

DESIGN FOR MANUFACTURING

# ALUMINUM SURFACE FINISH SELECTION GUIDE

Appearance | Protection | Wear | Tolerance | Inspection



## FUNCTION

defines the finish

## SUBSTRATE

controls the result

## PROCESS

changes dimensions

## ACCEPTANCE

needs a standard

A practical DFM handbook for selecting and specifying  
production finishes on aluminum parts and assemblies

Prepared by **BAOSONG**

[baosongprecision.com](https://baosongprecision.com)

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*Conceptual finish swatches - not color standards*

# 00 Selection logic

Select a finish by function, substrate and acceptance evidence - not by a color name alone.



| Question     | Define                                                                                  | Result                            |
|--------------|-----------------------------------------------------------------------------------------|-----------------------------------|
| Appearance   | Texture, color, gloss, viewing conditions and acceptable variation                      | Visual standard / approved sample |
| Environment  | Indoor/outdoor, chemicals, UV, salt, humidity, cleaning and temperature                 | Protection system and test plan   |
| Function     | Wear, friction, electrical contact, bonding, heat transfer and food/medical constraints | Finish family and masked zones    |
| Geometry     | Threads, fits, blind holes, cavities, welds, sharp edges and drainage                   | Process-ready drawing             |
| Verification | Thickness, color, adhesion, seal, corrosion and sampling                                | Inspection plan and records       |

SCOPE

This guide is a DFM selection aid. Final chemistry, process parameters, regulatory compliance and acceptance criteria must be agreed with the approved finisher and project authority.

# 01 Define the service environment

A finish can perform well in one exposure and fail early in another.

| Input                | Questions                                                               | Why it changes selection                         |
|----------------------|-------------------------------------------------------------------------|--------------------------------------------------|
| Location             | Interior, sheltered exterior, direct weather, marine or industrial?     | UV, moisture, salt and pollutants                |
| Chemical contact     | Cleaners, coolant, fuels, acids/alkalis, disinfectants or skin contact? | Coating compatibility and sealing                |
| Temperature          | Continuous range, cycles, localized heat and cure sensitivity?          | Color stability, adhesion and dimensional change |
| Mechanical duty      | Handling, abrasion, sliding, impact or bearing contact?                 | Hardness, wear layer and repairability           |
| Electrical / thermal | Insulating, conductive, grounded, bonded or heat-dissipating?           | Masking and coating family                       |
| Life + maintenance   | Required life, cleaning method, repair access and appearance retention? | Performance class and documentation              |

|              |                                                                                                                                                                                           |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TEST CONTEXT | Salt-spray hours, UV exposure or adhesion ratings are not universal service-life predictions. Specify a recognized method, specimen, conditioning and acceptance tied to the application. |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## 02 Compare finish families

Use this matrix for screening; confirm actual capability by alloy, geometry, color, size and supplier process.

| Finish                | Appearance                              | Protection / wear                             | Dimensional effect                      | Best fit                            |
|-----------------------|-----------------------------------------|-----------------------------------------------|-----------------------------------------|-------------------------------------|
| As-machined           | Tool-path dependent                     | Low added protection                          | None; burr control only                 | Internal precision parts            |
| Bead blast / brush    | Uniform matte / directional             | Mechanical texture, not a corrosion system    | Can round edges / change roughness      | Cosmetic pretreatment               |
| Decorative anodize    | Metallic; clear or dyed                 | Good general protection; moderate wear        | Oxide growth affects fits               | Consumer / industrial housings      |
| Hard anodize          | Typically gray to dark                  | Higher wear and electrical insulation         | Greater build; edge sensitivity         | Sliding / wear surfaces             |
| Conversion coating    | Subtle / iridescent depending chemistry | Corrosion aid, paint base, conductive options | Very thin                               | Bonding, grounding, pretreatment    |
| Powder coating        | Wide color/gloss/texture                | Robust organic barrier                        | Meaningful build; edge and hole effects | Frames, enclosures, outdoor parts   |
| Liquid coating / PVDF | Broad chemistry and color control       | System-specific durability                    | Meaningful build; multi-coat stack      | Architectural / demanding exposures |

### SELECTION RULE

If two functions conflict - for example electrical contact and corrosion protection - divide the part into coated, masked and sealed zones instead of asking one finish to do everything.

