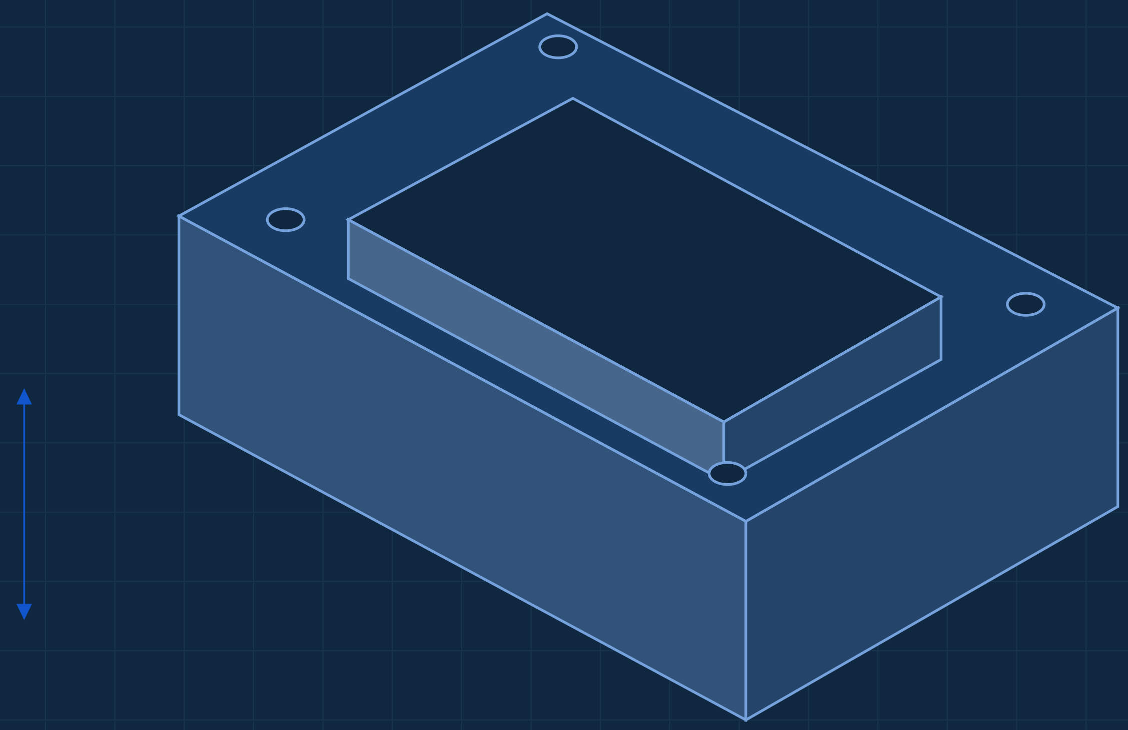
vetcnc
CNC MANUFACTURING

ENGINEERING WHITE PAPER / 01

CNC Part Design & Manufacturability

An engineering guide to geometry, tolerances, materials and inspection.



FUNCTION　GEOMETRY　VERIFICATION

V1.0 / SEPTEMBER 2026

READER MAP

Make the guide work for you

For mechanical designers, sourcing teams and quality engineers preparing CNC parts for quotation.

Scope and use

This vetcnc guide covers common CNC milling and turning decisions. Its diagrams and worked examples are original teaching illustrations, not released manufacturing drawings or customer production results.

Use the questions to prepare an engineering discussion. Final material, functional requirements, tolerances and acceptance methods must be agreed for the part. This publication does not certify a design or specify guaranteed machining limits.

METRIC EXAMPLES / DIMENSIONS IN mm UNLESS NOTED / REFERENCES ON PAGE 27

01 / DESIGN INTENT

Decisions before dimensions

A useful DFM review protects what the part must do before changing how it is made.

01 FUNCTION
What must remain unchanged?

02 GEOMETRY
Can tools and fixtures reach it?

03 SPECIFICATION
Can the requirement be interpreted?

04 VERIFICATION
Can acceptance be demonstrated?

Protect these first

- Mating interfaces, sealing surfaces and necessary load paths.
- Required location, orientation and operating clearances.
- Material or finish requirements tied to the service environment.

Discuss these deliberately

- Non-functional internal corners and pocket depth.
- Unnecessary feature variety or hard-to-reach detail.
- Tight tolerances applied to surfaces with no defined need.

DECISION TO RECORD

For every proposed change, write: function preserved, geometry changed, manufacturing effect to evaluate, and approval owner.

02 / PROCESS SELECTION

Choose the process by geometry

Start with feature relationships, not with the largest axis count on a machine brochure.

Part requirement	Route to discuss	Check before selection
Rotational surfaces and coaxial steps	Turning	Grip length, support, bore access and features that need a second process.
Pockets, prismatic faces and hole patterns	Milling	Tool approach directions, setup changes and fixture contact.
Features on several fixed orientations	Indexed / 3+2 machining	Accessible indexed positions and clearance during reorientation.
Geometry needing a changing tool direction	Simultaneous multi-axis machining	Tool/holder envelope, fixture interference and verification of the surface.

One part may need more than one route

For a sleeve with an external flat, review the turned interfaces and the flat together. The important question is not whether both operations exist, but how the functional relationship between them is preserved and inspected.

Ask the designer

- Which surfaces must relate to one another?
- Can a non-functional face or corner be changed?

Ask the manufacturer

- Which setup establishes each critical feature?
- What needs a secondary operation or special fixture?

