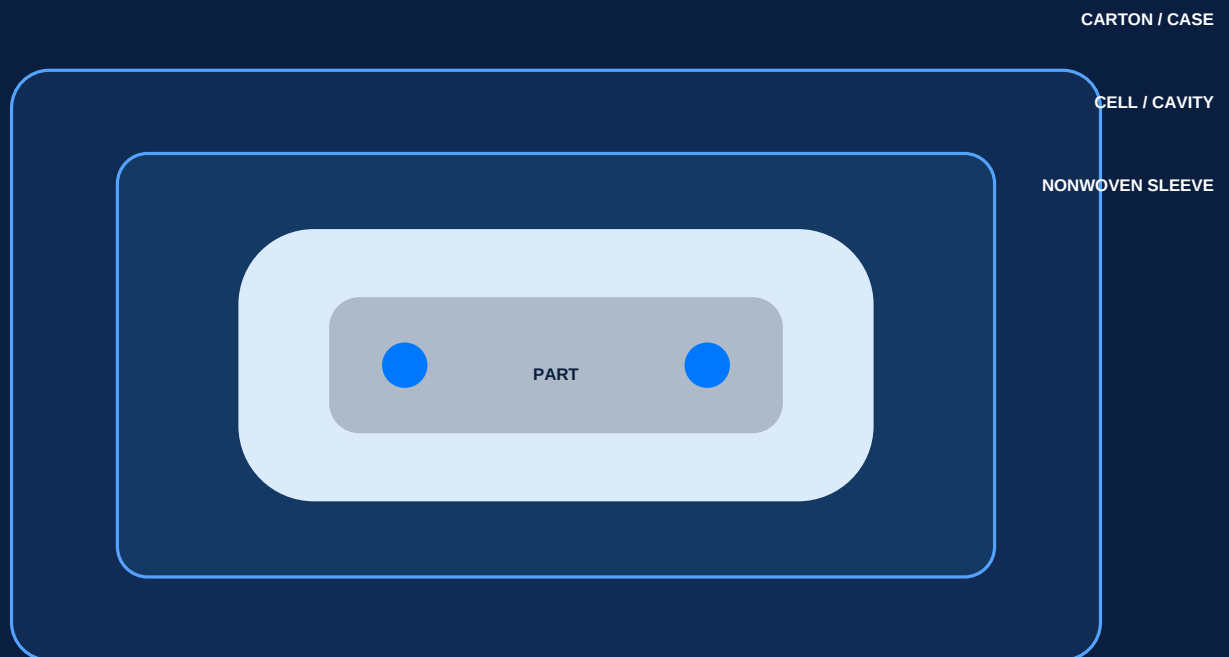


DESIGN FOR DELIVERY

PACKAGING & COSMETIC PROTECTION GUIDE

Surfaces | Films | Separators | Pack-out | Transport validation



A practical guide for delivering aluminum parts
without scratches, stains, rub marks or finish damage