## 03 As-machined and mechanical finishes

Mechanical texture controls the starting surface; it rarely replaces a corrosion-protection system.

| Condition                        | What it controls                                      | Specify                                                           |
|----------------------------------|-------------------------------------------------------|-------------------------------------------------------------------|
| As-machined                      | Tool marks, burrs and local roughness                 | Surface texture only where functional; deburr/edge requirement    |
| Vibratory / tumble               | Edge break and broad cosmetic blending                | Media intent, protected features, acceptable rounding and sample  |
| Bead blast                       | Uniform matte texture and reduced reflectivity        | Media/material, target appearance, cleanliness and witness sample |
| Brushed                          | Directional grain                                     | Direction, grit/process family, start/stop zones and sample       |
| Polished                         | Reflectivity and smooth appearance                    | Gloss/roughness target, distortion limits and protected edges     |
| Shot peen / engineered treatment | Mechanical surface effects when specifically designed | Qualified process, coverage/intensity and verification            |

### SEQUENCE

Mechanical finishing before anodize or paint changes the final appearance. Use production-equivalent coupons; a flat sample may not reproduce corners, welds or machined faces.

Coordinate machined surface requirements with [BAOSONG CNC Machining](#) and [Surface Finishing](#).

# 04 Decorative and protective anodizing

Anodizing converts the aluminum surface into an oxide layer; alloy and pretreatment remain visible in the result.

| Decision                  | Specify                                                                | Watch for                                                          |
|---------------------------|------------------------------------------------------------------------|--------------------------------------------------------------------|
| Alloy + temper            | Exact designation and product form                                     | Different alloys, tempers and extrusion lots can color differently |
| Pretreatment              | As-machined, etched, brightened, blasted or brushed intent             | Texture changes and defect visibility                              |
| Coating class / thickness | Recognized standard and required range                                 | Build on dimensions; recess/edge variation                         |
| Color                     | Named color plus approved physical sample and variation agreement      | Black/clear are not universal across alloy and thickness           |
| Sealing                   | Required performance and any downstream bonding/electrical constraints | Seal affects corrosion, dye retention and surface behavior         |
| Racking                   | Permitted contact locations and orientation                            | Witness marks and current distribution                             |

STANDARD

ISO 7599:2018 provides a method for specifying decorative and protective anodic oxidation coatings and highlights alloy suitability and pretreatment effects. It excludes engineering hard anodize.

Explore [BAOSONG anodizing](#) for project-specific feasibility review.

# 05 Hard anodizing

Choose hard anodize for validated wear, insulation or surface-performance needs - not simply because 'harder is better.'

| Requirement            | Design implication                                                                    | Drawing / test input                               |
|------------------------|---------------------------------------------------------------------------------------|----------------------------------------------------|
| Wear resistance        | Counterface, lubrication, load and motion dominate system wear                        | Functional wear test or recognized abrasion method |
| Thickness / build      | Coating changes bores, shafts, slots and edges                                        | Final-size target, allowance and mask plan         |
| Electrical insulation  | Breakdown depends on thickness, pores, geometry and damage                            | Voltage/test method and protected contact zones    |
| Color / appearance     | Natural shade varies with alloy and process; dark cosmetic consistency may be limited | Appearance class or explicitly non-cosmetic        |
| Surface roughness      | Hard coating can reflect or amplify substrate texture                                 | Pre- and post-finish texture requirement           |
| Sealing / impregnation | Changes corrosion, friction and dimensional behavior                                  | State required treatment and performance           |

|           |                                                                                                                                                                                              |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| STANDARD  | ISO 10074:2021 specifies requirements and test methods for hard anodic oxidation coatings and lists information the customer should supply. It does not cover plasma electrolytic oxidation. |
| EDGE RISK | Sharp edges and thin walls can create nonuniform coating or functional interference. Add practical radii and review masking/allowance with the processor.                                    |

