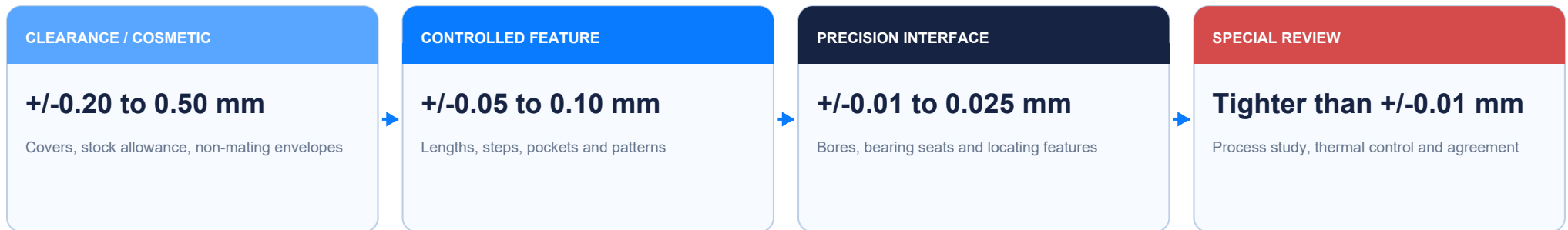


Choose tolerances by function - then prove them by measurement

Use the widest tolerance that protects assembly, sealing, alignment, motion or load transfer. Values below are RFQ discussion starts, not universal capability guarantees.

TOLERANCE LADDER: PRECISION, COST AND EVIDENCE



WHAT TIGHTENING CHANGES



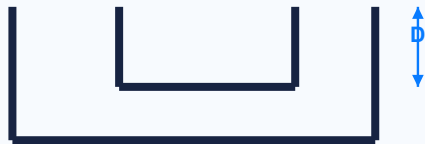
FIVE QUESTIONS BEFORE A TIGHT LIMIT



FEATURE / FUNCTION	DISCUSSION START (MM)	WHAT MAKES IT HARDER	CONTROL TO DEFINE	VERIFICATION
Envelope / clearance	+/-0.10 to 0.50	Span, thin wall, stock	Size/profile only if functional	Caliper, height gauge, CMM
Pocket depth / step	+/-0.05 to 0.15	Deep reach, floor flatness	Depth from stable face	Depth gauge, CMM
Drilled hole	+/-0.05 to 0.15	Small drill, breakout, wear	Size plus position	Plug, bore gauge, CMM
Bore / bearing seat	+/-0.01 to 0.025	L/D ratio, thermal state	Fit plus form/location	Bore/air gauge, CMM
Hole-pattern location	0.05 to 0.20 position	Long span, weak datums	Position to datum frame	CMM or functional gauge
Flat sealing face	0.03 to 0.15 flatness	Area, wall, unclamping	Flatness + orientation	Surface plate or CMM

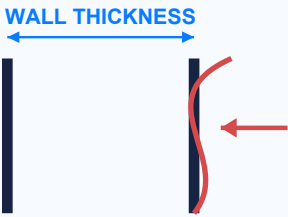
THREE DRAWINGS THAT PREVENT AMBIGUITY

POCKET DEPTH



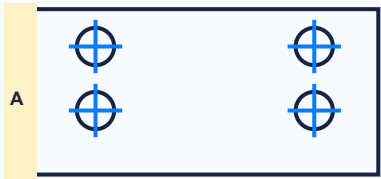
Dimension from the stable top datum; control floor form separately only when function needs it.

THIN WALL



Define free-state inspection and support. Tight size limits do not remove cutting-force deflection.

HOLE PATTERN



Use basic dimensions plus position to functional datums; avoid duplicate coordinate tolerances.

