



AF 9400

Aerospace Manufacturing, Materials & Supply Chain

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Document identity and authority

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Use of this publication

AF 9400 defines controls for aerospace manufacturing, material integrity and supply-chain assurance. It connects approved requirements, material pedigree, qualified processes, actual execution, verification and bounded release. Product-specific values, process recipes, permissions and authorities are completed for the actual application.

The supporting set supplies original implementation models, technical profiles, examination checklists and blank controlled records. It does not supply fabricated results, signatures, approvals or recognition.

Informative calculations and cases use synthetic values. They illustrate decision boundaries and reproducible methods; they are not mandatory defaults, material allowables or evidence from actual production.

Reader route and decision boundaries

1 Define the product and responsibility

Use Clauses 0-8 and Annexes A-C for scope, roles, requirements, configuration, critical characteristics and readiness.

2 Establish trustworthy supply and material

Use Clauses 9-14 and Annexes D-E and I for suppliers, continuity, receipt, authenticity, material suitability, genealogy and life.

3 Demonstrate production capability

Use Clauses 15-17 and Annexes F-G for equipment, people, qualified processes and actual execution.

4 Apply the actual technical activities

Select Clauses 18-24 for metallic, composite, additive, joining, surface, electronic and integrated manufacturing.

5 Verify, contain and release

Use Clauses 25-33 and Annexes H and J-L for inspection, digital evidence, first article, nonconformity, change, logistics and release.

6 Maintain evidence and truthful claims

Use Clauses 34-36 and Annexes M-N for sourcing, circular claims, assurance, records and local adoption.

Decision boundary: Material approval, process qualification, lot acceptance, product release and operating permission are distinct. No overall score compensates for an unresolved essential condition.

Contents - clauses and annexes

Entries and PDF bookmarks locate the controlled clauses and annexes. Page references apply to this file.

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0 Introduction and intended outcomes

AF 9400 establishes requirements for controlling aerospace manufacture, material integrity and supply-chain performance. Its purpose is to preserve the relationship between the intended product, the material actually used, the operations actually performed and the evidence supporting release. The same principles apply to a large assembly, a small critical fastener, a chemical batch, a software-controlled production operation and a distributor holding material without transforming it.

0.1 The manufacturing assurance chain

The organization shall establish a traceable route from the approved product and material requirements to sourcing, receipt, preparation, manufacture, verification, preservation and delivery. Every handoff shall identify the transferred object, its configuration, its condition, its evidence and the authority accepting responsibility. An approved supplier, capable machine or successful sample does not by itself demonstrate conformity of the supplied population. Assurance shall combine suitable requirements, demonstrated process capability, controlled actual execution, appropriate product verification and an eligible release decision. Where final inspection cannot reliably reveal a process-induced defect, prevention and demonstrated process control shall remain essential.

0.2 Distinct questions and states

The organization shall distinguish permission to perform work from the acceptability of the work performed. It shall also distinguish a material specification, an approved source, a qualified process, an accepted lot and a released item. Evidence and status shall not be silently inherited across these objects.

Table 0-1. Separate manufacturing decisions

Decision	Question	What it does not establish
Material approval	Is this defined material state suitable for the intended application?	Acceptance of every delivered batch.
Process qualification	Can this bounded process produce the required characteristics?	Conformity of a run outside the qualified envelope.
Lot acceptance	Does this defined population meet its approved acceptance basis?	Unrestricted suitability for other applications.
Product release	Is the identified output complete and conforming for the stated delivery?	Permission to operate it or approval of an unassessed design.

0.3 Evidence and exception boundaries

The organization shall preserve adverse observations, missing information and uncertainty. An unresolved essential condition shall block the affected use or release. An overall quality score, delivery score, audit rating or supplier ranking shall not compensate for a failed mandatory condition. Records shall distinguish observations, technical interpretations, authorized dispositions and implemented actions. A concession may authorize a bounded departure where the necessary authority exists; it shall not rewrite the original measured result or imply that the original requirement was satisfied.

0.4 Language and publication status

Shall identifies a proposed requirement. Should identifies guidance. May identifies permission within the stated conditions. Informative material shall not be converted into mandatory numerical values without an approved local basis. This FIRST EDITION manuscript is prepared for Aerospace Federation review. Publication approval and an effective date are not assigned. Local adoption, publication approval, product release and recognition of an organization are separate decisions.

Required evidence: Defined objects and decision states; accountable handoffs; retained exceptions; controlled local adoption and publication state.

Decision control: A favorable document status shall not promote unidentified, unverified or nonconforming material into an accepted product state.

1 Scope and organizational application

1.1 Activities covered

This standard applies to organizations that specify, procure, manufacture, process, assemble, inspect, store, distribute, package or transport aerospace materials and products. It covers original production, industrialization, production transfer, outsourced operations, approved rework and repair during manufacture, and the production consequences of returned or suspect products. Application shall follow the activities actually performed and the responsibilities retained. A distributor shall apply identity, authenticity, preservation, traceability and release controls even when it does not manufacture. An organization outsourcing a special process shall retain responsibility for effective technical flow-down, source suitability and acceptance of the returned output.

1.2 Materials, products and levels

The declared scope shall identify raw materials, semi-finished forms, consumables, chemicals, components, assemblies, equipment, embedded product software and relevant production data. It shall identify the evaluated level, product family, sites, processes and supply-chain boundaries. Civil aviation, space and defense activities may use this standard through an approved applicability profile. Common production controls do not remove activity-specific permissions or product requirements. A process suitable for a ground fixture is not automatically suitable for a flight-critical component.

1.3 Lifecycle and interfaces

The organization shall control the manufacturing lifecycle from feasibility and sourcing through delivery and subsequent feedback that can affect product integrity. Interfaces with design, testing, maintenance, operations, customers and external providers shall identify the information and authority required on each side. Prototype, development, qualification, production, repaired, returned and scrap items shall remain distinguishable. Transfer between these categories shall require an explicit assessment and authorization. Development success does not establish production readiness or permission to deliver a prototype as a production item.

1.4 Boundaries and non-substitution

This standard does not supply universal material allowables, process recipes, test levels, inspection intervals or product acceptance limits. The responsible authorities shall approve those values for the actual application and record their technical basis. Compliance with this standard does not itself grant design approval, airworthiness, operating permission, export permission or authority to use an AF recognition mark. Required external permissions shall be identified and obtained through the applicable route. A production release shall not be described as a broader authorization.

Required evidence: Scope statement, activity map, product and site boundaries, interface responsibilities, permissions and approved local parameter baseline.

Decision control: An activity shall not be excluded solely because it is outsourced or because an organization describes itself as a broker, integrator or digital service provider.

2 Applicability, precedence and local parameters

2.1 Selection by actual activity

The organization shall apply Clauses 0-17 and 25-36 as relevant to its retained production and supply responsibilities, and select the technical activity clauses 18-24 according to actual materials and processes. Annex A shall be used to identify triggers and interfaces. Each non-applicable provision shall have a positive technical rationale and eligible approval. The scope owner shall review application when products, sites, materials, sources, operations, digital systems or intended uses change. An absence of facilities or competent personnel is a capability gap, not a reason to declare an otherwise necessary requirement inapplicable.

2.2 Precedence and conflicting requirements

The organization shall identify the controlling requirements and authorities before commitment. Applicable obligations and product-specific authorized requirements shall be respected. Conflicts among purchase orders, drawings, material specifications, process instructions and acceptance documents shall be recorded and resolved by the responsible authorities. The organization shall not select the easiest interpretation after observing an unfavorable result. Work dependent on an unresolved requirement shall remain blocked. Where limited preparatory work is authorized, its scope and restrictions shall prevent unintended manufacture or release under an ambiguous baseline.

2.3 Mandatory parameter completion

The organization shall complete the P01-P40 parameter schedule in Annex B. Each value shall identify the object, unit or state, source, responsible owner, approving authority, effective configuration and change trigger. Referenced specifications shall be accessible at the point where they are used. Parameters include criticality, source controls, material condition, genealogy granularity, process windows, inspection rules, shelf-life accounting, supplier notification periods and release authority. A blank value is an unresolved dependency. Informative example values are not defaults.

2.4 Tailoring and equivalent controls

Tailoring shall preserve the objective and evidence strength of the affected requirement. The proposal shall identify the original requirement, alternative control, technical rationale, residual uncertainty and approving authority. It shall address dependencies and the actual product population. An equivalent inspection, alternative source or digital record route shall be demonstrated for its intended use before reliance. An administrative waiver shall not replace a necessary physical characteristic, authentication check or safety control. Retained duties and restrictions shall be communicated to every affected tier.

Required evidence: Applicability decisions, precedence register, completed parameters, resolved conflicts and justified tailoring or equivalence records.

Decision control: An unresolved decision-sensitive parameter shall block the affected operation, acceptance or release; it shall not be filled retrospectively to match the achieved result.

3 Terms, quantities and interpretation

3.1 Core terms

Table 3-1. Manufacturing and supply-chain terms

Term	Meaning within AF 9400
Material pedigree	Evidence of origin, specification, condition, processing and acceptance of an identified material population.
Genealogy	The recorded parent-child relationships connecting material, lots, parts, operations and assembled outputs.
Essential variable	A condition whose change can invalidate process qualification or the applicability of accepted evidence.
Critical characteristic	A characteristic requiring enhanced control because its variation or failure can materially affect safety, mission or intended function.
Special process	A process whose resulting conformity cannot be fully established by subsequent product verification alone.
Traveler	The controlled route and execution record for an identified production item or population.
Rework	Authorized action intended to restore conformity to the original applicable requirements.
Repair	Authorized action intended to make an item acceptable for a defined use through an approved repair basis.
Concession	Authorized permission for a specifically bounded departure, without changing the original result or requirement history.
Escape	A nonconforming or suspect output that has passed beyond its intended containment boundary.
Authenticity	Demonstrated confidence that identity, origin and representation are genuine for the claimed object.

3.2 Populations and quantities

The organization shall define lot, batch, heat, build, run, serial item and shipment according to their actual technical boundaries. A purchasing quantity or a shared package does not necessarily define a homogeneous acceptance population. Lot combination shall not erase different origins, process histories or acceptance states. Quantities shall identify units, count or mass basis, applicable tolerances and conversion rules. The same identifier shall not be reused for unrelated objects. Split, merge, conversion, consumption, scrap and return transactions shall preserve quantity reconciliation and parentage.

3.3 Decision meanings

PASS means that the applicable condition is demonstrated under the approved decision rule. FAIL means that the condition is not met. HOLD means that a decision remains unresolved or essential evidence is unavailable. N/A means that non-applicability has been justified and approved. Product state shall separately identify received, quarantined, authorized for processing, work in progress, accepted, released, returned, restricted and scrap, as applicable. A processing authorization shall not be displayed as a final product release.

3.4 Statistical and technical conventions

Specification limits are product requirements. Process control limits describe a defined process-monitoring model. Protective limits govern safe or controlled operation. These quantities shall remain distinct even where their numerical values happen to coincide. A capability index shall identify its estimator, data period, population, assumptions and uncertainty. A first article is an evidence object representing specified production conditions; it is not a synonym for approval of every future item.

Required evidence: Controlled terminology, unique object identifiers, quantity conventions, distinct states and explicitly defined statistical measures.

Decision control: A label or database field shall not collapse materially different objects or decision states into a misleading single category.

4 Governance, product integrity and decision authority

4.1 Accountable roles

The organization shall appoint accountable owners for product requirements, materials, manufacturing processes, sourcing, verification, data and release. Delegation shall identify the scope, sites, methods, decisions, limits and duration or review triggers. Authority shall be based on demonstrated competence and actual responsibility. The organization shall ensure that production and delivery pressure cannot overrule an essential technical hold. Where one person performs several functions, the arrangement shall preserve necessary independence and effective challenge. An ownership interest or job title alone shall not confer technical disposition authority.

4.2 Product safety and protected reporting

Personnel shall understand the consequences of defects, lost traceability, unauthorized substitution and falsified records for their work. The organization shall provide an accessible route for reporting suspected product-integrity issues and preserve the chronology of concerns and actions. A credible concern shall be assessed by an eligible owner. Retaliation, concealment and deliberate suppression of adverse evidence shall be prohibited. Immediate containment shall not await a completed causal investigation when the available evidence indicates a material risk to affected output.

4.3 Integrity and conflicts

The organization shall identify conflicts affecting source selection, inspection, disposition and release. Controls shall include reassignment, independent review or another effective arrangement appropriate to the risk. Purchasers shall not alter technical acceptance criteria to resolve a commercial dispute without the necessary technical authority. Records shall distinguish confirmed facts, allegations and unresolved hypotheses. Suspected counterfeit material shall be controlled as suspect until an eligible investigation supports a disposition. A serious allegation shall not be converted into an unsubstantiated public statement about a supplier.

4.4 Resources and communication

Management shall provide resources for required capability, preservation, inspection and recovery. Cross-functional decisions shall include the relevant materials, process, design, supply and quality expertise. Escalation routes shall identify who can stop work, contain product, notify recipients and authorize restart. Communication shall preserve confidentiality while enabling necessary technical review. Commercial confidentiality shall not justify withholding evidence essential to a release claim. An unresolved access restriction shall be evaluated as a limitation on that claim.

Required evidence: Role and delegation matrix, competence, conflict controls, reporting and escalation records, resourcing decisions and product-integrity actions.

Decision control: No manager, customer request or delivery target shall authorize a technical conclusion beyond the demonstrated evidence and the decision maker's actual authority.

5 Contract, design-interface and feasibility review

5.1 Review before commitment

Before accepting a new or changed order, the organization shall identify the product, configuration, quantity, required condition, delivery needs and intended use. It shall identify drawings, models, material and process specifications, acceptance criteria, required records, customer approvals and applicable permissions. The review shall test whether the organization and its proposed supply chain can satisfy the complete requirement. It shall consider unusual tolerances, inaccessible inspection features, long-lead materials, critical processes, authenticity risks and record access. An unsupported promise of later qualification shall not be treated as existing capability.

5.2 Design-to-manufacturing interface

The organization shall identify ambiguities and manufacturing constraints that could affect the design intent. It shall obtain authorized clarification before changing material, geometry, sequence, surface condition, software or another controlled requirement. A manufacturing workaround shall not silently become a design change. The interface shall address characteristics created or altered by processing, inspection access, handling damage, cleanliness, life limits and maintainability where relevant. Approval of a drawing does not establish that the selected production route can achieve it.

5.3 Capacity and delivery feasibility

The review shall consider demonstrated effective capacity, yield, changeovers, maintenance, inspection resources and constrained subtier capacity. It shall include time for qualification, customer review, transport and contingency. Planned overtime or a second source shall be supported by evidence of feasible and authorized implementation. The organization shall communicate material gaps and agreed restrictions before commitment. A delivery acceleration shall undergo an impact review where it changes sequencing, staffing, sources, process exposure or verification.

5.4 Customer property and information

Customer-supplied materials, tooling, data and software shall be identified, protected and assessed for suitability at receipt and before use. Damage, loss, inconsistency or missing pedigree shall be reported through the agreed route. Ownership shall not be confused with technical acceptance. Contract changes shall be propagated to manufacturing, purchasing, inspection, logistics and relevant providers. The organization shall retain the accepted baseline and a record of how work already in progress is dispositioned.

Required evidence: Feasibility and contract review, clarified design interfaces, capacity assumptions, accepted responsibilities and disposition of customer property and changed work.

Decision control: A commercial agreement shall not release work whose essential technical basis, capability or required permission remains unresolved.

6 Product definition, configuration and controlled instructions

6.1 Authoritative product definition

The organization shall identify the authoritative product definition and its relationship to drawings, models, bills of material, specifications, software and inspection requirements. Derived manufacturing data shall remain traceable to that definition. Differences among representations shall be resolved before use. The baseline shall identify effectivity by product, serial range, lot, build or another justified boundary. A later document date shall not automatically make a change applicable to every item already in production or delivered.

6.2 Work instruction control

Instructions shall state the operation, inputs, sequence, required equipment, essential parameters, acceptance and hold points, protective conditions and records. They shall be understandable to the authorized user and available in the correct version at the point of work. A drawing alone shall not replace necessary executable process instructions. Uncontrolled annotations, verbal instructions or locally altered machine recipes shall not override the approved baseline. Emergency deviations shall be bounded, authorized and retained with the affected product history.

6.3 Configuration at execution

The organization shall record the actual material, hardware, software, tooling, machine programme and procedure versions used where they can affect conformity. It shall verify the loaded programme and selected effectivity before execution. Work shall remain associated with its original baseline through interruption and restart. Changes shall identify whether previously completed operations and accepted evidence remain valid. The organization shall prevent mixing incompatible component variants, firmware loads, parameter sets or production conditions within an assembly.

6.4 As-built reconciliation

Before release, the organization shall reconcile the as-built configuration with the applicable product definition, approved departures and actual evidence. The reconciliation shall include incorporated changes, rework, repairs and substitutions. Unresolved discrepancies shall remain visible and block the affected claim. Superseded documents and records shall remain retrievable where needed to interpret historical work. Configuration history shall not be overwritten when a current master file is updated.

Required evidence: Authoritative baseline, controlled instructions, effectivity, execution configuration and complete as-built reconciliation.

Decision control: Availability of a newer model or programme shall not authorize its use until effectivity and dependent process, inspection and product consequences are approved.

7 Manufacturing risk, critical characteristics and control plans

7.1 Risk evaluation

The organization shall evaluate how material variation, processing, handling, software, human action, inspection limitations and supply failures can affect product requirements. The analysis shall address the actual route and interfaces, including common causes and operations performed by external providers. Risk evaluation shall identify prevention, detection, containment and recovery controls. A numerical risk ranking may support prioritization but shall not remove a necessary control for a severe consequence merely because an assumed occurrence value is small.