## 06 Chemical conversion coatings

Conversion coatings are commonly selected for corrosion support, paint adhesion or controlled electrical contact.

| Design need           | Selection question                                                         | Verification                                                |
|-----------------------|----------------------------------------------------------------------------|-------------------------------------------------------------|
| Paint / adhesive base | Is the conversion layer compatible with the exact organic system and cure? | System adhesion and environmental test                      |
| Bare protection       | What exposure and handling life are required?                              | Specified corrosion test and appearance limit               |
| Electrical bonding    | What maximum contact resistance and preparation are required?              | Defined measurement geometry and acceptance                 |
| Chromium restrictions | Are hexavalent-chromium-free or other regulatory constraints required?     | Supplier declaration and material/process records           |
| Local repair          | Is touch-up permitted and visible?                                         | Approved repair material, zone and reinspection             |
| Very thin layer       | Can the chosen thickness method resolve the coating?                       | Use standard-appropriate verification, not an assumed gauge |

SPECIFY CHEMISTRY

'Chem film' is incomplete. State the governing standard/class, color if applicable, corrosion or contact-resistance duty, paint/bonding compatibility and restricted-substance requirements.

ASTM B449-93(2022) covers chromate conversion coatings on aluminum for corrosion protection, organic-coating bases and low electrical contact impedance.

# 07 Powder coating

Powder coating is a system: substrate, pretreatment, powder chemistry, application, cure and film build all matter.



| Variable        | Define                                                      | DFM risk                                        |
|-----------------|-------------------------------------------------------------|-------------------------------------------------|
| Exposure class  | Interior/exterior, UV, corrosivity and target durability    | Wrong resin/performance class                   |
| Pretreatment    | Approved aluminum pretreatment and rinse control            | Adhesion/corrosion failure beneath intact film  |
| Color + gloss   | Color system, gloss range, texture and physical sample      | Batch, geometry and cure variation              |
| Film thickness  | Target/range and measurement zones                          | Fits, threads, recess coverage and edge build   |
| Cure            | Part mass, alloy/temper sensitivity and assembled materials | Under-cure, over-cure or heat-sensitive inserts |
| Recoat / repair | Permitted method and visual/performance limit               | Local mismatch and reduced durability           |

CURRENT  
REFERENCES

ISO 18768-1:2022 covers specifying decorative/protective powder coatings on aluminum. The FGIA 2026 bundle includes AAMA 2603-26, 2604-26 and 2605-26 for architectural organic coatings.

# 08 Liquid coatings and PVDF systems

Use liquid systems where chemistry, field repair, film architecture or high-performance architectural exposure supports the choice.

| System decision            | Clarify                                                           | Avoid                                                       |
|----------------------------|-------------------------------------------------------------------|-------------------------------------------------------------|
| Primer + topcoat           | Compatible layers, total thickness and cure window                | Naming only a topcoat color                                 |
| PVDF architectural coating | Required performance specification and approved applicator/system | Using 'PVDF' as a generic quality level                     |
| Wet paint industrial       | Chemical/UV duty, gloss, texture, VOC/regulatory constraints      | Assuming all paints share resistance                        |
| Touch-up                   | Allowed area, preparation and appearance acceptance               | Uncontrolled aerosol repair                                 |
| Mixed-material assembly    | Sealants, adhesives, plastics and fasteners through cure/service  | Coating a complete assembly without compatibility review    |
| Edge/recess coverage       | Geometry-specific target and inspection zones                     | Applying one thickness requirement to inaccessible recesses |

PERFORMANCE  
CLASS

Choose the coating specification by exposure and required retention of color, gloss, adhesion and corrosion performance. Higher class adds cost and does not correct poor drainage or pretreatment.