AXIS COUNT IS NOT A PROMISE

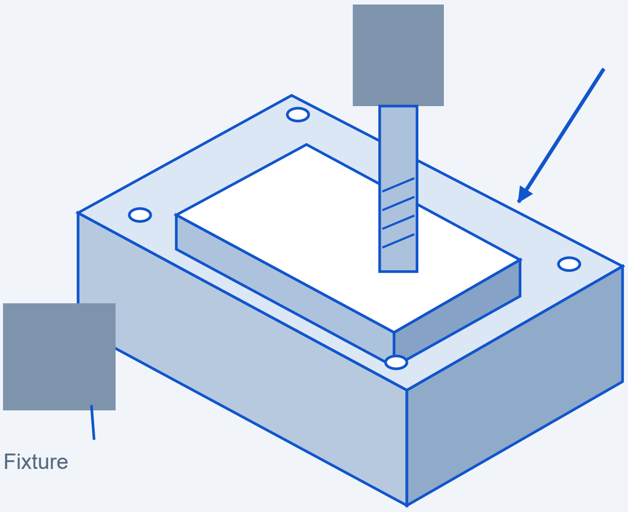
Multi-axis access can help a route. It does not remove every clamp, tool-length or inspection constraint, and does not automatically make the part less expensive.

Further reading: [06] Protolabs Network | [07] Carr Lane Manufacturing

03 / ACCESS AND SETUPS

Check access beyond the tool tip

A feature that looks open in CAD can still be blocked by a holder, shoulder or clamp.



F01 / SCHEMATIC ACCESS REVIEW

CHECK THE FULL TOOL ASSEMBLY

Cutter, shank and holder need a collision-free approach, not just contact at the tool tip.

Include stock, clamps and rotary travel in the review.

Review the complete envelope

- Include the cutter, shank and holder in the approach.
- Allow a route to enter, cut, leave and remove chips.
- Check the stock and fixture, not only the finished part.

Make setup intent visible

- Identify faces or features available for location.
- Show areas where clamp contact is acceptable.
- Flag surfaces that must not be marked or distorted.

> **A USEFUL RFQ ATTACHMENT**
>
> Add one annotated model view showing the functional surfaces, possible clamp zones and any surface that cannot accept witness marks. Treat these as review inputs, not mandatory toolpaths.

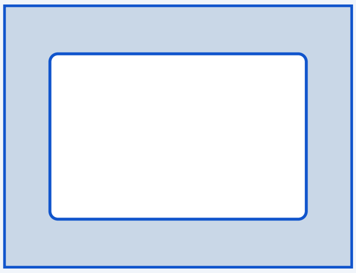
Further reading: [07] Carr Lane Manufacturing | [19] Sandvik Coromant

04 / POCKETS AND RADII

Give internal corners a job

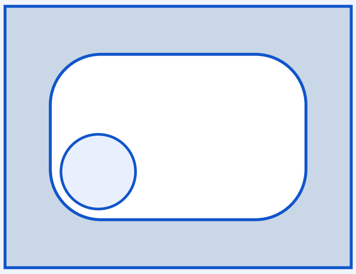
Specify the shape the assembly needs. Do not let a decorative corner control the entire machining route.

SHARP REQUEST



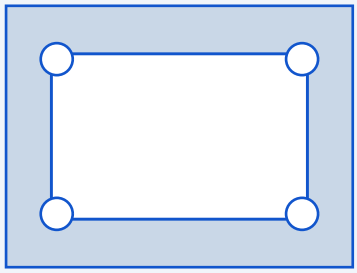
Ordinary end milling leaves an inside radius.

LARGER INTERNAL R



Leave clearance between the tool and part corner.

LOCAL RELIEF



A relief changes local material. Check fit and strength.

Separate fit from appearance

If a rectangular mating part must enter a pocket, compare a larger internal corner with a local relief or a change to the mating corner. Each option changes a different interface. Confirm the assembled clearance and remaining material before choosing.

Illustrative geometry check

A tool of diameter 6 has a radius of 3. A designed corner radius of 3.5 leaves a 0.5 difference between those radii. This is a geometric comparison only: toolpath, reach, stock and required finish still need review.

AVOID AN ACCIDENTAL CONSTRAINT

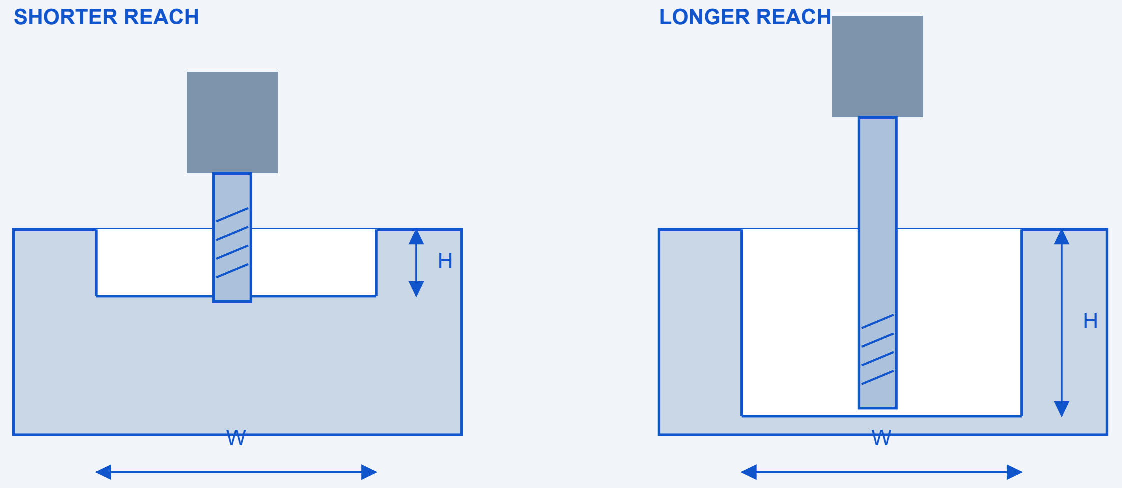
Identify corners that are functional and corners where the manufacturer may propose a larger radius. Do not change load-bearing or sealing geometry without design approval.

