



QUALITY MANUALS | FIRST EDITION

Remanufacturing and Circular Economy

Automotive Quality Manual

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Core acceptance, industrial restoration, product verification
and traceable release to the aftermarket

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Publication identity and use

This manual defines how an organisation accepts used automotive cores, restores them through controlled industrial processes and releases remanufactured products against a declared technical specification. It links product quality with component genealogy, customer information and verified circularity outcomes.

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Application of requirements

“Shall” identifies a requirement when adopted by an organisation or agreement.

“Should” identifies a recommendation. The responsible organisation shall implement the requirements through competent personnel, validated methods and controlled local specifications. Worked examples use fictional data and establish no universal test setting, tolerance or operating permission.

Publication and operational acceptance

Stable Release identifies the completed publication text. Actual technical validation, permits, product decisions and safe work authorisations shall be recorded by the responsible organisation. Mandatory requirements and current product-specific safety instructions remain controlling for the operation. Using this manual alone does not confer certification, accreditation, Corporate Recognised status or IAF mark rights.

Control of local implementation

Maintain exact legal identifiers, applicable dates, technical limits and operating parameters in controlled local registers. Use the annexes to build case records with actual evidence, names and dates. Apply the IAF Documents and Records Guide to revisions, retention, access and disposal. No approval or historical implementation is implied by a blank form or an illustrative calculation.

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1 Purpose and operating scope

1.1 This manual defines the controls for returning used automotive components to a specified condition through an industrial remanufacturing process. It covers alternators, starters, engine blocks and assemblies, transmissions, electronic control units and related product families expressly approved by the organisation. The intended output is a traceable remanufactured product that meets its declared performance, durability and safety specification.

1.2 The accountable director shall identify each operating site, product family, customer group and destination market within scope. Collection, disassembly, cleaning, inspection, restoration, replacement, assembly, testing and release shall form one controlled route even when different organisations perform individual stages. No stage may disappear from the record because a supplier calls its output serviceable.

1.3 The organisation shall distinguish remanufacturing from used-part resale, local repair, cosmetic refurbishment and material recycling. A part that has only been cleaned and tested shall not be described as fully remanufactured when the approved route requires further restoration or replacement. Product status shall remain visible in purchasing, stock, invoices and customer information.

1.4 This manual establishes process requirements. Family-specific drawings, test plans and authorised safe work instructions shall supply actual limits and operating settings. An operator shall stop and obtain engineering direction when the necessary specification is absent, contradictory or unsuitable for the observed core condition. Commercial urgency shall not supply a missing technical acceptance criterion.

2 Terms and product status

2.1 A core is the previously used product or assembly received as the starting material for remanufacturing. A component is an item within that core. A remanufactured assembly contains a controlled combination of accepted restored items and specified replacements. A batch identifies common processing conditions; a serial identity identifies an individual product where individual tracking is necessary.

2.2 A reference specification is the approved definition of the output, including fit, function, materials where relevant, safety, reliability, operating envelope and test criteria. A like-new claim concerns the declared characteristics against this reference. It does not mean every material in the product is new, nor establish equivalence to every later version of the original product.

2.3 A concession is a documented decision concerning a defined departure where the responsible authority may lawfully accept it. A concession shall not waive mandatory safety, market or customer requirements. Rework restores conformity to the approved specification. Repair under a different specification requires a separate status and an accurate commercial description.

2.4 A genealogy record links the core, retained components, replacement lots, process history, software and final product. Scrap is material formally removed from possible product use. Quarantine is a controlled hold pending a decision. Staff shall not treat a physical location, a painted mark or an accounting write-off as a substitute for the recorded disposition.

3 Governance and decision authority

3.1 The accountable director shall provide resources, approve scope and resolve conflicts between output targets and quality requirements. The remanufacturing manager owns the production route. Engineering owns the technical baseline and restoration methods. Quality owns verification, nonconformity control and release authority. Environmental and safety specialists approve controls within their competence.

3.2 Purchasing shall qualify core sources, replacement-part suppliers and external processors. Logistics shall maintain identity and condition during collection and delivery. The commercial function shall communicate the actual product status, application limits and warranty. Each role shall have a named deputy, an authorisation boundary and a route for escalating an unavailable decision maker.

3.3 The person authorising an unresolved technical departure shall possess the necessary competence and independence from the immediate sales incentive. A production supervisor may contain a defect or stop a process; unrestricted product release shall require the designated release authority. Access permissions in the production system shall reflect these distinctions and shall prevent shared approval credentials.

3.4 IAF committees may support technical development and consistent interpretation within their documented remit. Adoption of this manual shall not itself create statutory authority, product certification, Corporate Recognised membership or permission to use IAF marks. The operating organisation remains responsible for the product it releases and for the truth of its claims.

4 Product family adoption and readiness

4.1 Before launching a family, Engineering shall define the product boundary, compatible variants, expected core conditions, required restoration capability and intended applications. The assessment shall include known failure mechanisms, obsolete materials, unavailable technical data, counterfeit exposure and the capability to verify safety-related functions. A financially attractive core supply shall not compensate for an untestable output.

4.2 The readiness team shall produce a process map and an evidence plan. It shall identify every required inspection and replacement, specialised equipment, external operation, test coverage and retained record. The plan shall state which activities are performed on every item and which use qualified sampling or family validation. Sampling shall have a technical basis and defined reaction rules.

4.3 A controlled pilot shall challenge the route with representative variation, including worn, previously repaired and borderline cores. Engineering shall investigate failures and demonstrate that inspection separates acceptable material from unacceptable damage. Pilot products shall remain segregated until their individual conformity and the route's readiness are established.

4.4 Activation shall require an approved specification, competent personnel, functioning traceability, verified equipment, qualified suppliers, accepted pilot results and defined warranty support. The adoption record shall contain actual names, dates and evidence. Expansion to a new material, software architecture or safety function

shall receive a fresh scope assessment rather than inherit approval from a similar-looking part.

5 Legal obligations and market access

5.1 The legal and compliance owner shall maintain a controlled register for each manufacturing, processing and sales location. It shall address product safety, intellectual property, waste and product status, environmental permissions, consumer information, warranties, trade restrictions and any relevant vehicle approval requirements. Applicable editions, dates and evidence of interpretation shall be retained in the operating register.

5.2 The organisation shall establish when an incoming core is legally a product, a used part or waste, and which activities may change that status. Cross-border movements shall use the correct classification and permissions. A commercial purchase order or a remanufacturing intention shall not automatically remove waste shipment obligations or transfer lawful title.

5.3 Restoration shall preserve required safety and environmental functions. Changes to emission-related calibration, safety diagnostics or hardware compatibility shall receive the relevant engineering and market assessment. The facility shall not remove a required function, conceal a fault or mislabel an altered part in order to make an end-of-line test pass.

5.4 The compliance owner shall verify statements such as manufacturer authorised, equivalent to new, certified or approved before they appear on labels or marketing. Claims shall identify their scope and supporting decision. Unresolved legal or technical eligibility shall hold the affected transaction while competent advice establishes a lawful route; unrelated conforming products may continue under controlled segregation.