7.2 Critical characteristics

The organization shall identify critical characteristics and communicate their meaning to the roles and tiers that create, preserve or verify them. It shall identify where each characteristic is established, how it can be degraded, the applicable process window and how conformity is demonstrated. The control method shall account for inaccessible features and latent effects. A critical characteristic shall not be downgraded solely because it is expensive to inspect. Where direct verification is inadequate, validated process controls and suitable supporting evidence shall be specified.

7.3 Integrated control plan

The control plan shall link product characteristics and process parameters to operations, equipment, methods, sampling, acceptance criteria, frequency, responsible roles and reaction plans. The plan shall identify mandatory hold points and the evidence necessary to continue.

Table 7-1. Control-plan relationship

Element	Required connection	Reaction when inadequate
Product characteristic	Requirement, location and acceptance rule	Restrict affected product decisions.
Process parameter	Qualified window and monitoring method	Contain output since the last justified valid condition.
Verification	Method capability and actual records	Restore suitable evidence before release.
Reaction plan	Owner, protective action and restart basis	Keep the operation or population on HOLD.

7.4 Maintenance and feedback

The organization shall update the risk analysis and control plan after a relevant change, anomaly, escape or new knowledge. It shall verify that revised controls are implemented in actual instructions, systems and supplier requirements. Repeated inspection does not automatically reduce the underlying process risk. The organization shall evaluate control effectiveness through representative evidence, including adverse cases and actual reaction to signals.

Required evidence: Manufacturing risk analysis, critical-characteristic register, linked control plan, reaction plans and verified updates.

Decision control: An unresolved critical-characteristic control gap shall prevent the affected production or release, irrespective of aggregate risk or performance scores.

8 Industrialization, production readiness and transfer gates

8.1 Readiness strategy

The organization shall define the evidence needed to progress from development to pilot production, controlled production and changed production. Each gate shall identify its object, configuration, intended volume, responsible authority and mandatory prerequisites. Readiness shall address requirements, materials, sources, processes, tooling, people, measurement, data, capacity and logistics. A successful prototype made by exceptional methods shall not demonstrate readiness of a different routine production route.

8.2 Demonstration under representative conditions

Pilot and readiness evidence shall represent the proposed production equipment, operators, materials, sequence, process windows and inspection route. Differences shall be identified and assessed. Demonstrations shall address startup, changeover, interruption and representative adverse conditions where relevant. The organization shall evaluate actual cycle time, yield, bottlenecks, rework, inspection burden and record completeness. A nominal machine rate shall not be presented as proven shipment capacity. Additional evidence shall be required where a demonstration excludes a decision-sensitive production condition.

8.3 Gate decisions and open items

Table 8-1. Manufacturing readiness gates

Gate	Required evidence	Blocking condition
Feasibility	Clear requirements and plausible technical route	Unresolved essential requirement or capability gap.
Process release	Qualified method, resources and instructions	Unqualified essential variable or missing competent role.
Pilot acceptance	Representative output and complete evidence	Unexplained failure, incomplete genealogy or invalid verification.
Production release	Effective controls, capacity and authorized baseline	Unresolved prerequisite affecting the intended production scope.

An eligible authority shall record the gate decision, restrictions and invalidation triggers. Open items shall identify the scope they block. A conditional decision shall not permit work that depends on an unmet essential condition.

8.4 Production transfer

A transfer shall compare the old and proposed sites, equipment, personnel, environment, sources, digital systems and interfaces. The organization shall identify retained evidence, changed essential variables and required new demonstration. It shall not assume equivalence from the same machine model or procedure title. The transfer plan shall control overlap, stock, partially completed work, segregation, verification and customer or design approvals. The receiving site shall demonstrate readiness before unrestricted production is authorized.

Required evidence: Readiness plan, representative demonstrations, gate records, transfer comparison and controlled production authorization.

Decision control: Production volume or schedule demand shall not convert development evidence into an unrestricted readiness decision.

9 Supplier approval, procurement and subtier control

9.1 Approval for an exact scope

The organization shall approve providers for defined products, material forms, processes, sites and conditions. Approval shall evaluate demonstrated technical capability, capacity, competence, integrity, change control and access to evidence. A general certificate, previous commercial relationship or broad catalogue description shall not substitute for this scope-specific evaluation. The evaluation depth shall reflect product consequence, process sensitivity, authenticity risk and detectability of defects. Where direct observation or representative evidence is necessary, approval shall not proceed solely on a questionnaire. Restrictions, expiry conditions and reassessment triggers shall be recorded.

9.2 Technical purchasing information

Purchase documents shall identify the exact requirement baseline, material condition, essential processes, acceptance basis, traceability, required records and delivery preservation. They shall state requirements for approved sources, special-process providers, change notification, nonconformity disclosure and access or witnessing where applicable. The purchaser shall verify that the supplier understands and accepts the relevant obligations. Purchase-order shorthand shall not create ambiguous material, finish, process or inspection requirements. Changes to the order shall be reconciled with work already started and existing inventory.

9.3 Subtier responsibilities

The organization shall determine which requirements must be transmitted through each affected tier. The immediate supplier shall identify relevant outsourced work and demonstrate effective control of its providers. Approval of a prime supplier does not automatically approve an undisclosed process site or material source. The receiving organization shall retain responsibility for assessing the suitability of the received output. Delegated inspection or source release shall define the delegate's competence, scope, records and oversight. Delegation shall not remove necessary receiving checks or the authority to reject suspect evidence.

9.4 Supplier status and records

The supplier register shall distinguish approved, restricted, suspended and removed scopes. The purchasing system shall prevent unauthorized orders against a blocked scope or site. The organization shall preserve the status applicable when each order and operation occurred. Adverse findings shall trigger risk-based containment, reassessment and communication. A supplier may remain approved for one demonstrated scope while another is restricted, provided the boundaries are effective and visible.

Required evidence: Scope-specific approval dossier, controlled supplier status, complete purchase requirements, subtier flow-down and retained receiving responsibility.

Decision control: Commercial availability or an approved supplier name shall not authorize use of an unapproved site, process, source or material condition.

10 Supply continuity, capacity and disruption response

10.1 Dependency mapping

The organization shall identify dependencies whose loss can interrupt manufacture or compromise product integrity. The assessment shall include critical subtiers, unique tooling, scarce materials, utilities, transport routes, specialist people, digital services and inspection capacity. The organization shall distinguish independent alternatives from sources sharing the same upstream material, facility, ownership bottleneck or transport exposure. Two purchasing names shall not be counted as resilient dual sourcing without examining the actual dependency.

10.2 Capacity and inventory basis

Capacity decisions shall use a declared time basis and realistic assumptions for availability, performance, yield, changeover, maintenance and verification. The organization shall distinguish gross production, conforming output and released shipments. Unplanned rework and inspection constraints shall be considered. Buffer and replenishment decisions shall use qualified, usable stock and credible lead times. Quarantined, expired, unapproved or already allocated material shall not be counted as available inventory. The calculation shall identify demand variation, life limits and the risk of excess stock becoming unusable.

10.3 Continuity arrangements

The organization shall define response options and triggers for major disruption. Options may include protected inventory, restoration, qualified alternate sources, transfer or controlled changes in delivery. Each option shall identify the evidence, authority and lead time needed before it can be used. A continuity plan shall not authorize an unqualified substitute material or process. Emergency sourcing shall preserve authenticity, technical suitability and required approvals. Where continuity cannot be maintained safely and conformingly, the organization shall communicate the actual limitation and retain the affected hold.

10.4 Exercise and recovery

Continuity arrangements shall be exercised at a depth appropriate to the dependency. The organization shall test contact routes, access to records, recovery of tooling and data, and the technical prerequisites of an alternative route. A tabletop assumption that a supplier will respond shall be distinguished from demonstrated capacity. Recovery shall reconcile inventory states, configuration, genealogy and previously issued instructions before production resumes. The organization shall assess whether the disruption affected product condition, environmental exposure or data validity.

Required evidence: Dependency map, capacity and inventory assumptions, bounded continuity plans, exercise results and technically controlled recovery.

Decision control: Delivery urgency shall not relax material identity, process qualification, essential verification or eligible release requirements.

11 Receipt, authenticity and incoming verification

11.1 Controlled receipt

The organization shall identify each received population and reconcile the order, supplier, manufacturer, quantity, packaging, markings, material condition and accompanying records. Receipt shall create a controlled status before material becomes available for use. Physical receipt shall not automatically mean technical acceptance. The receiving process shall detect damage, tampering, environmental excursions, expired life and inconsistent identity. Required certificates and test records shall identify the actual lot or serial population and applicable baseline. A certificate referring only to a general product family shall not close a lot-specific evidence need.

11.2 Risk-based verification

The incoming verification plan shall address the consequences and detectability of defects, source confidence, historical performance, material variability and authenticity risk. It shall define inspection or testing, sampling, acceptance rules and escalation before results are evaluated. Reduced verification shall require a justified basis and continuing monitoring. Supplier declarations may be part of the evidence but shall not replace necessary independent confirmation. Where destructive or specialized tests are needed, the sampling and retained population shall be controlled.

11.3 Authenticity concerns

The organization shall evaluate inconsistent markings, unexplained source changes, altered documents, implausible dates, mixed conditions and other credible signs of misrepresentation. It shall preserve packaging and evidence, prevent use or redistribution and refer the concern to an eligible investigator. Verification shall distinguish genuine origin from fitness for the application. An authentic part may still be obsolete, damaged, improperly stored or unsuitable. Conversely, a favorable functional test alone does not establish authentic origin or recover missing pedigree.

11.4 Acceptance and segregation

Acceptance shall identify the population, evidence, authorized reviewer, restrictions and next permitted use. Conditional authorization for a controlled preparatory operation shall identify how the population is contained until full acceptance; it shall not be confused with shipment approval. Suspect and rejected material shall remain effectively segregated in both physical and digital systems. Returning suspect material to a supplier shall preserve the evidence and prevent uncontrolled re-entry into the supply chain.

Required evidence: Receipt record, identity and document reconciliation, verification results, authenticity investigation and controlled acceptance or quarantine state.

Decision control: Unresolved identity, pedigree, condition or acceptance evidence shall prevent use in a conforming production claim.

12 Material selection, qualification and substitution

12.1 Application-specific material basis

The responsible technical authority shall approve the material specification, product form, condition and permitted sources for the intended application. The basis shall consider mechanical, thermal, electrical, chemical, environmental, durability and compatibility needs as applicable. Material approval shall address manufacturing effects and service exposure, including anisotropy, residual stress, coatings, contamination, aging and interactions with adjacent materials. A shared alloy name or nominal composition does not establish equivalence of different forms, processing routes or material states.

12.2 Qualification evidence and design values

The material dossier shall identify the population represented, sampling, processing history, test conditions, statistical basis and limitations of property evidence. Design values shall be distinguished from typical values, batch acceptance values and individual test results. The organization shall not use a small favorable batch as an unrestricted material allowable. Evidence shall represent relevant suppliers, production routes, thicknesses, orientations and environmental conditions, or the dossier shall bound the permitted application. Changes affecting those assumptions shall trigger an assessment before prior evidence is reused.

12.3 Substitution and equivalence

A proposed substitution shall identify the original and proposed material, source, condition, processing, compatibility and intended application. The assessment shall evaluate all affected characteristics and interfaces, not only the property most easily compared. Equivalent designation tables and commercial cross-references may inform the review but shall not constitute approval. The responsible design and materials authorities shall approve the exact substitution and its effectivity. Existing inventory and downstream product shall be included where relevant.

12.4 Restricted and reclaimed materials

The organization shall identify prohibited or restricted substances, contamination limits and required sourcing evidence for its actual products and obligations. It shall control the introduction of recycled, reclaimed, repaired or reprocessed material through an approved technical basis. Recovered material shall retain known history and an assessed population. A recycled-content claim shall not establish material qualification. Unknown contamination or degradation shall not be averaged away by blending with conforming material unless a validated and authorized process explicitly permits the transformation and demonstrates conformity.

Required evidence: Material application dossier, qualified property basis, approved source and condition, substitution assessment and controlled use of reclaimed material.

Decision control: A material certificate, trade designation or sustainability claim shall not authorize an unassessed material substitution.

13 Identification, genealogy and quantity reconciliation

13.1 Identity architecture

The organization shall assign unique identifiers at the granularity required to contain defects and reconstruct material and process history. The granularity shall reflect product criticality, variability, shared processing, inspection limits and escape consequences. Identification shall survive the relevant operations or be transferred through a verified method. Marking methods shall not damage the product or introduce unacceptable stress, contamination or interference. Where direct marking is unsuitable, controlled carriers, positions or containers shall preserve the association without ambiguity.

13.2 Parent-child relationships

Genealogy shall connect source heats or batches, received lots, split quantities, blended materials, process runs, component serials and assemblies. Each transformation shall identify inputs, outputs, quantity, units, time, location, operation and responsible record. Merging shall retain every relevant parent and its status. The organization shall prevent duplication of identifiers, unexplained quantity creation and loss of parentage during relabeling or repackaging. A new local stock number shall not replace the original manufacturer's identity and lot history.

13.3 Reconciliation and affected populations

Quantity reconciliation shall account for received, issued, consumed, returned, scrapped, sampled, lost and remaining material on a consistent basis. Differences beyond the approved tolerance shall be investigated. Reconciliation shall distinguish administrative rounding from a possible identity or material-control failure. The system shall support forward tracing from a suspect input or process to affected outputs and backward tracing from an output to relevant inputs and operations. The organization shall demonstrate this capability on representative split, merge, rework and assembly cases.

13.4 Status-preserving transfer and recovery

Transfers among systems, sites, suppliers and storage locations shall preserve identity, parentage, configuration and acceptance state. A successful file transfer or scan shall not establish that relationships and states survived correctly. When genealogy is incomplete, the organization shall contain the conservatively bounded population and seek evidence-based reconstruction. An assumption that unrecorded parts were probably unused shall not narrow the affected population. Recovery shall be approved only after relationships and quantities are reconciled.

Required evidence: Unique IDs, transformation events, split/merge records, reconciled quantities, forward/backward trace demonstrations and verified recovery.

Decision control: Product with unresolved decision-sensitive genealogy shall remain restricted; relabeling shall not restore missing provenance.

14 Storage, shelf life and environmental preservation

14.1 Defined storage conditions

The organization shall specify storage and handling conditions for each material or product class. Controls shall address temperature, humidity, light, atmosphere, cleanliness, moisture, electrostatic sensitivity, mechanical damage, chemical compatibility and security as relevant. Locations and containers shall maintain identity and status. Incompatible or contaminating materials shall be separated. Environmental monitoring shall represent the actual storage conditions, with suitable sensor placement, intervals, alarms and response responsibilities.

14.2 Life accounting

Shelf life, out-time, pot life, open-container life, use-by dates and remaining service life shall be distinguished. The approved basis shall define when each clock starts, stops or continues, the relevant environment and the required event records. Returning material to storage shall not reset an accumulated life clock unless an authorized technical basis explicitly permits it. Stock rotation shall consider technical eligibility and remaining life, not receipt date alone. The organization shall prevent expired or inadequately documented material from being issued as conforming stock.

14.3 Excursions and extensions

An environmental excursion or missing monitoring interval shall trigger containment of the affected population. The assessment shall determine exposure bounds, material sensitivity, potential degradation, required examination and eligible disposition. Product may remain visually normal while its material properties have changed. A life extension shall identify the population, original basis, evidence, technical authority, new conditions and limitations. A supplier email or a changed system date without a supported technical assessment shall not establish an extension. The original expiry and extension history shall remain visible.

14.4 Issue, return and periodic verification

At issue, the organization shall verify identity, condition, remaining life and suitability for the planned process duration. Returned material shall be assessed for exposure, contamination, packaging and quantity before re-entry into usable stock. Periodic stock reviews shall verify actual location, count, label, environmental history and system state. A cycle-count correction shall not silently remove a discrepancy that could indicate mixed identity or unauthorized use.

Required evidence: Storage profile, monitoring, life and exposure clocks, excursion dispositions, issue/return checks and authorized extension records.

Decision control: Unknown exposure or expired eligibility shall block the affected material from production use until an eligible technical disposition is recorded.

15 Facilities, equipment, tooling and maintenance

15.1 Demonstrated capability

The organization shall define the usable capability of production equipment and facilities for the actual process. This shall include combined load, geometry, environmental, accuracy, control and protective limitations. A catalogue rating shall not replace demonstration of the configured system. Fixtures, dies, molds, cutting tools, handling equipment and utilities shall be included where their condition affects output. The organization shall identify wear, drift, distortion, contamination and incorrect setup mechanisms and provide suitable checks.

15.2 Tool and programme control

Tooling shall have identity, configuration, approved use, condition and maintenance history. The organization shall verify correct installation, alignment, clamping and associated offsets or programmes before production. Interchangeable-looking tools shall be controlled where their geometry or material differs. Machine programme loading shall be linked to the product and process baseline. Access to offsets and parameters shall be controlled according to their effect. A permitted operator adjustment shall remain within a defined and demonstrated range and be recorded where required.

15.3 Maintenance and restoration

Maintenance shall be planned from condition, use, criticality and demonstrated behavior. It shall distinguish servicing from changes that can invalidate process capability or qualification. Unplanned repair, relocation, controller replacement or major adjustment shall trigger an appropriate restoration review. Before return to production, the organization shall verify relevant capability and assess output produced since the last justified valid condition. A successful empty-machine check shall not necessarily represent loaded production performance.