# 09 Texture, gloss and surface preparation

Finish appearance begins with substrate condition and viewing conditions.

| Control           | Drawing / approval input                                                       | Common mismatch                                           |
|-------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------|
| Texture           | Directional/non-directional, process family and approved sample                | A roughness number alone does not describe visual texture |
| Gloss             | Measurement geometry, range and color/texture context                          | Comparing readings from different methods                 |
| Color             | Color space/tolerance if needed, illuminant/viewing geometry and master sample | Approving from a monitor or supplier name                 |
| Defect visibility | Cosmetic zones, viewing distance, lighting, angle and inspection time          | Applying one cosmetic rule to hidden and show surfaces    |
| Lot consistency   | Lot/batch grouping and retained samples                                        | Expecting separate alloys/lots to match exactly           |
| Handling          | Film cure, protective packaging and no-contact zones                           | Print-through, rub marks and adhesive residue             |

MASTER SAMPLE

Approve a production-equivalent physical sample made from the actual alloy/product form, pretreatment and finish route. Record revision, boundary sample rules and retention period.

# 10 Color and alloy variation

Anodized color is a combined result of alloy, temper, metallurgical history, geometry, pretreatment, coating and sealing.

DIGITAL SWATCHES ARE NOT ACCEPTANCE STANDARDS

CLEAR

NATURAL

GRAY

BLACK

BRONZE

BLUE

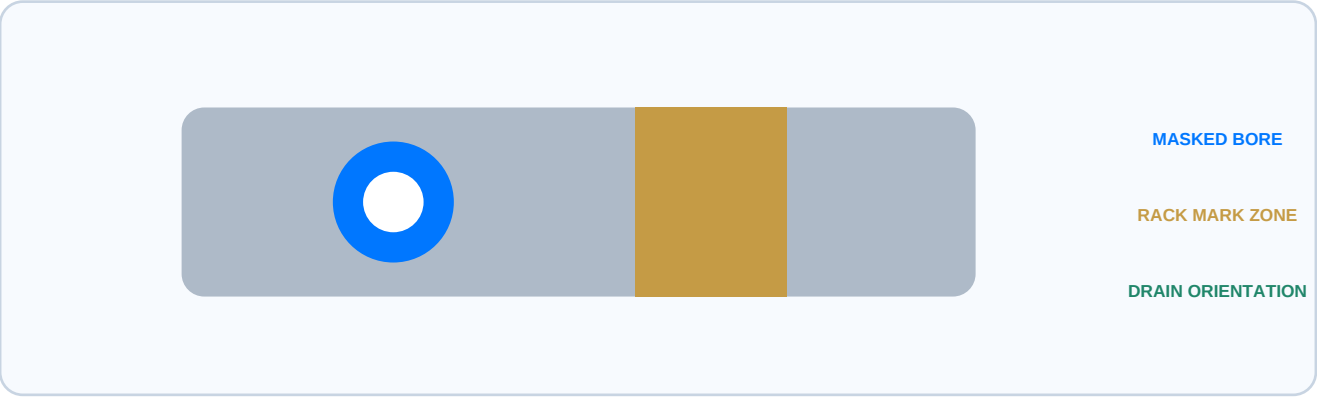
| Variation source              | Visible effect                         | Control strategy                                             |
|-------------------------------|----------------------------------------|--------------------------------------------------------------|
| Alloy / temper                | Shade and reflectivity shift           | Use one specified material route within an appearance family |
| Extrusion vs sheet vs casting | Different grain/chemistry response     | Avoid cross-form color match unless validated                |
| Weld / HAZ / filler           | Contrast after anodizing               | Place seams deliberately or use opaque organic coating       |
| Machining / forming           | Different texture and light reflection | Unify mechanical pretreatment or accept zone variation       |
| Thickness / dye / seal        | Color depth and tone variation         | Qualified process window and physical limits                 |
| Viewing light                 | Metamerism and gloss perception        | Defined lighting, angle and viewing distance                 |

NO SCREEN APPROVAL

The swatches above are diagrammatic only. Never accept production color from this PDF, a web page, RGB/HEX value or uncalibrated monitor.