6 Reference specification and equivalent quality

6.1 Engineering shall approve a reference specification before core acceptance criteria are finalised. It shall define interfaces, geometry, material properties where relevant, functional output, leakage, electrical characteristics, noise, durability and operating conditions. A reference drawing alone may be insufficient when field reliability depends on characteristics that are not dimensioned on the drawing.

6.2 The equivalence plan shall explain how the remanufactured product meets its declared new-product benchmark. Evidence may combine design information, validated restoration methods, replacement rules, laboratory results and representative endurance testing. Each evidence item shall be linked to the characteristic it supports. A brief functional test shall not establish an unsupported service-life claim.

6.3 Where the original specification is unavailable, a competent engineering programme shall establish a lawful, testable specification for the intended application. Any limitations shall be stated explicitly. The organisation shall not infer unrestricted equivalence solely from a successful vehicle fit, a comparable output current or the absence of a diagnostic fault code.

6.4 Changes in the new-product benchmark, known field failures or replacement materials shall trigger review of the equivalence case. Engineering shall preserve the approved revision used for each released unit. If the evidence supports only a restricted application or a different performance class, the label and sales offer shall state that condition and shall not imply the broader claim.

7 Process risk and control planning

7.1 Engineering and Quality shall assess failure modes throughout collection, restoration and use. The assessment shall include concealed cracks, material degradation, contaminated internal passages, incorrect variants, retained wear items, assembly errors, software mismatch and inadequate test sensitivity. Consequences shall address vehicle safety, reliability, environmental performance and the ability to detect the error before release.

7.2 The control plan shall translate significant risks into prevention, detection and reaction controls. Each control shall specify the characteristic, method, responsible role, applicable frequency, acceptance basis and response to failure. Safety-related characteristics shall remain identifiable through outsourced operations and final assembly. Colour coding alone shall not be the only control for a critical variant.

7.3 The team shall challenge apparently effective controls with known defective or representative challenge samples where safe and technically valid. A test that cannot distinguish the relevant defect shall be revised or supplemented. Detection capability shall be reassessed after changes to fixtures, software, thresholds, materials or the population of incoming cores.

7.4 Risk reviews shall use actual process failures and warranty information. A low numerical risk score shall not override an unresolved serious hazard. Changes to the control plan shall be approved before use, communicated to affected staff and tied to an effective serial or batch boundary so that subsequent audits can determine which controls applied.

8 Core sourcing and commercial acceptance

8.1 Purchasing shall approve sources according to lawful ownership, collection practices, identification quality, condition information and response to discrepancies. Contracts shall define eligible families, prohibited conditions, documentation, contamination controls, packaging, inspection rights and the treatment of rejected cores. Return deposits and credits shall encourage timely, accurate returns without rewarding concealed defects.

8.2 The supplier shall declare available service history, prior remanufacture, fire, flood, collision and unusual chemical exposure. Missing history shall be recorded as unknown rather than converted into a clean history. Engineering shall decide whether the uncertainty can be addressed by inspection and testing or makes the core ineligible for the intended programme.

8.3 Core ownership, customer exchange obligations and the right to dismantle shall be established before irreversible processing. The receiving team shall reconcile quantity and identity against the consignment. Disputed ownership, suspected stolen goods or altered identifiers shall trigger a hold and the appropriate legal review without unsupported accusations against the supplier.

8.4 Supplier performance shall include hidden damage rates, identity errors, contamination, delivery condition and corrective action effectiveness. Purchasing shall adjust source controls using this evidence. A supplier with a high acceptance rate shall still be subject to periodic verification, particularly when economic pressure or a new collection network changes the incoming population.

9 Reverse logistics and transport

9.1 The logistics planner shall choose packaging and transport suitable for residual fluids, sharp features, fragile connectors, heavy assemblies and any regulated contents. Openings shall be protected using materials compatible with later cleaning and inspection. Uncontrolled packing debris shall not be allowed into oil galleries, bearings or electronics housings.

9.2 Collection instructions shall identify the core, preparation permitted at the collection point, handling restrictions and required documents. The collector shall not drain unknown fluids, dismantle energised equipment or perform specialised work beyond its authorised scope. Cores requiring exceptional handling shall be identified before collection so that suitable personnel and transport arrangements are available.

9.3 Each transfer shall retain consignment identity, sender, recipient, quantity, condition and time. Damage, leakage or evidence of tampering shall be documented on receipt and linked to the specific items. Where several cores share a container, the internal identification system shall survive partial deliveries and removal of individual items.

9.4 Route changes and temporary storage shall preserve segregation, weather protection and custody. Logistics shall obtain the receiving site's acceptance before redirecting damaged or contaminated material. Recovery of reusable packaging shall be tracked separately from product conformity; a circular packaging target shall not justify a container that fails to protect the core or contain residual contamination.

10 Receipt and initial triage

10.1 Receiving personnel shall verify the consignment, supplier status, core family, visible identifiers and transport condition before entering unrestricted stock. The initial screen shall look for fire or flood indicators, severe impact, leakage, damaged electrical interfaces, unauthorised modifications and missing major components. This screen identifies the next safe route; it does not establish full technical acceptability.

10.2 The operator shall assign a unique intake identity and a visible status. Items awaiting technical review shall remain separated from accepted cores and released products. The system shall prevent a returned part from inheriting a previous release status merely because its old serial number already exists in the database.

10.3 Unexpected hazards shall stop ordinary handling. The receiving supervisor shall secure the area within the site's safe response plan and seek competent support. Staff shall not energise, pressurise or rotate an uncertain assembly to discover whether it is safe. The quarantine route shall identify handling restrictions and the authorised person who may change them.

10.4 Receiving discrepancies shall be communicated to Purchasing with evidence and an agreed disposition deadline. Technical acceptance, commercial credit and ownership decisions shall remain separate records where necessary. The intake record shall preserve the original observations even when later cleaning or disassembly changes the item's visible condition.

11 Identification and component genealogy

11.1 The production system shall link the intake core to its disassembly record, retained components, replacement lots and final output identity. The chosen level of

traceability shall support investigation of a defective material, process batch or software version. Safety-related or serialised components shall retain individual identity where batch-level tracking would leave the affected population uncertain.

11.2 Where components are pooled after inspection, the pool shall contain only a defined compatible family and accepted status. Each withdrawal shall link the assembly to the relevant inspection and processing lot. A pooled inventory shall not erase prior machining history, repair restrictions or a limit on repeated restoration.

11.3 Physical marks shall be durable enough for the route without weakening the part or obscuring required original information. Electronic records shall use controlled identifiers and change history. If a mark is lost, the item shall be held until identity is re-established from reliable evidence; visual similarity shall not be treated as sufficient proof.

11.4 Genealogy shall survive rework, subcontracting, split lots and final customer returns. The system shall permit a forward search from a suspect input to all affected outputs and a backward search from a finished serial to its critical inputs. Quality shall exercise both directions using actual records and shall investigate unlinked quantities.