15.4 Workplace conditions and interfaces

The organization shall maintain suitable layout, lighting, cleanliness, material flow, utilities and protective arrangements. Concurrent activities shall not introduce unacceptable contamination, vibration, electrical disturbance or mix-up risk. Production interruptions shall preserve item state and prevent uncontrolled restart. The organization shall identify equipment restrictions visibly and in the systems used to dispatch work.

Required evidence: Equipment and tooling capability, setup checks, maintenance, condition monitoring, restoration verification and affected-product assessment.

Decision control: Equipment availability in a planning system shall not imply technical fitness for a particular process or product.

16 Competence, task authorization and human performance

16.1 Competence requirements

The organization shall define competence for material identification, production, special processing, inspection, disposition, sourcing and release. Requirements shall include technical knowledge, practical skill, record quality, abnormal-condition response and awareness of product consequences. Training attendance shall not alone establish competence. Assessment shall use representative tasks and appropriate challenge, including recognizing incorrect inputs, responding to a process excursion and preserving an unresolved hold.

16.2 Bounded authorization

Authorization shall identify the person, role, process or method, equipment or range, location, permitted decisions, supervision and review triggers. Required qualifications shall remain current for actual work. An operator authorization shall not automatically include authority to change a process window or accept a departure. Temporary staff, subcontract personnel and personnel transferred between sites shall be subject to equivalent controls. A shortage of authorized personnel shall be treated as a capacity constraint rather than bypassed through shared credentials or retrospective signatures.

16.3 Work design and handover

The organization shall evaluate human-performance risks from fatigue, workload, interruptions, language, ergonomics, difficult inspection access and ambiguous displays. Instructions and interfaces shall support correct identification, sequence and response without depending on memory where a controlled record is necessary. Shift and task handovers shall identify item state, completed operations, open work, material exposure, abnormal events and restrictions. Interrupted critical work shall resume from a verified state, not an assumed point in the sequence.

16.4 Reassessment and learning

Competence shall be reassessed after relevant changes, extended inactivity, adverse performance or an identified knowledge gap. The organization shall provide supervised practice and verify effectiveness before restoring independent authority. Lessons from errors and escapes shall improve work design and controls. Blaming an operator shall not substitute for examination of unclear instructions, unsuitable resources, misleading systems or ineffective supervision.

Required evidence: Competence criteria, practical assessments, authorization scopes, handover records, reassessment and verified learning actions.

Decision control: A typed name, shared login or completion stamp shall not substitute for an eligible person's actual execution or review.

17 Process validation, qualification and essential variables

17.1 Identify validation needs

The organization shall identify processes whose resulting conformity cannot be fully demonstrated through subsequent verification alone. It shall determine the validation and qualification evidence necessary for those processes and other risk-sensitive operations. The qualification object shall include material, product geometry or range, equipment, tooling, environment, personnel, sequence, parameters, inspection and supporting data. Qualification of a machine alone shall not establish qualification of every material-product-process combination.

17.2 Qualification plan and demonstration

The plan shall define intended scope, mechanisms, essential variables, representative conditions, output characteristics, acceptance criteria, sampling and review authority before the demonstration. It shall address boundaries and interactions that can materially affect quality. The demonstration shall produce evidence that the proposed process window achieves the required output. Witness coupons and surrogate features shall be related to actual product behavior through a justified basis. A favorable coupon shall not automatically represent an inaccessible or materially different region of a complex item.

17.3 Release and continuing control

The qualification decision shall identify the approved process window, configurations, operators or competence requirements, monitoring, verification and limitations. Executable instructions shall reproduce the qualified basis. Actual run data shall demonstrate compliance with essential conditions. The organization shall define checks that can detect loss of process control. Failure of a continuing check shall trigger containment and an assessment of the affected production interval. Final dimensional conformity shall not by itself resolve a possible latent material or process defect.

17.4 Change and requalification

Changes to an essential variable, unexplained adverse trend, loss of required records or a relevant equipment event shall trigger qualification review. The review shall identify retained evidence, gaps and the required scope of requalification or bridging. A periodic date alone shall not establish continued validity, and passing one repeat shall not erase a valid earlier failure. The organization shall preserve the original result and record the technical basis for restoring the qualified process state.

Required evidence: Process classification, qualification plan, representative results, essential-variable register, bounded release and continuing-validity records.

Decision control: Product from an unqualified or invalidated essential process condition shall not be released solely on the basis of a favorable final inspection.

18 Metallic materials, forming, thermal processing and machining

18.1 Material state and primary production

The organization shall control alloy or composition, product form, heat identity, condition and the properties required by the approved application. Casting, forging and other primary routes shall address relevant segregation, inclusions, porosity, orientation, residual stress and local property variation through qualified controls and suitable verification. Changes in melt practice, feedstock, section size, working route or source shall be assessed for their effect on the qualified material population. A common nominal grade shall not establish equivalence of different manufacturing histories.

18.2 Thermal and thermochemical processing

The approved process shall define the material and load range, equipment configuration, relevant atmosphere, thermal cycle, transfer conditions, cooling or quench controls and required verification. Actual records shall demonstrate the conditions experienced by the representative load, not only the programmed controller setting. The organization shall qualify sensor placement, load arrangement and monitoring appropriate to the process. It shall address uniformity, delay, recovery, equipment condition and interruptions. An excursion shall be evaluated against its potential effect on material condition and the actual population exposed.

18.3 Forming and machining

Instructions shall control material orientation, stock allowance, sequence, tooling, restraint, lubrication or coolant, cutting or forming conditions and required intermediate checks. Controls shall address distortion, cracking, surface damage, excessive cold work, thermal damage and contamination as relevant. The organization shall identify characteristics that become inaccessible after subsequent operations. Tool wear, offset changes and re-clamping shall be managed through a demonstrated control plan. A dimension achieved after an unauthorized process adjustment shall not establish acceptable material integrity.

18.4 Verification and disposition

Verification shall represent the specified material condition, geometry and critical regions. The programme shall define dimensional, surface, mechanical, metallurgical and nondestructive evidence as applicable. The relationship between specimens and product shall be justified. Re-straightening, re-heat-treatment, blending or local material removal shall be controlled as a change, rework or repair with an assessed cumulative history. The organization shall verify final condition and preserve every relevant process cycle.

Required evidence: Heat and form pedigree, qualified process route, actual load and machine records, intermediate checks, representative verification and authorized final material condition.

Decision control: A favorable chemical analysis or final dimension shall not substitute for required evidence of the material's processing history and resulting properties.

19 Composites, polymers, adhesives and bonded structures

19.1 Constituent and life control

The organization shall identify constituent materials, batch relationships, storage history and relevant life clocks. Resin, reinforcement, adhesive, core, sealant and consumable compatibility shall be assessed for the approved process and application. Material mixing and substitutions shall remain within the qualified basis. Out-time, thawing, open-container exposure, pot life and cure timing shall be recorded using the approved definitions. Re-cooling or re-sealing shall not erase consumed life. Unknown exposure shall be assessed as an uncertainty affecting suitability.

19.2 Preparation and layup

Instructions shall define surface preparation, cleanliness, ply or layer identity, orientation, sequence, joints, core details, geometry and tooling. The organization shall control material handling and environmental conditions that affect adhesion, moisture, contamination or defects. Critical features shall be verified before closure or cure makes them inaccessible. The traveler shall preserve actual constituent lots, layup or placement records and authorized deviations. An operator's general recollection shall not replace required contemporaneous evidence of hidden features.

19.3 Cure and bonding control

The qualified process shall define the relevant temperature, pressure, vacuum, time, ramp and dwell relationships for the actual material and geometry. The organization shall demonstrate how monitoring represents the product, including tooling and thermal-mass effects. Leakage, interrupted cycles, sensor failures and deviations from the qualified envelope shall trigger containment and technical review. Chamber air temperature alone shall not establish product cure. A witness specimen shall support only the conditions it demonstrably represents.

19.4 Verification and repair boundaries

Verification shall address dimensional, surface, internal and bond-quality characteristics appropriate to the design and detectability limits. The organization shall distinguish inspectable defects from process deficiencies that cannot be ruled out by the selected inspection. Repair or re-cure shall follow an approved basis that considers prior exposure, material compatibility, local load transfer and remaining limitations. Cosmetic acceptability shall not demonstrate structural or functional adequacy.

Required evidence: Constituent genealogy, life accounting, preparation and hidden-feature records, actual cure/bond data, inspection capability and authorized repair or disposition.

Decision control: A complete cure programme file or favorable surface appearance shall not release an item whose actual constituent condition or essential process exposure is unresolved.

20 Additive manufacturing and feedstock reuse

20.1 Defined process and part scope

The organization shall define the material, additive process, machine configuration, part family, build orientation, geometry range and intended performance basis. It shall distinguish process demonstration, material property qualification and part-specific verification. The approved route shall address anisotropy, local thermal history, support strategy, internal features, surface condition and post-processing. Qualification of one geometry or machine condition shall not automatically cover another.

20.2 Feedstock and build preparation

Feedstock shall be controlled for source, batch, condition, handling, storage and relevant contamination or degradation. Reuse, blending and recovery shall follow a validated rule with retained parentage and actual exposure history. A simple count of reuse cycles shall not replace material-condition evidence where that evidence is necessary. Build preparation shall control the authoritative geometry, orientation, nesting, supports, parameter set, machine software and output files. The organization shall verify transformations between design data and the executable build and prevent unapproved edits.

20.3 Execution, monitoring and interruptions

The build record shall identify actual machine state, feedstock allocation, environment, parameters, monitoring, interruptions and anomalies. In-process monitoring shall be validated for its intended decision and detection capability. An apparently normal monitoring signal shall not replace required product verification unless an approved technical basis establishes equivalence. Restart after an interruption shall assess the affected material state, interfaces and resulting part integrity. The organization shall identify which portions of the build are represented by supporting specimens and which remain uncertain.

20.4 Post-processing and acceptance

Removal, thermal processing, consolidation, machining, cleaning and inspection shall preserve part identity and build genealogy. The route shall address inaccessible powder, support remnants, internal passages and geometry-dependent inspection limits as applicable. Acceptance shall combine the required process, material and part evidence. A favorable coupon or one surface measurement shall not establish the integrity of every location in a complex part. Changed feedstock, software, optical or energy-delivery condition, machine repair or essential parameter shall trigger qualification impact review.

Required evidence: Qualified process/part scope, feedstock genealogy, verified build file, actual build history, post-processing and representative acceptance evidence.

Decision control: Reused feedstock or a transferred build file shall not be treated as equivalent without demonstrating that the required material and process basis remains valid.

21 Joining, welding, brazing, bonding and mechanical fastening

21.1 Joint definition and process selection

The organization shall identify the joint's materials, geometry, function, load path, environmental needs and required integrity. It shall use an approved joint and process definition with suitable inspection access and a justified method of demonstrating conformity. Joining process qualification shall represent relevant material combinations, thicknesses, joint configurations and position or access limitations. Where a bond or joint cannot be fully evaluated after assembly, the preceding process controls shall be explicitly identified.

21.2 Preparation and execution

Instructions shall control fit-up, edge or surface preparation, cleanliness, consumables, alignment, restraint and relevant process variables. Personnel and equipment shall be authorized for the actual operation. The record shall identify the joint, operation, material and consumable lots and actual process evidence as required. The organization shall control waiting periods and environmental exposure between preparation and joining where these affect quality. A repeated cleaning or joining attempt shall not be assumed harmless; its effect on material and geometry shall be assessed.

21.3 Fasteners and installation evidence

Mechanical fastening shall control fastener identity, grade, finish, condition, mating features and installation method. The process shall account for lubrication, tool configuration, access and other variables affecting the intended joint state. An installation torque value shall not be represented as a direct measured preload unless a validated relationship supports that claim. Locking, retention, orientation and accessibility shall be verified at the appropriate stage. Reuse or reinstallation shall follow an approved rule. Paint marks or witness marks alone shall not demonstrate that the required installation process was correctly performed.

21.4 Inspection, repair and continued validity

Inspection shall address the joint characteristics and relevant defect types with a demonstrated capability. The organization shall record inaccessible areas, technique limits and unresolved indications. Repair cycles shall be bounded and followed by required verification. Changes in material, consumable, equipment, joint configuration, operator qualification or essential variable shall be assessed before prior qualification is relied upon. A different filler, adhesive or fastener finish shall not be accepted solely because it appears interchangeable.

Required evidence: Approved joint basis, qualification, preparation and installation records, actual consumable identity, inspection and bounded repair history.

Decision control: A visually acceptable joint shall not be released when an essential joining or installation condition was not demonstrated.

22 Surface treatment, chemical processing and contamination control

22.1 Surface function and compatibility

The organization shall define the required surface condition and its function, including corrosion protection, adhesion, wear, conductivity, optical behavior, cleanliness or another specified property. The selected treatment shall be compatible with the substrate, subsequent processing and intended environment. The process basis shall address relevant risks such as material attack, dimensional change, embrittlement, residues, dissimilar-material interactions and masking errors. A generic finish description shall not replace required technical controls.

22.2 Chemical and process condition

Chemicals, mixtures and process media shall have controlled identity, concentration or other relevant condition, life, storage and contamination limits. The organization shall define methods and intervals for checking process condition and responding to adverse results. Actual processing shall record the relevant preparation, equipment, load, time, temperature, electrical or chemical conditions and post-treatment steps. The monitoring shall represent the process experienced by the product. Replenishment and bath maintenance shall not erase the history of an out-of-control interval.

22.3 Cleanliness and protection

The organization shall establish contamination controls appropriate to product sensitivity and subsequent operations. It shall control cleaning agents, rinsing, drying, handling, packaging and temporary protection. Visual cleanliness shall not be used as the sole criterion where chemical, particulate or molecular contamination limits are necessary. Clean and dirty areas, tools and material flows shall be separated where cross-contamination is credible. Cleaning effectiveness shall be demonstrated for the actual geometry and contaminant, including difficult-to-access features.

22.4 Verification and reprocessing

Verification shall address the specified surface properties and relevant adverse effects. Sample placement and witness specimens shall represent actual product exposure through a justified basis. The organization shall record coverage, masking and local variations where relevant. Stripping, re-coating, repeated cleaning or other reprocessing shall require assessment of cumulative material effects and remaining tolerances. A cosmetically improved surface shall not establish that the original material requirements remain satisfied.

Required evidence: Surface-function requirements, qualified chemistry and process controls, actual run condition, contamination verification and reprocessing history.

Decision control: A process-media correction shall not automatically release products processed during an unassessed prior condition.

23 Electronic assemblies, components and electrostatic control

23.1 Component identity and suitability

The organization shall control component source, manufacturer identity, part number, lot or date code, condition and permitted substitutions. It shall assess authenticity risk, obsolescence, storage and relevant environmental sensitivities. Brokered or reclaimed components shall not be represented as new original-source stock without evidence supporting that representation. The approved configuration shall identify hardware, firmware, programmable-device content and parameter dependencies. A matching package outline shall not establish electrical, environmental or reliability equivalence.

23.2 Assembly process control

Instructions shall define preparation, handling, attachment or soldering, cleaning, rework and inspection conditions. The process shall control consumable life, moisture exposure, thermal history and protection of sensitive features as applicable. Electrostatic protection shall be designed for the actual sensitive items and work environment. The organization shall verify protective equipment and practices through suitable checks and record failures that can affect exposed product. A compliant workstation label alone shall not establish effective control during an actual operation.

23.3 Programming and verification

Programming shall use approved files, versions, checks and access controls. The organization shall verify the loaded content or an equivalent reliable identity and link it to the serial item or population. Failed or interrupted programming shall not automatically produce an accepted state. Inspection and functional verification shall address the intended characteristics, test coverage and limitations. Missing test steps, bypassed fixtures or altered limits shall remain visible. A successful power-on check shall not be presented as complete conformity where additional requirements apply.

23.4 Rework and latent damage

Rework shall be authorized for the component and assembly, with control of cumulative thermal, mechanical and cleaning exposure. The organization shall assess potential latent damage, affected neighboring components and required verification. Unauthorized component replacement shall not be hidden by updating the final bill of material. Changes in components, assembly materials, programming, process settings or test software shall undergo the relevant configuration and qualification review.

Required evidence: Authentic component pedigree, assembly and environmental controls, programmed-content identity, complete test evidence and bounded rework history.

Decision control: Functional success shall not resolve an unassessed authenticity concern, prohibited substitution or essential process-control failure.

24 Harnesses, mechanical assembly, integration and foreign-object control

24.1 Assembly and interface definition

The organization shall identify the assembly configuration, component compatibility, interface requirements and sequence constraints. Kitting shall verify identity, quantity, condition, remaining life and effectivity before items reach the work location. The process shall address hidden features and access needed for inspection before closure. Temporary devices, protective covers, tooling and test connections shall have controlled removal or retention requirements.

24.2 Harness and connection integrity

Harness production shall control wire and cable identity, terminals, connectors, shielding, routing, bend or strain limits, termination and protection as defined by the product requirements. Tools and settings shall be suitable for the actual combination and condition. Verification shall address the specified electrical and mechanical characteristics, including correct circuit identity and unintended connections. Testing shall avoid damage to sensitive attached equipment. Continuity alone shall not establish every required insulation, shielding or installation characteristic.

24.3 Foreign objects and closure control

The organization shall establish foreign-object prevention, detection and accountability appropriate to product sensitivity. Controls shall address tools, fasteners, consumables, debris, packaging and personal items. Counts shall use a defined issue-and-return basis and investigate discrepancies. Before closing inaccessible areas, the organization shall verify the required internal condition and retain appropriate evidence. An unexplained missing tool or component shall trigger containment and investigation. A favorable final external inspection shall not resolve a credible internal foreign-object concern.