Further reading: [06] Protolabs Network | [17] Protolabs

05 / POCKETS AND REACH

Depth changes the access problem

Cavity depth, tool cutting length and tool overhang are different dimensions.



Record separately	Why the distinction matters
H / W: cavity depth to width	Describes the pocket, but not which cutter or holder will reach its floor.
Tool reach / tool diameter	Describes the tool assembly demand; it is not identical to H / W.
Cutting length and neck clearance	A long tool is not necessarily cutting along its full exposed length.

Change the requirement before changing the tool

Ask whether the full floor must sit at the deepest level. A stepped depth, an opening from another direction or a split assembly may be worth comparing if the function permits it. Check the new interfaces and sealing implications as carefully as the original pocket.

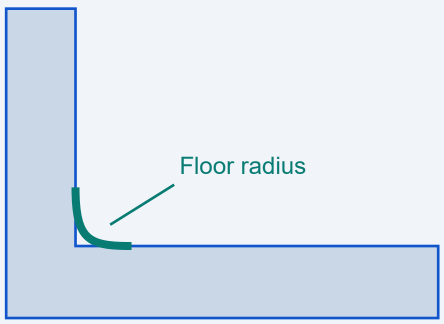
Further reading: [06] Protolabs Network | [19] Sandvik Coromant

06 / FLOORS AND UNDERCUTS

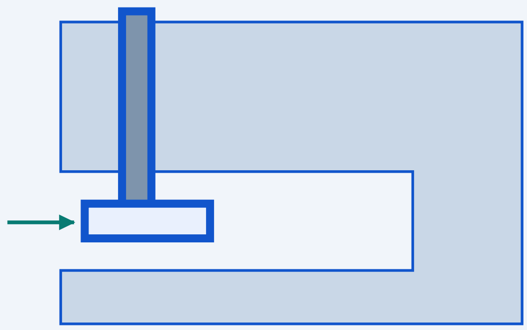
Treat transitions as features

The floor blend, wall corner and undercut each create a different access requirement.

FLOOR TRANSITION



UNDERCUT ACCESS



Neck and cutter clearance

Floor blends

- Identify why the blend exists: fit, cleaning, flow or structural function.
- Distinguish the floor-to-wall radius from the corner radius in plan view.
- Keep permitted geometry variation explicit.

Undercuts

- Review the entry opening and the cutter neck, not only the hidden recess.
- Ask whether a standard tool can reach and leave the feature.
- Include deburring and inspection access in the same review.

DO NOT ERASE A FUNCTIONAL DETAIL

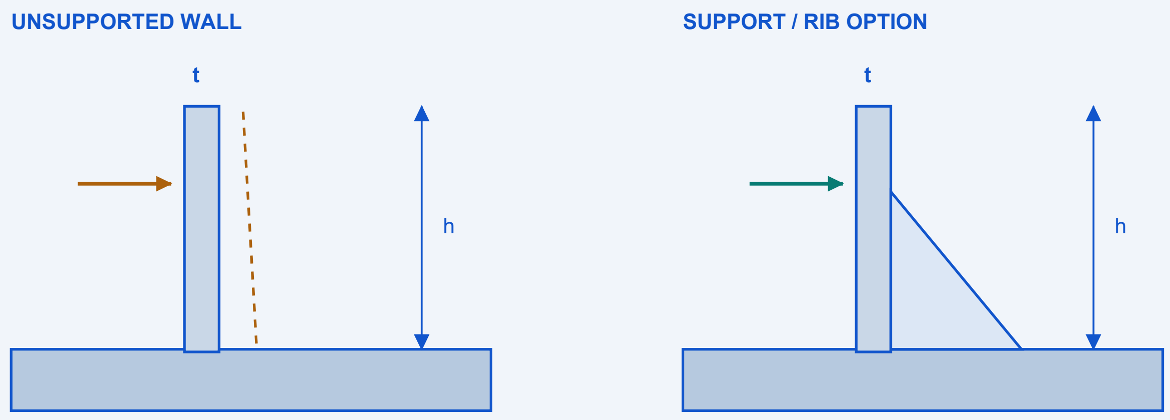
A change that simplifies machining can also alter stress, sealing, retention or cleanability. Record the function before proposing a simpler geometry.

Further reading: [06] Protolabs Network | [07] Carr Lane Manufacturing

07 / THIN FEATURES

Thin walls are a system problem

Thickness alone does not describe the behavior of a wall during machining or after release.



The same thickness can behave differently when height, support or restraint changes.

Describe the feature	Ask in the design review
Thickness, height and unsupported span	Where is the wall supported during each operation?
Material and stock condition	Could removal or temperature change the final shape?
Allowed geometry and finish	Is the requirement checked clamped, free or assembled?
Permitted modification	Can a rib, local thickening or different sequence preserve the function?

USE A REVIEW TRIGGER, NOT A UNIVERSAL MINIMUM

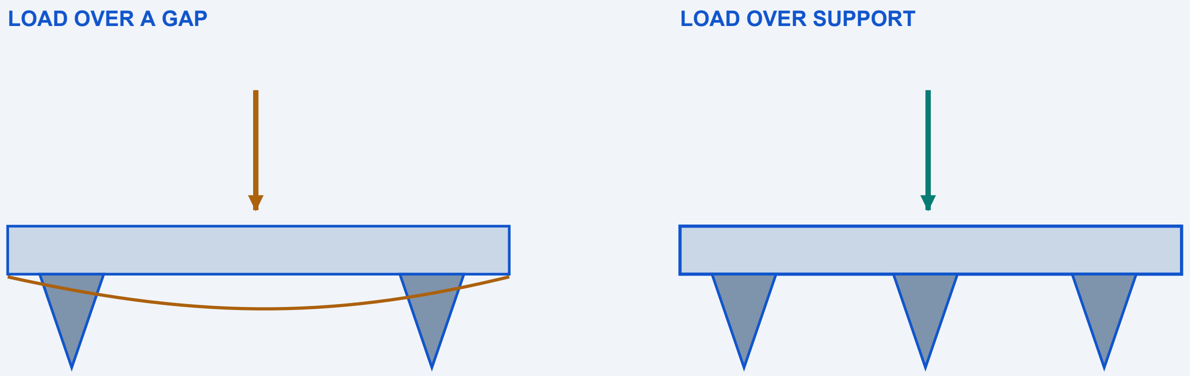
A thin wall becomes a discussion item when its stability, finish or acceptance condition is uncertain. Confirm the complete geometry instead of applying a single minimum thickness to every part.