12 Quarantine and hazardous condition control

12.1 The site shall provide distinct hold arrangements for technical uncertainty, chemical contamination, suspected counterfeit material and immediate safety hazards. Each hold shall identify the item, reason, restrictions, responsible owner and next decision. Staff shall not assume that all quarantined cores can share the same storage or handling conditions.

12.2 Potentially energised electrical assemblies, damaged energy storage, pressurised units and pyrotechnic components shall enter the relevant specialist route. Isolation of an external connector does not establish that internal stored energy is absent. Only authorised personnel using an approved task-specific procedure may establish and document the safe work boundary.

12.3 Contamination assessment shall consider unknown oils, fuel, biological material, fire residues and incompatible cleaning chemicals. The safety and environmental functions shall define containment, exposure controls, waste classification and suitable contractors. Ordinary production cleaning shall not be used to hide or spread contamination whose identity and treatment requirements are unresolved.

12.4 Quality shall control disposition and removal from hold. A commercial manager may decide whether to return a core but may not overrule a technical safety restriction. Disposal or return shall preserve necessary evidence and lawful transport arrangements. Periodic quarantine reviews shall prevent forgotten items, expired decisions and accidental return to production.

13 Controlled disassembly

13.1 The disassembly instruction shall identify the approved family, required safe condition, special tooling, retained matches and features that must remain undamaged. Personnel shall record the as-found condition before destructive work obscures evidence. Paired or selectively fitted components shall be marked and kept together until Engineering permits pooling or separation.

13.2 The operator shall follow the approved sequence and support heavy or spring-loaded items using suitable equipment. Unusual resistance, broken fasteners, corrosion or evidence of earlier repair shall trigger the stated exception route. Improvised heat, force or cutting shall not be used where it could alter material properties or compromise a retained component.

13.3 Removed items shall be sorted into mandatory replacement, candidate reuse, further inspection and scrap streams. Status containers shall carry the core or batch identity. Small parts, shims and calibration elements shall be controlled to prevent unnoticed mixing. The disassembly record shall explain missing items and any damage created during the operation.

13.4 The supervisor shall verify completeness before releasing components to cleaning. Defect information shall be retained for supplier and design feedback. When disassembly reveals an unapproved variant or a core beyond the programme's capability, work shall stop at a safe point and Engineering shall determine whether a validated route exists.

14 Cleaning and contamination verification

14.1 Engineering shall qualify cleaning methods for each material and contamination type. The method shall define chemicals, equipment, exposure conditions, rinsing or drying requirements and protection of surfaces, coatings and electronic parts. A method that removes visible dirt may still leave abrasive particles, ionic residues or blocked internal passages capable of causing early failure.

14.2 The cleaning plan shall separate dirty intake areas from inspected and assembly-ready stock. Fixtures, baskets and reusable containers shall themselves be controlled for contamination. Process fluids shall be monitored against defined replacement or treatment criteria. Changes to detergent, blasting media or drying conditions shall receive an assessment of compatibility and residue risk.

14.3 Verification shall use the family-specific cleanliness criteria and method. Critical oilways, cooling paths, bearing seats and electrical insulation surfaces shall receive the required checks. The organisation shall validate extraction and inspection methods where cleanliness is measured indirectly. An attractive surface finish shall not replace evidence that internal contamination has been removed.

14.4 Failed cleaning shall produce a recorded hold and an approved repeat or alternative treatment. Repeated cleaning shall be limited where it may damage materials or coatings. The environmental function shall control wastewater, recovered solvents and contaminated media, while Quality shall retain the cleaning lot and verification evidence linked to the affected components.

15 Material condition and nondestructive examination

15.1 The inspection plan shall identify damage mechanisms relevant to the core's material, geometry and service history. These may include fatigue cracking, corrosion, overheating, erosion, fretting and loss of protective coatings. The selected examination method shall be capable of detecting the relevant defect in the location and surface condition being assessed.

15.2 Qualified personnel shall perform visual and nondestructive examinations using approved procedures, suitable equipment and verified reference conditions. The record shall identify the method, inspected region, indication, interpretation and acceptance

basis. Access restrictions and unexamined areas shall be explicit. A negative result from one method shall not be treated as proof that every form of damage is absent.

15.3 Engineering shall define material property checks where heat exposure, prior welding or unknown restoration could affect suitability. Uncertain material identity shall require a reliable verification route before machining or structural acceptance. Surface blending or cosmetic treatment shall not be used to remove an indication from the record without resolving its technical significance.

15.4 Reject criteria shall be applied consistently, including when a replacement core is scarce. Borderline indications shall receive competent review and additional examination where justified. Scrap controls shall prevent a rejected load-bearing part from re-entering another product pool under a different identity or a less demanding visual classification.

16 Dimensional inspection and decision rules

16.1 Each dimensional plan shall identify the datum system, characteristic, measuring method, equipment capability, temperature or other relevant condition and acceptance limit. Dimensions affected by wear, distortion, repeated machining or matched assembly shall be assessed together where their interaction determines function. A single diameter measurement shall not establish bore geometry or alignment.

16.2 Operators shall verify equipment status, fixture cleanliness and correct part orientation before recording results. Measurements shall retain units, actual values and relevant conditions rather than only a pass mark. Automated inspection software shall be version controlled and challenged after changes to programmes, fixtures or the accepted variant range.

16.3 Quality shall define how measurement uncertainty affects acceptance near a limit. The decision rule shall be approved before examining borderline production results and shall be compatible with customer requirements. Retesting with a different instrument shall investigate a suspected measurement problem, not provide repeated opportunities to select a favourable result.

16.4 Out-of-limit parts shall remain on hold pending an approved restoration route or rejection. Where machining changes a component to a controlled oversize or undersize class, the class shall appear in genealogy and assembly selection. Mixed dimensional classes shall be prevented through system controls and physical identification rather than operator memory.

17 Core grading and restoration disposition

17.1 Engineering shall establish grading categories that describe the next permitted route. A typical scheme may distinguish direct restoration, additional approved machining, specialist evaluation and rejection, but the organisation shall define its own evidence-based categories. Grades shall not conceal missing history or imply final product quality before processing is complete.

17.2 The disposition record shall combine identity, inspection findings, dimensional results, previous restoration history and applicable restrictions. The decision shall state which components may be retained, which must be replaced and which validated process is required. A decision to accept a core shall not automatically accept every item removed from it.

17.3 Repeated restoration shall be controlled where material removal, thermal cycles or repair history can affect integrity. Engineering shall define the information necessary to determine remaining restoration allowance. If essential history cannot be recovered and examination cannot resolve the risk, the affected component shall be rejected for that use.

17.4 Commercial value, yield targets and customer demand shall be considered only after technical eligibility is established. Quality shall review grading consistency across operators and suppliers. Unusual shifts in grade distribution shall trigger investigation of core mix, inspection sensitivity or production incentives before they are celebrated as an improvement.

