AXIOM

GLOBAL PACKAGING SOLUTIONS

The Packaging Optimization Playbook

A field guide to specifying corrugated packaging: choosing a flute, reading ECT against burst, right-sizing without failing a transit test, and running an acceptance plan your auditors will accept.

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Manufactured and delivered across India, APAC and the US.

How to use this

This is a working reference, not a brochure. Every recommendation here is tied to a published test method rather than to a rule of thumb, so you can check it, argue with it, or hand it to a supplier.

- **1.** Choosing a flute - and why B sometimes beats C
- **2.** ECT or burst: which grade your failure mode is asking for
- **3.** Right-sizing: the constraints to write down first
- **4.** The derates people forget
- **5.** AQL sampling and defect classes, with a worked lot
- **6.** Replacing foam with fiber
- **7.** The specification checklist

> **One principle underlies all of it:** a strength number without a climate is not a number. Corrugated is hygroscopic - it loses compression strength as it takes on moisture - so every published value is quoted at a standard test climate of 23 C and 50% relative humidity (DIN EN 20187). That is a measurement convention, not a description of your warehouse.

1. Choosing a flute

Flute profile is defined by arch height and pitch. Height and pitch decide stiffness, energy absorption and how flat the print surface is. Under DIN 55468-1:

PROFILE	HEIGHT (MM)	PITCH (MM)	TYPICAL USE
A	4.0 - 5.0	7.9 - 10.0	Maximum cushioning and stacking
C	3.1 - 4.0	6.5 - 7.9	The general-purpose shipper
B	2.2 - 3.1	4.8 - 6.5	Flat, crush-resistant, prints well
E	1.0 - 1.9	2.6 - 3.5	Retail and primary packs
F	0.6 - 1.0	1.8 - 2.6	Fine retail

B or C?

C is taller. A taller arch deflects further before the medium collapses and puts material further from the neutral axis, so it absorbs more energy and stiffens the panel. That makes C the default shipper.

B is shorter with a tighter pitch, so there are more arches per metre supporting the flat face. That resists **crush** - the flat, localized pressure of a clamp truck or a tight stack - and gives a flatter surface for print and die-cutting. B also produces a smaller outside dimension for the same inside dimension, which can decide whether a layer fits the pallet.

CHOOSE C WHEN	CHOOSE B WHEN
The box is dropped; it stacks high; cushioning matters; board thickness is acceptable	The box is squeezed or clamped; print quality matters; height is constrained; retail-ready

> **Do not identify a flute by thickness**
>
> Calliper varies with converting pressure, moisture and liner choice, so a B board and a thin C board can measure closer together than the spec suggests. **Pitch is the reliable tell** - count arches over a known length on a cut cross-section, away from creases and edges.

When it is neither: E-flute for retail (not a shipper); double-wall **BC** when single-wall C cannot carry the derated load; **EB** where print also matters; triple-wall for heavy export.

2. ECT or burst

Two grading systems circulate and get mixed up constantly. They answer different questions.

GRADE	MEASURES	CORRELATES WITH	SPECIFY IT WHEN
ECT	Edgewise compression of the board	Stacking performance	Boxes crush at the bottom of a stack
Burst	Pressure to rupture the liner	Puncture, rough handling	Corners tear, product punches through

Specifying a high burst number to fix a stacking failure is a common and expensive mistake: you buy heavier liner and still crush.

3. Right-sizing: constraints first

A right-sizing exercise that starts from a target percentage is not engineering. Start from what must remain true, then search inside it.

- **Stacking load** - how much weight sits on the bottom case, for how long, at what humidity.
- **Drop height** - follows from weight and handling mode. Parcel gets thrown; palletized freight gets forked.
- **Vibration** - long road lanes fret and abrade in ways a drop test never shows.
- **Line envelope** - your case erector and sealer have minimum and maximum blank sizes. A box your line cannot run is not optimal.
- **Mandates** - shelf-ready formats, labelling panels, customer-specified ISTA profiles.

Where the money actually is

Trimming a few millimetres per wall sounds trivial until it fits another column per layer or another layer per pallet. For parcel, box dimensions drive **dimensional weight**, which is billed on every unit, forever. Freight is frequently the larger prize - and it usually sits in someone else's budget line, which is why it goes unclaimed.

Reducing headspace often improves freight *and* protection at once, because the product has less room to accelerate before it hits something. That is rare. Chase it.

4. The derates people forget

The number from the press is not the number in your warehouse. Compression capacity is eroded by:

- **Moisture** - board weakens as relative humidity rises. The effect is large, not marginal.
- **Creep** - under sustained load board deforms progressively. A stack that holds for a minute may not hold for a month.
- **Pallet overhang** - a case whose edge is unsupported has lost the column carrying it.
- **Misalignment** - offset stacking loads panels instead of corners, and nearly all the strength lives in the corners.
- **Vents and hand holes** - every one interrupts a load path. Convenient, popular, quietly expensive.
- **Interlocked patterns** - good for stability, poor for compression. A real trade-off; make it knowingly.

> **If you do not know your humidity or dwell time**
>
> Measure them. A derate applied to a guessed humidity is a guess with a decimal point. Finding the real numbers is higher-value than any further optimization of the box.