# 11 Masking, racking and drainage

Every finish needs contact, flow and handling strategy; give those marks a designed home.



| Zone                     | Define                                                        | Why                                                        |
|--------------------------|---------------------------------------------------------------|------------------------------------------------------------|
| Threads / precision fits | Mask, plug, chase or machine after finish                     | Coating build changes fit and torque                       |
| Electrical contacts      | Bare area, boundary tolerance and protection after processing | Oxide/organic layers can insulate                          |
| Bonding / sealing        | Surface state and maximum time to bond                        | Contamination and seal chemistry affect adhesion           |
| Racking contacts         | Permitted hidden areas and maximum mark                       | Electrical connection and handling leave witness marks     |
| Blind holes / cavities   | Drain/vent orientation and trapped-solution control           | Staining, contamination, outgassing or incomplete coverage |
| Cosmetic faces           | No-contact zones through finishing, cure and packing          | Prevents hook, clamp and rub marks                         |

DRAW IT

Provide a masking/racking view with controlled boundaries. 'Mask all critical areas' forces the supplier to guess which surfaces are critical.

# 12 Account for dimensional change

Finish thickness, oxide growth, stripping and post-finish operations can all change functional geometry.



| Feature            | Planning question                                                   | Release requirement                                  |
|--------------------|---------------------------------------------------------------------|------------------------------------------------------|
| Bore / shaft fit   | Does coating grow inward/outward and is it later honed or machined? | Final-size tolerance and allowance route             |
| Thread             | Masked, coated, chased or formed after finish?                      | Thread class, gauge timing and lubrication condition |
| Sharp edge         | Can the process cover uniformly without buildup/burn?               | Edge radius/break and permitted exposure             |
| Datum face         | Will it be coated, masked or finish-machined?                       | Final datum state used for inspection                |
| Grounding pad      | How is boundary and corrosion sealing controlled?                   | Mask tolerance plus electrical test                  |
| Rework / stripping | How many cycles are allowed before size/material risk?              | Disposition authority and reinspection               |

TOLERANCE STACK

Separate substrate tolerance, coating thickness variation and final functional tolerance. Do not simply add a coating note to an already closed fit.

## 13 Weldments, castings and extrusions

Different product forms and thermal histories can produce different appearance and coating behavior in one assembly.

| Substrate condition           | Finish concern                                                         | Design response                                               |
|-------------------------------|------------------------------------------------------------------------|---------------------------------------------------------------|
| Weld + HAZ                    | Color/texture contrast, oxide and cleanup variability                  | Approve a welded sample; place seam or choose opaque coating  |
| Filler metal                  | Composition differs from parent alloy                                  | Select with welding and finishing appearance in mind          |
| Casting                       | Porosity, silicon content, trapped media and variable anodize response | Validate alloy/process; consider conversion + paint or powder |
| Extrusion seam / grain        | Directional appearance and lot-to-lot response                         | Orient show faces; group appearance-critical parts by lot     |
| Machined surface on extrusion | Tool marks contrast with extruded skin                                 | Define whether texture is intentionally unified               |
| Assembled inserts / fasteners | Chemical/cure incompatibility and trapped solution                     | Finish before assembly or validate complete assembly route    |

### ROUTE REVIEW

Coordinate [extrusion](#), [fabrication](#), [machining](#) and finishing before selecting a cosmetic requirement that crosses multiple product forms.

# 14 Match finish to functional duty

Select the surface system at each zone based on corrosion, wear, friction, electrical and thermal behavior.