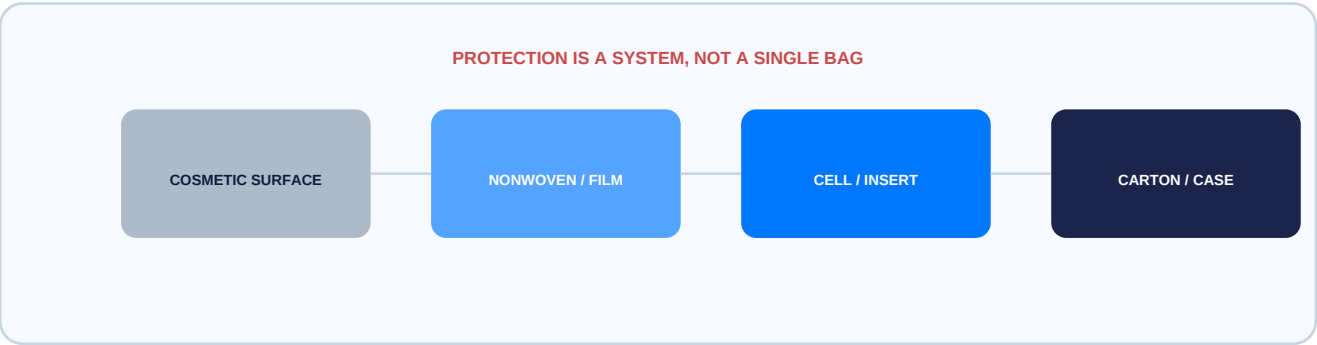
Prepared by BAOSONG

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00 Treat packaging as part of the product

A conforming aluminum part can become nonconforming during handling, storage or transport. Protection must be designed and validated with the part.



Layer	Design decision	Release evidence
Part surface	Finish, cosmetic zones, cure state, cleanliness and sensitive features	Controlled drawing and approved sample
Primary contact	Film, sleeve, tissue or soft insert compatible with the finish	Material identification and compatibility evidence
Location	Cavity, cell, fixture or blocking that prevents motion	Pack-out drawing and movement check
Secondary protection	Bag, barrier, desiccant or corrosion control when required	Storage and route justification
Distribution pack	Carton, crate, pallet, closure and unitization	Transport validation and inspection record

CORE RULE

Do not allow cosmetic surfaces to carry uncontrolled load or rub against another part, fastener, carton, foam seam or dirty handling surface.

01 Define the protection requirement

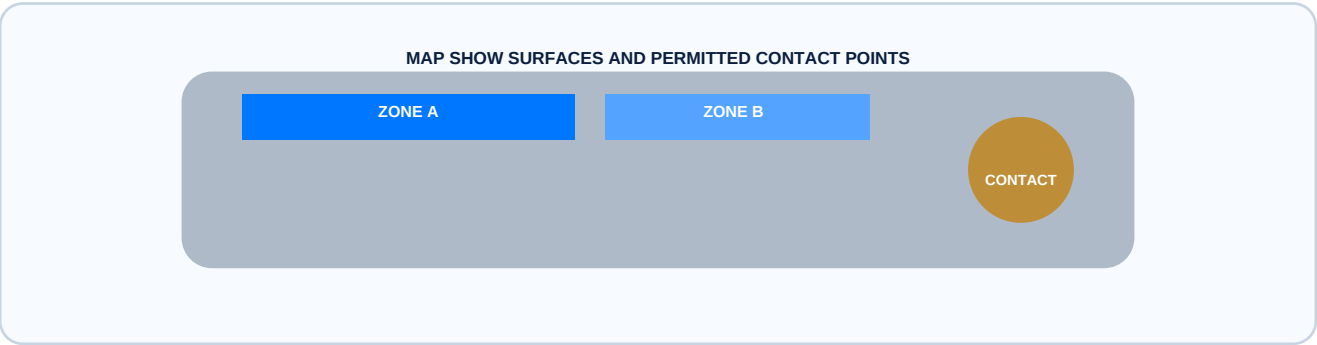
Start with the delivered condition, distribution route and customer handling - not with a preferred bag or foam.

Input	Questions to close	Effect on packaging
Surface system	As-machined, brushed, polished, anodized, powder coated, painted or plated?	Compatibility, hardness, cure and scratch sensitivity
Cosmetic standard	Which faces are Zone A/B/C and what defects are limited?	Contact map, inspection and allowable witness marks
Part geometry	Sharp edges, bosses, threads, cavities, long profiles or flexible panels?	Sleeve puncture, nesting, support and restraint
Distribution	Parcel, LTL, air, sea, export crate, warehouse transfers or line-side use?	Shock, vibration, stack, humidity and handling severity
Storage	Duration, temperature, humidity, UV, cleanliness and film removal window?	Barrier, desiccant, ventilation and shelf-life rules
Customer use	Bulk feed, manual unpack, clean assembly, returnable pack or retail presentation?	Pack quantity, access, labeling and debris control

DELIVERED STATE	State whether protective film stays on through customer assembly, who removes it, and the maximum time and temperature before removal.
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02 Map cosmetic zones and contact points

Packaging decisions become objective when the drawing shows where contact is prohibited and where support is permitted.



