, 0.00444522)	FAIL	FAIL	PASS
DR-A (49.97, 50.03, 50.02555478, 0.00444522)	PASS	PASS	PASS
DR-A (49.97, 50.03, 50.02555479, 0.00444522)	HOLD	HOLD	PASS
DR-A (49.97, 50.03, 50.024, -0.01)	HOLD	HOLD	PASS
DR-A (50.03, 49.97, 50, 0.001)	HOLD	HOLD	PASS
DR-A (49.97, 50.03, 'NaN', 0.001)	HOLD	HOLD	PASS
DR-A (49.97, 50.03, 'Infinity', 0.001)	HOLD	HOLD	PASS
DR-A (49.97, 50.03, None, 0.001)	HOLD	HOLD	PASS
DR-A (49.97, 50.03, 50.03, 0)	PASS	PASS	PASS
DR-A (49.97, 50.03, 50.031, 0)	FAIL	FAIL	PASS
Independent uc	0.002222611077089287	0.002222611077089287	PASS
Expanded U	0.004445222154178574	0.004445222154178574	PASS
Correlated uc	0.0024779023386727736	0.0024779023386727736	PASS
Union	0.004994000000000054	0.004994	PASS
Independent intersection	6e-06	6e-06	PASS
Common cause	0.001005994	0.001005994	PASS
Exponential 1000	0.9801986733067553	0.9801986733067553	PASS
Exponential 5000	0.9048374180359595	0.9048374180359595	PASS
Series	0.9830799	0.9830799	PASS
Parallel	0.9996	0.9996	PASS
Success trials 0.9	29	29	PASS
Success trials 0.95	59	59	PASS
Success trials 0.99	299	299	PASS
Success trials 0.999	2995	2995	PASS
Success trials 0.9999	29956	29956	PASS
Lower reliability bound	0.9900639180555423	0.9900639180555423	PASS

Check	Calculated / observed	Expected	Result
Zero failure upper rate	4.992887122589985e-05	4.992887122589985e-05	PASS
Observed failure rate	7.753656527932725e-05	7.753656527932725e-05	PASS
Weibull R	0.7021885013265596	0.7021885013265595	PASS
B10	2230.7552563691706	2230.755256368871	PASS
Intrinsic availability	0.9950248756218906	0.9950248756218906	PASS
Operational availability	0.96	0.96	PASS
SPC data rows	25	25	PASS
SPC mean	50.00215328	50.00215328	PASS
SPC Rbar	0.01354599999999948	0.013546	PASS
Cp	1.7171120626015721	1.717111324375	PASS
Cpk	1.5938646271962493	1.593864954	PASS
Gauge component ratio	0.3004626062886658	0.3004626062886658	PASS
Sampling alpha	0.016053161102786095	0.01605316	PASS
Sampling beta	0.09918726248514663	0.09918726	PASS
Alternative alpha	0.33035217952943563	0.3303521795	PASS
Hypergeom50	0.08696215881093149	0.08696216	PASS
Hypergeom5	0.9903796061267442	0.99037961	PASS
Zero sample defects upper	0.036754197779982345	0.03675419778	PASS
AI Precision	0.926829268292683	0.926829268292683	PASS
AI Recall	0.95	0.95	PASS
AI Specificity	0.98125	0.98125	PASS
AI Accuracy	0.975	0.975	PASS
AI F1	0.9382716049382716	0.9382716049382716	PASS
Recall lower	0.9099724622986486	0.90997	PASS
Challenge lower	0.6183092518959619	0.61831	PASS
Inventory total	98400.0	98400.0	PASS
Inventory intensity	98.4	98.4	PASS
Inventory uncertainty	8460.26595326648	8460.266189666138	PASS
Reduction percent	4.2682926829268295	4.2682926829268295	PASS
New intensity	94.2	94.2	PASS
First-pass yield	0.94	0.94	PASS
Rolled throughput yield	0.941094	0.941094	PASS
On-time due orders	0.92	0.92	PASS
Defective units ppm	350.0	350.0	PASS

Check	Calculated / observed	Expected	Result
Cost ratio	0.03	0.03	PASS
OEE	0.8379	0.8379	PASS
Cost index	0.9	0.9	PASS
Schedule index	0.8	0.8	PASS
Power demand margin	0.25	0.25	PASS
Power unused fraction	0.2	0.2	PASS
Audit B	5	5	PASS
Audit K	1.35	1.35	PASS
Audit f	0.3	0.3	PASS
Audit T	9.0	9.0	PASS
Audit T1	2.5	2.5	PASS
Audit T2	6.5	6.5	PASS
Audit surveillance	4.5	4.5	PASS
Audit renewal	7.0	7.0	PASS
Audit band 1	2	2	PASS
Audit band 10	2	2	PASS
Audit band 11	3	3	PASS
Audit band 25	3	3	PASS
Audit band 26	4	4	PASS
Audit band 75	4	4	PASS
Audit band 76	5	5	PASS
Audit band 150	5	5	PASS
Audit band 151	7	7	PASS
Audit band 300	7	7	PASS
Audit band 301	9	9	PASS
Audit band 600	9	9	PASS
Audit band 601	10	10	PASS
Nine-site pool	5	5	PASS
Nine-site random	2	2	PASS

6 Safe numerical workflow and rejected-input rules

Freeze requirement and parameter basis → verify evidence identity and input validity → compute with retained precision → check model and uncertainty → apply the pre-agreed rule → obtain authorized review → retain the exact inputs, outputs and limitations. Do not bypass an unresolved condition by coercing a blank to zero or comparing rounded display values.

Actual calculation identity / decision purpose / source criterion

Actual inputs and units / original evidence / model validity

Expected known answer / independent method / boundary cases

Observed result / numerical precision / uncertainty and decision

Reviewer and genuine approval / remaining limitations