



QUALITY MANUALS | FIRST EDITION

IAF INDUSTRIAL PACKAGING & CIRCULARITY MANUAL

Product protection and
measurable circular packaging

STABLE RELEASE

Document No. IAF-MAN-IPC-001 | Revision 01

Zero-plastic policy and material control
Reusable smart containers and return loops
Industrial and aftermarket packing rules

International Automotive Federation

English master text | 15 September 2026

iaf.com

Publication identity and use

IAF Industrial Packaging & Circularity Manual

This manual provides the requirements, operating procedures and evidence framework for its defined automotive supply, distribution and packaging activities. Apply it through a controlled site implementation plan and equipment-specific work instructions.

Control	Publication record
Document	IAF-MAN-IPC-001 IAF Industrial Packaging & Circularity Manual
Edition / revision	First Edition Revision 01 Stable Release
Text issue	15 September 2026 English master text
Document owner	IAF Quality function with the relevant automotive technical committee
Custodian	IAF Secretariat / Document Controller
Institutional authority	Competent authority under IAF-CON-001; publication does not amend the Constitution.
Site adoption	Accountable operating director and technical leads record the actual approval reference, scope and operational effective date.
Classification	Public core manual. Completed operational records follow their assigned access and retention controls.

Reading and applying requirements

“Shall” identifies a requirement when adopted by a site, programme or agreement. “Should” identifies a recommendation. An example is illustrative; it is not a machine setting, test acceptance limit or completed operating record. Annex worksheets may be reproduced for controlled internal use.

Controlled implementation

Stable Release identifies the completed publication text. Site approval, process validation, competence authorization and equipment release are recorded when performed. A missing safety limit, test criterion or release authority prevents activation of the affected operation. Mandatory law, product requirements and validated equipment instructions remain applicable.

Relationship to IAF recognition

Use of this manual does not by itself confer membership, Corporate Recognised status, accreditation, certification or a licence to use IAF marks. Those decisions follow the applicable IAF guides, independent evaluation and recorded scope.

Contents

Every entry links to its section. Page numbers include the cover.

1 Purpose, scope and packaging outcomes	5
2 Definitions, boundaries and material states	6
3 Zero-plastic policy and transition control	7
4 Roles, approvals and competent operation	8
5 Packaging bill of materials and composition evidence	9
6 Product risk and distribution assessment	10
7 Packaging specification and design release	11
8 Material selection and plastic-free alternatives	12
9 Qualification, test sequencing and acceptance	13
10 Packing workstation and load preparation	14
11 Reusable metal racks and structural containers	15
12 Fibre, wood and non-plastic transport systems	16
13 Protection for electronics and sensitive surfaces	17
14 Heavy parts, batteries and regulated goods	18
15 Reusable pool design and container availability	19
16 Cleaning, inspection, repair and re-release	20
17 Smart crates, sensors and connected identity	21
18 Return booking, custody and asset reconciliation	22

Contents - continued

Every entry links to its section. Page numbers include the cover.

19 Supplier approval and packaging change control	23
20 Warehouse, line-side and transport interfaces	24
21 Aftermarket packing and parcel distribution	25
22 Customer returns and damaged-product packaging	26
23 Retirement, segregation and recovery evidence	27
24 Circularity metrics, cost and public claims	28
25 Nonconformity, containment and packaging recovery	29
26 Implementation, competence and assurance	30
Annex A Packaging specification and material record	31
Annex B Plastic baseline and controlled exception	32
Annex C Packaging qualification and release	33
Annex D Packing and dispatch release checklist	34
Annex E Asset return, service and retirement history	35
Annex F Pool sizing and circularity calculations	36
Annex G Deployment gates and controlled interfaces	37

Using the annexes

Enter actual values, evidence references, names and dates in the worksheets. A blank, unsigned or illustrative record is not proof of completion. Retain the record with its governing instruction and revision.

1 Purpose, scope and packaging outcomes

1.1 This manual governs industrial and aftermarket packaging for automotive parts, assemblies, tooling and approved return flows. It covers supplier-to-factory movement, internal handling, distribution, customer shipment, reusable-container return and final recovery. Each organization shall define its sites, products, lanes, packaging ownership and service partners.

1.2 The intended outcome is an identifiable, conforming product delivered without avoidable damage, contamination or waste. Packaging shall protect the product and people while reducing material demand and supporting verified reuse. A lighter package that increases damage, unsafe handling or replacement shipments is not automatically an improvement.

1.3 The manual establishes a zero-plastic packaging policy, controlled qualification, reusable smart-container management and practical packing rules. The policy requires transparent material accounting and validated alternatives. It shall not be used to conceal polymer content, remove necessary protection before validation or claim that a transition has already been completed.

1.4 Actual load limits, cleanliness, corrosion protection, electrostatic performance, environmental limits and test severities shall be defined from the product and distribution risks. There is no universal carton strength, drop height, stack limit or acceptable moisture exposure for all automotive goods.

1.5 IAF-MAN-SCL-001 governs logistics and trade interfaces; IAF-MAN-ASI-001 governs aftermarket identity and inventory; IAF-MAN-GAA-001 governs battery-related handling; IAF-MAN-OTC-001 governs connected devices and data. Compliance with this manual does not alone confer IAF membership, recognition, certification or mark-use rights.

2 Definitions, boundaries and material states

2.1 Packaging includes the containers, racks, pallets, dividers, cushioning, wraps, closures, coatings, labels and other materials used to contain, protect, handle or present the transported item. The product itself is outside the packaging material total unless a component is supplied for packaging use. State this boundary in the material register.

2.2 Primary packaging directly contains or protects the part; secondary packaging groups protected units; transport packaging forms the handling load. These levels can overlap in a returnable rack. Record components once at the appropriate level and avoid counting the same container at every custody transfer as newly manufactured packaging.

