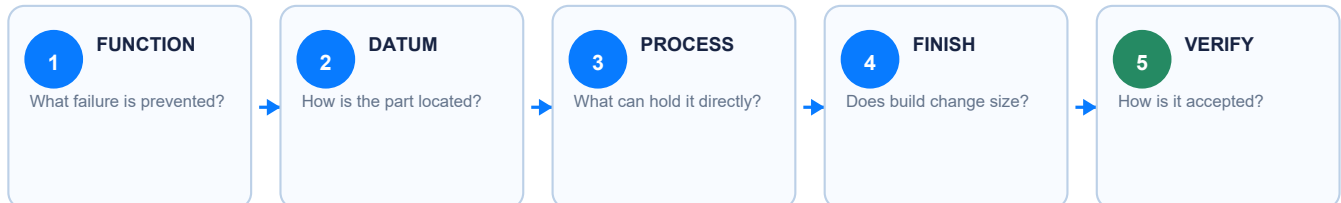


Tolerance strategy starts with function

A tolerance should protect assembly, motion, sealing, alignment, appearance or interchangeability. Tightening every dimension raises inspection time, scrap risk and cost without improving the product.

FIVE-STEP DECISION PATH



WHERE PROCESS VARIATION BEGINS



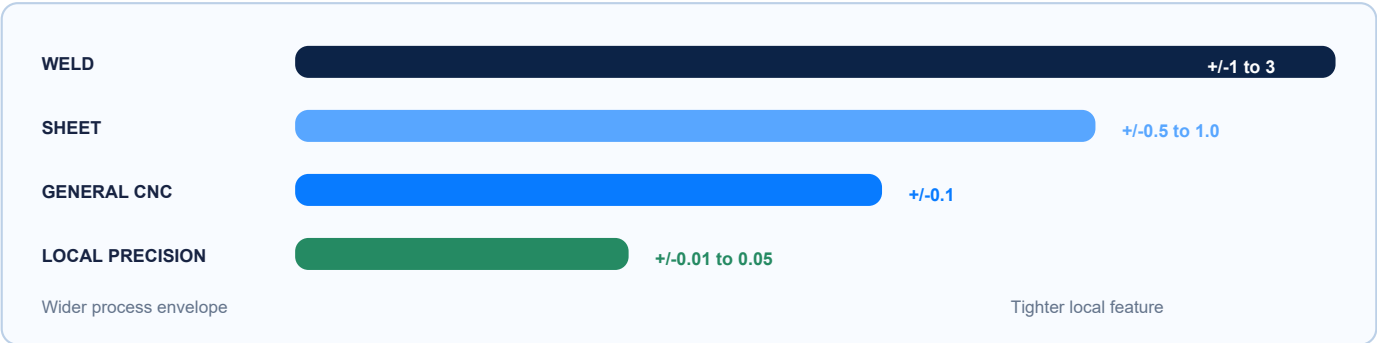
CORE RULE

Start from realistic process capability, then apply tighter local controls only to critical interfaces, datum relationships, fits, sealing surfaces and inspection features.

Confirm alloy, temper, product form, geometry, quantity, process sequence, finish and inspection plan with the supplier.

PROCESS / FEATURE	COMMERCIAL START	TIGHTER LOCAL FEATURE	MAIN COST / RISK DRIVER
CNC milling - linear	+/-0.10	+/-0.025 to 0.05	Setup, reach, wall stiffness
CNC milling - bore	+/-0.025	+/-0.010 locally	Boring/reaming, depth, temperature
CNC turning - diameter	+/-0.025 to 0.05	+/-0.010 locally	L/D ratio, chucking, runout
Sheet cutting - profile	+/-0.20 to 0.50	+/-0.10 to 0.20	Thickness, heat input, burr
Sheet bending - formed	+/-0.50 to 1.00	Local review	Springback, grain, sequence
Machined extrusion	+/-0.10 to 0.25	+/-0.025 to 0.05	Bow/twist, clamping, stiffness
Die casting - as cast	+/-0.10 to 0.30 + size	Machine interfaces	Draft, shift, shrinkage, porosity
Welded structure	+/-1 to 3 overall	Machine datums	Heat, sequence, restraint, size

TOLERANCE BAND VISUAL



ASK THE SUPPLIER

1

Process capability or 100% sorting?

2

Does the value include raw material and finish build?

3

Which datum simulation and measurement method?

4

Is capability based on full production quantity?

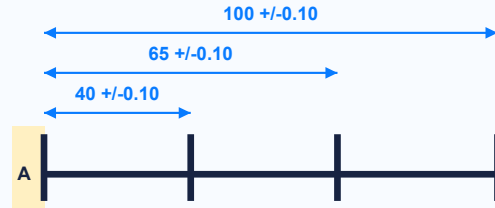
CHAIN VS BASELINE

CHAIN DIMENSIONING



End position worst case: +/-0.25 mm

BASELINE / ORDINATE



Each interface relates directly to datum A

STACK QUICK CHECK

WORST CASE

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

Use when all contributors may reach limits together.