Zone	Typical requirement	Packaging implication
A - primary show	Visible in normal use; strictest scratch, dent, stain and print limits	No uncontrolled contact; individual soft protection
B - secondary	Visible at an angle or during handling	Limited clean contact at approved areas
C - hidden	Not visible after assembly	Preferred support/contact zone if function allows
D - functional	Fit, seal, thread, datum, bond or electrical surface	Protect from load, debris, coating transfer and corrosion
Edge / corner	Highly exposed to impacts and sleeve puncture	Add guards, clearance or dedicated supports
Permitted witness	Approved clamp, rack, film edge or support location	Dimension location and maximum mark

DRAW IT

A note such as 'protect cosmetic surfaces' is incomplete. Add a zone map, permitted support points and any no-label/no-tape areas.

03 Recognize cosmetic damage modes

Different mechanisms leave similar-looking defects; the countermeasure must address the actual source.

Damage mode	Common source	Effective control
Scratch / scuff	Part motion, hard debris, rough carton, staples or exposed fasteners	Clean soft interface plus positive location
Rub / burnish	Repeated micro-motion under vibration	Eliminate motion; do not rely on thicker wrap alone
Dent / edge bruise	Drop, concentrated load or insufficient clearance	Load-spreading support and crush space
Imprint / blocking	Pressure, heat, uncured finish, foam texture or film adhesive	Cure, compatible contact material and storage trial
Stain / corrosion	Moisture, fingerprints, acid paper, wood emissions or trapped cleaner	Clean/dry part, compatible materials and moisture strategy
Residue / color shift	Wrong adhesive, excessive dwell, UV or elevated temperature	Qualified film and controlled application/removal window
Debris contamination	Foam shedding, cardboard dust, machining chips or dirty gloves	Clean pack area, sealed primary bag and material control

ROOT CAUSE

If damage repeats at the same feature, redesign the locating/support system. Adding more loose wrap rarely fixes geometry-driven motion.

04 Select compatible contact materials

Anything touching the part becomes part of the finish system during storage and transport.

Material family	Good use	Watch items
Clean nonwoven sleeve	Individual protection for anodized, brushed, painted or powder-coated parts	Fiber/lint, seam placement, trapped debris and reuse cleanliness
PE bag or sheet	Moisture/dust barrier and low-cost separation	Blocking, print-through, static, sliding and sharp-edge puncture
Tissue / paper	Light interleaf for clean dry low-risk parts	Acidity, moisture uptake, abrasion, ink transfer and tearing
EPE / PE foam	Cushioning, edge guards and shaped supports	Surface texture imprint, migration, pressure and debris
EVA / cross-linked foam	Durable returnable inserts and precise nests	Hardness, color transfer, plasticizer and compression set
Corrugated board	Cells, dividers and external container	Dust, cut edges, moisture and direct show-surface contact
Wood / plywood	Export crates, blocking and heavy loads	Moisture, emissions, splinters, fasteners and compliance treatment

COMPATIBILITY TRIAL

Test the exact finish/contact-material combination under representative pressure, temperature, humidity and dwell. Generic material names do not prove compatibility.

05 Use protective film deliberately

Protective film can prevent scratches, but the adhesive and removal window can also create cosmetic defects.