2.3 For this policy, the material inventory includes intentionally used plastics and polymer components such as films, foams, synthetic cushioning, coatings, tapes, labels, adhesives and polymer housings of tracking devices. Recycled, renewable-feedstock, biodegradable or compostable plastic remains plastic for the zero-plastic assessment.

2.4 A reusable container is designed and qualified for repeated service within a managed return system. A completed use cycle includes the defined delivery, return, inspection and acceptance for the next use. A purchase order stating reusable is not evidence of actual completed cycles or acceptable condition.

2.5 Packaging states shall distinguish new and unqualified, clean and released, loaded, in transit, empty awaiting return, dirty, inspection hold, repair, retired and recovery-confirmed. Product status and container status are independent: a sound crate may contain rejected parts, and released parts may be inside a damaged crate.

3 Zero-plastic policy and transition control

3.1 The default for new and redesigned packaging shall be no intentionally added plastic within the defined packaging scope. Procurement and Engineering shall prioritize elimination, suitable reusable metal systems and qualified fibre or wood alternatives. Suppliers shall disclose the composition of all components, including coatings, tapes, liners and smart-device elements.

3.2 The organization shall establish a dated baseline and an approved transition plan by part family and lane. State current plastic mass, functional purpose, validated replacement route, owner and completion milestone. Existing reusable plastic assets shall be identified explicitly; continued use during a controlled transition shall not be reported as plastic-free.

3.3 Where eliminating plastic would presently prevent safe, lawful or technically adequate protection, Engineering and Quality shall document the necessity and evaluate alternatives. A limited exception requires defined scope, quantity or duration, competent approval, review date and a replacement action plan. Cost or convenience alone is not sufficient justification.

3.4 An exception is a controlled deviation from the zero-plastic target, not proof of meeting it. Include exception material in the inventory and public claim boundary. The operating team shall not remove a required moisture, electrical or dangerous-goods barrier until the replacement has passed the relevant qualification.

3.5 A zero-plastic claim may be issued only for a clearly identified packaging configuration whose material evidence supports it. State the assessment boundary and any material uncertainty. Unknown composition or undisclosed polymer content prevents the claim. Reduction, transition and achieved elimination shall be described as different states.

4 Roles, approvals and competent operation

4.1 The Packaging Programme Owner owns policy deployment, material baseline, standard configurations and performance. Packaging Engineering owns design, validation and technical change. Product Engineering defines sensitive features and damage limits. Quality approves product acceptance and packaging release evidence.

4.2 Procurement owns supplier disclosure, composition requirements, approved materials and change notification. Logistics owns lane definition, handling events, loading interfaces and return performance. Warehouse and packing supervisors own correct execution, clean working conditions, container inspection and operator competence.

4.3 The Safety lead owns handling-risk arrangements with Engineering, including mass, ergonomics, sharp edges, unstable stacks, lifting and restraint. Dangerous-goods specialists determine the actual transport requirements for regulated items. A general packaging approval shall not substitute for specialist acceptance where required.

4.4 The circularity owner maintains asset balances, reuse records, cleaning and recovery evidence. Finance verifies ownership, deposits and cost assumptions. OT Security and Privacy oversee smart-container access, data and device retirement. Each outsourced cleaner, repairer, pool operator or recycler shall have a defined scope and oversight.

4.5 Approval gates shall distinguish material-policy acceptance, technical protection, safe handling, trade or transport permissions and product release. One commercial sign-off shall not silently cover them all. Every worker may hold a damaged container or unsafe pack operation; production or dispatch pressure shall not override a failed critical gate.

5 Packaging bill of materials and composition evidence

5.1 Each configuration shall have a controlled bill of materials identifying container, dividers, cushions, fasteners, closures, coatings, labels, inserts and tracking device. Record material, mass, quantity, supplier, revision, functional purpose and whether the component is reused, consumed, repaired or replaced during each cycle.

5.2 Material declarations shall distinguish the base substrate from coatings, laminates and additives. Paperboard with a plastic barrier shall not be counted as wholly plastic-free paper. Record known composition and the evidence method; unknown or mixed fractions shall remain visible rather than being assigned to the preferred category.

5.3 Weigh representative complete configurations using suitable equipment and an agreed moisture or condition basis. Reconcile component totals with assembled mass within the defined measurement allowance. Where supplier estimates are used, label them as estimates and establish verification proportional to their importance.

5.4 Recycled content, recyclability, renewable origin and plastic absence are separate attributes. Retain the evidence and boundary for each claim. A recycling symbol or supplier marketing statement alone shall not establish actual composition, local recovery capability or a verified environmental outcome.

5.5 Changes to supplier, coating, adhesive, label, insert, sensor or closure shall trigger a material and performance review. Keep obsolete revisions for traceability of shipments and reuse assets. Annex A records the packaging specification; Annex B records the plastic inventory and any time-bounded exception.

6 Product risk and distribution assessment

6.1 Before design, identify part mass, centre of gravity, dimensions, fragile features, critical surfaces, cleanliness needs, corrosion sensitivity and allowable movement. Include terminals, sealing faces, machined surfaces, painted areas, optics and calibration-sensitive functions. Define damage that makes the part unusable even if no visible break occurs.

6.2 Map the actual distribution sequence: supplier packing, storage, forklift or robot transfer, loading, transport legs, consolidation, unloading, final unpacking and possible return. Record expected orientations, handling equipment, dwell periods, climate, humidity, vibration, shock and stacking. Assess foreseeable abnormal conditions proportionate to consequence.

6.3 The product risk owner shall specify protection and acceptance criteria with a test or inspection method. Distinguish cosmetic acceptance from functional, dimensional, electrical and safety performance. A visual inspection alone may not detect a damaged sensor, distorted sealing surface or compromised battery insulation.