18 Replacement parts and controlled materials

18.1 The bill of materials shall distinguish mandatory replacements, condition-based replacements and items permitted for validated restoration. Seals, wear elements, locking devices and life-limited items shall follow the family-specific replacement policy. The policy shall consider degradation that cannot be reliably measured during incoming inspection and shall not rely only on visible appearance.

18.2 Purchasing shall approve replacement suppliers for technical capability, identity, material control and change notification. Specifications shall include relevant fit, strength, electrical, chemical and durability characteristics. Substituting a lower-cost item with the same nominal dimensions shall require Engineering's assessment of the complete functional requirement.

18.3 Incoming verification shall be proportionate to risk and supplier evidence. Suspected counterfeit or misrepresented components shall be segregated and investigated. The organisation shall not install an uncertain electronic device, bearing or fastener solely because a supplier certificate uses the correct part number. Supplier documents shall be checked for scope and traceability.

18.4 Materials with storage life or environmental sensitivity shall have controlled conditions and expiry rules. Assembly records shall link critical replacement lots to outputs. A supplier change, formulation change or new manufacturing location shall trigger the defined review and any necessary revalidation before the material enters unrestricted production.

19 Machining and surface restoration

19.1 The restoration instruction shall define the allowed material removal, resulting geometry, surface condition and downstream inspection. Engineering shall establish whether machining, sleeving, coating or another restoration method is suitable for the component and application. Repair methods affecting structural integrity shall require a qualified technical basis and appropriate validation.

19.2 Machine programmes, tools, fixtures and setup checks shall be controlled by revision. The operator shall verify the correct dimensional class and remaining restoration allowance before cutting. Tool wear, coolant condition and fixture damage shall have reaction limits. A programme proven on one casting or alloy shall not automatically apply to another variant.

19.3 After restoration, the part shall receive the specified dimensional, material and surface examinations. Critical internal passages shall be re-cleaned and verified where processing can introduce debris. Any change to hardness, coating thickness or surface

texture that affects fit or fatigue performance shall be addressed in the acceptance plan.

19.4 The record shall retain the method, programme revision, operator, machine, resulting class and verification evidence. Unapproved welding, metal filling or crack concealment shall be prohibited. Failed restoration shall return to technical disposition, with additional processing allowed only when the engineering route explicitly supports it.

20 Engine blocks and structural castings

20.1 The engine block route shall assess identity, material, overheating, freeze damage, corrosion, cracks and earlier machining or repair. Inspection shall cover relevant deck surfaces, cylinder bores, bearing supports, threaded features, oil galleries and coolant passages. The approved plan shall define which indications require rejection and which have a validated restoration method.

20.2 Dimensional assessment shall address the relationships that affect assembly and operation, including bore geometry, deck condition and main bearing alignment where applicable. Approved oversize or undersize classes shall be linked to the matching components. The shop shall not remove additional material merely to obtain a visually clean surface when the final geometry would exceed the approved allowance.

20.3 Restored castings shall undergo the specified integrity, passage and leakage checks under a controlled test method. Test media, pressure, temperature and acceptance criteria shall come from the validated family plan. Trapped fluids, plugs and temporary fixtures shall be accounted for before the block reaches assembly or sale as a bare remanufactured component.

20.4 Final release shall identify the exact casting variant, restoration class, replaced inserts or plugs where relevant and any application limitations. The record shall permit investigation of a later lubrication or cooling failure. Rejected structural castings shall be physically and administratively prevented from returning as apparently acceptable cores.

21 Engine assemblies and lubrication systems

21.1 The engine assembly route shall control rotating components, cylinder heads, valve gear, lubrication and cooling systems as an interacting product. Engineering shall define inspection and replacement rules for fatigue-sensitive, wearing and sealing elements. Components from different variants shall not be combined merely because they can be physically assembled.

21.2 Crankshafts, connecting rods and other loaded components shall receive the specified material, dimensional and damage checks. Matched classes, orientation and balance requirements shall be preserved. Cylinder head restoration shall address sealing faces, valve operation and the relevant fluid passages. Any repair beyond the qualified route shall require engineering approval before work continues.

21.3 Assembly controls shall prevent contamination, incorrect clearances, omitted plugs and inappropriate lubricants. Critical fasteners shall follow the approved replacement and tightening policy. The record shall link measured assembly conditions to the individual engine where needed for reliability and investigation. A completed torque operation alone shall not demonstrate that the correct fastener or component was installed.

21.4 The test plan shall verify the declared configuration and relevant operating characteristics under controlled conditions. Abnormal noise, pressure, temperature, leakage or diagnostic behaviour shall trigger investigation. The organisation shall preserve the test result before adjustment and retest, and shall establish whether the cause affects other engines assembled from the same material or process lot.

22 Transmissions and driveline units

22.1 Transmission and driveline programmes shall identify the exact architecture, ratios, control configuration and compatible applications. Disassembly shall preserve information about clutch packs, shims, selective fits, wear debris and lubrication condition. The as-found evidence shall be evaluated before cleaning removes indications of the original failure mechanism.

22.2 Inspection shall cover gears, shafts, bearings, cases, hydraulic paths and electronic or mechatronic elements within scope. Engineering shall define acceptance for tooth damage, surface deterioration, distortion and wear. Replacement and restoration decisions shall consider interacting components; installing a new element against a damaged mating surface may leave the original failure mechanism active.

22.3 Assembly shall control cleanliness, clearances, preload, sealing, lubrication and the prescribed adjustment sequence. The final hardware and software configuration shall match the declared application. Calibration or adaptation requirements shall be documented for the remanufacturing facility and the installing service organisation, including which checks remain necessary after vehicle installation.

22.4 End-of-line testing shall cover the functions supported by the product claim, including relevant operating states and failure detection. A unit shall not be released simply because it rotates without load. The report shall state test coverage, untested installation-dependent functions and the evidence required from the installer before unrestricted vehicle use.

23 Alternators starters and rotating electrical units

23.1 The approved route shall distinguish alternator, starter and other rotating electrical families by electrical rating, mounting, drive interface and control method. Cores shall be assessed for heat damage, corrosion, mechanical wear, winding condition and previous modifications. A housing match shall not establish electrical or communication compatibility.

23.2 Inspection and restoration shall cover the relevant rotor, stator, commutator or slip-ring surfaces, bearings, drive mechanism, rectification and regulation components. Electrical insulation and connection integrity shall be verified using methods appropriate to the design. Test settings shall protect the equipment and personnel and shall not be improvised from another product family.

23.3 Assembly shall control alignment, clearances, balancing where applicable, fastening, soldered or welded connections and sealing. Replacement regulators and power devices shall be traceable and compatible with the intended control system. Cosmetic refinishing shall not obscure identification or create unacceptable insulation, heat transfer or grounding conditions.

23.4 The final test shall measure the required output across the approved operating envelope and include relevant mechanical, thermal and electrical checks. The record shall identify the load conditions, actual results and software configuration where

present. A single no-load reading shall not support a full rated-output or durability claim.