DATUMS AND TOLERANCE STACKS

BAOSONG

Locate the part as it assembles; avoid hidden accumulation

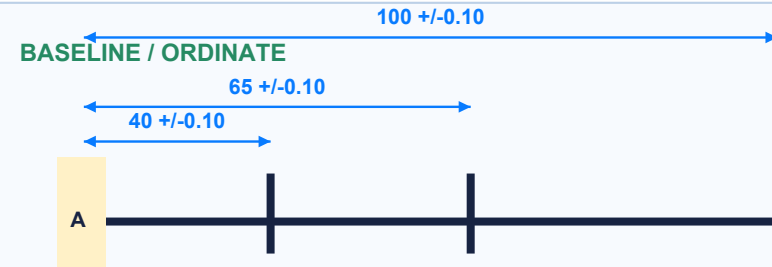
03 / 06

BASELINE BEATS AN UNCONTROLLED CHAIN

CHAIN DIMENSIONING



End position worst case: +/-0.25 mm

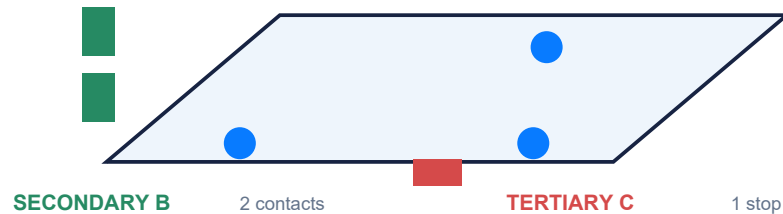


Each interface relates directly to datum A

3-2-1 DATUM CONCEPT

PRIMARY A

3 supports remove translation normal to the base and two rotations.



STACK CHECK

Worst case

$$T = |t1| + |t2| + \dots + |tn|$$

Use when every contributor may reach its limit together.

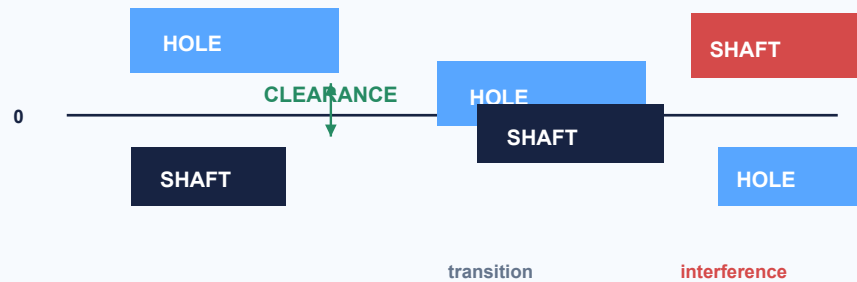
Root-sum-square

$$T = \sqrt{t1^2 + t2^2 + \dots + tn^2}$$

Use only with stable processes, accepted assumptions and capability evidence.

HOLE / SHAFT FIT LOGIC

TOLERANCE ZONES AROUND NOMINAL



CALL OUT THE COMPLETE INTERFACE

- **FREE ASSEMBLY** Clearance remains at worst material condition.
- **ACCURATE LOCATION** Fit plus controlled position to assembly datums.
- **BEARING SEAT** Use maker guidance; control size, form and runout.
- **THREAD** Standard, class, depth, coating and gauge condition.

GD&T VISUAL CHOOSER

FLATNESS

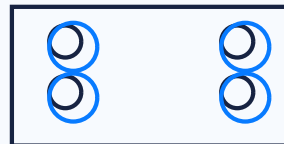
One surface | No datum



Do not duplicate with conflicting +/- dimensions.

POSITION

Hole pattern | To A|B|C



Do not duplicate with conflicting +/- dimensions.

PERPENDICULARITY

Face or axis | To datum A



Do not duplicate with conflicting +/- dimensions.

RUNOUT

Rotating surface | To datum axis



Do not duplicate with conflicting +/- dimensions.