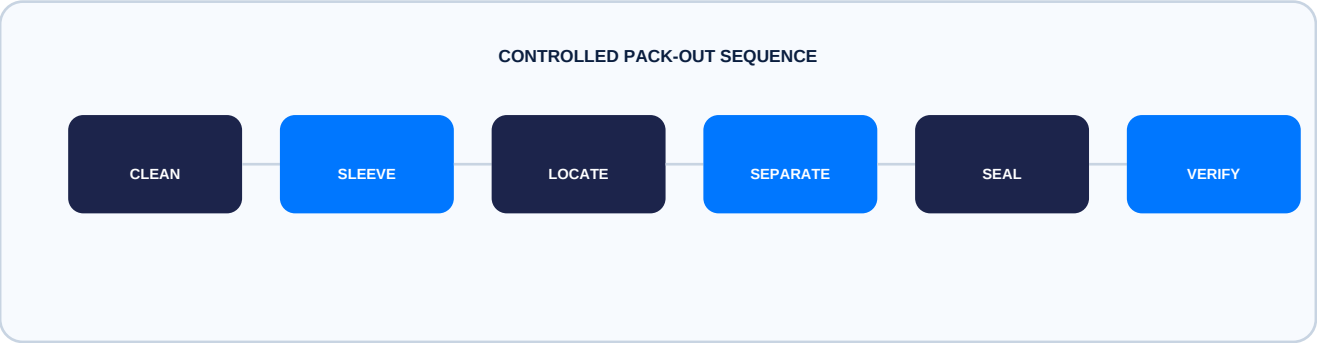
Control	Specify	Failure if omitted
Finish readiness	Minimum cure/cool time and clean, dry application condition	Entrapped solvent, blocking or poor adhesion
Film grade	Supplier/product, backing, adhesive type, color and thickness	Uncontrolled tack, stretch or residue
Adhesion window	Initial/aged peel range on the actual surface	Lift during fabrication or difficult removal
Application	Direction, overlap, edge setback, bubble/wrinkle limits and roller cleanliness	Print, trapped grit or exposed edges
Processing	Whether cutting, bending, machining, anodizing, coating or laser work occurs with film	Melt, contamination, trapped chemistry or fire risk
Storage	Maximum duration, temperature, humidity and UV exposure	Residue, staining or adhesive transfer
Removal	Who removes it, pull direction, temperature and acceptance after removal	Edge lift, finish peel or hidden damage

DO NOT ASSUME

A film approved for bare mill-finish aluminum may not be suitable for anodize, powder coat, paint, polish or a freshly cured surface.

06 Stop motion before adding cushioning

Cosmetic protection fails when the part can slide, rattle, nest too deeply or transfer load through fragile features.



Pack feature	Design rule	Check
Cavity / cell	Locate on robust non-show geometry with clearance from cosmetic faces	No part-to-part or part-to-carton contact
Blocking	Resist movement in all three axes without point-loading thin walls	Manual shake and transport-test inspection
Separator	Extend beyond sharp features and remain positioned during vibration	No cut-through, fold-back or migration
Edge guard	Spread impact load and avoid finish imprint	Clearance after compression
Nested parts	Control overlap depth, orientation and removal force	No wedging, rubbing or vacuum lock
Pack density	Limit stack height and cumulative load on lower parts	Worst-case bottom-part inspection

SHAKE IS A SCREEN

A shake check is useful for finding obvious movement, but it does not replace a route-based vibration, shock and compression validation plan.

07 Control moisture and corrosion

Sealing a damp or contaminated aluminum part can be worse than allowing a clean dry part to breathe.

Condition	Risk	Control strategy
Freshly washed part	Water remains in blind holes, hems, tubes or porous surfaces	Dry completely; verify cavities and trapped volumes
Temperature cycling	Condensation forms inside sealed packs	Barrier/desiccant sized to route or managed ventilation
Ocean/export storage	Long humidity exposure and salt contamination	Qualified barrier, desiccant, humidity indicator and seal control
Wood/cardboard contact	Moisture and volatile compounds may stain or corrode	Isolate metal; control moisture and packaging material
Fingerprints / salts	Localized staining, especially on bare or sensitive finishes	Clean gloves, final clean and no-touch zones
VCI system	Chemistry may be incompatible or ineffective for aluminum/finish	Use an aluminum-compatible qualified system only
Mixed metals	Galvanic cell develops if moisture bridges the parts	Separate materials and prevent electrolyte contact

DESICCANT

Desiccant is not a substitute for dry parts and a controlled barrier seal. Define quantity, placement, replacement and humidity-indicator logic from the package volume and route.

