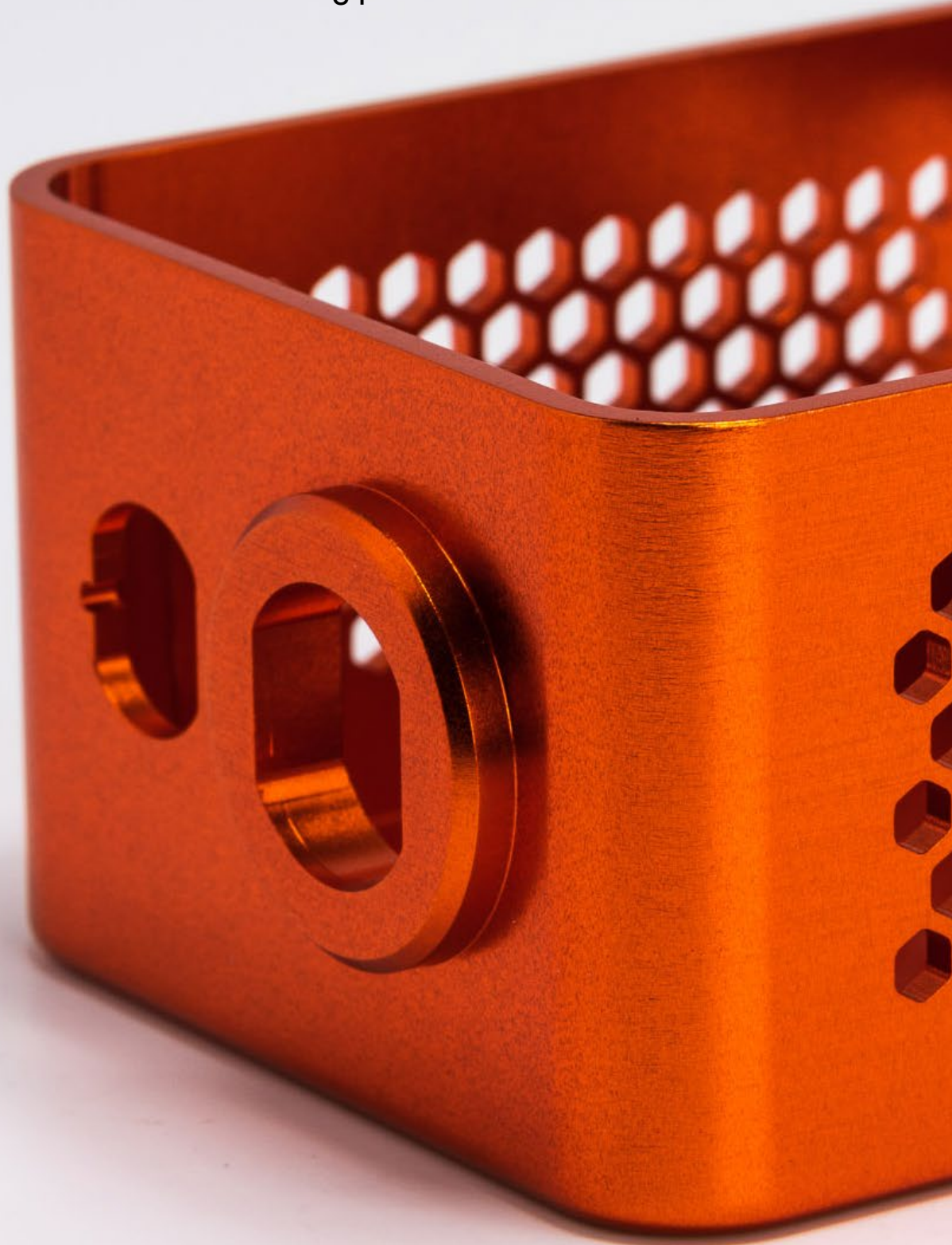


CNC Manufacturing Standards

v 2.5

- as communicated to our manufacturing partners



CNC manufacturing standards

Tolerances

Our tolerances follow ISO 2768-1 standards.

General tolerances table

Limits for nominal size	Plastics Medium class (m)	Metals Medium class (m)	Metals Fine class (f)
0.5 mm* to 3 mm	±0.1 mm	±0.1 mm	±0.05 mm
Over 3 mm to 6 mm	±0.1 mm	±0.1 mm	±0.05 mm
Over 6 mm to 30 mm	±0.2 mm	±0.2 mm	±0.1 mm
Over 30 mm to 120 mm	±0.3 mm	±0.3 mm	±0.15 mm
Over 120 mm to 400 mm	±0.5 mm	±0.5 mm	±0.2 mm
Over 400 mm to 1000 mm	±0.8 mm	±0.8 mm	±0.3 mm
Over 1000 mm to 2000 mm	±1.2 mm	±1.2 mm	±0.5 mm
Over 2000 mm to 4000 mm	±2 mm	±2 mm	

* Please clearly indicate tolerances for nominal sizes below 0.5mm on your technical drawing.