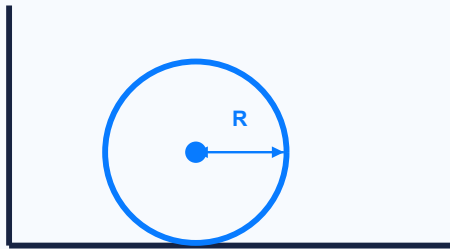
TOOL ACCESS, THIN WALLS AND TEMPERATURE

BAOSONG

Geometry and inspection condition can consume the tolerance before cutting begins

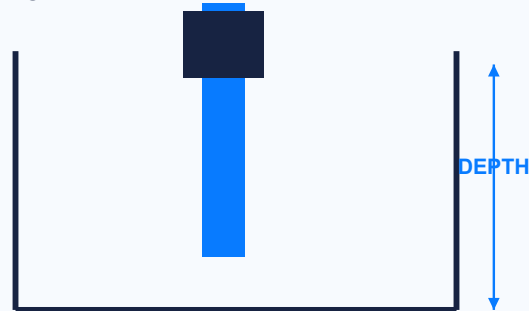
05 / 06

INTERNAL CORNER



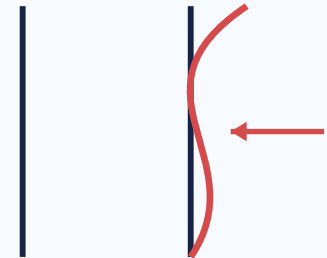
Internal radius must be at least the cutter radius. Larger radii shorten cycle time and improve finish.

DEEP POCKET



Deep reach increases taper, chatter and tool deflection. Review depth-to-tool diameter and chip evacuation.

THIN WALL



Cutting force and unclamping can move the wall. Specify support condition and only the functional zone.

THERMAL SCALE CHECK FOR ALUMINUM

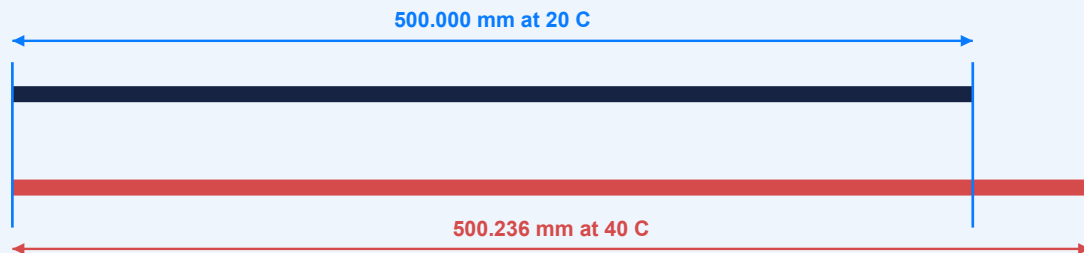
$$dL = \alpha \times L \times dT$$

Approximate alpha for aluminum: 23.6 micrometres per metre per degree C

Example

A 500 mm aluminum feature changes about 0.236 mm across a 20 C temperature change.

If thermal change is material to acceptance, state reference temperature, stabilization and compensation.



INSPECTION, RELEASE AND RFQ CHECKLIST

The measurement plan is part of the tolerance

INSPECTION FLOW



CHARACTERISTIC	POSSIBLE METHOD	SETUP / RISK QUESTION	EVIDENCE TO AGREE
OD / thickness / step	Micrometer, caliper, comparator	Contact force, burr, temperature	Instrument, resolution, stage
Precision bore	Bore gauge, air gauge, plug, CMM	Depth, form, coating	Limits, gauge class, calibration
Flatness / parallelism	Surface plate, indicator, CMM	Free-state vs restrained	Datum simulation, point strategy
Position / profile	CMM, vision, functional gauge	Alignment and algorithm	Datums, modifiers, uncertainty
Runout	Indicator, roundness system, CMM	Functional axis and fixturing	Speed, sections, TIR

RELEASE CHECKLIST

- ☐ Drawing and 3D model revisions match
- ☐ Alloy, temper and stock form are stated
- ☐ Governing standard and edition are stated
- ☐ Datums reflect assembly and are inspectable
- ☐ CTQs are identified; general tolerances stay practical
- ☐ Pre-finish and final acceptance are separated
- ☐ Method, sampling and reports are agreed
- ☐ Decision rule / uncertainty is addressed

SEND FOR TOLERANCE REVIEW

Provide the latest 2D drawing and 3D model, material and temper, quantity, critical interfaces, finish and inspection expectations.

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