24.4 Integrated verification and handover

Assembly records shall link installed serials and lots, process steps, adjustments, software and required inspections to the finished configuration. Integration tests shall identify actual setup and limitations and shall not overwrite component-level failures or open conditions. At handover, the receiving owner shall verify completed work, open items, protective state and restrictions. A partly assembled item shall remain distinguishable from a completed released assembly.

Required evidence: Verified kits, interface and harness records, tool and foreign-object accountability, closure checks, as-built genealogy and controlled handover.

Decision control: An assembly shall not be closed or released while an essential internal condition, missing object or configuration discrepancy remains unresolved.

25 Measurement, inspection, nondestructive evaluation and sampling

25.1 Measurement and inspection capability

The organization shall select methods capable of resolving the required characteristic for the actual geometry, material, range and environment. Equipment calibration shall be suitable for the use and shall include relevant corrections and uncertainty. Calibration alone shall not validate an entire inspection method. The method shall identify setup, references, operators, software, detection or measurement limits and decision rules. Automated and manual methods shall be challenged with representative conforming, nonconforming and ambiguous conditions.

25.2 Nondestructive evaluation

Technique selection shall address credible defect types, orientation, size, location, material and accessibility. Reference items and demonstrations shall represent the intended inspection sufficiently to support its stated capability. The organization shall retain technique settings, coverage, indications, interpretation and reviewer eligibility. An absence of indications shall be reported within the demonstrated method and coverage limits. It shall not be expressed as proof that all defects are absent. Uninspected or inadequately accessible regions shall remain visible in the acceptance assessment.

25.3 Sampling and acceptance decisions

A sampling plan shall define the population, unit, selection method, sample size, acceptance/rejection rule and response to failures before selection. It shall justify the plan for the product consequence and defect behavior, including lot homogeneity and destructive-test constraints. Convenience samples, repeated measurements of one item and replacement of failed specimens shall not be represented as independent random sampling. A plan with zero observed defects does not establish a defect-free lot. Critical characteristics shall receive the controls justified by their risk and detection limits.

25.4 Uncertainty and invalid evidence

Conformity decisions shall apply the approved rule to valid results, including uncertainty and boundary handling where material. Results shall not be rounded into acceptance. Missing or invalid evidence shall retain the affected decision on HOLD. When equipment or a method is found unsuitable, the organization shall identify the affected historical interval and population, re-evaluate dependent decisions and notify recipients as necessary. Updating the calibration record shall not alone close the product impact.

Required evidence: Demonstrated method capability, metrology, actual inspection coverage, predeclared sampling, valid results and historical-impact assessment.

Decision control: Inspection completion, an absence of indications or a favorable sample shall not be presented as broader conformity than the evidence supports.

26 Process monitoring, capability and reaction plans

26.1 Monitoring design

The organization shall define what is monitored, why it is informative, the unit or subgroup, collection conditions, data integrity, decision rules and response. Monitoring shall address relevant process parameters and product characteristics. It shall not rely solely on a final aggregate defect count when earlier signals are necessary. The plan shall consider autocorrelation, batch effects, changing product mix, measurement limitations and low-volume production. It shall identify when the selected statistical model is unsuitable and define an alternative technically justified monitoring route.

26.2 Stability and capability

The organization shall distinguish process stability from conformity and capability. A stable process may produce unacceptable output; an unstable process may temporarily produce apparently conforming output. Control limits shall not be substituted for specification limits. Capability statements shall identify the characteristic, configuration, time period, sample, estimator and assumptions. The organization shall distinguish within-subgroup variation from overall observed variation and shall not conceal drift by selecting a favorable short interval. Confidence and model limitations shall be reported where they affect the decision.

26.3 Reaction to signals

A signal shall trigger the approved response: verify the observation, protect the process, identify potentially affected output, investigate the condition and establish a justified restart basis. Investigation shall not delay necessary containment. The affected interval shall be bounded by evidence, not automatically by the time the alarm was noticed. Repeated adjustment without a technical basis shall not be used to chase ordinary variation or suppress signals. Control limits shall not be widened merely to make the data appear acceptable.

26.4 Performance interpretation

Yield, scrap, rework, delivery and supplier metrics shall use declared denominators and consistent states. The organization shall distinguish first-pass yield from eventual yield after rework and shall disclose exclusions. A high overall yield shall not offset an unresolved critical defect. Improvement claims shall compare equivalent populations and account for changes in inspection, product mix and data capture. Reduced inspection shall require an authorized technical basis and a defined route for restoring controls when conditions deteriorate.

Required evidence: Monitoring plan, stable data definitions, capability assumptions, actual signals, reaction and affected-output records, and truthful performance metrics.

Decision control: A favorable capability index or dashboard shall not release an individual item or population with a failed mandatory condition.

27 Production software, automation and the digital thread

27.1 Intended use and baseline

The organization shall identify software and digital data that can affect manufacture, inspection, identity, status or release. This includes machine programmes, post-processors, models, scripts, automated inspection, scheduling rules, genealogy systems and interfaces. Validation shall address the intended use, consequence of error, operating conditions and complete workflow. A supplier software release note shall not establish suitability of the organization's configured implementation.

27.2 Validation and prohibited transitions

The organization shall challenge data transformation, units, identifiers, effectivity, missing input, duplicate transactions, interrupted processing and incorrect authorization. The workflow shall prevent prohibited transitions, including quarantine to released stock without eligible disposition, expired material to unrestricted issue and missing inspection to PASS. Automated or AI-assisted decisions shall have a defined domain, validated performance, uncertainty handling and human escalation. A confidence score shall not substitute for a required characteristic or eligible authority. Model or rule updates shall be controlled changes.

27.3 Access, integrity and evidence

Access shall match actual role and decision authority. Changes to programmes, limits, recipes and records shall be attributable and protected against unrecorded alteration. Original observations and meaningful history shall remain retrievable. The organization shall preserve the relationships among product baseline, execution, raw data, transformation, review and release. A checksum may demonstrate byte consistency but does not establish that the right file belongs to the right item or that its status is valid.

27.4 Recovery and incident impact

Recovery shall demonstrate restoration of identity, genealogy, quantity, configuration and decision states, as well as file availability. The organization shall reconcile transactions performed during an outage before normal dispatch or release resumes. A cyber, data or automation incident shall trigger an assessment of affected production and issued claims. Suspect outputs shall remain restricted until their technical validity is demonstrated. Restoring a server shall not automatically restore product conformity.

Required evidence: Intended-use validation, controlled software/data baselines, adverse-case tests, access and change history, semantic recovery and incident impact.

Decision control: A system-generated acceptance state shall not be relied upon when its rule, input, identity or authority is invalid or unresolved.

28 Production verification, first article and pilot evidence

28.1 Purpose and scope

The organization shall define the purpose of initial production verification and distinguish it from design qualification, process qualification and routine lot acceptance. The verification shall demonstrate that the specified production route, resources and instructions can produce an output matching the applicable product definition. The plan shall identify the representative article or population, configuration, characteristics, methods, evidence and independent review. A specially selected or specially corrected article shall not be represented as typical production without disclosing and assessing the differences.

28.2 Complete characteristic accounting

The organization shall identify every applicable characteristic and requirement, including notes, material conditions, process requirements, software content and hidden features. Each shall have an actual result or justified evidence reference and an eligible disposition. Characteristic accountability shall preserve the relationship between the design definition, inspection record and actual item. A summary stating that all dimensions were checked shall not replace traceable results where individual characteristic evidence is required. Missing characteristics shall remain open rather than being silently marked complete.

28.3 Representative production evidence

The dossier shall identify actual material sources, tooling, equipment, programmes, process qualifications, operators and inspection capability. It shall include deviations, rework, anomalies and limitations. The review shall assess whether the evidence represents the intended production rate and variation. A first article with conforming dimensions does not by itself validate every special process or establish statistical capability. The organization shall identify additional evidence required for the specific production and product claim.

28.4 Repetition and change triggers

The organization shall define when full or partial repetition is required after a design change, process change, transfer, tooling event, source change, extended interruption or adverse finding. The selected scope shall follow affected characteristics and dependencies. Partial verification shall identify retained evidence and the rationale for its continuing applicability. Renumbering a product or changing only the document title shall not avoid a required impact review.

Required evidence: Production-verification plan, complete characteristic matrix, representative actual production dossier, review and justified repetition scope.

Decision control: A completed first-article form shall not release future output produced outside the demonstrated and controlled production basis.

29 Nonconformity, rework, repair, concessions and escapes

29.1 Detection and containment

The organization shall identify nonconforming and suspect output and prevent unintended use, processing or delivery. Containment shall extend to potentially affected work in progress, stock, suppliers, shipments and delivered items, using the available genealogy and process history. The record shall preserve the requirement, actual observation, object, quantity, discovery point and initial state. Where identity or affected boundaries are uncertain, the organization shall use a conservative containment scope until evidence supports narrowing it.

29.2 Eligible technical disposition

Disposition shall be performed by an authority competent and authorized for the product and departure. Options shall distinguish rework to original requirements, approved repair, bounded concession, return and scrap. Customer or design approval shall be obtained where required; internal commercial approval shall not replace it. The technical assessment shall consider safety, function, durability, interfaces, cumulative processing and downstream effects. A concession shall state the exact population, departure, permitted use, restrictions and authority. It shall not imply that the original condition passed.

29.3 Execution and verification of action

Rework or repair shall use controlled instructions, preserve prior history and identify required verification. The organization shall record the actual action and result, including repeated attempts. Reinspection shall address both the corrected feature and relevant effects of the action. Scrap shall be controlled to prevent unintended use or re-entry as conforming stock. Destruction, defacement or other disposition shall respect actual product and information constraints and retain a record of the affected quantity and authority.

29.4 Escapes and notification

An escape assessment shall identify affected recipients, configurations, quantities and potential consequences. Required notifications shall be made within approved times and shall convey known facts, uncertainty, immediate restrictions and the next update route. Necessary containment shall not wait for a final root cause. The organization shall reconcile containment effectiveness and recipient actions. Closure shall require evidence that the population and consequences have been addressed; sending a notice alone shall not establish recovery.

Required evidence: Preserved original finding, containment scope, eligible disposition, implemented action, verification, escape notifications and recovery evidence.

Decision control: A repair, concession or passing repeat shall not erase the original nonconformity or automatically authorize a broader product claim.

30 Supplier changes, production transfers and obsolescence

30.1 Change identification

The organization shall require notification of changes that can affect supplied product or evidence. These include source, site, material, process, tooling, equipment, software, ownership of critical capability, inspection, subtiers and production discontinuation. The agreed notification point shall allow necessary review before the changed output is supplied or used. A supplier shall not classify a technically material change as administrative merely to avoid approval. The receiving organization shall identify changes detected through incoming evidence or performance even where notification was absent.

30.2 Impact and equivalence assessment

The assessment shall compare old and new configurations, mechanisms, process windows, populations and interfaces. It shall identify qualification and verification evidence that remains applicable, evidence that is invalidated and new work needed. The organization shall consider common dependencies and downstream uses. A successful test of one convenient item shall not establish equivalence across an unrepresented family. Bridging shall have an explicit technical argument and eligible approval.

30.3 Obsolescence and alternate sourcing

Obsolescence management shall identify time-critical materials, components, tooling, software and specialist capability. Last-time buys shall account for usable life, storage, authenticity, forecast uncertainty and future support. Excess purchase quantity shall not be treated as a substitute for a technically viable continuity plan. Alternate sources and replacements shall undergo the required suitability, qualification and acceptance controls. A commercially recommended replacement shall not be installed or supplied without an assessment of affected requirements and configuration.

30.4 Controlled transition

Transition shall control effectivity, old and new inventory, work in progress, labels, programmes, instructions and evidence. The organization shall prevent mixing incompatible states and shall reconcile partially completed items. The receiving decision shall state the permitted changed scope, restrictions and continuing checks. Relevant customers and internal users shall receive the updated basis and any implications for delivered products.

Required evidence: Change notification, old/new comparison, retained and invalidated evidence, alternate-source qualification and controlled transition closure.

Decision control: An unassessed material change shall block the affected supply or release even when the part number, supplier name or certificate format is unchanged.

31 Preservation, packaging, transport and custody

31.1 Packaging and preservation design

Packaging shall protect the identified product against the relevant mechanical, environmental, contamination, electrostatic and security conditions through the intended route. The organization shall identify permitted storage orientation, restraint, interfaces, temporary protections and handling equipment. The packaging basis shall consider product sensitivity and actual route conditions. Reusable packaging shall be inspected and maintained for continued suitability. A package designed for one product or route shall not be assumed suitable for another without assessment.

31.2 Pack-out verification

Before pack-out, the organization shall verify product identity, quantity, condition, release status, remaining life, required records and special handling. It shall confirm the removal or declared retention of temporary tooling and protective devices. Labels and documents shall preserve configuration and traceability without exposing restricted information unnecessarily. A transport label shall not be mistaken for a technical release. Multiple lots in one shipment shall remain individually identifiable.

31.3 Transport and handoffs

The route shall identify carriers, custody transfers, environmental needs, monitoring, security and response to delay or damage. Hazardous or restricted goods shall be handled by competent authorized parties under the applicable permissions and product-specific instructions. Each material handoff shall record the object, quantity, condition, time and receiving responsibility as required by the risk. A signed delivery receipt establishes receipt only to the extent it actually records; it does not automatically establish technical acceptance.

31.4 Excursions and returns from transit

Damage, broken seals, missing data, delay beyond a life limit or environmental excursion shall trigger a controlled assessment before use. The assessment shall identify the affected population, actual or bounded exposure and required verification. Returned shipments shall not be restored to unrestricted stock merely because the external package appears intact. The organization shall reconcile custody, conditions, identity and release status through the return route.

Required evidence: Packaging basis, pack-out verification, custody and route records, environmental monitoring and disposition of transit anomalies.

Decision control: Delivery urgency, a carrier receipt or an intact outer package shall not resolve an unassessed product-condition concern.

32 Product release, as-built dossier and truthful declarations

32.1 Release prerequisites

The organization shall define the evidence required for release of each product or population. It shall verify the applicable baseline, completed operations, material pedigree, process compliance, inspection results, configuration, approved departures, preservation and required permissions. Every mandatory condition shall be resolved for the claimed release scope. Incomplete evidence shall remain visible. A system-generated completion percentage shall not compensate for one unresolved essential characteristic or process condition.

32.2 As-built dossier

The dossier shall link the released identity and quantity to its actual materials, source lots, relevant process runs, installed components, software and inspections. It shall include rework, repairs, concessions and limitations and identify the exact supporting record versions. The organization shall confirm cross-record consistency among the traveler, genealogy, inspection, nonconformity, stock and shipping systems. Contradictory status shall be resolved before release. A certificate shall not be issued against a population different from the population supported by its evidence.

32.3 Declaration and authority

The release statement shall identify the issuer, eligible authority, product, configuration, quantity, acceptance basis, date and restrictions. It shall accurately describe the decision made and shall not imply design approval, operating permission or AF recognition that has not been granted. Authentication shall follow the approved local mechanism. Typed names and blank template fields are not self-authenticating signatures. Delegated release shall remain within the recorded scope and oversight arrangements.

32.4 Amendments and withdrawal

If an issued statement is found incorrect or unsupported, the organization shall assess affected products and recipients, restrict reliance where necessary and issue a controlled amendment or withdrawal. The record shall identify the original issue, changed information, reason, authority and recipient actions. The original history shall remain retrievable. A replacement PDF with the same filename shall not conceal a material change in release status or technical conclusion.

Required evidence: Complete release checklist, consistent as-built dossier, authenticated bounded declaration and controlled amendment or withdrawal trail.

Decision control: Shipment documentation shall not be issued with a favorable conformity claim inconsistent with a known mandatory failure, unresolved evidence gap or restricted product state.

33 Returns, field feedback, recall and corrective action

33.1 Receiving feedback and returned product

The organization shall capture relevant complaints, returns, service findings and field information and link them to product identity, configuration and genealogy. Returned items shall be contained until condition, exposure, configuration and permitted disposition are assessed. A returned item shall not be represented as unused new stock unless evidence supports that exact condition and an eligible authority permits it. Repairs, tampering, missing components and altered software shall be considered.

33.2 Population and consequence assessment

The organization shall determine whether a finding affects related lots, process intervals, suppliers, designs or delivered configurations. It shall consider common causes and incomplete traceability. A single observed failure may require broader containment when the underlying mechanism is shared. The assessment shall distinguish established facts from hypotheses and shall update the affected population as evidence develops. Notification and protective action shall reflect the potential consequence and approved response times, not only the number of confirmed failures.

33.3 Correction and root cause

Immediate correction shall be distinguished from action preventing recurrence. The causal investigation shall examine technical, organizational and interface conditions, including requirements, process windows, measurement, instructions, software and supplier control. The organization shall not close an investigation with retraining alone unless the evidence demonstrates that competence was the relevant cause and that other contributors were addressed. Corrective actions shall identify owners, scope, implementation and verification evidence.

33.4 Effectiveness and recovery closure

Effectiveness checks shall challenge the failure mechanism under representative conditions and examine whether the action created new risks. An absence of reported recurrence over an undefined period shall not automatically demonstrate effectiveness. Recall or recovery closure shall reconcile affected quantities, locations, recipient actions, replacement or repair status and unresolved residual populations. Residual uncertainty shall be communicated and controlled. Lessons shall update risk, control plans, sourcing, qualification and monitoring as appropriate.

Required evidence: Linked feedback, conservative population assessment, timely containment, causal analysis, implemented action and demonstrated effectiveness and recovery.

Decision control: Closing an administrative ticket shall not close a technical risk or an unaccounted affected product population.