ROOT-SUM-SQUARE

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

Use only with stable processes and accepted assumptions.

THERMAL SCALE CHECK

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

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



For large or flexible parts, state temperature, stabilization, support points and free-state / restrained-state inspection.

FLATNESS

Surface form | No datum



Avoid duplicate or conflicting coordinate acceptance controls.

POSITION

Feature location | Usually datums



Avoid duplicate or conflicting coordinate acceptance controls.

PERPENDICULARITY

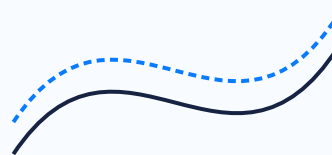
90-degree orientation | Datum required



Avoid duplicate or conflicting coordinate acceptance controls.

PROFILE

Contour relation | Optional / usual



Avoid duplicate or conflicting coordinate acceptance controls.

RUNOUT

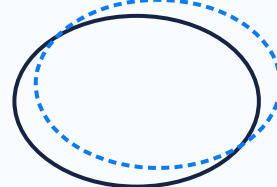
Rotating surface | Datum axis



Avoid duplicate or conflicting coordinate acceptance controls.

CYLINDRICITY

Whole cylinder form | No datum



Avoid duplicate or conflicting coordinate acceptance controls.

3-2-1 DATUM SELECTION



PRIMARY A

3 supports stabilize the main assembly surface.

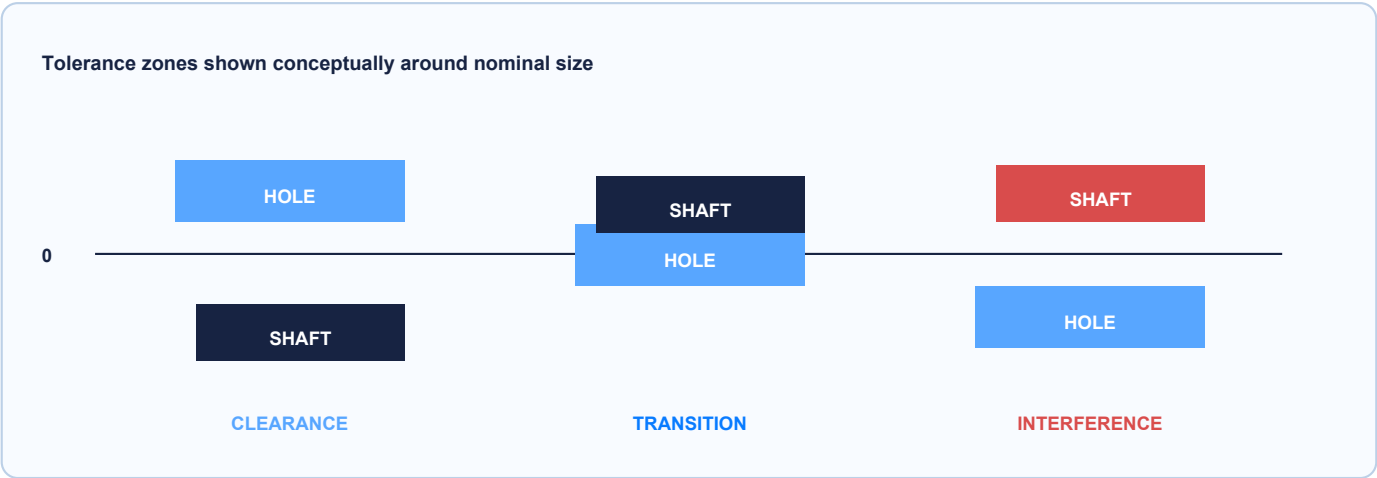
SECONDARY B

2 contacts remove remaining rotation / translation.

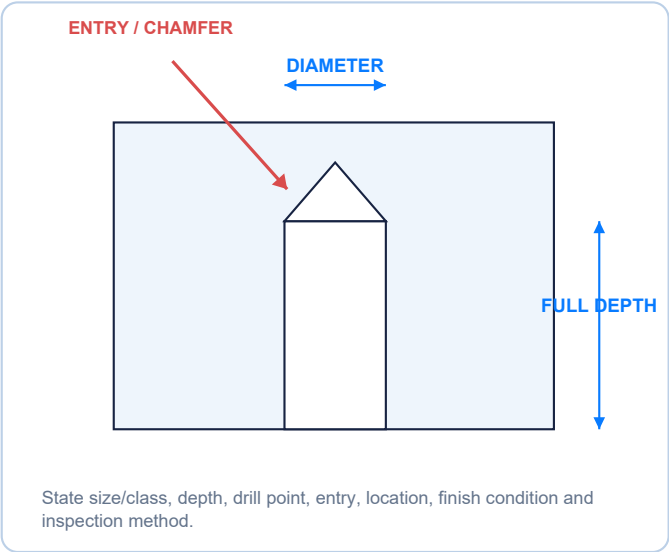
TERTIARY C

1 stop completes location.