Tightest tolerance: ±0.0008" (0.02 mm)

Tighter tolerances are examined on a case by case basis

For specific hole tolerances please contact our sales team at sales@hubs.com

The default order surface finish is "as machined" and requires a surface roughness of Ra 3.2µm. Visible tool marks are acceptable. All sharp edges and burrs will be removed. If you do not include your detailed requirements on our quote platform (for example, any form of external or internal threads, any non-standard tolerances or any non-standard surface finish), you must clearly indicate these specifications in a technical drawing and on the quote.

Threads and tolerance specifications

The purchase order will indicate the tolerances followed (ISO 2768-1 as per “General tolerances” table or tighter) and whether threads are included.

The Manufacturing Partner must receive a technical drawing that clearly defines the specifications for these features. If you require threads or tolerances tighter than our standard (ISO 2768-1), the technical drawing will be required.

By accepting an order, the Manufacturing Partner indicates that they have reviewed all technical drawings and have acknowledged the presence of threads or tighter tolerances. Hubs is not responsible for informing the Manufacturing Partner that threads or tighter tolerances are present.

Threads

We offer four types of standard threads:

- UNC and UNF threads (Defined as per ASME/ANSI B1.1-2019)
- Metric threads (Defined as per ISO 261/262. Tolerances as per ISO 965)
- NPT threads (Defined as per ANSI/ASME B1.20.1)

We do not accept ACME or Thorlabs threads.

Threads-Tolerances

Unless specified on the technical drawing, the Manufacturing Partner is required to follow:

- Metric threads:
ISO 965-1 standard (6H for internal threads, 6g for external threads)
- UN threads:
ASME B1.1-2019 standard (2A for external threads, 2B for internal threads)

Surface finishes

Hubs offers customers a number of surface finish options. Manufacturing Partners must not apply any surface finishes (including but not limited to sanding or grinding) unless it is clearly stated in the Hubs' purchase order. This does not include the removal of sharp edges or burrs. For our standard surface finishes the following quality standards must be met:

As machined (Ra3.2µm, 125µin)

Regular machining finish obtained without the use of high-end tools or machinery. Resulting surface roughness is Ra3.2µm/125µin.

Smooth machining (Ra1.6µm, 63µin)

Part surfaces are soft to the touch. Machining marks should be slightly visible, consistent in texture and appearance across the different surfaces. Resulting surface roughness is Ra1.6µm/63µin.

Bead blasting

A matte finish with a light grainy texture and consistent surface. Bead blasting should only be used when it does not damage part geometry or features. As a standard, we use glass bead blasting #120.

Brushing (Ra1.2µm, 43µin)

Smooth-looking parts that have been successively sanded after the main machining steps. All machining marks are removed through this process. Smooth machining marks are acceptable on:

- Assembly or tight tolerance areas, to ensure good fit and flatness
- Areas indicated on a technical drawing
- Hard-to-access surfaces that cannot be accessed by brushing tools

Polishing (Ra 0.8µm, 32µin)

Parts are manually polished in multiple directions. Surface is smooth and slightly reflective. Hard-to-access areas or features with tighter tolerances may not be compatible with polishing.

As machined + anodized type II (Matte)

Parts are run through machining (as per our “as machined” option) and then anodized type II. Machining and hanging marks are visible but controlled and consistent across the batch.

- Surface preparation: As machined
- Thickness: 8-12µm (clear), 12-16µm (black)

Bead Blasted + anodized type II (Matte)

Parts are bead blasted (as per our “bead blasted” standard option) and then anodized type II (matte).

- Surface preparation: Bead blasted (Glass beads #120)
- Thickness: 8-12µm (clear), 12-16µm (color)
- Gloss units: 2-10GU

Bead blasted + anodized type II (Glossy)

Parts are bead blasted, anodized type II and bright dipped. Results in glossy color. Ideal for cosmetic parts needing an increase in corrosion resistance.

- Surface preparation: Bead blasted (Glass beads #120)
- Thickness: 8-12µm (clear), 12-16µm (color)
- Gloss units: Above 20GU

Brushed + anodized type II (Glossy)

Parts are brushed (as per our “brushing” option), anodized type II and bright dipped.

- Surface preparation: Brushing #400
- Thickness: 8-12µm (clear), 12-16µm (color)
- Gloss units: Above 20GU

As machined + anodized hardcoat (type III)

Parts are run through machining (as per our “as machined” option).