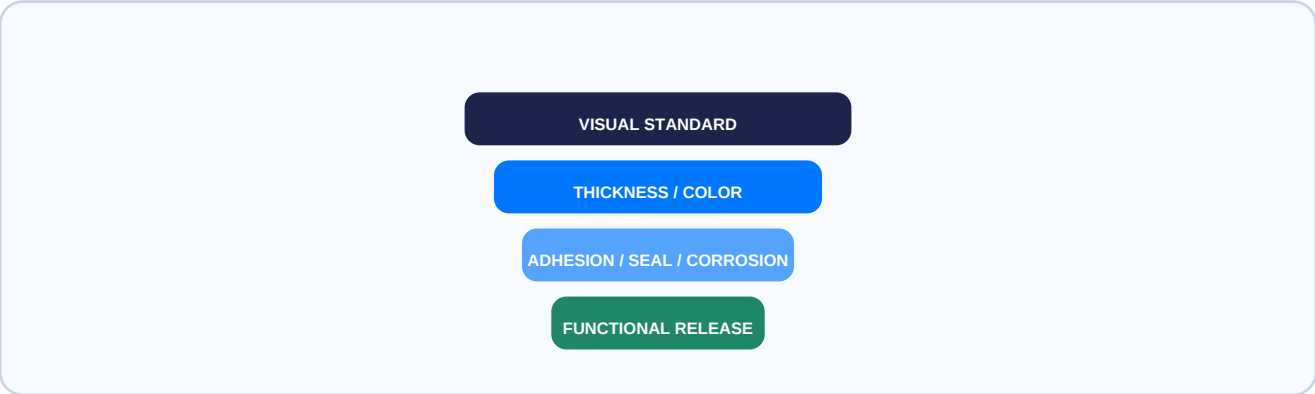
| Duty                    | Promising candidates                                           | Critical validation                                              |
|-------------------------|----------------------------------------------------------------|------------------------------------------------------------------|
| General indoor cosmetic | Decorative anodize, powder or liquid coating                   | Appearance sample, handling and cleaner compatibility            |
| Outdoor architectural   | Specified anodize or qualified organic coating class           | UV/color/gloss retention, corrosion, applicator and pretreatment |
| Sliding / abrasion      | Hard anodize or engineered coating system                      | Counterface, lubrication, load, debris and wear test             |
| Electrical bonding      | Conversion coating or masked bare contact with sealed boundary | Contact resistance, corrosion and fastener preload               |
| Electrical insulation   | Anodic/organic coating where suitable                          | Breakdown/withstand, thickness, pores and damage                 |
| Food / medical contact  | Application-approved material and process system               | Regulatory/cleanability evidence specific to market and use      |
| Adhesive bonding        | Validated pretreatment/conversion and controlled time-to-bond  | Surface energy, contamination, cure and environmental durability |

ZONE THE PART

One component may need a cosmetic shell, bare grounding pad, masked bearing bore and adhesive-prepared surface. Put each requirement on a controlled finish map.

# 15 Inspection and acceptance

A complete finish specification defines what is measured, where, when, how and against which limit.



| Characteristic            | Typical control                                        | Drawing / plan input                                     |
|---------------------------|--------------------------------------------------------|----------------------------------------------------------|
| Appearance                | Master/boundary sample under controlled viewing        | Zones, lighting, distance, angle and allowed defects     |
| Thickness                 | Standard-appropriate instrument and sampling           | Range, measurement areas and edge/recess exclusions      |
| Color / gloss             | Instrumental and/or visual comparison                  | Method, geometry, tolerance and reference sample         |
| Adhesion                  | Method suitable for coating/substrate system           | Conditioning, cut/tool/tape details and acceptance       |
| Seal quality              | Anodizing standard method where required               | Test method, frequency and limit                         |
| Corrosion / UV / abrasion | Recognized exposure and evaluation method              | Specimen, duration/cycles, scribe, rating and acceptance |
| Function                  | Fit, electrical contact, wear, leak or bond validation | Final assembly state and test conditions                 |

THICKNESS METHOD

ISO 2360:2017 covers eddy-current measurement of non-conductive coatings on non-magnetic conductive substrates. It is applicable to many anodic/organic coatings but not all very thin conversion coatings.