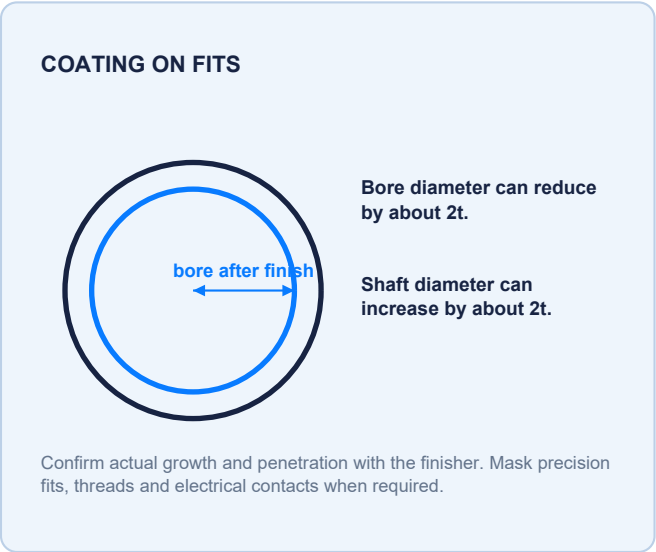
HOLE / SHAFT FIT ZONES



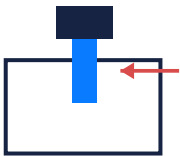
COMPLETE HOLE CALLOUT



COATING ON FITS



FUNCTIONAL INTENT	DRAWING APPROACH	VERIFICATION
Clearance fastener	Size + position	Pin, CMM, functional gauge
Locating dowel	Reamed/bored + position	Plug gauge + CMM
Bearing seat	Size + form/runout	Bore gauge + runout setup
Threaded hole	Class + depth + finish	Thread gauge + depth



CNC MACHINING

Variation: Tool deflection, setup transfer, heat

Design response: Shorten reach; support thin features; consolidate datums.



ALUMINUM EXTRUSION

Variation: Wall/gap shift, twist, bow

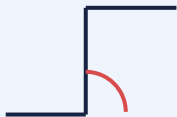
Design response: Add machining stock; control cut length and straightening.



DIE CASTING

Variation: Shrinkage, draft, parting shift, porosity

Design response: Machine sealing, bearing and threaded interfaces.



SHEET METAL

Variation: Thickness, bend deduction, springback

Design response: Dimension formed state; control critical flange references.



WELDED STRUCTURE

Variation: Heat input, sequence, restraint

Design response: Balance welds; fixture datums; machine after welding.

FINISH BUILD CHANGES TOLERANCE



Define whether dimensions apply before or after finish, and show mask boundaries on the controlled drawing.

INSPECTION FLOW



CHARACTERISTIC	PREFERRED METHOD	WATCH FOR
Simple outside size	Micrometer / caliper	Force, burr, coating, temperature
Bore / diameter	Bore gauge, air gauge, CMM	Ovality, taper, depth, temperature
Position / profile	CMM or functional fixture	Datum alignment and free-state support
Flatness	Surface plate / indicator / CMM	Gravity sag, clamp distortion
Runout	Datum simulation + indicator	Axis quality and rotation method
Surface texture	Profilometer / optical	Cutoff, direction, finished state

DRAWING RELEASE GATE

- ☐ Units, projection, standard and edition are explicit
- ☐ Alloy, temper, product form and stock condition defined
- ☐ 3D model and 2D drawing authority is clear
- ☐ Dimensions before/after finish and mask zones controlled
- ☐ General tolerances match the process
- ☐ Free-state or restrained-state inspection defined
- ☐ Datum system reflects assembly and inspection
- ☐ Thread class, depth, position and coating complete
- ☐ Critical fits, sealing and alignment are identified
- ☐ Method, sampling, report format and temperature agreed
- ☐ Worst-case or justified statistical stack checked
- ☐ Supplier deviations incorporated into controlled revision

RELEASE RULE Functional, measurable, process-compatible and unambiguous.

STANDARDS MAP

REFERENCE	USE	OFFICIAL SOURCE
ASME Y14.5-2018	Dimensioning and tolerancing rules	asme.org - Y14.5
ISO 8015:2011	GPS concepts and principles	iso.org/standard/55979
ISO 286-1:2010	Fits, tolerances and deviations	iso.org/standard/45975
ISO 2768	General linear/angular tolerances	verify current edition
ANSI H35.2 / H35.2M-2024	Aluminum mill-product tolerances	aluminum.org/ansi-h352

CHOOSE THE NEXT ENGINEERING REFERENCE

CNC FEATURES

→

CNC Machining Tolerance Guide

EXTRUSION PROFILE

→

Wall Thickness & Tolerance Guide

DIE CAST PART

→

Wall, Draft & Parting-Line Guide

SURFACE FINISH

→

Surface Finish Comparison Chart

INSPECTION PACKAGE

→

Inspection & Documentation Guide

BAOSONG PRECISION - SEND FOR TOLERANCE REVIEW

Provide the latest 2D drawing and 3D model, material and temper, quantity, mating-part details, finish, critical features and inspection expectations.

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General guidance only. The governing drawing, specification, supplier quotation and approved inspection plan control acceptance.