08 Control cleaning and handling

The cleanest packaging cannot recover a finish already damaged at inspection, transfer or pack-out.

Step	Control	Evidence
Final process	Confirm finish cure/seal/cool time before contact or wrapping	Batch record and release time
Cleaning	Approved chemistry, lint-free method and residue-free dryness	Work instruction and periodic validation
Gloves	Clean compatible gloves changed at defined triggers	Visual standard and supervisor audit
Work surface	Dedicated soft clean surface with no chips, staples or mixed hardware	Start-of-shift and changeover check
Transfer	Use trays/racks; avoid stacking unprotected parts	Defined WIP route
Inspection	Inspect under controlled lighting before primary protection	Accepted quantity and defect record
Pack-out	Verify part number, orientation, quantity, accessories and closure	Traveler/checklist and pack ID

DEBRIS CONTROL

A single chip trapped inside a sleeve can scratch many parts. Separate machining/deburring from final clean inspection and pack-out.

09 Design the pack-out architecture

Build protection from the part outward and assign each layer one clear job.

Layer	Primary job	Typical release question
Surface interface	Prevent abrasion, residue and imprint	Is the material qualified on the actual finish?
Part restraint	Prevent motion and contact	What locates the part in X, Y and Z?
Cushioning	Limit shock and spread local loads	Does it protect the fragile feature without over-compression?
Primary bag/barrier	Control dust, moisture or part grouping	Should it be sealed, vented, antistatic or moisture-barrier?
Cell/carton	Separate units and carry stacking load	Does strength remain adequate after humidity and handling?
Case/pallet	Enable transport and mechanical handling	Are loads unitized and forklift/strap contact controlled?
Label/seal	Preserve identity, orientation and tamper evidence	Can labels be read without opening or touching the part?

RETURNABLE PACK

For reusable trays or racks, define cleaning, inspection, repair, contamination limits, retirement criteria and ownership of empty-pack return.

10 Control cartons, crates and pallets

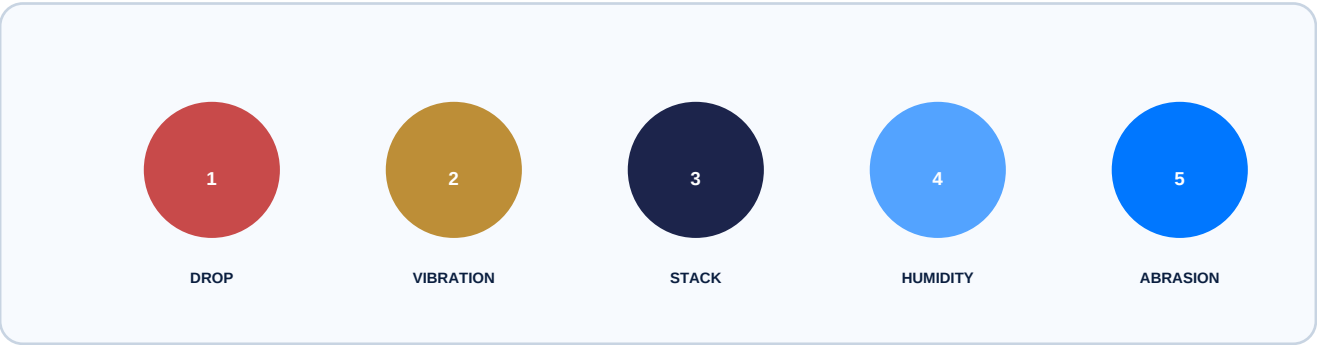
The outer pack must carry distribution loads without transferring strap, fastener, fork or stack damage to the parts.