- Surface preparation: As machined (Ra3.2µm, 125µin)
- Thickness: 35 to 50µm
- Color: Clear or black

Brushed + Electropolished (Ra0.8µm, 32µin)

Parts are brushed as per our “brushed” option and then ran through an electropolishing process. Up to 10µm of material will be removed after the finish is applied.

This finish is “Cosmetic” by default, meaning that the finish will be cosmetically pleasant, mostly free of defects.

Black oxide

Parts are first “As machined”, cleaned, degreased before applying black oxide.

As a post-treatment parts are sprayed with anti-rust oil to maximize corrosion resistance. Thickness added by Black oxide is 0-30µm.

Chromate Conversion Coating

Parts are first “as machined” and then receive chromate conversion coating.

Our standard chromate conversion coating is RoHS compliant (Hexavalent chrome-free) and has a clear color.

Electroless Nickel Plating

Parts are finished to meet our “smooth machined” (Ra1.6µm, 63µin) standard and then go through the Electroless Nickel Plated process. Machining marks are reduced but still visible.

Powder coating

The surface must be smooth and consistent with no visible marks or scratches. Powder coating will add a thickness of 50-150µm. Tolerances are met before the finish is applied. Hubs will provide the Manufacturing Partner with a Pantone or RAL color unless the finish is black. Threads and fits are masked by default.

Cosmetic standards

Finishes are differentiated into two categories, cosmetic and non-cosmetic. This is meant to standardise how good the finish should look, so that we can focus on doing only what your project really requires. For all of our available finishes, we have categorized them by their cosmetic availability:

Non-cosmetic

Primary machining marks will still be visible

- As machined
- Smooth machining
- Chromate Conversion Coating
- Electroless Nickel Plating
- As machined + Anodized type III (Hardcoat)
- Powder coating
- Black oxide
- As machined + Anodizing Type II

Cosmetic on request

Finishes can be either cosmetic or non-cosmetic as per request

- Brushed + Anodizing type II
- Bead Blasted + Anodizing type II
- Bead Blasted
- Brushed
- Polishing

Cosmetic by default

These finishes will not have the option to be non-cosmetic.

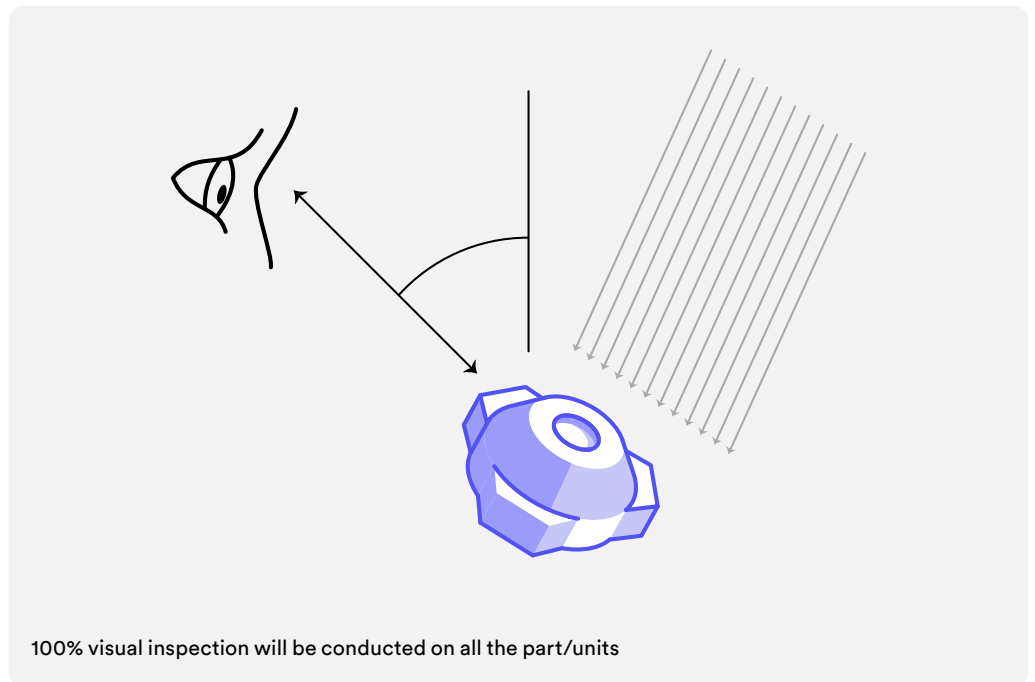
- Brushed + Electropolished

When you select a cosmetic finish, we commit to producing high-end, customer facing products. We guarantee that you will receive "beautiful-looking" parts according to our cosmetic standards described below.