34 Responsible sourcing, circular materials and environmental claims

34.1 Sourcing responsibilities

The organization shall identify material-origin, labor, environmental, substance and supply-chain information obligations relevant to its actual products, contracts and activities. It shall assign owners and define evidence needed from relevant tiers. Risk evaluation shall consider origin uncertainty, complex intermediaries, high-risk transformations and the reliability of declarations. A general supplier policy shall not be treated as evidence that a particular shipment meets a material-origin or content claim.

34.2 Reclaimed and circular flows

Reuse, remanufacture, recycling and material recovery shall preserve the technical controls necessary for product integrity. The organization shall distinguish physical material history, ownership, accounting allocation and environmental attributes. A recycled-content percentage shall not establish that the resulting aerospace material is technically qualified. Recovered streams shall be characterized for contamination, degradation, mixing and identity. The approved process shall define eligible input populations, transformations and output verification. Ineligible material shall not be diluted into apparent compliance without an authorized validated basis.

34.3 Quantified claims

A quantitative claim shall define its boundary, functional or mass basis, period, data sources, allocation method, exclusions and uncertainty. The organization shall distinguish measured values, estimates and supplier declarations. Comparable claims shall use compatible boundaries and methods. Where mass-balance accounting is used, the organization shall prevent double counting, preserve input/output reconciliation and state clearly whether the claim represents physically segregated material or an accounting allocation. It shall not describe an allocated attribute as measured physical content without evidence.

34.4 Verification and correction

Claims shall be reviewed by a competent person independent of their preparation where the risk requires it. The review shall trace material quantities and attributes to evidence and test the effect of missing data and assumptions. An unsupported claim shall be corrected or withdrawn and affected recipients informed. Environmental benefits shall not compensate for nonconforming product, unknown pedigree or an unapproved process.

Required evidence: Defined sourcing obligations, material-origin evidence, qualified circular routes, transparent calculation boundaries and reviewed claims.

Decision control: Sustainability or responsible-sourcing claims shall remain bounded by demonstrated evidence and shall not override product safety, material suitability or traceability.

35 Assurance, management review and record continuity

35.1 Risk-based assurance

The organization shall establish an assurance programme covering actual manufacturing and supply activities, interfaces and retained outsourced duties. It shall select representative products, critical processes, sites, providers and record trails, including adverse and interrupted cases. An audit shall follow evidence from a requirement through actual material, operation, verification and release, and in reverse from a delivered item. Document presence alone shall not establish effective implementation. The programme shall examine whether containment and prohibited digital transitions work in practice.

35.2 Findings and independent decisions

Findings shall identify the requirement, evidence, affected scope and consequence. Classification shall reflect technical significance and systemic reach. A favorable aggregate rating shall not neutralize an unresolved essential finding. The person authorizing closure shall be eligible and sufficiently independent of the corrective work for the decision's consequence. Closure shall verify implementation and effectiveness, not only acceptance of a proposed action plan.

35.3 Management review

Management shall review product integrity, escapes, supplier performance, process capability, capacity, life-limited inventory, continuity, resource adequacy and ineffective controls. It shall consider trends and uncertainty, including information suppressed by aggregate metrics. Decisions shall allocate owners and resources and identify affected operational restrictions. Resource constraints shall be addressed explicitly; they shall not be concealed by weakening inspection, removing criticality or redefining nonconformity.

35.4 Record retention and recovery

The organization shall approve retention periods, access, storage and disposal based on actual product, contract and obligation needs. Records needed for current claims, investigations or affected-population reconstruction shall remain available. Migration and recovery shall preserve content, relationships, configuration and decision states. Disposal shall identify the exact scope and eligible authority. Loss of essential records shall trigger an impact assessment on dependent product and process claims.

Required evidence: Assurance plan and representative trails, evidence-based findings, independent closure, management decisions and verified record continuity.

Decision control: A successful audit or management review shall not be represented as product acceptance or as permission to disregard unresolved manufacturing evidence.

36 Publication, local adoption and maintenance of the standard

36.1 Publication authority

Aerospace Federation controls the publication identity, edition and authorized interpretation. Its eligible publishing authority shall record approval separately from preparation, formatting and drafting. The publication dossier shall retain technical review, consultation, comment dispositions, consistency checks, claimed validation evidence and unresolved limitations. No document shall invent an approval, signature, recognition or effective date.

36.2 Local adoption

The adopter shall define scope, accountable roles, applicable clauses, approved parameters, local methods, technical profiles, records and transition arrangements. It shall identify the exact edition and controlled support documents. Local adoption shall not imply AF certification or recognition. The adopter shall demonstrate implementation through actual manufacturing and supply evidence; completed templates alone do not establish conformity.

36.3 Interpretations and changes

Interpretation requests shall identify the requirement, scenario, competing readings and affected decisions. The responsible authority shall preserve the question and reasoned response. Informal explanations shall not silently amend normative text. Publication changes shall identify affected requirements, rationale, technical review and transition needs. Adopters shall assess implications for profiles, instructions, systems and existing claims. Required historical editions and interpretations shall remain traceable.

36.4 Continuing coherence

The set maintainer shall keep document codes, titles, source anchors and relationships consistent. Forms, checklists and digital rules shall not apply superseded conditions without an explicit transition basis. The master list and coverage matrix provide navigation; they do not establish implementation. Actual evidence and eligible decisions remain necessary.

Required evidence: Publication dossier, controlled edition, local adoption record, interpretation and change history, and maintained document relationships.

Decision control: This review manuscript shall not be described as an approved publication or an organization's verified implementation until the corresponding authorized decision actually exists.

Annex A - Activity-based applicability and retained responsibility

Status: Normative within the proposed AF 9400 requirement set.

A.1 Selection procedure

The scope owner shall list actual activities, products, sites, lifecycle states and outsourced functions. For each row below, it shall determine whether the trigger exists, select the applicable clauses and identify the accountable owner. The table is a navigation aid; other clauses apply where their conditions are present.

Table A-1. Activity triggers and primary clauses

Activity or responsibility	Primary clauses	Boundary to retain
Raw-material producer	5-19, 25-36	Material state, population, process history and delivered pedigree.
Stockist or distributor	5-14, 25, 27, 29-36	Authenticity, splitting, life, preservation and truthful release.
Machining or forming	6-8, 13, 15-18, 25-33	Material condition, process effects and intermediate characteristics.
Special-process provider	9, 13, 15-22, 25-30, 32-36	Qualified scope, actual exposure and product-linked records.
Composite or bonded product	12-17, 19, 21-22, 25-33	Constituents, life, preparation and represented cure or bond conditions.
Additive manufacture	12-18, 20, 25-33	Feedstock, build, essential variables and geometry-specific evidence.
Electronic production	9-17, 23, 25-33	Authentic components, exposure, programmed content and test coverage.
Harness or integrated assembly	6-8, 13-17, 21, 24-33	Interfaces, hidden features, installed genealogy and closure checks.
Inspection or production data service	4-6, 16, 25-29, 32-36	Intended-use capability, raw evidence, authority and status integrity.
Packaging, storage or logistics	9-14, 27, 29-36	Identity, condition, custody, excursions and delivery restrictions.
Product owner or integrator	0-17, 25-36 plus actual processes	Retained supply, configuration, release and affected-population duties.

A.2 Multi-party closure

A responsibility matrix shall identify who specifies, performs, verifies, accepts, releases, retains records and communicates adverse information. Unassigned interfaces shall remain open dependencies. A purchase contract shall not silently transfer a responsibility that the receiving party has not accepted or cannot perform.

A.3 Non-applicability and review

Each N/A decision shall identify the absent activity or condition, supporting facts, authority and review trigger. Missing capability, records or personnel shall be recorded as a gap. A change in activity or intended use shall reopen the relevant applicability decisions.

Annex B - Mandatory parameter baseline and common record payload

Status: Normative within the proposed AF 9400 requirement set.

B.1 Parameter schedule

Each parameter below shall have an approved value, controlled reference or justified N/A decision before dependent work is authorized. A value may be a structured specification, rule, state, interval or matrix. It shall identify units, boundaries, owner, authority, effectivity and evidence basis as applicable.

Table B-1. P01-P40 parameter schedule

ID	Parameter	Required distinction or basis
P01	Scope and sites	Actual activities, retained duties and outsourced interfaces.
P02	Product definition	Authoritative configuration and effectivity.
P03	Requirement precedence	Conflicts, permissions and eligible resolution.
P04	Product criticality	Consequences and enhanced controls.
P05	Critical characteristics	Creation, preservation, verification and reaction.
P06	Material specification	Form, condition, source and application.
P07	Material property basis	Represented population, orientation and limitations.
P08	Source approval	Product/process/site scope and restrictions.
P09	Procurement flow-down	Technical records, changes, access and subtiers.
P10	Authenticity controls	Risk indicators, verification and suspect disposition.
P11	Receipt acceptance	Population, evidence, sampling and authority.
P12	Genealogy granularity	Heat, batch, lot, serial and transformation relationships.
P13	Quantity reconciliation	Units, conversion and investigation tolerance.
P14	Storage conditions	Environment, locations, alarms and response.
P15	Material life clocks	Start/stop rules, accumulation and extensions.

ID	Parameter	Required distinction or basis
P16	Manufacturing route	Sequence, hold points and hidden features.
P17	Process qualification	Object, range, essential variables and evidence.
P18	Process parameters	Actual limits, interactions, tolerance and monitoring.
P19	Tooling and equipment	Configured capability and restoration checks.
P20	Personnel authority	Tasks, ranges, supervision and reassessment.
P21	Production software	Baseline, validation, access and permitted changes.
P22	Measurement capability	Range, corrections, uncertainty and reference basis.
P23	Inspection technique	Defects/characteristics, coverage and detection limits.
P24	Acceptance decision rule	Boundaries, uncertainty, equality and unresolved states.
P25	Statistical sampling	Population, selection, sample size and disposition.
P26	Process monitoring	Subgroups, model, limits and reaction plan.
P27	First-article scope	Characteristic accountability and representative route.
P28	Nonconformity authority	Rework, repair, concession, return and scrap.
P29	Escape response	Containment, notifications, clocks and recipients.
P30	Change and transfer	Essential changes, effectivity and requalification.
P31	Capacity and buffers	Qualified resources, usable stock and assumptions.
P32	Continuity and recovery	Dependencies, triggers, alternatives and restoration.
P33	Packaging and transport	Product protection, custody and route conditions.
P34	Release dossier	Mandatory evidence, statement scope and authentication.

ID	Parameter	Required distinction or basis
P35	Return and recall	Population, actions, reconciliation and closure.
P36	Sourcing and circular claims	Boundary, origin, allocation, units and evidence.
P37	Record retention	Periods, access, relationships and disposal holds.
P38	Assurance programme	Coverage, independence, findings and effectiveness.
P39	Publication and local adoption	Actual authority, edition and effective conditions.
P40	Unresolved dependencies	Owner, blocked scope, next evidence and review.

B.2 Common payload

Every significant record shall identify its unique ID, object and configuration, site or process, creator, time basis, applicable requirements, evidence references, actual result, limitations, disposition and eligible authority. Attachments shall have stable identity and version. A signature field shall identify the authentication mechanism rather than imply authentication by appearance.

B.3 Cross-record consistency

The traveler, genealogy, stock, inspection, nonconformity, supplier and release systems shall agree on the object and relevant state. Differences shall be resolved before a dependent decision. A migration or recovery shall demonstrate preservation of relationships and history, not only file readability.

Annex C - Manufacturing plan, risk and control-plan payload

Status: Normative within the proposed AF 9400 requirement set.

C.1 Manufacturing plan

The plan shall identify product scope, configuration, volume, sites, process route, sources, make/buy decisions, equipment, people, verification, records, logistics and gate authorities. It shall distinguish development, pilot and routine production and identify what evidence permits each transition.

C.2 Control-plan minimum content

Table C-1. Required control-plan row

Field	Minimum content
Object and characteristic	Requirement ID, location, criticality and configuration.
Operation and mechanism	Where created or affected; credible failure mechanism.
Prevention	Material/process conditions and accountable owner.
Monitoring and verification	Method, equipment, capability, frequency or sample plan.
Criterion and decision	Actual limit/rule, units, uncertainty and authority.
Reaction	Protective action, affected-population basis, escalation and restart.
Evidence	Traveler/run/inspection links and retained record.

C.3 Readiness gates

A gate record shall compare required and available evidence, list gaps, identify blocked scope and record the eligible decision. Mandatory conditions shall not be traded against favorable scores. Representative production conditions and differences from the intended route shall be explicit.

C.4 Updating the plan

Changes, escapes and adverse trends shall be traced to affected risk and control-plan rows. The owner shall verify that revised controls appear in actual instructions, system rules and supplier requirements. Closing the plan action requires evidence of implementation and effectiveness appropriate to the consequence.

Annex D - Supplier approval and purchasing information

Status: Normative within the proposed AF 9400 requirement set.

D.1 Approval dossier

The dossier shall identify the provider and actual sites, proposed scope, product/process capability, subtiers, competence, capacity, integrity, evidence access and continuity dependencies. It shall retain the evaluation method, representative evidence, findings, restrictions and eligible decision.

D.2 Purchase requirement matrix

Table D-1. Purchasing and flow-down controls

Topic	Required content
Product	Exact identity, configuration, quantity and material condition.
Processes	Approved route, sources, essential controls and special-process evidence.
Verification	Criteria, method/sampling basis, witnesses and required actual results.
Genealogy	Manufacturer origin, heat/batch/serial relationships and split rules.
Exceptions	Nonconformity disclosure, authorized dispositions and escape notification.
Changes	Notification timing, approval points, subtiers and transfer restrictions.
Delivery	Preservation, life, packaging, custody and required release records.
Access and retention	Record availability, confidentiality, retention and audit rights.

D.3 Delegation

Delegated inspection or release shall specify the delegate, eligible scope, independence, methods, records, oversight and suspension conditions. The receiving organization shall retain the duty to assess the completeness and suitability of the output for its intended use.

D.4 Continuing status

Approval changes shall identify affected orders, stock, work in progress and delivered output. The system shall prevent blocked scopes from being ordered or used without the required eligible disposition. Historical approval status shall remain retrievable.

Annex E - Material pedigree, genealogy and quantity events

Status: Normative within the proposed AF 9400 requirement set.

E.1 Material pedigree record

The record shall identify manufacturer and relevant intermediaries, specification and condition, original heat or batch, local receipt lot, quantity, dates, storage needs, source documents, actual verification and acceptance state. Altered or inconsistent origin evidence shall be investigated rather than normalized into a new certificate.

E.2 Transformation record

Table E-1. Genealogy event payload

Field	Required relationship
Event identity	Unique event, time, location, responsible actor and operation.
Parents	Every input ID, configuration, quantity/unit and accepted condition.
Children	Every output ID, quantity/unit, configuration and next state.
Transformation	Split, merge, blend, machine, assemble, rework, sample, scrap or return.
Evidence	Process run, traveler, inspection and authorized departure links.
Reconciliation	Consumed, remaining, recovered, lost and unexplained quantities.

E.3 Containment demonstration

A trace exercise shall start from a suspect input or process and locate all potentially affected outputs, then start from a released output and recover the relevant inputs and operations. It shall include a split, a merge or assembly and a return or rework case where these activities occur.

E.4 Reconstruction and uncertainty

Reconstruction shall distinguish documented facts from assumptions. Missing links shall expand the conservative affected population until evidence supports narrowing it. The original incomplete state and the basis for any restoration shall remain recorded.

Annex F - Process qualification and essential-variable dossier

Status: Normative within the proposed AF 9400 requirement set.

F.1 Qualification plan

The plan shall identify the exact process object, intended product/material range, mechanism, essential variables, boundaries, representative samples, methods, criteria, independent review and decision authority. Development trials shall be distinguishable from the formal demonstration used for qualification.

F.2 Essential-variable matrix

Table F-1. Process qualification relationship

Variable family	Required basis
Material	Composition/form/condition, source range and representative pedigree.
Product geometry	Thickness, mass, orientation, features and relevant worst cases.
Equipment and tooling	Actual configuration, control, sensors, maintenance and capability.
Environment and sequence	Preparation, delay, contamination, interfaces and exposure history.
Parameters	Approved values, tolerance, interactions and actual recording method.
Personnel and software	Competence, authorization, programme and data baseline.
Verification	Output characteristics, method capability, specimens and coverage limits.

F.3 Qualification statement

The statement shall identify the demonstrated scope, conditions, limitations, monitoring, requalification triggers and authority. It shall link to complete results, including failures and deviations. A qualified process shall not imply acceptance of a run that did not satisfy its essential conditions.

F.4 Continuing validity

Checks shall address the mechanisms that can invalidate qualification. A failed check, equipment event, source change or unexplained adverse trend shall trigger containment and assessment of prior output. The restoration record shall identify evidence and the exact scope returned to an authorized state.

Annex G - Traveler, production execution and handover records

Status: Normative within the proposed AF 9400 requirement set.

G.1 Traveler identity

The traveler shall identify the product or population, effectivity, quantity, authoritative route, actual material and relevant process baselines. It shall identify the required operations, hold points, inspections, responsible roles and completion evidence.

G.2 Operation record

For each decision-sensitive operation, record actual equipment/tooling, programme, material/consumable lots, operator, time, parameters or linked run data, observations, inspection and deviations. A prefilled completion field shall not replace evidence of execution. Corrections shall preserve the original entry and reason.

G.3 Interrupted and hidden work

The record shall identify the verified state before interruption, exposure or life implications, open work and restart authority. Hidden features shall be inspected and recorded before closure. A later external check shall not be substituted where it cannot resolve the original condition.