6.4 Evaluate interactions between packaging and product. Fibre dust, wood debris, corrosion inhibitors, adhesives and cleaning residues may create contamination or material incompatibility. Electrostatic and moisture-sensitive products can require competing protections; no substitute material is accepted solely because it meets the plastic policy.

6.5 Assess workers and recipients as part of the design. Include opening tools, sharp straps, trapped energy, lifting, reach, manual handling, centre-of-gravity changes and safe unpacking sequence. The qualified pack shall be practical at both shipping and receiving sites, including smaller aftermarket repair locations.

7 Packaging specification and design release

Owner: Packaging Engineering. Trigger: new product, new lane, zero-plastic redesign, recurring damage or changed handling. Output: a controlled configuration ready for qualification and operational release.

Step / owner	Required action and evidence
1 Define the use	Identify product family, condition, part revision, lane, quantity, handling units, ownership and intended reuse. Obtain product sensitivity and destination constraints before selecting materials.
2 Set requirements	Specify movement restraint, surfaces to protect, environmental and contamination limits, stacking, lifting and unpacking. Define measurable acceptance and the relevant inspection or test method.
3 Design the pack	Create the bill of materials, drawing, part orientation, support points, closures and labels. Prioritize plastic-free solutions. Record any proposed exception and the alternatives considered.
4 Verify interfaces	Check rack, pallet, conveyor, AGV/AMR, vehicle, warehouse and customer compatibility. Include mass, overhang, fork entry, centre of gravity and safe access. Validate the intended container-to-load combination.
5 Qualify and approve	Complete the risk-based test plan with representative products and conditioning. Resolve failures. Obtain technical, Quality, Safety and specialist approvals appropriate to the scope.
6 Deploy the instruction	Issue the packing sequence, photographs or drawings where useful, inspection criteria and labels. Train operators, verify a representative first shipment and withdraw superseded instructions.

A drawing approval without physical qualification is not a production pack release. Annex A shall identify the exact product, configuration and lane scope to which the approval applies.

8 Material selection and plastic-free alternatives

8.1 Select material by required protection and demonstrated performance. Options include reusable steel or aluminium racks, qualified wood systems, corrugated fibreboard, moulded fibre, paper-based cushioning and mechanical closures. The selection shall consider weight, durability, contamination, moisture, repair, local recovery and worker handling.

8.2 Metal structures shall protect the part from hard contact, sharp edges and abrasion through qualified supports. Any coating, insert, wheel, pad or gasket shall remain in the composition inventory. A metal frame with polymer dunnage is not a zero-plastic configuration simply because metal dominates its mass.

8.3 Fibre alternatives shall be verified for compression, humidity response, dust, abrasion and repeated handling where relevant. Water resistance shall not be inferred from a dry-room trial. Laminated, coated or impregnated fibre requires composition disclosure and a recovery route suitable for the actual composite.

8.4 Wood shall be suitable for load, fasteners, moisture, cleanliness and the destination's applicable treatment or declaration requirements. Verify actual obligations for the route. Do not apply an official treatment mark or claim treatment merely because the material supplier describes the pallet as export quality.

8.5 Adhesives, tapes, protective papers and corrosion-control materials require compatibility and residue review. Eliminating a plastic component shall not introduce uncontrolled chemical migration, part corrosion or unsafe opening. Select alternatives through qualified trials and retain the evidence for both protection and material claims.

9 Qualification, test sequencing and acceptance

9.1 The qualification plan shall define product variants, packaging revision, samples, conditioning, distribution hazards, test sequence and acceptance criteria before testing. Select representative worst-case combinations such as maximum mass, vulnerable geometry, humid storage or repeated reuse. Record why the sample represents the intended scope.

9.2 As applicable, evaluate compression and stacking, handling drops, vibration, shock, impact, restraint, corrosion, moisture, leakage, electrostatic performance and contamination. Test severities shall reflect the product and route risk with competent technical rationale. This manual does not prescribe a universal height, duration or load factor.

9.3 Inspect both package and product before and after the sequence. Record functional or dimensional checks needed to detect hidden damage. A package remaining visually intact does not establish that its contents meet acceptance. Failed or missing measurements shall remain visible in the qualification report.

9.4 Reusable systems shall be assessed after representative wear, cleaning, repair and environmental exposure, not only when new. Verify hinges, latches, stacking interfaces, supports, labels and tracking devices. Define rejection and retirement criteria from the qualified design and field evidence.

9.5 Approve the tested scope and any justified extensions explicitly. Failed tests require cause analysis, controlled redesign and repeat verification of affected functions. Lane, product, payload, material, supplier or cleaning changes trigger impact assessment and partial or full requalification as appropriate. Annex C records the decision.

10 Packing workstation and load preparation

Owner: Packing Supervisor. Execute the current instruction for the exact part and configuration. The workstation shall support safe, clean and repeatable work.

Step / owner	Required action and evidence
1 Verify readiness	Confirm current instruction, competent operator, clean work area, required equipment and released packaging components. Check that the selected configuration covers the product and destination.
2 Verify the product	Confirm part identity, revision, condition, quantity, release status and relevant serial or lot. Hold damaged, contaminated, expired or unidentified parts before they are concealed by packaging.
3 Prepare the container	Inspect structural condition, supports, closures, cleanliness and labels. Remove obsolete routing information through the approved method. Confirm the reusable asset is released for this cycle.
4 Position and protect	Place parts at approved supports and orientation. Protect critical surfaces and terminals, prevent contact and movement, and use the specified quantity of each component. Do not add unapproved filler as a shortcut.
5 Close and inspect	Apply the approved closure and restraint sequence using safe tools. Verify count, mass, stability, label readability and required transport markings. Record the defined independent check for high-risk loads.
6 Release and record	Link product identity to the handling unit and packaging revision. Record operator, inspection, weight where required and actual release. Move the pack to its controlled dispatch or storage location.