24 Electronic boards and control units

24.1 Electronic remanufacturing shall begin with lawful access, hardware identity and an assessment of contamination, corrosion, overheating and physical damage. Engineering shall define whether the board architecture and available diagnostic coverage permit a defensible remanufacturing claim. Units with concealed multilayer damage or uncertain safety-critical integrity shall not be accepted through cosmetic repair alone.

24.2 The workstation shall control electrostatic discharge, cleanliness, moisture-sensitive materials and traceable replacement components. Rework methods shall be qualified for the board, package and materials involved. Operators shall use controlled thermal and inspection profiles; repeated rework shall be limited where it can weaken joints, pads, laminates or neighbouring devices.

24.3 Testing shall combine the relevant inspection, electrical and functional evidence. It shall challenge required inputs, outputs, communications and fault responses using a validated fixture. A unit that communicates with a diagnostic tool may still have unverified power stages or safety functions. Engineering shall document test coverage and any remaining limitation.

24.4 Software, security credentials and customer data shall follow authorised processes. The organisation shall not bypass immobilisation, safety or emission functions to sell an apparently working unit. Final identity shall link board revision, replaced components, rework history, firmware, configuration and test results while protecting personal and confidential information.

25 Traction motors and power electronic assemblies

25.1 High-voltage product families shall be included only where the site holds the relevant technical capability, safe work authorisations and test facilities. The scope shall distinguish traction motors, inverters, converters and energy storage. Approval to remanufacture a conventional alternator shall not authorise work on a high-voltage traction assembly.

25.2 Engineering shall evaluate insulation systems, cooling paths, power devices, mechanical integrity and control interfaces as applicable. Suspected flood or thermal damage shall receive specialist assessment. A functional bench run shall not resolve uncertain insulation integrity or latent damage. Safe isolation of external supplies shall not be assumed to remove internal stored energy.

25.3 Restoration and assembly methods shall preserve the validated electrical, thermal and mechanical design. Changes to potting, insulation, sealing, bus connections or cooling materials shall receive technical qualification. Production staff shall not substitute visually similar materials where dielectric, thermal or ageing behaviour may differ.

25.4 The release plan shall combine unit-level verification with appropriate design and durability evidence. Test boundaries and vehicle integration requirements shall be explicit. If the organisation cannot establish the required integrity or lawful software compatibility, it shall route the item to a permitted alternative disposition rather than issue an unrestricted remanufactured-product claim.

26 Assembly control and error prevention

26.1 Assembly instructions shall identify the current bill of materials, component status, selective classes, approved consumables and required checks. Workstations shall permit only compatible material to enter the operation. Line clearance shall remove obsolete parts and instructions when the product variant changes. Recovered small components shall not bypass acceptance because they are available beside the station.

26.2 Critical connections and fasteners shall use the specified tools and process parameters. The system shall record actual completion and react to interrupted, repeated or out-of-range operations. Error prevention shall be validated with safe challenge conditions. An operator acknowledgement shall not substitute for a required physical or measured verification.

26.3 Work in progress shall retain identity and status through breaks, shift changes and equipment outages. An interrupted assembly shall return at a defined restart point with checks for omitted or repeated steps. Supervisors shall prevent informal continuation based solely on an operator's memory of the last completed task.

26.4 Final assembly inspection shall reconcile the build record, component genealogy and visible configuration before functional testing. Discrepancies shall be resolved at the relevant process stage. The organisation shall analyse recurring assembly errors for fixture, instruction or material-control causes rather than relying only on repeated training or disciplinary action.

27 Software configuration and diagnostic integrity

27.1 Engineering shall maintain an approved compatibility matrix linking hardware revision, software, calibration and intended application. The loading process shall use authorised files with verified integrity and controlled access. An apparently newer version shall not automatically be suitable for an older hardware variant or a different destination market.

27.2 Before programming, the operator shall verify identity, supply stability, tool status and the approved recovery process. The record shall retain the previous configuration where relevant, the installed package and the result. Failed or interrupted programming shall create a hold until a controlled recovery establishes the actual state of the unit.

27.3 Diagnostic data shall be used to investigate the condition, not merely cleared to remove visible symptoms. Engineering shall specify which functions and communications must be demonstrated after programming. Security or emissions-related coding shall require the applicable authority and shall not be altered to make an incompatible product appear acceptable.

27.4 Customer data, paired identities and credentials shall be handled under the IAF privacy and security policies and applicable contractual rights. Released products shall include accurate installation and adaptation requirements. The customer shall be told when a legitimate authorised service step remains necessary before the unit can operate in its intended vehicle.

28 Verification and validation programme

28.1 The verification matrix shall link every declared characteristic to evidence, acceptance criteria and a responsible reviewer. Unit-level tests shall confirm the condition of each released product where required. Family validation shall establish the suitability of the design and remanufacturing route, including durability or environmental performance that cannot be fully demonstrated on every saleable unit.

28.2 Test plans shall define specimens, configuration, conditioning, equipment, sequence, data capture and failure handling. Selection shall reflect actual core variation and significant restoration routes. Convenient samples shall not be described as representative without justification. Destructive or endurance testing shall use designated specimens and shall not return stressed items to ordinary stock without an approved disposition.

28.3 Failures shall be retained in the result history and assessed for population impact. Engineering shall distinguish a fixture problem from a product problem using evidence. Repeating a test shall follow a defined investigation and retest rule. Averaging results shall not conceal an individual mandatory characteristic that fails its acceptance criterion.

28.4 Validation shall be reviewed after significant process, supplier, material, software or application changes. The release authority shall confirm that current production remains within the validated boundary. Where a new route is not yet supported, its products shall remain controlled until the required evidence is accepted.

29 Measurement resources and test equipment

29.1 The equipment register shall identify each gauge, fixture, test bench, reference item and software tool used to accept product. It shall define its range, required capability, verification or calibration basis, maintenance and permitted use. The equipment's suitability shall be established for the decision it supports, not merely by the presence of a current sticker.

29.2 Operators shall check status and relevant function before use. Reference samples and check routines shall detect drift, incorrect setup and data mapping errors. Automated systems shall prevent results from being assigned to the wrong serial number and shall preserve raw data where needed for review or failure investigation.

29.3 When equipment is found unsuitable, Quality shall assess products accepted since the last reliable check. The assessment shall identify affected characteristics, likely error, uncertainty and the need for containment or retesting. Repairing the instrument shall not close the product-impact investigation by itself.

29.4 Access to test limits, programmes and result editing shall be controlled. Changes shall be approved, verified and tied to an effective date or serial boundary. Backup and restoration arrangements shall preserve configuration and evidence so that a computer failure does not lead to undocumented acceptance of otherwise completed products.

30 Production flow and capacity management

30.1 The production plan shall distinguish core availability from technically accepted material and finished conforming output. Capacity calculations shall include inspection, specialist restoration, test benches and rework demand. A large stock of unassessed cores shall not be counted as immediately available replacement-part capacity.