Element	Design requirement	Common failure
Carton	Strength and flute/board grade suited to gross mass, stack and humidity	Bulge, collapse, abrasion or divider escape
Crate	Frame, panels, blocking and lifting points sized for load path	Fastener penetration, loose blocking or racking
Pallet	Footprint, deck support, entry direction and load distribution	Overhang, broken deck or fork contact
Strapping	Edge protectors, tension and approved strap paths	Crushed profiles, finish rub or loosened load
Stretch/shrink wrap	Containment without trapping damaging moisture or deforming cartons	Condensation, heat damage or insufficient restraint
Forklift clearance	Marked entry and blocking that prevents fork/part interaction	Puncture or concentrated impact
Stacking	Maximum tiers/load, orientation and warehouse duration	Creep, carton compression and bottom-part imprint

EXPORT ROUTE	Confirm wood-treatment/marking, dangerous-goods, labeling, customs and customer requirements with the responsible logistics authority. This guide does not define regulatory compliance.
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11 Validate the real distribution system

A package test should reproduce the relevant sequence of conditioning, handling, vibration, shock and compression - then inspect the product, not only the box.



Hazard	Define	Product acceptance
Conditioning	Temperature/humidity state before test	No film change, stain, corrosion or material transfer
Manual handling/drop	Package mass, orientation and route severity	No dent, edge impact, loosened restraint or cosmetic defect
Vibration	Transport mode, spectrum/method, duration and top load	No rub, separator migration, debris or fastener contact
Compression/stack	Warehouse/vehicle load, duration and safety factor	No finish imprint, distortion or lower-layer damage
Horizontal impact	Palletized handling, rail/truck events or incline impact	No movement or support failure
After-test inspection	Unpack sequence, controlled lighting and functional checks	Meets drawing, cosmetic standard and pack integrity criteria

SEQUENCE MATTERS

ASTM D4169 uses distribution-cycle test schedules; the same shipping unit is normally kept unopened through the performance sequence so combined hazards are evaluated.

12 Write a controlled packaging specification

The pack standard should let different operators reproduce the same protection and let quality audit it.

Specification element	Minimum content
Scope	Part numbers/revisions, finishes, suppliers, plants and shipment modes covered
Approved materials	Material name, supplier/grade, thickness/density and prohibited substitutes
Pack sequence	Cleaning, orientation, film/sleeve, separator, quantity, closure and unitization
Contact map	Permitted supports, no-contact zones, edge protection and accessory locations
Diagrams/photos	Clear views, dimensions, labels and acceptable completed pack
Environment	Cure/cool time, cleanliness, humidity, storage and film-removal window
Inspection	In-process checks, sample frequency, cosmetic criteria and records
Change control	Approval required for material, supplier, geometry, quantity or route changes
Nonconformance	Containment, reinspection, repack, damage coding and disposition authority

SUBSTITUTIONS

Do not permit 'equivalent foam/bag/film' without an approval path. Surface compatibility and compression behavior can change even when dimensions look identical.

13 Label for identity and safe unpacking

Labels should preserve traceability and guide handling without placing adhesive or staples on protected surfaces.

Label / mark	Include when applicable	Placement rule
Part / lot identity	Part number, revision, lot/batch, quantity and supplier	Readable without contacting or uncovering Zone A
Orientation	This side up, stack direction, center of gravity or long-part support	Visible on handling faces
Handling	Do not stack, fragile surface, team lift, no clamp or fork zones	At point of handling decision
Moisture control	Desiccant quantity, humidity indicator and barrier-open instructions	Inside and outside as required
Film removal	Remove-by date, temperature, direction and responsible operation	On outer bag or approved film tab
Unpack sequence	Fastener removal, lid support, lifting points and part extraction	Prevent tool contact and sudden movement
Returnable pack	Asset ID, inspection status, cleaning and return destination	Durable area protected from abrasion

NO ADHESIVE ON
SHOW SURFACES

Place labels on the bag, tray, carton or a drawing-approved hidden zone. Validate residue-free removal if direct application is unavoidable.