G.4 Handover and closure

The receiving role shall confirm the transferred identity, completed operations, remaining work, restrictions and evidence. Traveler closure shall reconcile quantities, configuration, nonconformities and as-built records; it shall not by itself issue a product release.

Annex H - Inspection, sampling and production-verification records

Status: Normative within the proposed AF 9400 requirement set.

H.1 Characteristic accountability

The inspection matrix shall identify each applicable requirement, characteristic, location, configuration, criticality, method, equipment, criterion, actual result, evidence and reviewer. Notes, material conditions, processes, software and hidden features shall be included where they impose requirements.

H.2 Method and sampling payload

Table H-1. Verification record controls

Topic	Required information
Capability	Measurand or defect, range, geometry, method validation and detection limits.
Metrology	Equipment identity, corrections, reference basis and relevant uncertainty.
Sampling	Population, selection, sample identity, sample size and predeclared rule.
Conditions	Actual setup, environment, configuration and inspection coverage.
Results	Native observations, processing, missing/invalid data and limitations.
Decision	Approved criterion/rule, PASS/FAIL/HOLD/N/A, rationale and authority.

H.3 First-article dossier

The dossier shall demonstrate complete characteristic accountability and represent the actual proposed production route. It shall identify material and source pedigree, process qualifications, tools, programmes, personnel, deviations, rework and the review decision. The scope shall distinguish initial production verification from design or process qualification.

H.4 Out-of-tolerance or invalid-method impact

The assessment shall identify the last justified valid condition, potentially affected equipment use, product population, issued decisions and required actions. The organization shall preserve uncertainty in the interval and shall not narrow it solely to the most recent calibration date without evidence.

Annex I - Stock eligibility, life clocks and environmental excursions

Status: Normative within the proposed AF 9400 requirement set.

I.1 Eligibility record

The stock record shall identify material/product identity, pedigree, quantity, location, packaging, acceptance state, required environment, life-clock definitions and actual accumulated exposure. Allocated, quarantined, expired and usable quantities shall remain distinguishable.

I.2 Exposure and issue

Each relevant exposure event shall identify start, end, conditions, source of time, quantity and accountable actor. The planned use shall fit within remaining eligible life, including justified handling and contingency. Returning material to controlled storage shall not reset consumed life without an approved technical basis.

I.3 Excursion assessment

The record shall identify the affected location and population, known and uncertain exposure, monitoring reliability, material sensitivity, containment, technical evaluation and disposition. Missing monitoring data shall not be treated as evidence of acceptable conditions.

I.4 Extension and return

An extension or return-to-stock decision shall identify the original limit or condition, new evidence, population, eligible authority, new restrictions and next review trigger. Original dates and history shall remain visible. Visual acceptability alone shall not establish restored material properties or life.

Annex J - Nonconformity, concession, escape and recovery dossier

Status: Normative within the proposed AF 9400 requirement set.

J.1 Finding and containment

Table J-1. Nonconformity minimum payload

Element	Required content
Identity	Finding ID, object/configuration, population, location and discovery time.
Requirement and observation	Exact criterion, actual facts and original evidence.
Containment	Stock/WIP/shipment/recipient scope, restrictions and verification.
Assessment	Mechanism, consequences, uncertainty and affected dependencies.
Authority	Eligible design/material/process/customer roles and required approvals.
Disposition	Rework, repair, concession, return or scrap with exact permitted scope.
Closure	Actual action, verification, residual limits and authenticated decision.

J.2 Rework, repair and concession

Instructions shall identify the product, allowable actions, cumulative history, process controls, verification and acceptance basis. A concession shall retain the original failed condition and state the specific permitted departure and effectivity. It shall not create an unrestricted precedent for later lots.

J.3 Escape notification

The notification shall identify known facts, affected or potentially affected products, immediate actions, uncertainty, contact route and next update conditions. The record shall identify recipients, transmission, acknowledgment where needed and resulting actions. Urgent containment shall not await complete causal certainty.

J.4 Recovery and effectiveness

Closure shall reconcile affected quantities and locations, implemented remedies, verification and unresolved residual populations. Corrective-action effectiveness shall address the mechanism and representative conditions. An administrative closure shall not remove a technical restriction that remains justified.

Annex K - Change, transfer, obsolescence and requalification

Status: Normative within the proposed AF 9400 requirement set.

K.1 Change assessment

The record shall compare old and new product, material, source, site, equipment, process, software, inspection and intended-use conditions. It shall identify essential-variable changes, affected characteristics, populations and interfaces.

K.2 Evidence retention and bridging

Table K-1. Bridging decision matrix

Question	Required record
What remains unchanged?	Exact baseline and evidence supporting continued applicability.
What mechanism can change?	Technical comparison, dependencies and uncertainty.
What evidence is invalidated?	Affected qualification, acceptance, reports and product population.
What new work is needed?	Tests, inspection, process demonstration, pilot or first-article scope.
What is permitted during transition?	Bounded work, segregation, hold points and eligible authority.
What restores or extends the scope?	Accepted new evidence, final decision and communicated effectivity.

K.3 Transfer execution

The transition plan shall control old/new inventory, partially completed work, tooling, instructions, programmes, supplier orders and records. The receiving site or source shall demonstrate readiness for the actual scope. A plan to qualify later shall not authorize current release.

K.4 Obsolescence closure

The organization shall document replacement suitability, source approval, life and storage implications, qualification gaps and support needs. A last-time buy shall have a justified usable quantity and continuity basis. The changed claim shall be communicated to affected users and retained in configuration history.

Annex L - Release, packaging, custody and declaration payload

Status: Normative within the proposed AF 9400 requirement set.

L.1 Release dossier

The dossier shall contain the product identity, configuration, quantity, material genealogy, completed route, qualified-process evidence, inspection results, nonconformity dispositions, required approvals, preservation and eligible release. All references shall identify the actual record versions relied upon.

L.2 Pack-out and custody record

The record shall identify package and product relationships, protective configuration, labeling, remaining life, transport conditions, monitoring, carrier and required handoffs. Each relevant transfer shall preserve quantity, condition and accountable custody. Receipt and technical acceptance shall remain distinct.

L.3 Bounded declaration

Table L-1. Release statement content

Field	Required scope
Issuer and authority	Actual organization, eligible issuer and authentication reference.
Object	Product/lot/serial, configuration, quantity and condition.
Basis	Applicable requirement baseline and accepted dossier.
Result	Exact conformity or permitted departure and remaining restrictions.
Delivery	Preservation, life, handling and receiving duties.
History	Issue identity, date, amendments, supersession and withdrawal route.

L.4 Amendment and withdrawal

An amendment shall identify the original statement, changed facts or conclusion, reason, authority and recipients. Product and claim impacts shall be assessed. The original record shall remain retrievable and shall not be silently overwritten by a replacement representation.

Annex M - Sourcing, circular-material and quantified-claim records

Status: Normative within the proposed AF 9400 requirement set.

M.1 Sourcing evidence

The dossier shall identify the material, population, relevant origin or sourcing obligation, supply tiers, source evidence, risk assessment, gaps and review. A broad supplier declaration shall be linked to the actual scope it supports and its limitations.

M.2 Technical suitability of circular inputs

Recovered, recycled or remanufactured inputs shall have defined eligible populations, contamination and degradation assessment, processing controls and output qualification. Technical suitability shall be recorded separately from the environmental attribute or commercial claim.

M.3 Quantity and attribute accounting

The calculation shall state boundary, period, units, inputs, outputs, losses, allocation, inventory changes and evidence. It shall distinguish physically segregated content from mass-balance allocation and prevent double counting. Assumptions about allocation through yield loss shall be explicit and reviewed.

M.4 Claim review

A competent reviewer shall verify source data, arithmetic, boundaries, exclusions and wording. The result shall state the supported claim and limitations. Missing information shall not be converted to favorable default values. Unsupported statements shall be corrected or withdrawn through a controlled route.

Annex N - Assurance, publication and local adoption dossier

Status: Normative within the proposed AF 9400 requirement set.

N.1 Assurance programme

The programme shall identify activities, products, sites, providers, interfaces, independent reviewers, sampling rationale and timing or event triggers. Representative trails shall include adverse cases, genealogy transformations, digital restrictions and released output.

N.2 Findings and effectiveness

Findings shall retain the requirement, actual evidence, affected scope, consequence and blocked decisions. Actions shall have owners, implementation evidence and an effectiveness method. Closure shall be authorized by an eligible reviewer with the required independence.

N.3 Publication dossier

Table N-1. Publication controls

Element	Required record
Identity	AF 9400, FIRST EDITION, exact content and controlled file identity.
Technical review	Eligible reviewers, comments, conflicts and reasoned dispositions.
Consultation	Stakeholder input and responses to material technical issues.
Validation	Implementation evidence actually obtained and known limitations.
Authority	Actual publication decision and effective conditions when assigned.
Maintenance	Interpretation, correction, change and transition arrangements.

N.4 Local adoption and current boundary

This edition is a review manuscript until the eligible publication decision exists. An adopter shall separately identify local scope, parameters, authorities, methods, records, training and transition. Local adoption is not AF recognition, product release or permission to operate. Actual implementation claims require evidence from the adopted activities.

Annex O - Reproducible manufacturing and supply calculations

Status: Informative. Every value, population and outcome in this annex is synthetic. These examples explain methods and limitations; they are not material allowables, test evidence, mandatory targets or records of actual production.

0.1 First-pass yield, eventual yield and rolled yield

A hypothetical route receives 1,000 units. Of these, 920 pass without rework, 50 initially fail but pass after authorized rework, and 30 are scrapped. The categories are mutually exclusive and reconcile to the input quantity.

$$\text{First-pass yield} = 920 / 1000 = 92.0\%$$

$$\text{Eventual yield} = (920 + 50) / 1000 = 97.0\%$$

The 97.0% value does not describe first-pass performance. Reporting only eventual yield would hide the 5.0% rework burden and the original failure history. Neither percentage establishes acceptance of an individual unit with an unresolved mandatory condition. For a second illustrative route, stage first-pass yields are 0.98, 0.97 and 0.99, each defined conditionally on units reaching that stage through the intended route.

$$\text{Rolled first-pass yield} = 0.98 * 0.97 * 0.99 = 0.941094$$

The resulting 94.1094% describes the model's through-route first-pass fraction. Use compatible populations and definitions; do not multiply unrelated dashboard percentages or combine reworked and unreworked streams without explaining the accounting.

0.2 Capability and overall performance

Assume a synthetic dimensional specification from 9.90 to 10.10 mm, mean 10.04 mm, a justified within-subgroup standard-deviation estimate of 0.020 mm and an overall sample standard deviation of 0.030 mm.

$$C_p = (10.10 - 9.90) / (6 * 0.020) = 1.66667$$

$$C_{pk} = \min(0.06, 0.14) / (3 * 0.020) = 1.00000$$

$$P_p = 0.20 / (6 * 0.030) = 1.11111$$

$$P_{pk} = \min(0.06, 0.14) / (3 * 0.030) = 0.66667$$

These point estimates depend on the stated estimators and population. They do not supply an AF acceptance threshold. Investigate stability, distribution, dependence, sample adequacy and measurement effects before predictive interpretation. The larger overall variation may reflect between-group variation, drift or other conditions requiring explanation. A mean outside a specification can produce a negative centered index; it shall not be silently truncated to zero. A one-sided specification requires the appropriate one-sided expression. A high index does not release a known nonconforming item.

0.3 Control limits are not specification limits

For illustration, suppose a stable process model has known mean 10.000 mm and standard deviation 0.020 mm. Independent subgroups contain five items. A chosen three-standard-error chart gives:

$$\text{Standard error} = 0.020 / \text{sqrt}(5) = 0.00894427 \text{ mm}$$

$$\text{Lower control limit} = 10 - 3 * 0.00894427 = 9.97317 \text{ mm}$$

$$\text{Upper control limit} = 10 + 3 * 0.00894427 = 10.02683 \text{ mm}$$

A subgroup mean of 10.040 mm exceeds the upper control limit even though it lies inside the illustrative product specification of 9.90 to 10.10 mm. It signals a process-model concern; it does not by

itself identify which individual products fail the specification. The example assumes known parameters and independent, suitably distributed observations. Estimated limits, variable subgroup size, autocorrelation or low-volume mixed production require an appropriate model. Three-sigma limits are an illustrative selection, not a universal AF requirement. Follow the approved reaction plan and assess the affected population.

O.4 Measurement uncertainty and a guarded decision

Three independent standard-uncertainty contributions are 0.002, 0.003 and 0.001 mm, already expressed at the output quantity. The illustrative budget has no covariance terms.

$$uc = \sqrt{0.002^2 + 0.003^2 + 0.001^2} = 0.00374166 \text{ mm}$$

$$U = 2 * uc = 0.00748331 \text{ mm}$$

The factor 2 is illustrative; its coverage interpretation requires justification. Suppose the approved rule accepts only when the complete interval from $y-U$ to $y+U$ lies within the inclusive 9.90 to 10.10 mm specification. It rejects when the complete interval is outside; other cases remain HOLD.

Table O-1. Illustrative guarded decisions

Result y	Upper interval endpoint	Outcome under the stated rule
10.089 mm	10.09648331 mm	PASS; the lower endpoint is also inside.
10.094 mm	10.10148331 mm	HOLD; the interval crosses the upper boundary.
10.109 mm	10.11648331 mm	FAIL; the lower endpoint is 10.10151669 mm, above the limit.

The second result is nominally inside the specification but not accepted by this rule. Use unrounded calculation values. The example does not prescribe one decision rule for every application.

O.5 A finite-lot zero-acceptance sampling plan

Consider a hypothetical lot of 1,000 items containing exactly 10 defective items. Select 100 items uniformly without replacement and accept only if no defect is observed, assuming perfect defect detection. The probability of accepting this particular lot is:

$$P(\text{accept}) = C(990, 100) / C(1000, 100) = 0.34692771$$

An independent Bernoulli approximation would give:

$$P(\text{accept, approximation}) = 0.99^{100} = 0.36603234$$

The difference arises because the actual sampling is without replacement from a finite population. The plan still accepts this 1%-defective lot about 34.69% of the time under the stated assumptions. Zero defects in the sample does not mean zero defects in the remaining lot. This is a model illustration, not a recommended plan. Real selection, lot homogeneity, inspection sensitivity and defect consequence require justification. The plan's risks shall be approved before sampling; failed samples shall not be replaced merely to obtain acceptance.

O.6 Zero observed defects and an upper bound

For 125 independent representative Bernoulli observations with zero observed defects, an exact one-sided 95% upper confidence bound on the defect probability under that model is:

$$p_{\text{upper}} = 1 - 0.05^{(1/125)} = 0.02368096$$

The bound is approximately 2.3681%, not zero. It describes the confidence procedure under the assumptions; it is not a 95% posterior probability statement about a fixed unknown value without an additional inferential model. Repeated tests of one item, common-cause dependence, selective

exclusion and imperfect detection can invalidate the simple interpretation. A finite fixed lot sampled without replacement requires its own appropriate model. The calculation does not establish that a particular uninspected item is conforming.

O.7 Material reconciliation and genealogy

A synthetic receipt contains 1,000 kg. The store issues 640 kg and retains 360 kg. The issued quantity becomes 420 kg in product, 190 kg in chips, 20 kg in test specimens and 10 kg in documented process loss.

$$\text{Stock balance} = 640 + 360 = 1000 \text{ kg}$$

$$\text{Issued-material balance} = 420 + 190 + 20 + 10 = 640 \text{ kg}$$

This closes the declared mass account but does not by itself establish correct alloy identity or process conformity. Chips remain recovered material with their own identity and disposition; they do not automatically return to qualified input stock. If the recorded components sum to 635 kg, the unexplained difference is 5 kg. Investigate it against the approved measurement and reconciliation basis. Do not create a fictitious scrap transaction to force closure. Split and merge events must preserve every relevant parent even when the mass total balances.

O.8 Accumulated out-time and issue eligibility

A hypothetical material has an approved cumulative out-time allowance of 8 hours under defined conditions. Recorded exposures are 85, 110 and 95 minutes, all subject to the same accumulation rule.

$$\text{Consumed out-time} = 85 + 110 + 95 = 290 \text{ minutes}$$

$$\text{Remaining out-time} = 480 - 290 = 190 \text{ minutes}$$

A planned operation needs 150 minutes plus an approved 45-minute handling and contingency allowance, totaling 195 minutes. It exceeds the remaining allowance by 5 minutes and is not eligible under this basis. Returning the material to a freezer does not reset the 290 minutes unless a separate authorized technical basis explicitly permits it. Unknown exposure, changed temperature or a different life-clock definition requires assessment rather than automatic subtraction. These values are illustrative and shall not be used as material-specific storage instructions.

O.9 Effective equipment output and OEE

Assume a declared planned production period of 480 minutes, 60 minutes of downtime, an ideal cycle of 1 minute per unit, 360 units produced and 342 conforming units. All quantities refer to the same period and definition.

$$\text{Availability} = (480 - 60) / 480 = 0.875$$

$$\text{Performance} = (360 * 1) / 420 = 0.85714286$$

$$\text{Quality fraction} = 342 / 360 = 0.95$$

$$\text{OEE} = 0.875 * 0.85714286 * 0.95 = 0.7125$$

The equivalent calculation is 342 ideal-cycle minutes divided by 480 planned minutes, or 71.25%. This diagnostic does not establish that all 342 units are released; their individual mandatory evidence remains necessary. Declare planned-time exclusions, rework treatment and product mix. Do not improve the metric by excluding unplanned losses from the denominator or selecting an unrealistic ideal cycle. Capacity planning shall also account for downstream inspection and release constraints.