30.2 Material flow shall preserve separation between dirty, cleaned, inspected, assembly-ready, tested and released items. Workstation layout shall reduce repeated handling and accidental mixing. The system shall make a status change visible at the physical item and in the production record so that a delayed database update cannot release a quarantined batch.

30.3 Supervisors shall monitor bottlenecks and respond through approved staffing, maintenance or sequencing changes. Quality checks and required hold times shall not be removed to recover schedule. Temporary work areas or external capacity shall undergo the same readiness review for identity, contamination, equipment and competence as the normal route.

30.4 During an outage, the site shall use a controlled manual record or stop the affected process. Manual records shall be reconciled before unrestricted shipment. Recovery plans shall address unfinished assemblies and uncertain test status, with a defined restart check rather than a blanket assumption that all work in progress was complete.

31 Final review and product release

31.1 The release authority shall confirm identity, completed route, accepted inspections, replacement records, final configuration and test evidence. Open nonconformities shall be resolved through the authorised process before unrestricted release. A production completion code shall not automatically create quality acceptance if the supporting evidence is missing or inconsistent.

31.2 The product label shall identify the remanufacturer, remanufactured status, product or application code, traceable identity and any required ratings or limitations. Information shall remain legible through the expected distribution and installation conditions. Original marks shall not be used in a way that falsely implies an appointment or approval that the organisation does not hold.

31.3 The release record shall identify the specification revision, date, responsible person and applicable warranty terms. It shall state installation-dependent checks or adaptations that remain necessary. A customer shall be able to distinguish a bare component, a fully assembled tested unit and an assembly supplied with restricted or incomplete functions.

31.4 Shipment controls shall prevent unreleased stock from leaving through an urgent-order or sample route. Where a product is supplied for development or evaluation, its status and restrictions shall be explicit and accepted by the recipient. Evaluation supply shall not be used to avoid requirements applicable to a product placed into ordinary service.

32 Preservation packaging and installation information

32.1 Packaging shall protect restored surfaces, internal cleanliness, connectors and calibration-sensitive features. Openings shall be sealed with compatible, identifiable protective items. Heavy assemblies shall have defined lifting and restraint points. Packaging validation shall consider normal transport handling and storage conditions, including the consequences of a return journey with a used core.

32.2 Storage rules shall address corrosion, humidity, contamination, shelf-sensitive materials and software or configuration obsolescence. The warehouse shall review aged stock against the current specification and market requirements before release. A

product that passed its original test may require reinspection after damage, prolonged storage or loss of preservation.

32.3 The installation information shall specify compatible applications, necessary ancillary inspections, approved fluids or interfaces and the checks required after fitting. It shall explain conditions that could cause a replacement unit to fail again, such as unresolved contamination in a connected system. Instructions shall be understandable to the intended competent installer.

32.4 Logistics shall record transport damage and protect evidence for investigation. Returned packaging shall be inspected before reuse. Environmental packaging preferences shall be implemented without reducing product protection or obscuring remanufactured status, and any material substitutions shall be checked for their effect on corrosion, cleanliness and recycling routes.

33 Warranty and field performance

33.1 The commercial and quality functions shall establish warranty terms that accurately describe the product and its declared benchmark. Any claim of the same warranty as a new counterpart shall be supported by the actual coverage offered. Exclusions shall be lawful, clear and consistent with installation requirements rather than hidden conditions that undermine the advertised quality claim.

33.2 A warranty intake shall capture product identity, application, installation date, service exposure, symptoms, diagnostic evidence and the condition of connected systems. The returned unit shall remain linked to its original genealogy. Customer reports shall be retained as reports until investigation distinguishes confirmed product failure, installation issues and unresolved causes.

33.3 Engineering shall examine repeated failure modes and compare field information with the validation assumptions. Early-life failures, safety-related symptoms and clusters involving a common replacement lot shall trigger prompt containment assessment. A low total return rate shall not justify ignoring a serious individual failure mechanism.

33.4 Corrective action shall reach suppliers, process controls, specifications and installation information as appropriate. The organisation shall verify that the action prevents recurrence and shall assess whether previously supplied products need contact, restriction or recall. Warranty cost recovery from a supplier shall remain separate from the obligation to address the affected customer and product risk.

34 Nonconformity containment and corrective action

34.1 Any employee shall be able to report a suspected defect and stop the affected operation within the defined authority. Quality shall identify the potentially affected population using the last reliable control point, common materials, equipment and process history. When traceability is incomplete, the initial hold shall cover the uncertainty until evidence supports a narrower boundary.

34.2 Containment shall separate suspect cores, work in progress, finished stock and shipped products. The team shall define customer and internal communication, inspection or retest instructions and responsibility for disposition. An extra inspection shall not be introduced without showing that it can detect the actual failure mode.

34.3 Root-cause investigation shall consider why the defect occurred and why existing controls did not prevent or detect it. Corrective actions shall have owners, completion evidence and an effectiveness check. Rework shall follow an approved instruction, preserve genealogy and include verification of any characteristics affected by the additional processing.

34.4 Closure shall require evidence that the population is controlled and the action is effective. Serious field safety concerns shall enter the relevant IAF warranty and recall process and applicable market reporting route. Records shall preserve the original failure, decisions and communications rather than overwrite them with a final pass result.

35 Outsourced operations and engineering changes

35.1 The organisation shall retain responsibility for conformity when machining, coating, electronic rework or testing is outsourced. Supplier qualification shall assess the actual site, process, equipment, competence and traceability needed for the assigned operation. A broad certificate or previous commercial relationship shall not establish capability for every specialised restoration method.

35.2 Purchase instructions shall identify the technical revision, material or product status, acceptance evidence, prohibited substitutions and change notification requirements. Returned items shall be reconciled by identity and quantity. Quality shall verify the required output evidence and address unexplained differences, mixed lots or missing process records before downstream assembly.

35.3 Engineering changes shall assess fit, function, safety, durability, software, market eligibility and effects on existing inventory. The change record shall define validation, approval, implementation boundary and customer communication where necessary. Equivalent-looking replacement materials shall not be substituted through an informal purchasing note.

35.4 Emergency sourcing shall follow the same technical decision principles with an expedited, documented review. Where verification cannot support the required claim, the product shall remain on hold or move to a separately authorised restricted route. The business continuity process shall support lawful alternatives without weakening the remanufacturing acceptance standard.

36 Resource use and environmental claims

36.1 The environmental programme shall measure core input, retained material, new replacement material, process losses and final destinations. It shall distinguish product reuse through remanufacture from material recycling and energy recovery. The same mass shall not be credited twice because it passes through more than one facility or process stage.

36.2 Energy, water and chemical use shall be measured against a defined boundary and production quantity. Comparisons with new manufacture shall use a consistent functional unit, service assumptions and allocation method. Claims shall account for relevant collection, replacement, processing and transport burdens instead of counting only the mass retained in the finished unit.