Further reading: [07] Carr Lane Manufacturing | [10] Ensinger

08 / WORKHOLDING

Design for release, not just restraint

A part can satisfy a measurement while clamped and move when the fixture is removed.



Unclamping can reveal movement.

Support the load path.

Define the contact zones

- Show where gripping or support is allowed.
- Protect cosmetic, sealing and delicate surfaces.
- Consider access for the last operation, not only the first.

Define the measurement state

- State whether acceptance is free-state or under specified restraint.
- Agree how a flexible part will be supported for inspection.
- Record any restraint needed to represent assembly.

A practical release check

For a distortion-sensitive design, ask for a plan that connects machining restraint, stabilization and final inspection. If re-clamping is used for measurement, it should not conceal the very deformation the drawing is intended to control.

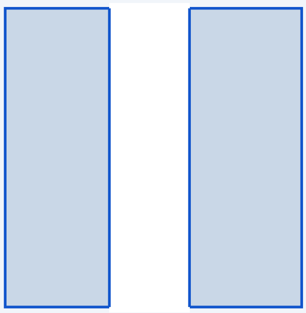
Further reading: [07] Carr Lane Manufacturing | [10] Ensinger

09 / HOLE DESIGN

Define the hole you need

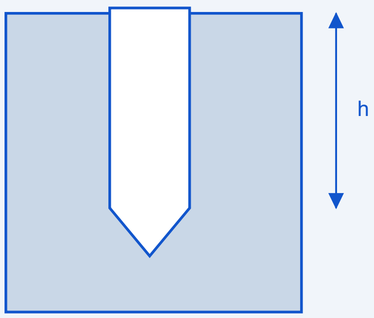
A diameter is only part of the requirement. Depth, entry, exit and inspection also matter.

THROUGH HOLE



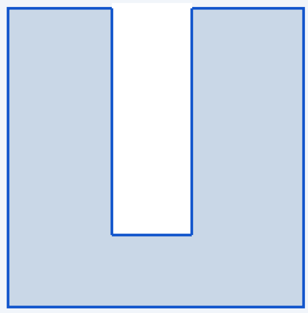
Define exit-edge condition.

DRILLED BLIND HOLE



Distinguish full-diameter depth from drill-tip depth.

FLAT-BOTTOM NEED



Specify function, then discuss a suitable process.

Make the geometry unambiguous

- Separate full-diameter blind depth from the drill-tip extension.
- Identify a flat-bottom requirement only where its function needs it.
- Specify critical entry and exit edges, rather than relying on a vague deburr note.

Review difficult intersections

- Flag angled entry, partial holes and intersecting passages.
- Ask how chips and internal burrs will be removed.
- Agree how a deep or hidden feature will be verified.

DEPTH IS A PROCESS DISCUSSION

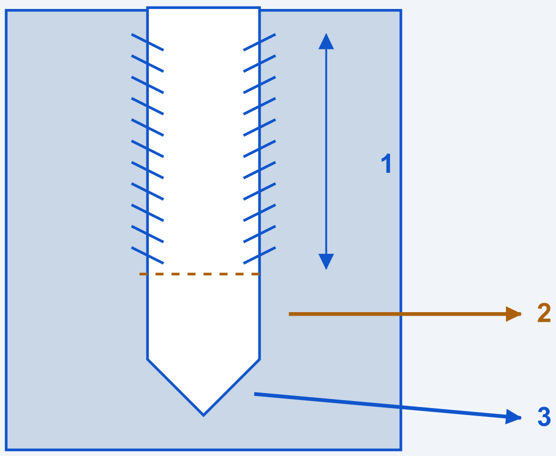
Specialized deep-hole tools exist, so a simple depth/diameter ratio is not a universal prohibition. Material, straightness, diameter control and inspection requirements still govern the route.

Further reading: [06] Protolabs Network | [18] Sandvik Coromant

10 / THREADS

Separate three thread questions

What thread is specified? How much complete thread is needed? What actually engages in assembly?



ORIGINAL SECTION SCHEMATIC / NOT A THREAD STANDARD DRAWING

1 Complete thread
State the minimum usable length. Assembly engagement is a separate requirement.

2 Runout / clearance
Allow for the selected tool and process. Do not assume a fixed allowance fits every tap.

3 Drill tip
Not part of the full-diameter depth or usable thread length.

A useful specification package

Communicate the thread system, nominal size and pitch, class/tolerance, handedness where relevant, required complete thread length and blind-hole constraints. Identify inserts and their installation requirements when they are part of the design.

Keep strength and manufacturing checks separate

An engagement length should follow the joint requirement, including the mating materials and loads. A convenient tapping depth is not a strength calculation. NASA RP-1228 discusses threaded-hole pullout in terms of material shear strength and engagement length [09].

BEFORE QUOTATION

Provide the mating fastener information and clarify whether the indicated depth means complete thread, assembly engagement or the drilled hole.