If the specified material is unavailable, obtain an approved alternate configuration or hold the shipment. Informal replacement with bubble wrap, tape or loose filler can invalidate both qualification and the zero-plastic claim.

11 Reusable metal racks and structural containers

11.1 The structural specification shall identify rated payload, gross mass, centre-of-gravity envelope, stacking conditions, support points, lifting and fork interfaces, tie-down points and permitted attachments. State whether ratings apply to static storage, transport or dynamic handling; these conditions are not interchangeable.

11.2 Inspect welds, joints, frames, feet, stack locators, hinges, doors and latches against defined criteria. Distortion can prevent safe stacking even when the rack still stands upright. A damaged load-bearing feature shall place the container on hold until competent assessment or approved repair.

11.3 Dunnage and supports shall locate the part without overconstraint, harmful contact or uncontrolled movement. Verify ease of loading and safe removal. Any removable support shall have identity and configuration control so that a rack cannot be used with the wrong insert or missing restraint.

11.4 Repairs to structural members, welds, lifting points or stacking features require an approved method and qualified personnel. Record the defect, work, materials and verification. Straightening, welding or drilling by an operator to keep a rack in service is not an authorized repair process.

11.5 Durable identity shall remain legible through cleaning and reuse. Record owner, asset number, configuration, restrictions and inspection status. The asset shall be retired when it cannot meet the qualified criteria or when safe restoration is not demonstrated. Recover materials through a documented route after removing sensitive devices or data.

12 Fibre, wood and non-plastic transport systems

12.1 Fibre and wood packaging shall be specified by actual construction, dimensions, joining method, material condition and approved load. Do not substitute visually similar board grades or pallet designs without review. Moisture and storage history can materially change performance before the first shipment.

12.2 Stack design shall consider load distribution, creep over dwell time, pallet support and environmental conditioning. Specify permissible orientation, height and duration for the qualified configuration. A short dry compression test shall not automatically validate prolonged humid storage under the same load.

12.3 Protect parts from staples, nails, splinters, abrasive edges and loose fibres. Locate fasteners so that they cannot contact critical product surfaces or create an unsafe opening operation. Parts requiring exceptional cleanliness may need a separately qualified clean barrier or a controlled policy exception.

12.4 Assess destination acceptance and treatment requirements for solid wood where relevant. Retain actual treatment and traceability evidence through the supplier and shipment records. Repaired or mixed-material pallets shall be reviewed for continued load suitability and applicable transport requirements.

12.5 Reuse fibre or wood containers only when the design and condition criteria permit it. Wet, weakened, contaminated or structurally damaged packaging shall not be accepted because it has completed only one cycle. Segregate recoverable material by actual composition and contamination, with a viable local processing route.

13 Protection for electronics and sensitive surfaces

13.1 Packaging Engineering shall identify electrostatic, moisture, magnetic, optical, contamination and mechanical sensitivities for each product family. Define the required protection at the part surface and through the entire route. Ordinary paper or a metal box shall not be assumed to provide all necessary electrical or environmental protection.

13.2 Where electrostatic protection is required, qualify the complete pack, handling method and relevant electrical properties under representative conditions. Avoid exposed conductive structures that could short terminals or damage components. A material colour, printed symbol or supplier description is not test evidence.

13.3 Moisture-sensitive components require a validated barrier or controlled exposure strategy, with opening and resealing rules where applicable. State how exposure is measured and when stock is held. Desiccants or indicators shall be suitable for the product and shall not create loose contamination or an unrecorded mixed-material fraction.

13.4 Painted, polished, machined, optical and sealing surfaces require qualified contact materials and orientation. Verify abrasion, pressure marks, staining and residue after representative vibration and storage. Surface protection that leaves harmful adhesive or fibres shall not pass merely because the part has no visible impact damage.

13.5 Where a necessary protective function cannot yet be achieved without plastic, apply the time-bounded exception process and continue development of validated alternatives. Keep the material quantity and affected configurations visible. Remove the exception only after the new system passes product and distribution acceptance.

14 Heavy parts, batteries and regulated goods

14.1 Heavy assemblies shall be supported at approved structural points and restrained against the anticipated movement. Identify mass, centre of gravity, lifting and fork locations, orientation and unpacking sequence. A shipping frame shall not be used as a lifting device unless its design and authorization cover that purpose.

14.2 Battery packs, cells, pyrotechnic items, chemicals and other potentially regulated goods require competent classification for their actual condition and transport mode. The specialist shall determine the necessary packaging, testing, quantity limits, markings, documents and carrier acceptance. General industrial pack approval does not establish acceptance for every mode or condition.

14.3 Protect exposed terminals and prevent conductive contact, unintended activation, mechanical damage and load movement through the approved product-specific design. Packaging shall account for residual stored energy. Removing an external connector or reducing indicated charge does not make a battery an ordinary inert metal assembly.

14.4 Damaged, defective, recalled, prototype, waste or unknown-condition energy-storage products shall not use the normal new-product pack without specialist review. Inform the receiving party and carrier truthfully. A zero-plastic objective shall not override a necessary safety or legally required packaging function.

14.5 For exceptional loads, verify the complete handling chain at origin, transfer points and destination. Confirm equipment, restraints, access and competent personnel before dispatch. Any mandatory polymer component shall be recorded through the controlled exception route and included in the material inventory; the configuration shall not be claimed as plastic-free.

15 Reusable pool design and container availability

15.1 The pool owner shall define who owns each container, who may use it, the permitted product and lane combinations, custody rules, return deadlines, cleaning responsibility and loss settlement. Shared pools require common identity and acceptance criteria. A container compatible in size may still be incompatible in cleanliness or structural configuration.