O.10 A fixed-lead-time inventory illustration

Suppose independent daily demand has mean 40 eligible units and standard deviation 8 units. Lead time is fixed at 12 days. Under a justified normal approximation and a selected factor of 1.645:

$$\text{Mean lead-time demand} = 40 * 12 = 480 \text{ units}$$

$$\text{Demand standard deviation} = 8 * \text{sqrt}(12) = 27.71281$$

Illustrative safety stock = $1.645 * 27.71281 = 45.58758$

Reorder point = $\text{ceil}(480 + 45.58758) = 526$ units

The factor, service interpretation and distribution assumptions require local approval. Variable lead time, correlated demand, minimum order quantities and shelf life change the model. Inventory position shall distinguish eligible stock, firm replenishment and commitments. Material on order is not physically available and remains subject to incoming acceptance. Quarantined or expired stock shall not be counted as usable buffer. The calculation is a planning illustration, not a supply-continuity guarantee.

O.11 Recovery gap and qualified alternatives

A hypothetical critical source has 240 usable units available and demand of 40 units per day. Its qualified stock coverage is 6 days. A demonstrated restoration route takes 9 days.

Coverage = $240 / 40 = 6$ days

Uncovered interval = $\max(0, 9 - 6) = 3$ days

Nominal gap = $3 * 40 = 120$ units

An alternate supplier promising delivery in 5 days is not a solution if an additional 6 days of necessary qualification must occur first; its earliest eligible availability is 11 days in this simple sequential case. Activities may overlap only where a technically justified plan supports the overlap. The example assumes constant demand and fully usable stock. Actual response shall include life, transport, inspection, approval and uncertainty. A continuity dashboard shall display the technical eligibility date rather than only the commercial delivery date.

O.12 Recycled-content allocation through yield loss

A synthetic batch uses 1,000 kg of input: 400 kg eligible recycled material and 600 kg other material. Output is 900 kg and documented loss is 100 kg. Under an expressly approved proportional-loss allocation:

Recycled input fraction = $400 / 1000 = 40.0\%$

Allocated recycled output = $900 * 0.40 = 360$ kg

Output fraction = $360 / 900 = 40.0\%$

Claiming $400/900 = 44.44\%$ would allocate all recycled input to output while assigning every loss to the other input, which is not the stated proportional model. A different allocation requires its own authorized evidence and transparent claim wording. Physical segregation, measured composition and accounting allocation are distinct. No quantity claim establishes aerospace material qualification, and the same environmental attribute shall not be counted again for another output without a valid accounting basis.

Annex P - Integrated manufacturing and supply-chain cases

Status: Informative. These fictional cases illustrate the decision logic. No case records actual production, a real supplier finding or an approved concession.

P.1 A split lot loses its original heat identity

A distributor receives an identified material heat and splits it into three local stock lots. Two lots retain the original pedigree; the third receives a new label linked only to the purchase order. A customer asks for a release statement covering all three. The release owner places the third lot on HOLD and prevents shipment. The investigation compares receipt, cutting, packaging, quantity and label events. A balanced quantity is supporting evidence but does not alone prove that no other material was mixed in. If reconstruction is incomplete, the conservative affected population remains restricted. The corrected route verifies parent-child identity at every split and preserves original manufacturer and heat records. Relabeling is performed only after an eligible evidence-based decision. The outcome is a bounded restored identity or a restricted disposition, not automatic acceptance because the stock looks similar.

P.2 A thermal cycle has a complete controller log but poor load evidence

A metallic batch completes the programmed cycle. The controller trace is within its limits, but a load sensor failed during a decision-sensitive interval and the load configuration differs from the qualification demonstration. The process owner contains the batch and checks whether remaining evidence represents the actual material exposure. A clean controller trace does not resolve the missing load condition. The review considers qualification scope, thermal response, sensor evidence and possible cumulative effects of another cycle. Any repeat processing requires an approved technical basis and preserves the first cycle. Final hardness alone is not assumed to demonstrate every required material property. Closure identifies the exact evidence supporting acceptance, approved reprocessing or another disposition.

P.3 Composite out-time is reset by a stock-system return

Material is issued for layup, returned to cold storage and later reissued. The stock system displays a full allowance because a return transaction reset the clock. Paper records show prior exposure that should have accumulated. The team restricts the material and identifies all work that relied on the incorrect state. It reconstructs exposure from reliable timestamps and applies the actual material rule. Unknown periods remain uncertainty rather than zero exposure. The digital workflow is corrected to preserve the cumulative clock through return, split and reissue. Validation challenges demonstrate that a return cannot restore consumed life without an authorized extension. The product assessment and the software correction are separate closure activities.

P.4 Reused additive feedstock is mixed without retained parentage

A recovered powder stream is blended with new feedstock. The mixture passes one screening check, but records do not identify every recovered parent or its exposure. Several builds use the blend. The organization contains the blend and traces potentially affected builds, post-processing and delivered parts. One favorable screening result does not establish all required contamination, degradation or material-property conditions. Qualification of a feedstock-reuse rule cannot be assumed after the blend has already been used. The technical authority determines what evidence can establish suitability and what population remains unresolved. Future recovery records preserve parentage, actual condition and the approved blending basis. An environmental claim about reuse does not change the technical disposition.

P.5 A post-processor change alters an uninspected feature

A machine programme is regenerated after a post-processor update. Most measured dimensions remain acceptable, but a toolpath change affects a hidden feature not included in the routine check. A pilot item reveals the discrepancy. The organization restricts output generated by the affected software and identifies the interval and configurations. It compares source geometry, executable programmes, machine setup and inspection coverage. A passed general software installation test does not establish correct intended-use transformation. Correction includes validated adverse geometry cases and a controlled software baseline. Product disposition addresses the actual feature and affected population, while change review determines whether additional first-article or process evidence is required.

P.6 An automated stock rule releases quarantined material

An integration script interprets any completed inspection task as accepted stock. A material lot with a completed but failed inspection becomes available to production. No shipment has yet occurred, but part of the lot has been consumed. The team disables the affected transition, contains the parent and descendants and preserves transaction logs. It separates task completion from evidence validity and from the acceptance decision. The consumed portion remains traceable through genealogy. Validation challenges now include FAIL, HOLD, missing results, duplicate transactions and unauthorized approvals. Recovery verifies item states and relationships rather than merely replaying files. Closure requires both corrected workflow evidence and a technical disposition of every affected output.

P.7 A chemical-process excursion is discovered after delivery

A process-media check shows that a surface-treatment bath was outside its approved condition. The last reliable acceptable check predates several runs, including shipped items. The provider initially proposes correcting the bath and closing the issue. The receiving organization requires an affected-interval assessment and identifies product populations, requirements and recipients. Restoring the bath addresses future work but does not establish prior product conformity. Available run data may narrow the interval only through a technical argument. Notifications describe known facts, uncertainty and immediate restrictions. Verification or authorized disposition addresses the actual product effects. The provider's corrective action is reviewed separately for effectiveness and subtler communication.

P.8 Two alternate suppliers share one critical upstream source

A continuity plan lists two approved providers and assumes independence. A disruption reveals that both obtain the same qualified material from one upstream plant and rely on the same specialist process. The organization revises the dependency map and uses only usable, traceable stock in the coverage estimate. Commercial delivery promises from an unqualified alternative are separated from the earliest technically eligible date. The plan communicates the actual gap rather than presenting two supplier names as assured resilience. Longer-term action may include a demonstrated alternative, protected inventory or a controlled product change. Each option retains material qualification, source approval and release requirements. Schedule pressure does not create an emergency technical equivalence.

P.9 A recycled-content claim ignores process losses

A supplier claims that all certified recycled input remains in the finished output while assigning all processing loss to other inputs. Its published calculation implies a higher content fraction than its approved proportional allocation permits. The claim reviewer reconstructs input, output, inventory and loss quantities and checks attribute ownership and possible double counting. The unsupported statement is corrected and receiving users are informed where their claims relied on it. The review separately verifies whether the recovered input and production route were technically qualified. A corrected environmental percentage cannot remedy an unapproved material source, and material conformity alone cannot validate an unsupported environmental claim.

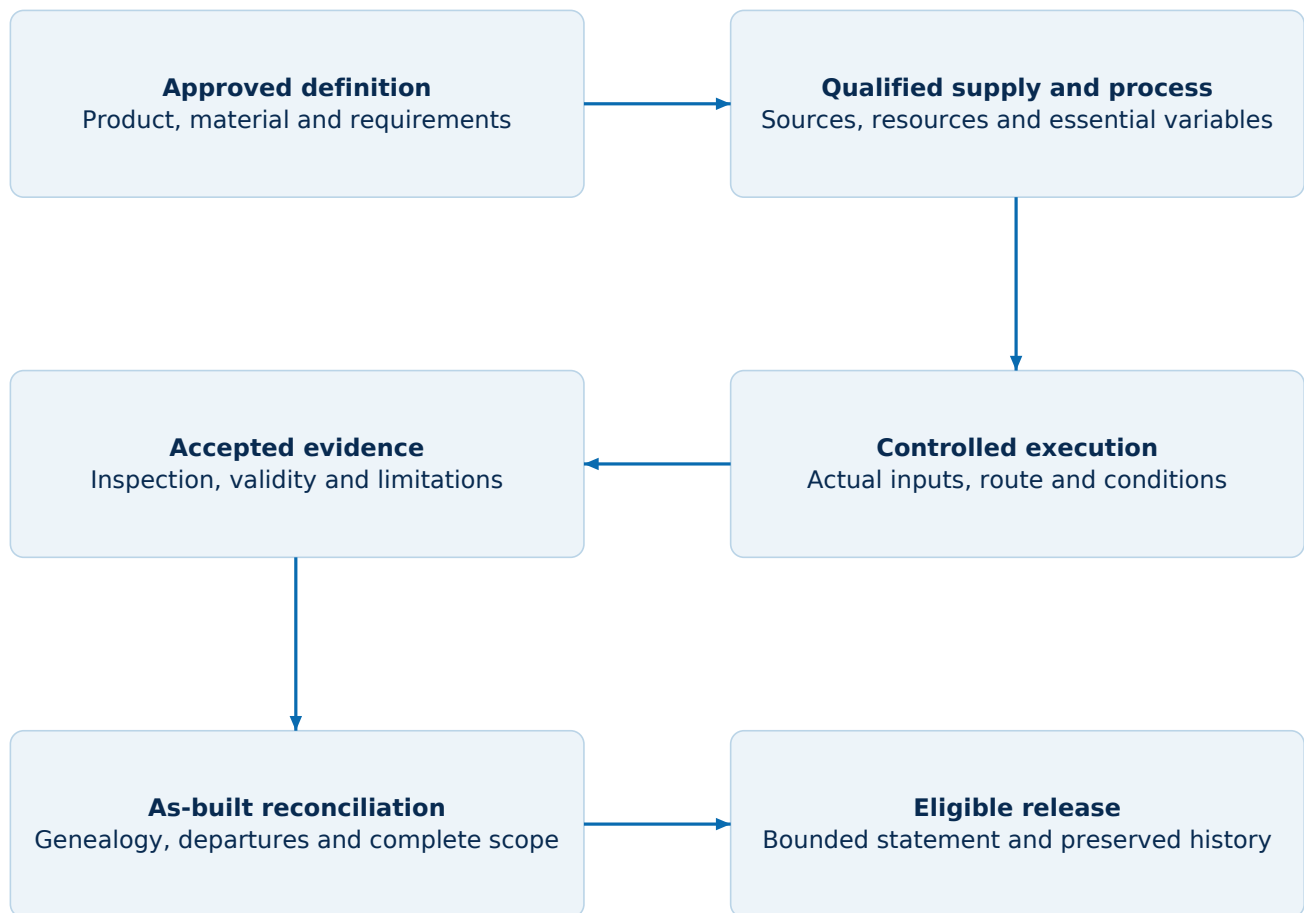
P.10 A returned electronic assembly passes a functional check

A returned assembly powers on and passes a short functional check. Its custody and environmental history are incomplete, and a component appears to have been replaced. The warehouse proposes returning it to new-stock inventory. The organization retains a returned/restricted state and investigates configuration, authenticity, exposure and prior use. The functional result supports only the functions actually checked under the test conditions. It does not establish unused condition, original configuration or absence of latent damage. An eligible disposition may require further evidence, approved repair, restricted use or scrap. The item is not relabeled as new merely because it works. Its original and returned histories remain linked to any subsequent release.

Annex Q - Manufacturing assurance and decision diagrams

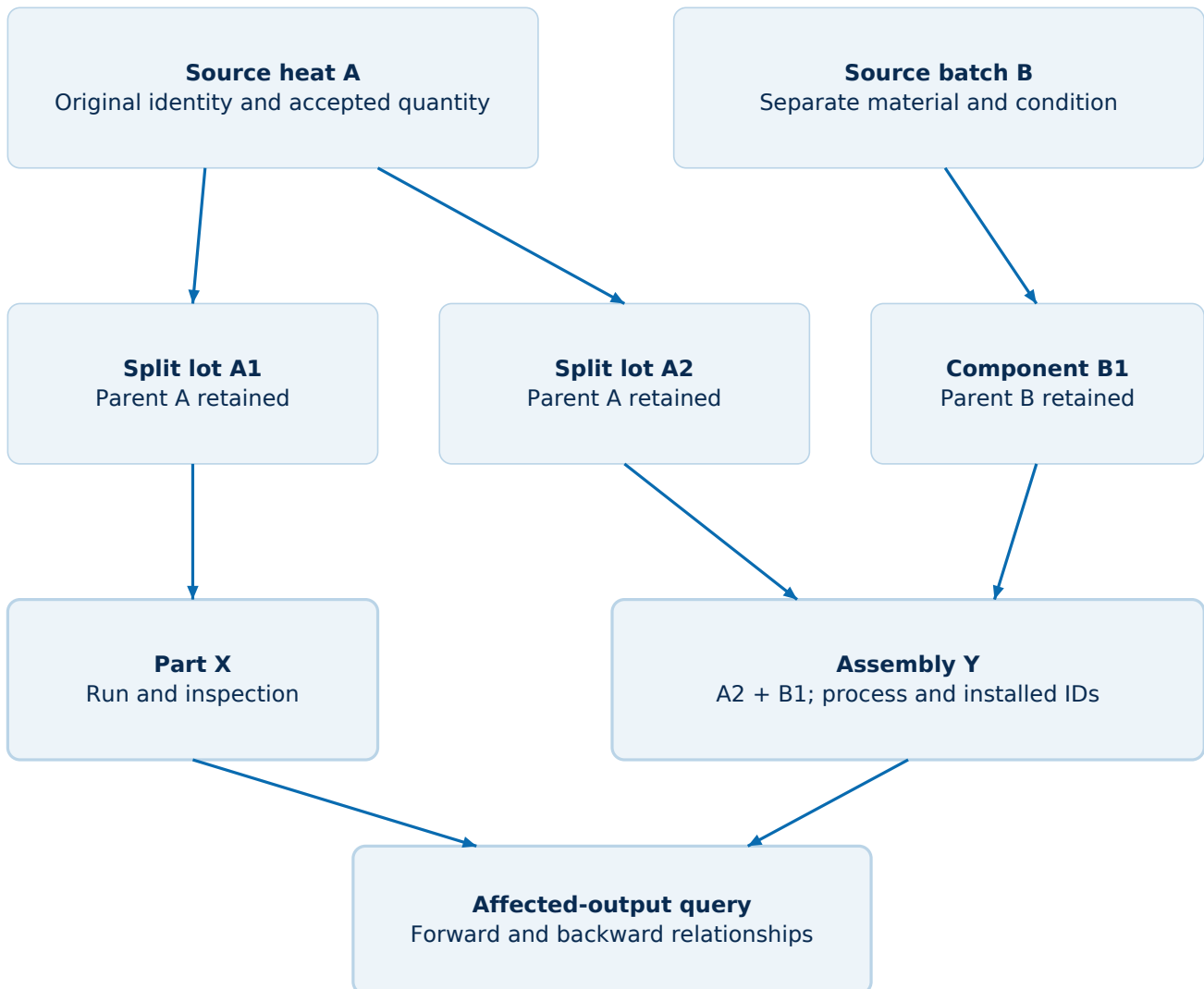
Status: Informative. The diagrams summarize relationships; applicable requirements remain in the main clauses and normative annexes.