36.3 The organisation shall investigate opportunities to improve yield, reduce repeated cleaning and machining, recover process fluids and design products for future restoration. A higher salvage rate shall be accepted only when product conformity is

preserved. Waste reduction targets shall not pressure inspectors to accept uncertain material or weaken mandatory replacement rules.

36.4 Published statements shall state their scope, period, methodology and limitations. A favourable result from one product family shall not be presented as a universal saving for all remanufactured parts. Environmental records shall remain traceable to measured data and verified downstream treatment, with independent review proportionate to the significance of the claim.

37 Competence and safe working

37.1 The competence matrix shall distinguish receiving, disassembly, inspection, machining, electronics rework, assembly, testing and release. Authorisation shall be based on demonstrated task performance, relevant technical knowledge and understanding of stop conditions. Attendance at a general course shall not qualify a person for every material examination or high-voltage operation.

37.2 Task-specific safety controls shall address lifting, rotating equipment, stored energy, chemicals, dust, fumes, noise and ergonomic exposure. The site shall use suitable guarding, isolation, ventilation and handling aids. Operators shall not bypass a protective control to maintain production or perform a specialist task outside their authorisation.

37.3 Supervision shall be defined for trainees and temporary staff. Practical assessment shall include abnormal conditions such as an unknown core variant, a failed gauge or interrupted assembly. Changes to equipment, materials or procedures shall trigger training and competence review before the revised task is assigned.

37.4 Employees shall have accessible reporting routes for safety, quality and integrity concerns, with protection from retaliation under the relevant IAF policy. Management shall review recurring errors for workload and process-design causes. Emergency response arrangements shall be practiced using safe simulations and shall preserve rapid access for rescue and incident control.

38 Performance measures and management review

38.1 Management shall define measures with a clear population, time period and calculation. Useful measures include accepted core yield, first-pass test yield, rework hours, missing genealogy, warranty failures by service exposure, on-time release and resource use per conforming unit. A single output quantity shall not represent product quality or process stability.

38.2 The dashboard shall distinguish incoming core mix from internal process effectiveness. A higher rejection rate may reflect worse incoming material or improved detection, while a higher yield may reflect an unapproved acceptance change. Reviews shall examine supporting evidence before assigning causes or incentives.

38.3 Quality-related costs shall include inspection, scrap, rework, warranty, transport and investigation, with estimates identified separately from actual costs. Financial analysis shall not count unreleased stock as completed saleable output. Investments in equipment or process change shall be evaluated against both conformity and operating performance.

38.4 The management review shall assign actions for significant trends, resource gaps and unresolved risk. Decisions shall identify owners, dates and expected evidence.

Targets shall not reward concealed rework, deleted failed tests or delayed warranty registration. Annex F illustrates calculations using fictional data and does not set universal acceptance rates.

39 Internal audit and traceability exercises

39.1 The audit programme shall cover the complete product route and the interfaces between functions. Auditors shall select actual released products and trace them backward to cores and critical inputs, then select a suspect input lot and trace forward to outputs. The sample shall include reworked, outsourced and software-controlled products where these are in scope.

39.2 Auditors shall observe practical work and compare it with the current instruction. They shall verify that equipment status, operator authorisation and acceptance criteria applied at the time of the recorded activity. A well-completed form shall not close a finding when the physical process or underlying result contradicts it.

39.3 Findings shall identify the requirement, evidence and affected risk. The responsible manager shall contain immediate issues and establish corrective action. Auditors shall have sufficient independence and technical support to challenge restoration and test claims without relying solely on the person whose work is under review.

39.4 Periodic exercises shall test recall searches, manual-record recovery and the handling of an unknown or counterfeit core. Results shall be used to improve the system and verify response capability. Closure shall require demonstrated correction and an assessment of affected products, not only a rewritten procedure or a new training attendance sheet.

40 Records interfaces and revision control

40.1 The controlled record set shall include scope approval, technical baselines, core intake, inspection, restoration, replacement lots, assembly, software, test data, release and field feedback. Retention shall follow the IAF Documents and Records Guide and the applicable product, market and contractual obligations. The schedule shall define triggers, access, legal holds and authorised disposal.

40.2 This manual connects to the IAF Quality Manual, supplier quality, aftermarket inventory, authorised service, packaging, business continuity and warranty and recall manuals. Each interface shall identify the responsible owner and required handover evidence. Battery repurposing shall follow IAF-MAN-SLB-001; vehicle depollution and final material treatment shall follow IAF-MAN-ELV-001.

40.3 Revisions shall follow the competent IAF authority and document-control process. The change notice shall explain affected requirements and any transition arrangements. Operating organisations shall assess the effect on specifications, training, inventory and customers, and record their actual adoption date rather than presume that publication proves operational readiness.

40.4 The organisation shall review the manual after significant failures, new technologies or changes in its operating obligations. Controlled local supplements shall contain product-specific parameters and evidence without presenting them as universal IAF limits. Obsolete instructions shall be removed from use while historical revisions remain available for the products released under them.

Annex A Programme adoption and product family register

Complete one adoption record for each site and product family. Link evidence rather than treating the form as proof that the work is complete.

Record field	Required entry and decision
Identity and scope	Enter the legal entity, site, family, application range, manual code and actual adoption date. Identify activities performed externally.
Reference product	Identify the declared new-product benchmark, specification revision, performance scope and any limitations on equivalence claims.
Permitted core history	Define accepted and excluded conditions, required history and the decision route for unknown prior repairs, fire or flood exposure.
Process capability	Link the route, equipment, restoration allowances, mandatory replacement policy and qualified external operations.
Validation evidence	List representative pilot configurations, durability or other family evidence, failures, corrections and the accepted boundary.
People and authority	Name the technical owner, quality release authority, safety leads and deputies with their task authorisations.
Commercial controls	Confirm accurate remanufactured labelling, warranty, installation information and approved market claims.
Activation decision	Record approval, outstanding restrictions, effective production boundary and the evidence required to remove each restriction.

Reassess adoption after a new variant, material, restoration method or significant field failure. A signature shall not waive missing technical evidence.

Annex B Core intake and genealogy traveller

Use one traveller per core or an approved traceable batch. Preserve parent-child relationships when components are pooled or combined.

Record field	Required entry and decision
Receipt	Record core ID, source, consignment, date, physical identifiers and ownership or exchange authority.
As found condition	Record missing items, leakage, corrosion, impact, heat or water exposure and whether each history statement is observed, supplied or unknown.
Initial status	Choose hold, eligible for assessment or rejected for the programme. State restrictions and the deciding person.
Disassembly	Link removed components, retained matches, created damage and mandatory replacement items.
Inspection and grade	Link actual measurements, examination results, prior restoration class, acceptance criteria and disposition.
Processing	Record cleaning, machining, coating or other restoration lots and any external transfers.

Record field	Required entry and decision
Build and test	Link critical replacements, software, assembly results, failed tests, rework and accepted final results.
Final identity	Connect released serial, specification revision, customer shipment and any later return to the original core and inputs.