15.2 Size the operating pool from validated container throughput and the complete release-to-release cycle time, including loading, transit, customer dwell, empty return, cleaning, inspection and normal repair queues. Add an explicit allowance for variability, planned downtime and separately assessed long-term repair or loss exposure.

15.3 Use a consistent time and unit basis. If throughput is in loaded containers per working day, the cycle and demand calendar shall be aligned. Do not count a cleaning queue both inside average cycle time and again as a separate fixed allowance. Annex F shows an illustrative calculation.

15.4 Availability planning shall distinguish physically present, serviceable, released, committed, in-transit, dirty and repair-held assets. Only suitable released containers may support a new load promise. Excess assets at one site do not protect another site unless an approved timely transfer is feasible.

15.5 Monitor cycle-time distribution, overdue returns, loss, damage and product mix. A longer actual cycle requires corrective action or a justified pool adjustment, not uncontrolled disposable packaging. Emergency substitutes require technical approval and material-policy review before use.

16 Cleaning, inspection, repair and re-release

Owner: authorized Container Service function. Apply the approved instruction for the asset and contamination type. A visually empty container is not automatically clean or fit for reuse.

Step / owner	Required action and evidence
1 Receive and classify	Identify asset, last use, reported damage and possible contamination. Assign dirty, hold or repair status. Isolate unknown residues or unsafe components for specialist assessment before routine cleaning.
2 Clean by the method	Use the validated process, compatible agents and protective arrangements. Control residues, effluent and exposure. Protect or remove electronics as specified; do not assume every smart tag tolerates immersion.
3 Verify cleanliness	Inspect and test as required for the product sensitivity. Confirm dryness and absence of unacceptable residues, particles, odour or corrosion. A completed wash cycle alone is not cleanliness acceptance.
4 Inspect structure	Check load-bearing features, supports, closures, stack interfaces, labels and sensors. Compare with rejection criteria. Record defects and hold affected assets instead of returning them to the clean pool.
5 Repair and verify	Use approved methods and competent personnel. Record replaced components and material changes. Structural or functional repairs require the specified verification before the asset returns to service.
6 Release the asset	Record asset identity, service action, inspection results, configuration and competent release. Update the pool status and next inspection trigger. Retain the history of failed checks and prior repairs.

Cleaning shall not erase product or incident evidence under investigation. Contaminated packaging may require a different handling or disposal route from ordinary reusable assets. Annex E records service and re-release.

17 Smart crates, sensors and connected identity

17.1 A smart-container design shall state the operational purpose of each device, such as asset identity, custody, temperature, humidity, shock or location. Select sensing range, resolution, sampling and battery life for that purpose. Avoid adding electronics without a defined decision or operational benefit.

17.2 Asset identity shall remain separate from the part lot, shipment and customer identity carried during a particular cycle. Bind these records at loading and close the binding at verified unloading. Reuse shall not attach a new shipment to an old active association or expose a prior customer's confidential information.

17.3 Environmental and shock readings shall identify device, placement, calibration or verification status, time basis and data gaps. Set excursion rules from product qualification. A sensor at one location may not represent every part, and absence of an alarm does not prove that a failed sensor recorded acceptable conditions.

17.4 Protect device configuration, credentials, firmware and platform access under IAF-MAN-OTC-001. Authenticate consequential status changes, limit partner access and retain an audit trail. A printed code or radio response is not by itself proof of authenticity, quality release or current physical location.

17.5 Include device housings, batteries, adhesives and tags in the material and end-of-life inventory. Design devices for service and removal where feasible. A smart metal crate with plastic electronic components shall not be described as wholly plastic-free unless the claim explicitly concerns a separately defined, verified component rather than the complete configuration.

18 Return booking, custody and asset reconciliation

Owner: Pool Operations and Logistics. Trigger: unloading completion or an agreed collection schedule. Each custody transfer shall maintain identity and condition evidence.

Step / owner	Required action and evidence
1 Confirm unloading	Close the product-to-container association after physical verification. Record damage, missing dunnage and residual material. Do not mark an asset empty solely because an order was financially closed.
2 Prepare the return	Use the approved nesting or collapse method. Secure moving parts and segregate dirty, damaged and restricted assets. Do not combine incompatible residues to improve vehicle utilization.
3 Book and hand over	Confirm quantities, asset identities, collection route, ownership and any trade requirements. Record actual carrier custody and condition. Distinguish booked collection from completed departure.
4 Receive and reconcile	Scan returned assets and compare physical count with dispatch. Record shortages, substitutions, damage and configuration differences. Update custody without automatically marking the containers clean or released.
5 Service and release	Route assets through required cleaning, inspection and repair. Only competent release returns them to the usable pool. Capture actual cycle completion and any replaced components.
6 Resolve balances	Investigate overdue, missing or disputed assets with the partner. Reconcile deposits and costs separately from physical status. Close losses only through authorized evidence and adjust the pool plan.

Return performance shall use a due-date or shipment cohort basis that allows for transit time. Comparing all receipts this month with all dispatches this month can misstate performance when the cycle spans periods.

19 Supplier approval and packaging change control

19.1 Packaging suppliers shall provide verified entity and site information, material composition, process capability, quality controls and change notification. Approval shall identify the exact construction or asset configuration. A supplier's broad product catalogue does not authorize any visually similar substitute.

19.2 Initial acceptance shall include representative samples, dimensional and material checks, manufacturing consistency and the required qualification evidence. Verify critical welds, joints, closures, coatings and label performance as appropriate. Procurement shall confirm that the supplied revision matches the approved specification.

19.3 Changes to material, construction, supplier site, process, coating, adhesive, repair method, cleaning agent or tracking device require an impact review. Assess product protection, safety, plastic content, recovery route and system interfaces. A cost-saving change shall not bypass requalification.