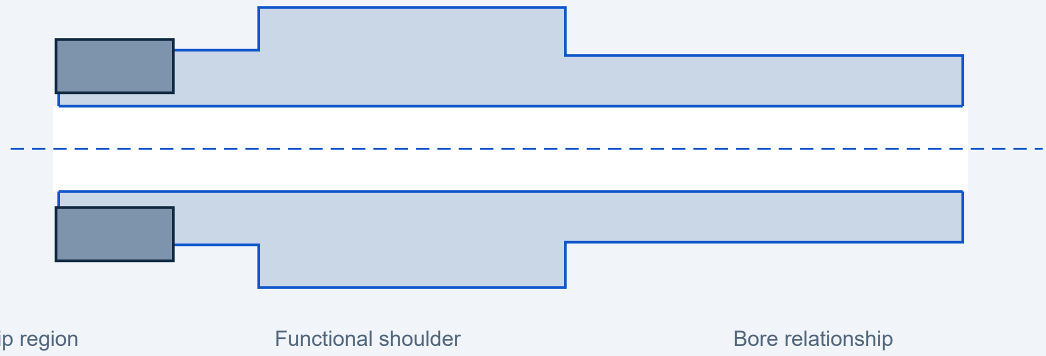
Further reading: [08] OSG Corporation | [09] NASA / R. T. Barrett

11 / TURNING

Give turned features a reference

Think in connected surfaces: the outside diameter, bore, shoulder and end face may serve different functions.

TURNED SLEEVE / SECTION SCHEMATIC



Feature to discuss	Design information to provide
Bore and outside diameter	Identify the required relationship, not only the two sizes.
Shoulder or seating face	State the mating function and required edge/transition.
Thin sleeve or slender region	Define grip restrictions and the accepted inspection state.
Groove, relief or thread end	Describe fit and retention needs, plus allowable tool access.
Cross hole, flat or secondary milling	Show its relationship to the turned interfaces.

AVOID AN INVISIBLE SETUP ASSUMPTION

If several features must relate closely, ask how they will be established and verified across operations. Do not assume that every surface can be finished from the same grip.

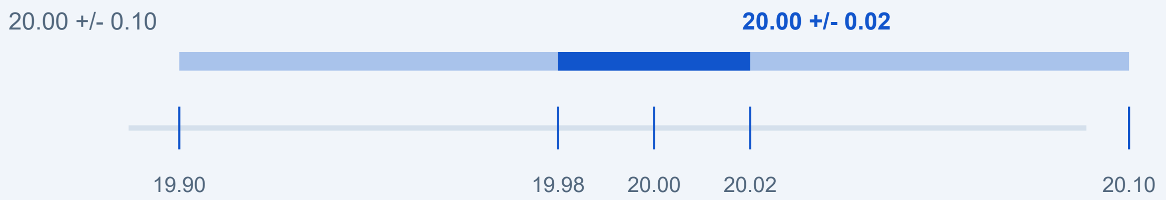
Further reading: [07] Carr Lane Manufacturing | [17] Protolabs

12 / TOLERANCES

Spend precision where it works

A tight number is useful only when it controls a functional requirement and can be verified.

ILLUSTRATIVE SIZE LIMITS / NOT A PROCESS CAPABILITY CLAIM



Classify the requirement

Question	Useful output
What must assemble or perform?	A named functional interface and its acceptable variation.
What geometric relationship matters?	A reviewed requirement for form, orientation or location where needed.
What does not need special control?	An agreed general-tolerance policy, not an invented default.
What is being accepted?	A defined final condition and a suitable inspection plan.

DO NOT CHANGE REQUIREMENTS SILENTLY

If a tolerance drives difficulty or cost, request a design review. The correct outcome may be to keep it and choose a suitable process, not to relax it.

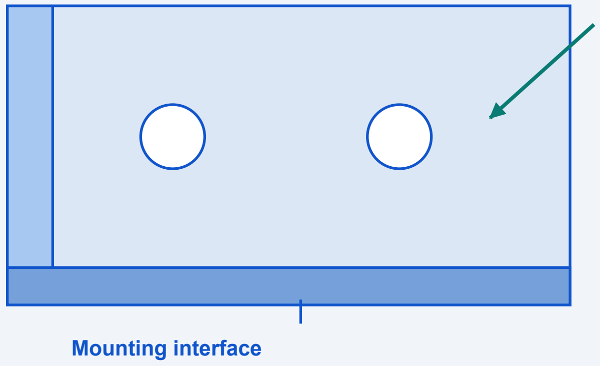
Further reading: [01] ASME | [02] ISO | [17] Protolabs

13 / FUNCTIONAL RELATIONSHIPS

Choose datums from the assembly

The question is not how many symbols fit on the drawing. It is how the part locates and performs.

INTERFACE MAP / NOT FORMAL GD&T ANNOTATION



Start with assembly.
Which surface seats?
Which feature locates?
Which feature prevents rotation?

Then define a datum scheme and inspection setup that reproduce those relationships.

From interface map to inspection plan

Step	Decision to document
1 / Identify the interfaces	Describe the seating surface, locating features and remaining allowed movement.
2 / Define the controls	Have the responsible designer choose the datum scheme and applicable geometric requirements.
3 / Verify the interpretation	Ensure manufacturing and inspection interpret the same reference relationships.

KEEP THE STANDARDS SYSTEM EXPLICIT

Use the specified ASME or ISO framework and edition consistently. A datum label, size tolerance and geometric control are not interchangeable ways of describing the same requirement.

Further reading: [01] ASME | [04] ISO | [16] NIST

14 / INSPECTION

Plan acceptance before production

Agree what will be measured, in what condition, and how the result will be reported.

Inspection-plan field	Example of the information needed
Characteristic	Feature identifier, nominal value and applicable limits.
Reference / method	Datum setup, appropriate instrument and measurement approach.
Part condition	After which operations? Free-state or specified restraint?
Environment	Temperature stabilization and correction where relevant.
Evidence	Sampling agreement, report format and required traceability.

A small thermal change can matter

The standard reference temperature for dimensional measurement is 20 degrees C [11]. Measurement away from that reference needs appropriate consideration of thermal expansion and uncertainty [12].