If identity is lost, place the affected item on hold. Reconstruct it only from reliable evidence and record the basis; do not create a clean history from appearance.

Annex C Product family verification matrix

Engineering shall complete actual methods and limits in the controlled family specification before production begins. The entries below identify required coverage, not universal numerical tolerances.

Product family	Verification coverage	Release evidence
Engine block	Material and damage; bore and datum geometry; approved restoration class; oil and coolant passage condition; required integrity and leakage checks.	Measured values, examination record, machining history and matching-component class.
Engine assembly	Compatible build; clearances and critical connections; lubrication and cooling; declared output and relevant operating behaviour.	Individual build record, test conditions, actual results and installation requirements.
Transmission	Architecture and ratio; gears and loaded parts; cleanliness; selective fits; hydraulic and electronic functions where present.	Parts genealogy, adjustment records, functional coverage and vehicle adaptation requirements.
Alternator or starter	Mechanical condition; insulation and connections; regulation or control; output across the approved operating envelope.	Bench configuration, load conditions, measured results and compatibility identity.
Electronic control unit	Board integrity; qualified rework; authorised software; relevant inputs, outputs, communications and protective functions.	Rework history, component lots, test coverage and final hardware-software baseline.
Traction assembly	Electrical insulation, thermal and mechanical integrity; control compatibility; verified high-voltage process capability.	Specialist test evidence, design validation boundary and explicit application limits.

A test that covers one characteristic shall not be used to imply coverage of every characteristic listed for the family.

Annex D Process execution and exception record

Use this sequence to review a job at each handover. Add the actual job number, operator, time and evidence link to the local record.

Stage	Required evidence	Hold condition
Prepare	Current route, safe condition, identity and competent operator.	Unknown variant, unsafe condition or missing instruction.

Stage	Required evidence	Hold condition
Restore	Approved method, remaining allowance and controlled process settings.	Unapproved repair or inability to achieve the specified class.
Inspect	Actual values, equipment status and predefined decision rule.	Failed characteristic or unresolved measurement uncertainty.
Assemble	Accepted inputs, correct classes, critical operation records.	Missing genealogy, incompatible parts or interrupted work without restart checks.
Test	Approved coverage, raw results and retained failure history.	Failed, incomplete or invalid result.
Resolve exception	Cause, affected population, approved rework and verification.	Concession outside the authority of the approving person.
Release	Complete dossier, correct label and authorised decision.	Any unresolved requirement necessary for unrestricted supply.

Record the original defect and all repeat processing. A later pass shall not overwrite the evidence needed to explain the exception.

Annex E Finished product release checklist

The designated release authority shall review this record against the actual product before shipment.

Record field	Required entry and decision
Identity	Confirm finished serial, part code, remanufactured status and intended application.
Specification	Confirm the exact approved revision and the supported quality or performance claim.
Genealogy	Verify core linkage, critical retained items, replacement lots and external process evidence.
Process completion	Confirm required restoration, assembly checks and closed nonconformities.
Test evidence	Verify complete coverage, accepted results, valid equipment and any required independent review.
Software and interfaces	Confirm firmware, configuration and lawful installation or adaptation requirements.
Customer information	Check warranty, limitations, handling, preservation and installer instructions.
Decision	Record release or hold, authoriser, actual date and shipment link. Identify evaluation-only restrictions where applicable.

Commercial shipment approval shall not replace this technical release. Retain the evidence under the product record schedule.

Annex F Worked yield and material calculations

Fictional closed-period example. These calculations illustrate transparent denominators and do not set IAF pass-rate targets.

Measure	Example data and calculation	Interpretation
Core acceptance	120 cores received; 96 technically accepted. $96 / 120 \times 100 = 80$ percent.	The 24 rejected cores remain in the incoming population.
First-pass test yield	Of 96 completed units, 84 pass at the first valid test. $84 / 96 \times 100 = 87.5$ percent.	Later rework does not improve the first-pass result.
Final release yield	8 of the 12 initial failures pass after approved rework; 4 are rejected. $92 / 96 \times 100 = 95.8$ percent.	This is yield from accepted cores, not from all received cores.
Overall release yield	92 released units / 120 received cores $\times 100 = 76.7$ percent.	Use this denominator when assessing the full incoming programme.
Finished mass	For one released unit: 6.0 kg retained core material plus 2.0 kg new parts = 8.0 kg finished mass.	Retained-material share is 75 percent of finished mass.
Material balance	The original core was 7.0 kg; 6.0 kg retained and 1.0 kg removed. Add 2.0 kg new parts: 9.0 kg input = 8.0 kg product + 1.0 kg removed material.	Destination evidence is needed before crediting the removed material as recycled.
Process energy	A defined production period uses 920 kWh and releases 92 units: 10 kWh per released unit.	Include energy for rejected and reworked units within that same boundary.
Environmental claim	The retained-material share and process energy are measured indicators.	Neither alone proves a lifecycle carbon saving against new manufacture.

Keep units, periods and boundaries consistent. Round displayed results only after calculations and retain the unrounded data.

Annex G Warranty investigation and population review

Open a linked investigation when a returned product or field report suggests a potential remanufacturing defect.

Record field	Required entry and decision
Case identity	Record customer, released serial, application, installation date and lawful contact information.
Complaint evidence	Preserve symptoms, operating conditions, diagnostic records and the customer account without converting it into a confirmed cause.
Product history	Retrieve core, replacement lots, process history, software, test data and previous rework.
Technical examination	Record as-received condition, test method, findings and any destructive examination approval.

Record field	Required entry and decision
Population boundary	Identify products sharing the suspect input, process or configuration. Explain any uncertainty and initial containment.
Cause and action	Distinguish product, installation and external-system causes; assign corrections and prevention actions supported by evidence.
Customer response	Record repair, replacement, information, restriction or recall decisions and applicable notifications.
Closure	Verify affected-product control, action effectiveness and feedback into the specification or control plan.

Do not close a safety concern solely because the customer received a replacement or a supplier paid the warranty cost.

Annex H Audit and traceability exercise

Use a real released product for record tracing and fictional defect information for the exercise. Do not create a live product hazard.

Record field	Required entry and decision
Sample selection	Choose a product with pooled components, outsourced processing or rework where these occur in scope.
Backward trace	Find the core and all critical input lots, actual processing and accepted results.
Forward trace	Select one fictional suspect replacement lot and identify all affected stock and customer shipments.
Physical challenge	Check whether system status agrees with the actual item, storage location and label.
Acceptance challenge	Verify that the test can detect the claimed defect and that the current specification was used.
Response exercise	Simulate an unavailable manager or system outage and demonstrate the approved substitute decision and record route.
Findings	Record gaps, uncertain population, immediate controls and responsible corrective actions.
Effectiveness	Repeat the relevant trace or control check after correction and retain evidence of the result.

Evaluate completeness and reliability as well as speed. A fast search with missing outputs is an unsuccessful traceability exercise.