## 16 Drawing and RFQ release checklist

Send the finisher enough information to quote the actual performance system and identify exceptions.

| Gate            | Required input                                                                     |
|-----------------|------------------------------------------------------------------------------------|
| Part definition | Controlled 3D/2D data, revision, material/alloy/temper and product form            |
| Finish system   | Process family, standard/class, pretreatment, color/gloss/texture and seal/topcoat |
| Service         | Environment, temperature, chemicals, UV, wear, cleaning and target life            |
| Zones           | Cosmetic classes, masked areas, rack-contact zones, drainage and orientation       |
| Dimensions      | Pre-finish allowance, final fits/threads/datums and gauge timing                   |
| Acceptance      | Physical samples, methods, measurement zones, sampling and report format           |
| Compliance      | Restricted substances, declarations, approved sources and traceability             |
| Commercial      | Quantity, lot grouping, sample/FAI, rework policy, packaging and schedule          |

### RFQ RESPONSE

Ask the supplier to state assumed thickness, pretreatment, racking points, color variation, masking method, test plan, tooling charges, minimum lot and any design exceptions.

### Cost levers

- Group parts by alloy, color and process family.
- Use cosmetic zones instead of perfect-all-over requirements.
- Standardize masks, racks and approved colors.
- Protect critical faces in packaging instead of relying on rework.

## 17 References and BAOSONG contact

Check the edition adopted by the purchase order. Standards and finish-system requirements can change.

| Reference               | Guide use                                                    | Link                                |
|-------------------------|--------------------------------------------------------------|-------------------------------------|
| ISO 7599:2018           | Decorative/protective anodizing specification method         | <a href="#">Official ISO page</a>   |
| ISO 10074:2021          | Hard anodic oxidation coatings                               | <a href="#">Official ISO page</a>   |
| ISO 18768-1:2022        | Powder coatings on aluminum                                  | <a href="#">Official ISO page</a>   |
| ISO 2360:2017           | Eddy-current coating-thickness measurement                   | <a href="#">Official ISO page</a>   |
| ASTM B580-25            | Anodic oxide coatings on aluminum                            | <a href="#">Official ASTM page</a>  |
| ASTM B449-93(2022)      | Chromate conversion coatings on aluminum                     | <a href="#">Official ASTM page</a>  |
| AAMA finish bundle 2026 | Includes AAMA 2603-26, 2604-26, 2605-26 and AAMA 611-24      | <a href="#">Official FGIA store</a> |
| QUALANOD 2026           | Current sulfuric-acid anodizing quality-label specifications | <a href="#">Official page</a>       |

### USE LIMITATION

Educational DFM guidance only. It does not replace an approved finish specification, production-equivalent sample, qualified processor, safety/environmental review, applicable law or contract acceptance criteria.

|                  |                                                                                                             |
|------------------|-------------------------------------------------------------------------------------------------------------|
| REQUEST A REVIEW | Send CAD, drawings, alloy/temper, quantities, exposure, appearance sample, masking map, tests and schedule. |
| WEB              | <a href="https://baosongprecision.com">baosongprecision.com</a>   <a href="#">RFQ / contact</a>             |
| EMAIL            | <a href="mailto:info@aagintr.com">info@aagintr.com</a>                                                      |
| PHONE            | +86-757 8556 3891   Mobile: +86-133 2675 8535                                                               |
| WHATSAPP         | <a href="https://wa.me/8613326758535">+86 189 3431 1334</a>                                                 |

BAOSONG resources: [Surface Finishing](#) | [Anodizing](#) | [Engineering](#) | [Quality](#)