ILLUSTRATIVE LINEAR EXPANSION CALCULATION

Assume L = 100 mm, alpha = 23 x 10^{-6} /K and a temperature change of 5 K.

Delta L = alpha x L x Delta T = 0.0115 mm

Assumed coefficient for teaching; not a specified property of every aluminum grade.

Record the relevant measurement conditions. Instrument display resolution alone is not proof that the whole measurement process can decide conformance.

Further reading: [11] NIST | [12] NIST / D. A. Swyt

15 / MATERIALS AND STOCK

Specify the material, not a family

An alloy name or polymer family is only the start of a usable material specification.

1	2	3	4
GRADE	**CONDITION**	**STOCK**	**SERVICE**
What material?	What state?	What form?	What exposure?

Information	Why the buyer and manufacturer need it
Grade and governing specification	Identifies the intended material; an informal family name can leave alternatives unresolved.
Temper, heat treatment or condition	Connects the supplied stock with the required properties and process sequence.
Product form and stock history	Clarifies plate, bar or other starting form and any relevant direction or preparation.
Service environment	Records temperature, exposure and compatibility needs that constrain alternatives.
Documentation and substitution	Defines required material evidence and who can approve a proposed change.

EXAMPLE OF THE DIFFERENCE

"Aluminum" is a family. "6061-T6" adds alloy and condition, but the purchase still needs the required product specification, form and evidence. Do not assume a similarly named material is automatically equivalent.

Further reading: [10] Ensinger | [20] Outokumpu

16 / DIMENSIONAL STABILITY

Give plastics their own review

A plastic part should not inherit a metal-part tolerance plan without checking its conditions of use.

STOCK	Grade, fillers and supplied condition
MACHINING	Heat input, support and stress release
STORAGE	Time, moisture and temperature
USE	Actual assembly and environment

Record conditions that travel with the part

- Define the temperature and moisture condition relevant to acceptance and use.
- Ask whether the selected stock and geometry call for stabilization or an intermediate process.
- Review thin sections, broad contact areas and features sensitive to clamping pressure.
- Confirm any coolant, cleaning or post-processing compatibility with the selected grade.

KEEP MATERIAL INSTRUCTIONS SPECIFIC

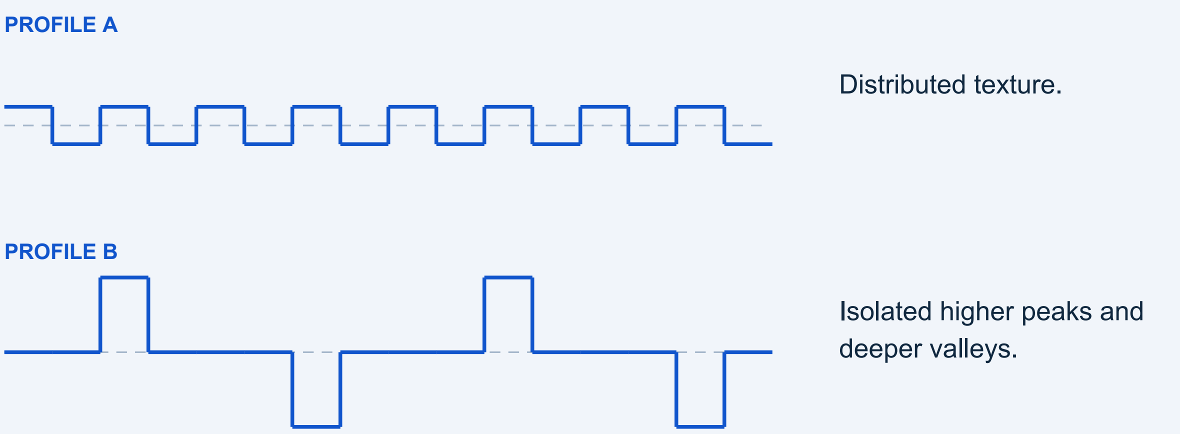
Ensinger describes moisture uptake, heat and stress relaxation as dimensional-stability factors [10]. A treatment suitable for one grade is not a universal instruction for every polymer.

Further reading: [10] Ensinger | [11] NIST

17 / SURFACE TEXTURE

Specify a surface, not a shine

Appearance, texture and performance are related questions, but they are not the same requirement.



Equal mean absolute height in this constructed example; different peak-to-valley height.

An average can hide a local extreme

The constructed profiles above have the same mean absolute height but different extremes. They are not measured traces. This illustrates why a single average value cannot describe every surface feature. Ra and Rz describe different aspects of a profile [13].

Put in the requirement	Clarify with the inspection team
Functional surface and parameter	Which surface matters, and which metric answers the function?
Value and unit	Do not leave the reader to infer micrometers or microinches.
Measurement conditions	Applicable standard, direction, filtering/evaluation conditions and part state.
Cosmetic requirement	Separate any agreed appearance sample or viewing criteria from texture limits.

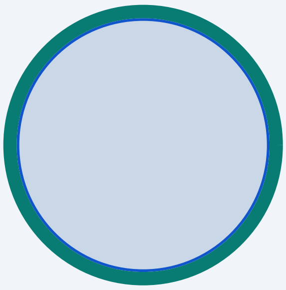
Further reading: [05] ISO | [13] KEYENCE

18 / FINISHING AND DIMENSIONS

Control the finished condition

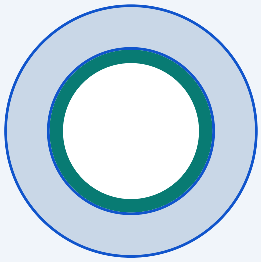
A correct pre-finish dimension is not automatically the correct delivered dimension.

EXTERNAL DIAMETER



D after = D before + 2g

INTERNAL DIAMETER



D after = D before - 2g

The diagram is a uniform outward-build model: g is net growth at one surface. It is not a universal anodizing rule. Conversion coatings and preparatory removal require process-specific dimensional assessment [14].