14 Inspect at pack-out and receipt

A matched outgoing/incoming inspection record separates manufacturing defects from handling and transport damage.

Gate	Check	Record
Before pack	Correct revision/finish, complete cure, clean/dry part and controlled lighting	Accepted quantity, lot, inspector and sample result
Primary protection	Correct film/sleeve, no debris, full coverage and approved contact	Material lot or pack standard revision
Restraint	Correct orientation, cell count, separators and no free motion	Pack-out checklist/photo
Closure	Bag/barrier seal, desiccant/HIC, carton tape, crate fasteners and straps	Seal/closure verification
Shipment	Labels, pallet condition, gross mass, carrier and route	Shipment and tracking record
Receipt	External damage before opening, moisture/HIC, movement and unpack condition	Photos and receiving report
Part inspection	Zone-based cosmetic check plus critical fit/function	Damage code, location and affected quantity
Feedback	Retain damaged pack interfaces and identify repeat locations	Corrective action linked to pack revision

PHOTO EVIDENCE

Photograph the unopened package, restraint condition and first damaged part before disturbing the pack. Preserve interfaces and debris for root-cause review.

15 Drawing and RFQ checklist

Packaging requirements should be quoted and approved with the finish, cosmetic standard and shipment route.

Gate	Required input
Part definition	Controlled CAD/drawing, revision, alloy/temper, mass, dimensions and sharp/fragile features
Finish	Process, cure/seal condition, color/texture and surfaces sensitive to pressure or adhesive
Appearance	Zone map, defect limits, viewing conditions, approved samples and permitted witness marks
Contact	Approved/prohibited materials, film requirement, no-contact zones and support locations
Pack-out	Quantity, orientation, separation, restraint, accessories, closure, carton/crate and pallet
Environment	Route, storage duration, temperature/humidity, export and moisture-control requirements
Validation	Adopted test schedule, severity, sample size, inspection and acceptance criteria
Operations	Pack/unpack instructions, labeling, traceability, returnables and change control
Commercial	One-time design/tooling, pack material, validation, replacement and logistics costs

RFQ RESPONSE

Ask the supplier to list assumptions, contact materials, pack quantity, allowed substitutions, test plan, reusable-pack life and exclusions.

Coordinate packaging with [BAOSONG Engineering Support](#), [Surface Finishing](#) and [Quality](#).

16 References and BAOSONG contact

Confirm the standard edition and test severity adopted by the purchase order. Packaging tests are route-specific and do not create universal acceptance levels.

Reference	Guide use	Link
ISO 4180:2019	General rules for compiling performance test schedules for complete filled transport packages	Official ISO page
ISO 2233:2000	Conditioning of complete filled transport packages and unit loads for testing	Official ISO page
ASTM D4169-23e1	Performance testing of shipping containers and systems	Official ASTM page
ASTM D4332-22	Conditioning containers, packages or packaging components for testing	Official ASTM page
ASTM D5276-19(2023)	Free-fall drop test of loaded containers	Official ASTM page
ASTM D999-08(2023)	Vibration testing of shipping containers	Official ASTM page

USE LIMITATION

Educational DFM guidance only. It does not replace a controlled drawing, approved cosmetic standard, qualified packaging specification, route-based validation, applicable law or contract acceptance criteria.

REQUEST A REVIEW	Send CAD, finish, cosmetic-zone map, quantity, shipment route, storage conditions, target pack-out and validation requirements.
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BAOSONG resources: [CNC Machining](#) | [Aluminum Extrusion](#) | [Anodizing](#) | [Powder Coating](#)