19.4 Engineering shall define the cut-in point, mixed-stock controls and disposition of old configurations. Keep both packaging and product traceability where the change could affect quality. A revised drawing shall not retroactively qualify containers already built with a different construction.

19.5 Temporary deviations shall state quantity, lane, product, compensating controls, approver and expiry. Record material-policy exceptions separately where relevant. At expiry, close the deviation through completed correction or a new accountable assessment; repeated automatic extension is not effective change control.

20 Warehouse, line-side and transport interfaces

20.1 Warehouse and line-side layouts shall support the qualified stack, aisle clearance, safe access and container orientation. Confirm floor and rack capacity for actual gross loads. Do not derive a permitted stack height from available building height or from the number of containers that physically fit.

20.2 AGV/AMR and conveyor interfaces shall be validated with the complete container and payload. Check support geometry, transfer alignment, retention, protrusions, scanner visibility and centre of gravity. Changes to a rack foot or load position may affect vehicle safety even when the robot software is unchanged.

20.3 Loading shall follow the approved restraint and distribution plan. Keep container stacking strength distinct from transport restraint capability. A stack lock that prevents vertical displacement may not provide the required restraint in every direction; the complete load arrangement requires competent assessment.

20.4 At unpacking, follow the safe sequence for restraints, lids, nesting and part removal. Account for shifted loads and stored energy in straps or closures. Preserve product identity when splitting a handling unit, and prevent discarded labels from being used to misidentify another lot.

20.5 Empty-container staging shall protect cleanliness, drainage, emergency routes and fire arrangements. Prevent accumulation that obstructs pedestrian or vehicle paths. Product, container and waste movements shall be recorded distinctly through IAF-MAN-SCL-001 and the local operating instructions.

21 Aftermarket packing and parcel distribution

21.1 Aftermarket packaging shall account for individual picking, small consignments, repeated carrier handling and recipients without industrial unloading equipment. Qualify the actual delivery mode, including parcel networks where used. A factory rack design does not establish suitable protection for a single replacement part in a box.

21.2 Packing instructions shall identify the correct product, condition, complete kit, orientation and protection. Original, alternative, remanufactured and used parts require truthful labels consistent with IAF-MAN-ASI-001. Repacking shall not conceal condition, remove traceability or reset shelf life.

21.3 Use right-sized qualified packaging with controlled void space and movement restraint. Heavy metal components shall not be packed with fragile electronic or optical parts without validated separation. Prevent terminals, edges and leaking residues from damaging other items or the recipient.

21.4 Include necessary safe opening, installation dependency and return information in a usable form. A digital code may supplement instructions, but essential safety or legally required information shall not disappear when the recipient lacks network access. Protect personal information on outer labels and reused boxes.

21.5 For split kits, fragile glazing, painted panels, fluids, batteries and oversized parts, issue specific configurations and carrier restrictions. A shipping-cost limit shall not authorize inadequate protection. Record pack revision and part-to-shipment identity so that recurring damage can be investigated by configuration and route.

22 Customer returns and damaged-product packaging

22.1 Return instructions shall be based on the actual product condition, completeness, contamination and hazard. Ask for enough information to assess the route before issuing a generic label. A part that failed in service may no longer be suitable for its original new-product packaging or normal carrier service.

22.2 For ordinary unused returns, explain how to preserve identity, protect surfaces, immobilize the part and close the qualified package. Inspect the original container before reuse; damaged or moisture-weakened packaging requires an approved replacement. Do not assume the customer retained every original support or closure.

22.3 For batteries, pyrotechnic parts, chemicals, leaking assemblies or unsafe damaged goods, competent specialists shall determine the collection and packaging method. Routine customers shall not be instructed to dismantle, drain, neutralize or improvise containment of a hazardous item to make it easier to ship.

22.4 Returned cores and repairable units shall have truthful condition labels and suitable restraint. Keep product evidence, removed components and required fault information together without loose contamination. Separate reusable packaging assets from returned product ownership and customer credits.

22.5 On receipt, hold both product and packaging until their respective condition decisions are complete. Preserve damage patterns and sensor records needed for investigation. Cleaning or repair of the container shall not destroy evidence before the authorized case owner permits it.

23 Retirement, segregation and recovery evidence

23.1 Retirement criteria shall cover irreparable structural damage, unacceptable contamination, obsolete configuration, unavailable safe repair and exhausted qualified service life where defined. The decision shall name the asset, reason, owner and disposition. Mark retired assets so that they cannot return to the released pool.

23.2 Segregate materials by actual composition and contamination: metals, clean fibre, suitable wood, mixed laminates, polymers, electronics and other controlled waste. Do not place a composite or contaminated item in a preferred stream solely because its main visible component appears recyclable.

23.3 Use authorized and competent recovery partners appropriate to the material and jurisdiction. Retain handover identity, mass, date, destination and processing evidence proportionate to the claim. A collection receipt establishes transfer, not necessarily that the material was recycled into a new product.

23.4 Remove tracking devices, batteries and confidential labels through safe approved methods. Revoke credentials and close asset identities while preserving required history. Device reuse shall retain verification of condition and authorized configuration; electronic waste shall follow its appropriate route.

23.5 Reconcile retired and lost assets with the physical pool and financial ledger. Record actual recovered material and residual disposal. Environmental reporting shall distinguish intended route, collected quantity and verified recovery outcome, including uncertainty and rejected loads.

24 Circularity metrics, cost and public claims

24.1 The scorecard shall include packaging mass per defined delivery, plastic mass, exception coverage, damage rate, completed reuse cycles, return timeliness, loss, repair, cleaning burden and verified recovery. Define whether the delivery unit is a part, kit, tonne or handling unit. Comparing different functional units without adjustment can mislead.

24.2 Reuse performance shall use actual asset or cohort histories. Separate first use, repeat use, serviceable returns and retired assets. A theoretical design life is not the number of cycles already achieved. Review lost assets and incomplete cycles rather than assuming every dispatched container returns.