Before ordering a finish	Decision to agree
Critical holes, fits and threads	Do dimensions apply before or after treatment?
Functional contact areas	Which surfaces must be masked, protected or left untreated?
Thickness and appearance	What specification, range and visual acceptance method apply?
Verification	Who checks the final condition and what evidence accompanies delivery?

ASK FOR THE NET EFFECT

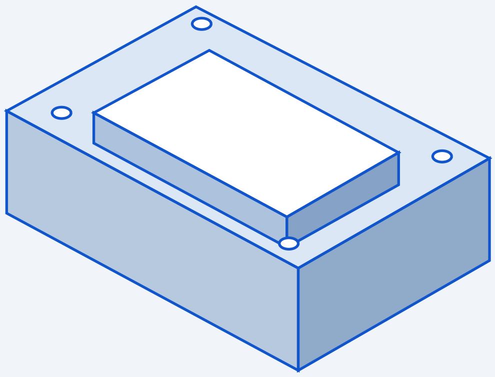
Confirm the whole finishing route with the actual processor, including preparation. Do not calculate a close fit from nominal coating thickness alone.

Further reading: [14] Aluminum Anodizers Council | [05] ISO

WORKED DESIGN REVIEW / A

Review a pocketed housing

Preserve the enclosure interface. Open a discussion about the geometry inside it.



ORIGINAL TEACHING EXAMPLE

DESIGN INTENT

The mating insert, mounting holes and outer envelope must remain compatible. The internal corner is open to review only if that fit is preserved.

Keep fixed	Compare	Verify
Mounting interface and required internal volume	A larger non-functional corner radius	Fit of the mating insert and local wall section.
Required deepest features	A stepped floor instead of a uniformly deep pocket	Clearance, access and any cleaning or sealing function.
Allowed external envelope	An alternative setup or access direction	Fixture space and relationships across operations.

ILLUSTRATIVE REVIEW NOTE

"Internal corner geometry may be proposed for approval. Mounting interfaces and mating-part clearance must remain unchanged. Please identify the proposed radius, affected area and process implication."

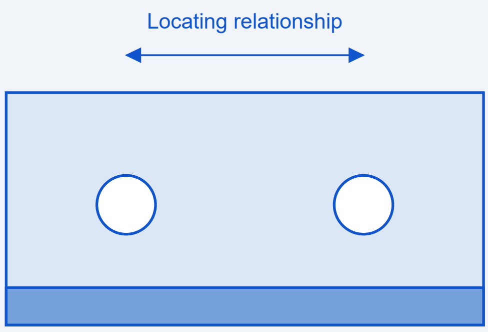
EVIDENCE TO COMPARE

Use the same material, quantity, finish and inspection scope. Record the route and quote basis for each approved alternative; do not claim a saving without comparable data.

WORKED DESIGN REVIEW / B

Review an installation bracket

Turn an assembly need into a clear manufacturing and inspection conversation.



Protect the interface.
Identify the seating face and locating features before discussing tolerances on unrelated outside faces.

Review question	Useful change to the information
What seats against the assembly?	Identify the functional interface and how it is supported.
Which features locate the bracket?	Define the necessary relationship and have the datum scheme reviewed.
Which outside dimensions are non-critical?	Use an agreed general-tolerance approach where the function permits.
How will acceptance be demonstrated?	Link each critical characteristic to the inspection plan.

ILLUSTRATIVE REVIEW NOTE

"Do not relax the locating interface. Please identify dimensions where an alternative tolerance could be considered and explain the functional and inspection consequences."

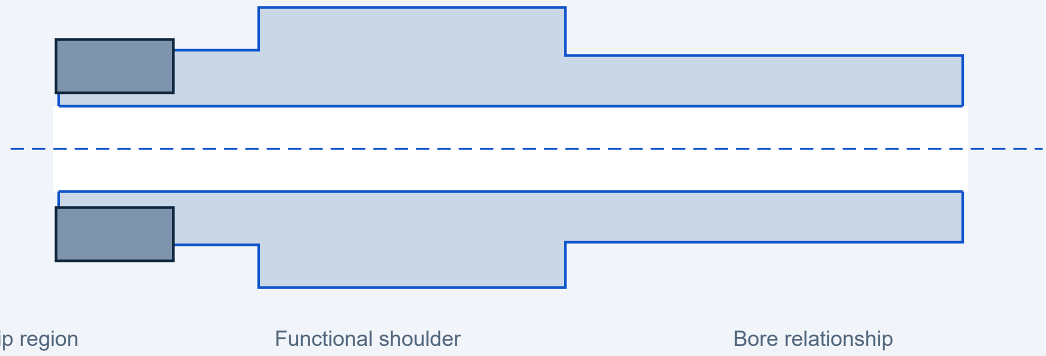
> **WHAT MAKES THIS USEFUL**
>
> The result is a clearer specification, not automatically a looser one. A functional requirement may remain tight even when it increases manufacturing effort.

WORKED DESIGN REVIEW / C

Review a precision sleeve

Connect bore function, grip strategy and delivered condition before releasing the drawing.

TURNED SLEEVE / SECTION SCHEMATIC



Review stage	Question to close
Assembly	Which bore, outside diameter and shoulder relationships control the fit?
Manufacturing	Where may the part be gripped, and could restraint affect its shape?
Finishing, if required	Which surfaces change, which are protected, and which limits apply afterward?
Acceptance	Is the part checked free, supported or under defined restraint?

ILLUSTRATIVE REVIEW NOTE

"The fit applies to the delivered condition. Please confirm the proposed process and inspection state, and flag any needed masking or permitted gripping area before production."

> **DO NOT ASSUME A RESULT**
>
> Compare actual inspection evidence in the agreed state. These teaching examples do not report measured performance, customer production or percentage improvements.