Q.1 Requirement-to-release chain



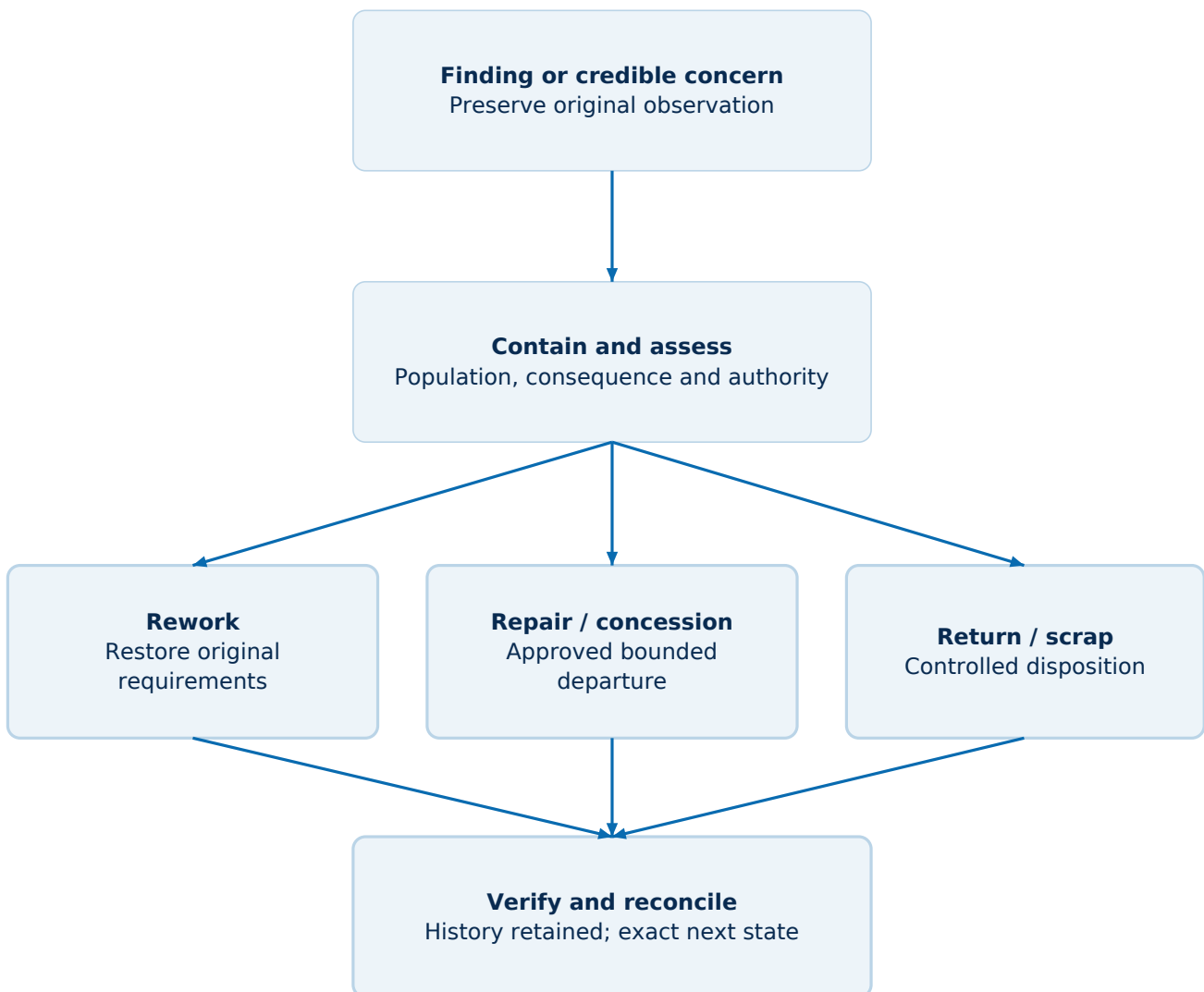
The final release combines accepted evidence for the exact object and configuration. A weakness in one essential relationship cannot be compensated by favorable evidence elsewhere.

Q.2 Split, transformation and assembly genealogy



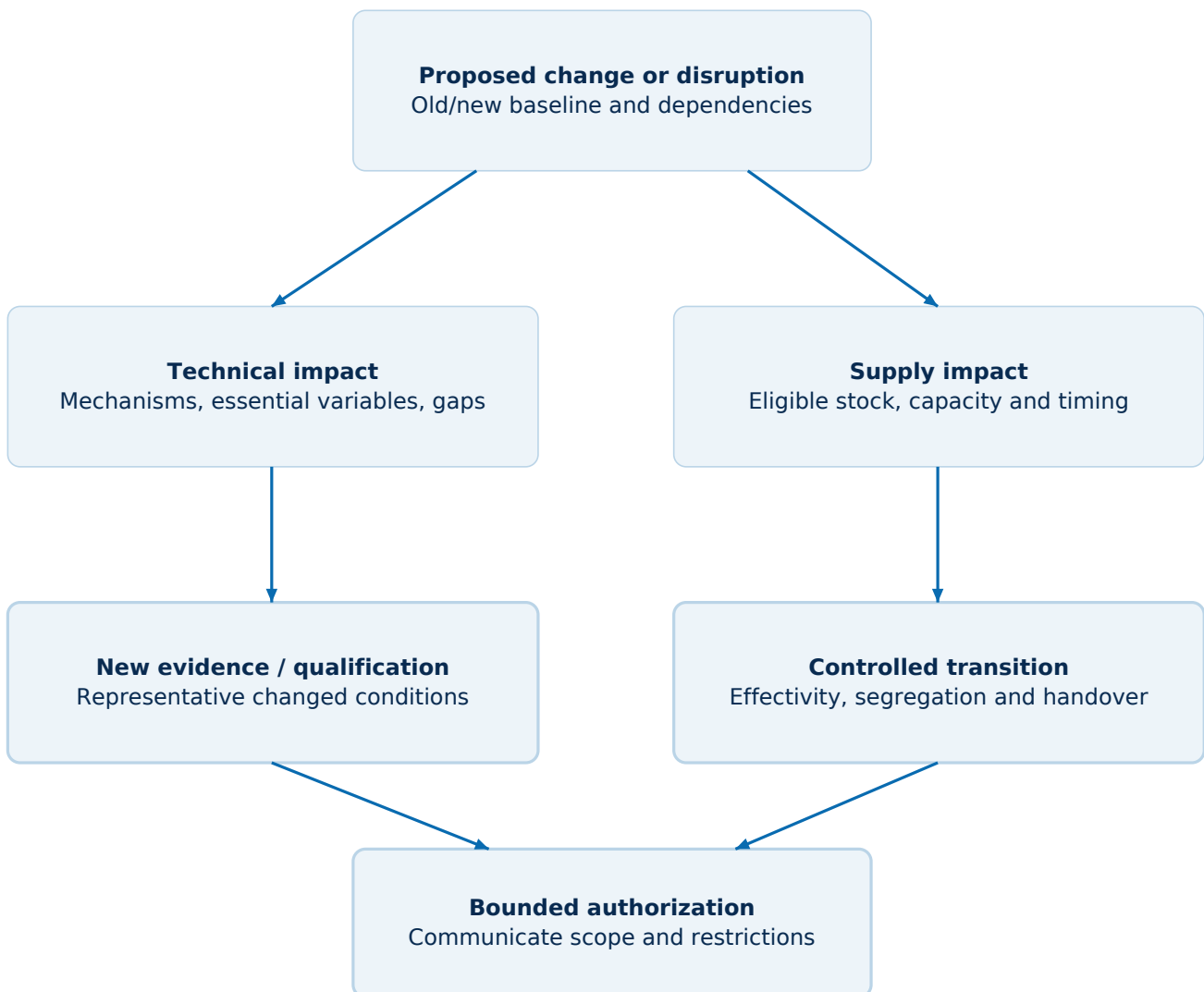
Every child retains its relevant parent relationships and quantities. Rework and return add history rather than replacing origin. A suspected parent can affect several finished outputs.

Q.3 Nonconformity, containment and eligible disposition



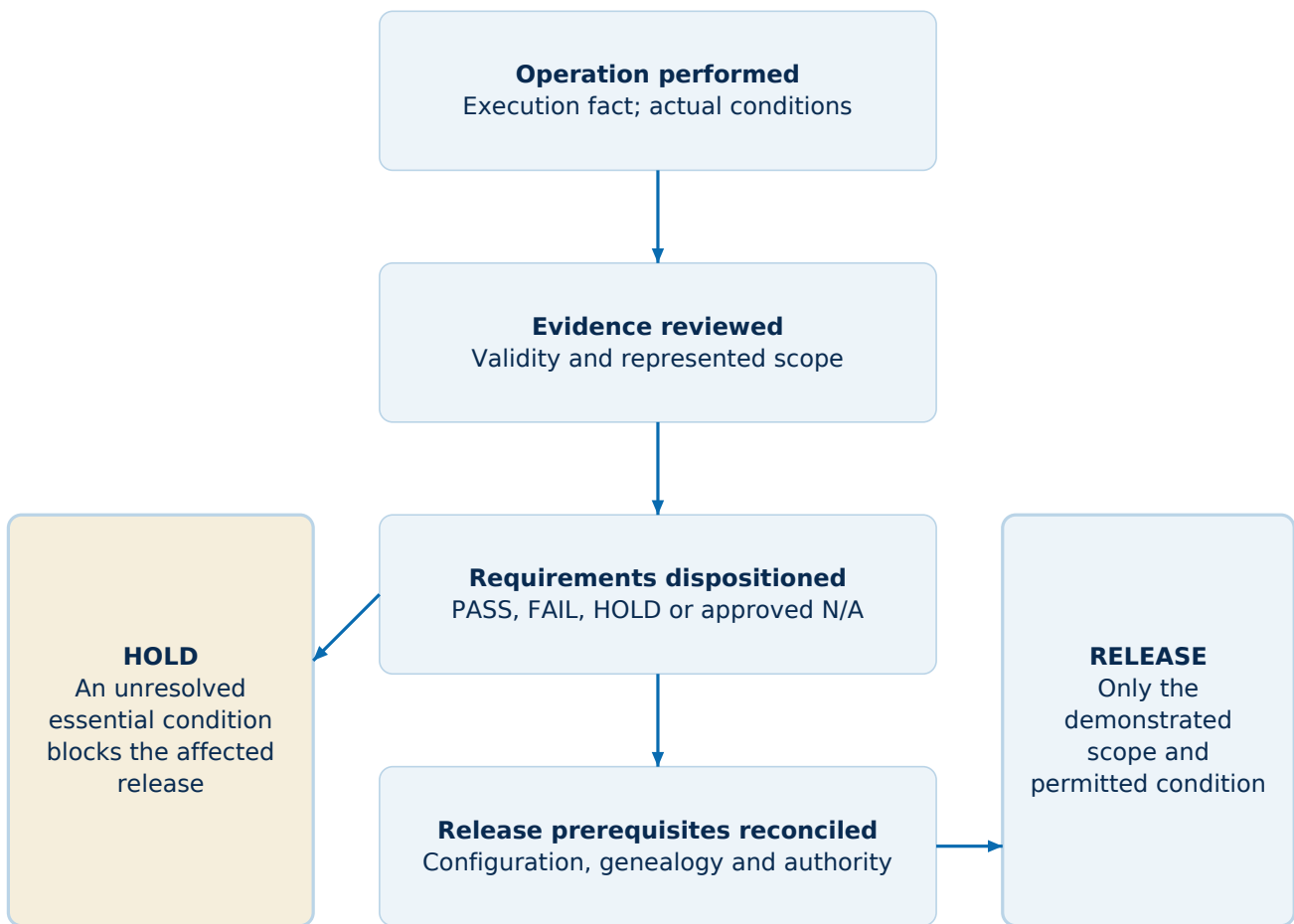
Protect the population before causal certainty where the consequence requires it. A permitted repair or concession preserves the original finding and remains bounded by its authority.

Q.4 Change and production continuity



Commercial availability and technical eligibility are different conditions. Production transfer or alternate sourcing requires evidence for the changed material-process-product combination.

Q.5 Separate operation, evidence and release states



Completion of work is an execution fact. Evidence validity, requirement conformity and product release are separate decisions. An unresolved essential condition retains the affected release on HOLD.

Annex R - Activity-based implementation routes

Status: Informative. Routes help adopters select an initial workflow. They do not waive other requirements triggered by actual activities.

R.1 Material producer

Begin with the material specification, application, represented property population and approved production route. Establish heat/batch genealogy, process qualification and actual run evidence. Link delivered material declarations to the exact population and condition. Demonstrate how an adverse process finding identifies downstream lots. Primary route: Clauses 5-19, 25-36 and Annexes B-F, H-L.

R.2 Distributor or stockist

Begin with source confidence, receipt acceptance, original pedigree and the rules for splitting and repackaging. Establish life and environmental controls and verify that stock eligibility survives transfers. Demonstrate forward and backward tracing through a split, a return and a shipment. Primary route: Clauses 9-14, 27, 29-36 and Annexes D-E, I-L.

R.3 Machining and metallic-product manufacturer

Connect product characteristics to material condition, operation sequence, equipment, tooling, programmes and intermediate checks. Identify hidden features and process effects not resolved by final dimensions. Demonstrate first-article accountability and a tool or programme change assessment. Primary route: Clauses 6-8, 12-18, 25-33 and Annexes C, F-H, J-L.

R.4 Special-process or composite provider

Define the qualified material/product range and essential variables, then demonstrate how actual product exposure is recorded. Preserve constituent identity, life, preparation, load and cycle evidence. Exercise an excursion assessment that includes prior delivered output. Primary route: Clauses 12-22, 25-30, 32-35 and Annexes E-J.

R.5 Additive-manufacturing provider

Establish the relationship among qualified material, configured machine, build preparation, actual build and part-specific evidence. Control feedstock reuse and post-processing genealogy. Challenge an interrupted build and a changed software or machine condition. Primary route: Clauses 12-17, 20, 25-33 and Annexes E-H, J-L.

R.6 Electronic, harness or integration organization

Control authentic component sources, environmental exposure, assembly processes, programmed content, interfaces and hidden features. Verify test coverage and prohibit automatic success for missing data. Exercise a returned-item assessment and an as-built reconciliation. Primary route: Clauses 6-17, 21, 23-33 and Annexes C-E, G-L.

R.7 Supply-chain owner and logistics provider

Map actual subtiers, capacity and common dependencies. Distinguish stock availability from technical eligibility and commercial delivery from release. Establish protective packaging and accountable custody through the actual route. Exercise disruption recovery and a transit excursion. Primary route: Clauses 5, 9-14, 27, 29-36 and Annexes D-E, I-N.

R.8 Digital production or inspection service

Define the intended decision supported by each system and validate the complete configured workflow. Separate execution, validity, acceptance and release states. Challenge wrong identifiers, units, missing results and recovery. Demonstrate that product relationships and authorities survive a system migration. Primary route: Clauses 4-6, 13, 16, 25-29, 32-36 and Annexes B, E, G-H, J-N.

Annex S - Interpretation questions and boundary examples

Status: Informative. Answers explain the proposed standard and do not supply product-specific approvals or numerical parameters.

S.1 Does an approved supplier make every delivery acceptable?

No. Approval has a defined scope, site and conditions. Each delivered population still requires the applicable identity, condition, evidence and acceptance controls. An approved supplier can deliver a nonconforming or wrongly configured item.

S.2 Can a material trade name establish equivalence?

No. Product form, condition, source, processing, orientation and intended application may affect properties. An eligible material and design assessment is required for a substitution; a commercial cross-reference alone is insufficient.

S.3 Does final inspection replace process qualification?

No. Some process effects cannot be fully demonstrated by the selected final inspection. Qualification and actual essential-variable control remain necessary where required. A favorable dimension does not resolve a possible latent material deficiency.

S.4 Can returning material to cold storage reset out-time?

Only if an approved technical basis explicitly permits the relevant reset. The default is to preserve actual accumulated exposure under the applicable rule. Stock transactions cannot create material life.

S.5 Does zero observed defects prove a defect-free lot?

No. The conclusion depends on the population, sampling, detection capability and statistical model. A zero-defect sample may still have a substantial probability of occurring in a defective lot. The sampling risk shall be understood before acceptance.

S.6 Is a high Cpk sufficient for product release?

No. The estimate has a defined population, time period, method and assumptions. It does not close an individual failed requirement or replace required process, genealogy, inspection and release evidence.

S.7 Can a concession turn FAIL into PASS?

A concession can permit a specific departure where the necessary authority exists. It does not change the original observation or establish that the original requirement was met. The permitted scope and remaining restrictions shall remain explicit.

S.8 Does a first article approve all future production?

No. It supports a stated representative route and configuration. Changed essential variables, sources, tooling, software or other conditions can require additional demonstration. Routine output still needs its applicable controls and release evidence.

S.9 Are two purchasing sources necessarily independent?

No. They may share an upstream plant, material, process, tooling or transport bottleneck. Resilience shall be assessed through actual dependencies and technically eligible recovery routes.

S.10 Can recycled material be used automatically because it is sustainable?

No. Technical suitability, source approval, process qualification and acceptance remain necessary. Environmental attributes and aerospace material conformity are separate claims with different evidence.

S.11 Does a restored database mean production can resume?

Not automatically. Identity, genealogy, quantities, configuration, restrictions and decision states must be reconciled. File availability alone does not establish semantic recovery or product conformity.

S.12 Does this document set confer AF recognition or operating permission?

No. Publication, local adoption, verified implementation, product release, recognition and operating permission are separate decisions. This set provides proposed requirements and implementation models; it does not invent any of those approvals.

Annex T - Navigation and implementation crosswalk

Status: Informative. The supporting master list and clause coverage matrix provide the complete document route.

T.1 Requirement families

Table T-1. Core navigation map

Requirement family	Clauses	Main normative annexes
Scope, authority and baseline	0-6	A-B, N
Risk, industrialization and readiness	7-8	C
Suppliers and continuity	9-10, 30	D, K
Receipt and material suitability	11-12	D-E, H
Genealogy, stock and life	13-14	E, I
Resources and qualified processes	15-17	F-G
Technical manufacturing activities	18-24	C, E-H
Measurement, monitoring and digital evidence	25-27	E, G-H
Production verification	28	C, H
Nonconformity and recovery	29, 33	J
Logistics and release	31-32	L
Sourcing and circular claims	34	M
Assurance, records and adoption	35-36	N

T.2 Practical implementation order

Start with one representative product and its actual route. Establish the scope, roles, parameter baseline and source requirements. Demonstrate material genealogy, process capability, actual execution and verification. Complete a bounded release and then exercise an adverse condition, a change and a recovery. Expand only after the pilot's required controls are demonstrated.

T.3 Completeness questions

Can the organization identify what was required, what material was used, what actually happened, what evidence is valid and who was authorized to decide? Can it locate every potentially affected output when an input, process or data record becomes suspect? Can it preserve these relationships through a split, merge, rework, return, transfer and system recovery? An unresolved answer identifies a gap in the assurance chain, even where individual documents appear complete.