24.3 For cost comparison, include acquisition, inserts, cleaning, repair, return freight, tracking, administration, loss and product damage over the same service function. Divide fixed costs by a justified number of completed or scenario cycles. Keep forecast savings distinct from realized results.

24.4 Environmental comparison shall use consistent boundaries and include manufacture, replacement components, cleaning, outbound and return movement, loss, recovery and product damage. Reuse can require a sufficient number of effective cycles to offset higher initial burden; the result depends on the actual lane and system.

24.5 Claims such as zero plastic, reusable, recycled content or lower impact require separately identified evidence and approval. Do not imply that one attribute proves another. Publish the relevant scope, period and material limitations; corrections shall be issued when evidence no longer supports a claim. Annex F provides transparent calculation examples.

25 Nonconformity, containment and packaging recovery

Owner: Quality with Packaging Engineering and Logistics. Trigger: damage, failed test, contamination, material mismatch, unsafe container, missing asset or unsupported claim.

Step / owner	Required action and evidence
1 Hold and protect	Identify affected product, containers, configurations and shipments. Stop unsafe use and apply physical and system holds. Assess whether packaging failure may have damaged parts that still appear acceptable.
2 Preserve evidence	Retain pack condition, photographs, product identity, route events, material lots and sensor data. Record what is known and uncertain. Do not clean, discard or repair evidence prematurely.
3 Define the population	Trace the packaging supplier, batch, revision, repairs and lanes. Review stock, in-transit loads and prior deliveries. Expand containment if identity or the failure boundary is unreliable.
4 Decide disposition	Engineering and Quality authorize inspection, repack, repair, product evaluation, return or retirement. Specialist acceptance is required for relevant hazardous goods. A new outer box does not cure hidden product damage.
5 Correct the cause	Address design, material, packing method, handling, lane or return-loop failure. Assess zero-plastic and claim implications. Requalify affected functions and train personnel before routine reuse.
6 Verify effectiveness	Monitor representative shipments and cycles against defined acceptance. Close holds only through recorded authority. Update specifications, supplier controls and public information where the evidence requires it.

A repeated damage pattern shall not be closed by adding unrecorded material to every shipment. The corrected configuration requires an approved specification, material inventory and validation.

26 Implementation, competence and assurance

26.1 Implementation shall begin with an inventory of current packaging configurations, plastic content, damage, return performance and asset ownership. Prioritize high-volume and high-risk flows. Assign accountable owners and a realistic sequence of qualified changes, with explicit acceptance before each rollout.

26.2 Personnel shall demonstrate competence in packing, inspection, safe handling, cleaning, repair, asset transactions and exception reporting within their role. Training shall use the actual product and container where practicable. Attendance alone does not establish competence for structural repair or specialist packaging decisions.

26.3 Assurance shall sample complete cycles from material declaration and pack release to customer receipt, empty return, service and re-release. Compare physical configuration with the approved bill of materials. Inspect tapes, coatings, replacement inserts and smart-device components that may be omitted from a superficial plastic review.

26.4 Management shall review progress, exceptions, product damage, safety incidents, cost, reuse and evidence quality at least annually and after significant failure. Record actions, resources and effectiveness checks. A zero-plastic target shall remain linked to product protection and transparent reporting throughout the transition.

26.5 Control specifications, tests, approvals, asset histories, repair records, material evidence and recovery documents through IAF-GUI-DOC-001. Set retention from product, contractual and legal needs and preserve investigation holds. Annex G defines deployment gates and interfaces with the IAF quality and conduct system.

Annex A Packaging specification and material record

Form IPC-A. Configuration: _____ Revision: _____ Product / lane: _____ Owner: _____
Approval date: _____

Specification field	Required entry
Product and scope	Part, condition, quantity, mass, geometry and lane: _____
Sensitive features	Critical surfaces, environment, cleanliness and movement limits: _____
Container design	Drawing, supports, restraints, orientation and closures: _____
Handling envelope	Gross mass, centre of gravity, stack, lift and interface limits: _____
Material inventory	Component / material / mass / supplier / plastic fraction: _____
Smart devices	Identity, sensors, housings, batteries, attachment and service: _____
Packing sequence	Instruction, checks, labels and safe opening: _____
Qualification	Test plan, representative samples, results and approved scope: _____
Reuse and retirement	Cleaning, inspection, repair, rejection and recovery route: _____
Approval	Engineering / Quality / Safety / specialist where required: _____

Material uncertainty and approved exception, if any: _____

A controlled detailed bill of materials may be attached. Include every consumable and replaced component; do not classify coated fibre, tape or a tracking device solely by its largest visible material.

Annex B Plastic baseline and controlled exception

Form IPC-B. Site / programme: _____ Configuration: _____ Reporting period: _____
Material owner: _____

Control item	Evidence and decision
Baseline	Complete packaging scope, units, mass and measurement basis: _____
Plastic components	Films, foams, coatings, tapes, inserts and devices / quantities: _____
Unknown content	Composition gaps, estimates and verification plan: _____
Functional necessity	Protection or applicable mandatory requirement: _____
Alternatives reviewed	Candidate materials, trials, failures and technical evidence: _____
Exception scope	Parts, lanes, quantity or duration and permitted configuration: _____
Approvals	Engineering, Quality and relevant specialist / actual date: _____
Replacement plan	Validated alternative work, owner, milestone and review: _____
Claim restriction	Accurate permitted wording and prohibited claims: _____
Closure	New qualification, inventory change and exception withdrawal: _____

An exception does not meet the zero-plastic target. Include its material in the reported plastic total. Do not use recycled or biodegradable content as a reason to remove plastic from that total.