Visual inspection conditions

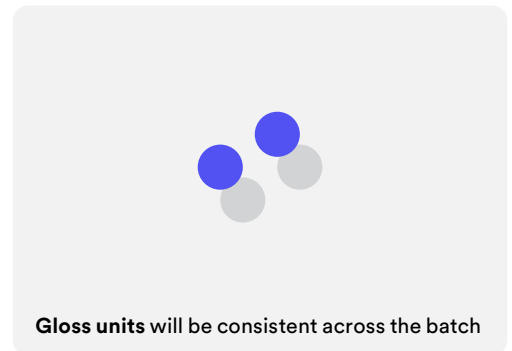
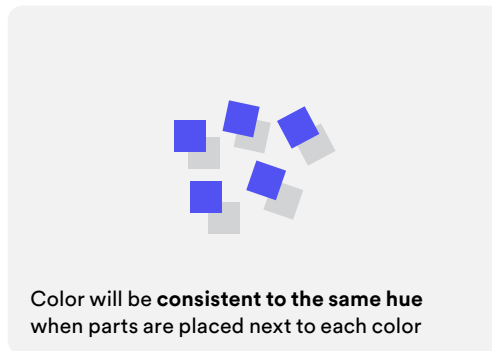
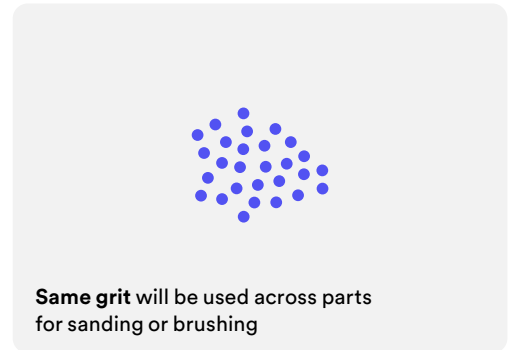
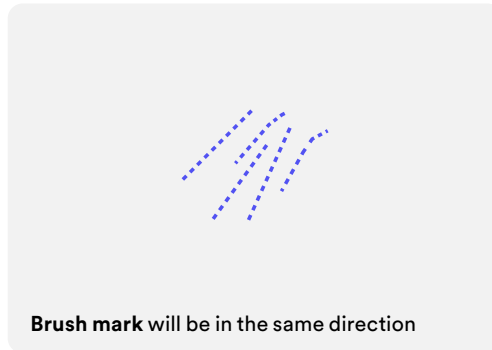
Surface quality on our side upon receiving will be visually inspected with the following conditions

- Distance: 50cm±10cm with a 10/10 vision (or corrected)
- Incidence angle: Approximately 45° in all directions
- Lightning conditions: 500-1000 Lux, color 3300-5300 Kelvin (neutral white)



Quantification of cosmetic surface quality

The parts are guaranteed to be visually consistent across the same batch



Only minor defects are allowed on the hidden B side

Defects	Primary side (A side)	Primary side (B side)
Scratches, dents, stains, blemishes	None**	None**
Hanging marks*	None**	Minor hanging marks
Minor defects	None**	Up to 2 minor defects

* When applicable to finish

** Not detectable under observation conditions.

100% visual inspection will be conducted on all the parts/units. When required, primary (A) side and secondary (B) side need to be indicated on the technical drawing.

Process requirement

1. Programming and process plan

Programming and process plan will be the same across the whole batch, unless adjustments needed for the quality result.

2. Raw material

Raw material will come from the same batch for the whole quantity of the parts, which is especially important for anodizing consistency output

3. Machining

Machining will be programmed so that minimal sanding is required to eliminates steps. Parts will not be stacked without protection to prevent dents.

4. Primary surface finish (brushing, blasting, etc)

Parts will be cleaned, degreased, and handled with gloves by the workers from that point, and never in contact with each other. The primary finish will stay consistent across the batch: same grit of sandpaper, same direction, same process parameters for bead blasting.

5. Secondary surface finish (if applicable) (anodizing, painting, etc)

Finish will be done at the same factory, and in the same batch. No re-anodizing is allowed on parts without permission. Batch should be the same (eg. anodizing).

6. Transportation, handling, packaging

Gloves are mandatory for handling, no fingerprints will be allowed, especially handling before anodizing. Packaging will be protective following our logistics standards, and individual packaging will be preferred at the discretion of the supplier, to protect the sensitive nature of the parts.

HUBS
A PROTO LABS COMPANY

CNC manufacturing standards
Copyright © 2021 3D Hubs B.V.
All rights reserved.