Re-test after every change

The previous pack's report certifies the previous pack. Change board, dimensions or fitment and the failure modes genuinely change. Run **ASTM D642** for compression and the **ASTM D4169** cycle or **ISTA** profile matching the lane, on conditioned samples, with the real product or a dummy matched in mass *and* rigidity.

5. AQL sampling and defect classes

You cannot inspect 100,000 boxes. Acceptance rests on a statistical bargain: inspect a defined sample, apply a defined limit, accept or reject the lot. ISO 2859 is the standard that ties it together.

TERM	MEANING
Lot (N)	Quantity presented for inspection at one time
Sample (n)	How many units you draw from it
Acceptance (c)	Most defective units you may find and still accept
AQL	The defect level the plan is built around

Classify by consequence

CLASS	DEFINITION	TYPICAL AQL
Critical	Endangers health, breaches law, destroys the goods, or halts a line	None - reject
Major	Pack fails its function; complaints; real efficiency loss	0.65 - 1.5
Minor	General quality reduction, no significant consequence	6.5

Worked lot

A delivery of **N = 20,000** folding boxes. The plan calls for **n = 80**, drawn at random across the whole delivery.

Within that 80: **unusable** - no defects permitted. **Seriously impaired** - 1 defect at AQL 0.65, or 2 at AQL 1.0. **Impaired to a lesser extent** - 3 defects. **Noticeable only** - 8 defects.

Two rules people get wrong

- **One box, one defect.** If a box has four things wrong, evaluate only the most serious. You are counting defective units, not defects.
- **Spread the sample.** Eighty units off the top of one pallet is a sample of one shift, not of 20,000. Draw from the beginning, middle and end.

Dimensional tolerance

Measured between creasing centrelines, or a crease to the associated outer edge:

DIMENSION	TOLERANCE
up to 300 mm	± 3 mm
over 300 to 700 mm	± 4 mm
over 700 to 1,200 mm	± 0.6%
over 1,200 mm	by agreement

Machine-erected cases often need tighter tolerances than this ladder. Specify it at quotation - a tolerance you never asked for is not one your supplier owes you. **Warp** is measurable, not aesthetic: maximum elevation divided by the distance between supporting edges, as a percentage.

6. Replacing foam with fiber

Fiber and foam protect by different mechanisms, so a one-for-one swap - same geometry, new material - is the most reliable way to fail a drop test and conclude, wrongly, that fiber cannot do the job.

Foam cushions by crushing: cells collapse progressively, absorbing energy over a distance. **Fiber immobilizes and distributes**, taking its energy absorption from geometry - ribs, flanges, crumple features, panel deflection. So fiber designs are far more sensitive to shape, and the bearing area must be recalculated rather than carried over.

Name the function first

FUNCTION	FIBER OPTION
Cushioning	Molded pulp with designed ribs; corrugated crumple fitments; honeycomb
Immobilization	Corrugated fitments, sleeves, paper suspension / retention
Void fill	Paper fill, honeycomb wrap
Abrasion	Tissue interleaf, coated liner
Moisture barrier	Coated / laminated board - check repulpability

Coatings decide recyclability

- **Wax** - performs well, typically not repulpable.
- **PE lamination** - strong barrier, hard fiber recovery.
- **Water-based dispersion** - can hold moisture back and stay repulpable, but that is a claim to test against the real recovery stream, not to read off a datasheet.

The question is never "is it recyclable?" in the abstract, but "is it recoverable in the stream this pack actually reaches, in the market where it is opened?" That answer differs across India, APAC and the US.

Where plastic still wins

Barrier-critical goods; sterile and regulated medical containment; extreme cushioning of high-value fragiles; and reusable systems, where a durable tote used hundreds of times can beat single-use fiber outright. Substituting where it does not work produces damage - and a destroyed product carries far more embodied carbon than the packaging that failed to protect it.

7. The specification checklist

Most acceptance disputes trace back to a specification that never existed. This is a page. It converts "these boxes look bad" into a number.

The board

- Flute profile and construction (single / double BC / triple).
- Grade, stated against ECT or burst - and which failure mode it addresses.
- Liner and medium specified by **performance**, not by one mill's product.
- Coating, if any - and the recyclability consequence, acknowledged.
- **Flute direction**, called out and verified. Rotated flutes look identical on the pallet and lose a large share of compression strength.

The test

- The profile matching your real lane: ASTM D4169 cycle, or ISTA 3A / ISTA 6.
- ASTM D642 compression, with the derate for your humidity and dwell time.
- Conditioning climate stated (23 C / 50% RH) on every report.
- ISTA 7E where the shipment is temperature-controlled.

The acceptance

- Defect classes, and which specific defects fall in each.
- The AQL per class and the sampling standard (ISO 2859).
- Lot size definition - how a delivery breaks into batches.
- Dimensional tolerances, including any tighter ones your line needs.
- Who pays for what when a lot is rejected.
- A change-notification commitment, so no substitution arrives silently.

> **The assumption log**
>
> Every specification should carry what it was derived under: stack height, dwell time, assumed RH, drop height, lane. When something fails eighteen months later, that log is the difference between a diagnosis and an argument - and it is what lets you re-run the decision when the lane changes. Lanes change more often than specifications do.

Axiom Global Packaging Solutions - we manufacture and deliver corrugated packaging across India, APAC and the US, and every recommendation we make is tied to a published test method.
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