Next review: _____ Accountable programme owner: _____

Annex C Packaging qualification and release

Form IPC-C. Test plan: _____ Configuration / revision: _____ Product samples: _____
Lane and use conditions: _____

Qualification item	Record and outcome
Risk basis	Handling, climate, storage, product sensitivity and worst case: _____
Samples	Identity, quantity, condition, material lots and representativeness: _____
Acceptance	Package and product criteria, methods and decision authority: _____
Conditioning	Temperature, humidity, dwell, reuse or wear preparation: _____
Test sequence	Relevant compression, handling, vibration, impact or other tests: _____
Measurements	Equipment, verification, raw results and uncertainty where relevant: _____
Product checks	Functional, dimensional, electrical or surface results: _____
Failures	Failed criteria, damage, containment and corrective action: _____
Repeat verification	Changes, retest scope, results and remaining limitations: _____
Release	Approved product and lane scope / restrictions / approvers: _____

Revalidation triggers: _____

Retain original failed results. A test pass applies to the defined configuration and scope; it is not a universal approval for different products, routes or repaired conditions.

Annex D Packing and dispatch release checklist

Form IPC-D. Shipment: _____ Workstation: _____ Date / shift: _____ Operator: _____
Configuration revision: _____

Release check	Result and evidence
Product identity	Part, revision, condition, quantity, lot or serial and release: _____
Pack availability	Approved container, supports, closures and material revision: _____
Container condition	Structure, cleanliness, dryness, labels and asset release: _____
Positioning	Orientation, supports, movement restraint and surface protection: _____
Closure	Approved sequence, restraint, count and safe opening: _____
Mass and interfaces	Gross mass, stability, lifting and stack restrictions: _____
Labels	Product, destination, condition and required transport information: _____
Smart record	Device status, time, product association and data checks: _____
Exceptions	Mismatch, damage, missing material or hold / disposition: _____
Final release	Checker, actual release and dispatch location: _____

Packaging approval shall not replace product or trade release. A missing protective component or unreadable identity shall be resolved before handover.

Receiver feedback or damage case linked to this shipment: _____

Annex E Asset return, service and retirement history

Form IPC-E. Asset: _____ Owner: _____ Configuration: _____ Cycle / service event: _____
Date: _____

Lifecycle event	Required entry
Custody return	Sender, carrier, receiver, actual times and condition: _____
Association closure	Previous product / shipment and verified unloading: _____
Initial classification	Dirty, inspection hold, repair or retirement candidate: _____
Cleaning	Method, agent, contamination, results and dryness: _____
Inspection	Structure, supports, closures, labels and devices / defects: _____
Repair	Approved method, personnel, replaced material and verification: _____
Release	Competent approver, accepted configuration and next trigger: _____
Cycle data	Actual release-to-release duration and completed-use count: _____
Retirement	Reason, authority, identity closure and safe device removal: _____
Recovery	Material mass, receiving partner and verified processing evidence: _____

Unresolved custody or condition issue: _____

A returned asset is not serviceable until accepted. A retired asset remains traceable through recovery, and a collection receipt alone shall not be reported as completed recycling.

Annex F Pool sizing and circularity calculations

Illustrative pool size

Assume 60 loaded containers per day and an 8-day average release-to-release cycle, including normal cleaning and inspection. The average circulating requirement is $60 \times 8 = 480$ containers. An additional, justified 90-container variability and contingency allowance gives 570. These are example values; validate the cycle, demand calendar and tail delays before adoption.

Illustrative completed-cycle cost

Assume a reusable container costs 120 monetary units and completes 40 usable delivery cycles. Acquisition allocation is $120 / 40 = 3$ per cycle. If cleaning, repair, return and administration total 2.5 per cycle, the model cost is 5.5 before any other excluded costs. At only 15 cycles it becomes $8 + 2.5 = 10.5$. State loss, damage and salvage assumptions explicitly.

Comparable environmental scenarios

Let A be the reusable system's initial burden, r its burden per completed cycle, and s the single-use burden per equivalent protected delivery. With consistent scope and no other differences, the reusable average $A/n + r$ is lower than s when n is greater than $A/(s - r)$, provided s is greater than r . If s is not greater than r , this simplified model has no positive break-even point. Use actual evidence and include product damage, return and recovery effects.

Reporting field	Entry
Boundary	Equivalent delivery function, period and included activities: _____
Evidence	Mass, actual cycles, return, cleaning, loss and damage data: _____
Uncertainty	Estimates, exclusions and sensitivity scenarios: _____
Approval	Result, permitted claim, reviewer and actual date: _____

Annex G Deployment gates and controlled interfaces

Deployment gate	Required evidence
1 Baseline	Current packs, material composition, damage and return performance.
2 Prioritize	Product risk, plastic reduction opportunities, lane and owner.
3 Design and qualify	Approved alternatives, trials, product checks and necessary exceptions.
4 Prepare the loop	Pool, custody, cleaning, repair, data and competent service partners.
5 Release operations	Packing instructions, trained staff, first shipments and acceptance.
6 Verify progress	Actual reuse, plastic totals, damage, cost, recovery and claim evidence.

Operational acceptance

Sites / products / lanes: _____

Open actions and restricted configurations: _____

Accountable approvals and actual operational date: _____

Document and policy interfaces

IAF-QM-001 governs quality oversight and IAF-GUI-DOC-001 governs document and record control. IAF-MAN-SCL-001 governs transport, supplier and trade flows; IAF-MAN-ASI-001 governs aftermarket condition and identity; IAF-MAN-GAA-001 governs battery handling; IAF-MAN-OTC-001 governs smart-device and information security interfaces.

Apply the IAF privacy, whistleblowing, complaints, conflict and mark policies to data, reporting, impartial decisions and claims. Assign record owners, access controls, retention triggers and disposal authority. Preserve evidence under product investigation or legal hold and verify long-term readability.