19 / COST DRIVERS

Compare total effort, not one feature

A DFM change is valuable when it preserves function and improves the overall route.

A SIMPLE COMPARISON MODEL

Cost per part = batch-level effort / quantity
+ recurring material, processing, finishing and verification

Driver	Question for a comparable quote
Programming and fixturing	Is one-time preparation included or charged separately?
Tool access and setup	Does a change remove an operation, or move effort elsewhere?
Material and stock removal	Are grade, condition and starting form unchanged?
Tolerance and surface requirements	Are both routes delivering the same accepted function and condition?
Finishing and inspection	Does the comparison include the same external processes and evidence?
Quantity and repeat orders	Are setup charges and recurring costs separated consistently?

MAKE A MEASURABLE COMPARISON

Label estimates, CAM time, quoted prices and actual production data separately. A lower cutting-time estimate is not the same as a shorter delivery lead time or lower total cost.

20 / HANDOFF

Send a complete RFQ package

Help the manufacturer understand the part once, instead of reconstructing the requirement across messages.

Package element	Include
Identification	Part number, revision, units and quantity; identify the current release.
Geometry	The requested CAD format and any necessary reference assembly.
Requirements	Drawing or agreed model-based definition with critical characteristics.
Material and processing	Grade, condition, finish, protected areas and permitted substitutions.
Verification	Inspection state, report needs, sampling agreement and material evidence.
Commercial context	Required date and quantities, including prototype versus repeat demand.
Open design questions	What may be proposed for approval and what must remain unchanged.

When model and drawing disagree

Stop and resolve the conflict. Record the agreed authoritative definition, update the revision and confirm the change with the parties involved. Do not rely on an assumed universal priority between CAD and drawing.

A USEFUL DATA CHECK, NOT A DESIGN APPROVAL

STEP/PMI tools can help inspect exchanged information [15]. A file opening successfully does not establish manufacturability or prove the design requirements are correct.

Further reading: [15] NIST | [16] NIST

21 / REUSABLE WORKSHEET

Your pre-RFQ DFM checklist

Tick a box only when the item is resolved or recorded as not applicable. Leave open items for discussion.

Project	Part number	Revision

- ☐ **01** Function and fixed mating interfaces are identified.
- ☐ **02** Material grade, condition and stock form are defined.
- ☐ **03** Required access directions have been reviewed.
- ☐ **04** Tool, holder and fixture clearance have been considered.
- ☐ **05** Locating, support and grip regions are available.
- ☐ **06** Internal corners and pocket depths are intentional.
- ☐ **07** Thin features have a support and distortion review.
- ☐ **08** Hole type and depth definitions are clear.
- ☐ **09** Thread specification and complete length are clear.
- ☐ **10** Hidden intersections have a deburring plan.
- ☐ **11** Turned-feature relationships are defined.
- ☐ **12** Critical requirements and references are identified.
- ☐ **13** General tolerances and standards editions are stated.
- ☐ **14** Surface texture parameters and units are specified.
- ☐ **15** Finish, heat treatment and protected areas are defined.
- ☐ **16** Critical limits refer to the agreed final condition.
- ☐ **17** Inspection state, method and evidence are agreed.
- ☐ **18** Model and drawing units and revisions agree.
- ☐ **19** Quantity, timing and permitted changes are clear.
- ☐ **20** Deviations require documented approval.

KEEP THE OPEN QUESTIONS WITH THE DRAWING

This is a preparation aid, not a conformity certificate. Save a completed copy in a PDF reader that supports forms, or print it. Confirm that entries persist after saving.

REFERENCE NOTES

Sources and further reading

Selected first-party references. Links open the original publisher; checked 20 September 2026.

[01] ASME
Y14.5-2018 (R2024): Dimensioning and Tolerancing

[02] ISO
ISO 2768-1:1989 - General dimensional tolerances

[03] ISO
ISO 2768-2:1989 - Withdrawn standard record

[04] ISO
ISO 22081:2021 - General geometrical specifications

[05] ISO
ISO 21920-1:2021 - Indication of surface texture

[06] Protolabs Network
How to design parts for CNC machining

[07] Carr Lane Manufacturing
Locating & Clamping Principles for Jig & Fixture Design

[08] OSG Corporation
AT-2 Carbide Thread Mill with End-Cutting Edge (2020)

[09] NASA / R. T. Barrett
Fastener Design Manual, RP-1228 (1990), p. 21

[10] Ensinger
Machining guidelines for engineering plastics - FAQ

[11] NIST
Engineering Metrology Toolbox - dimensional FAQ

[12] NIST / D. A. Swyt
Uncertainties in dimensional measurements at nonstandard temperatures (1994)

[13] KEYENCE
How Surface Height Is Quantified - From Ra to Rz

[14] Aluminum Anodizers Council
Anodizing Resource Center / FAQ

[15] NIST
STEP File Analyzer and Viewer

[16] NIST
CAD models, STEP files and PMI test cases

[17] Protolabs
CNC Milling Design Guidelines

[18] Sandvik Coromant
CoroDrill 861 - Deep hole drilling (2024)

[19] Sandvik Coromant
Optimized milling solution for titanium pockets (2025)

[20] Outokumpu
Machining guide - public introduction

Standards references identify the publisher and edition; this guide does not reproduce or replace the standards. Supplier guidance is application-specific. Original diagrams and worked examples are educational. Named organizations do not endorse this publication.

vetcnc
CNC MANUFACTURING

FROM DESIGN QUESTIONS TO A CLEAR RFQ

Bring the requirement into focus.

Use this guide to prepare a more useful conversation with vetcnc about your CNC part.

01 **YOUR PART**

Model, drawing, material and revision.

02 **YOUR PRIORITIES**

Critical interfaces, finish and acceptance needs.

03 **YOUR QUESTIONS**

Features that need a manufacturability discussion.

START AT

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VISIT VETCNC