DESIGN FOR MANUFACTURING

POWDER COATING, BRUSHING & POLISHING GUIDE

Texture | Color | Gloss | Masking | Inspection

A practical DFM handbook for aluminum appearance, organic coating performance and cosmetic control

Prepared by BAOSONG

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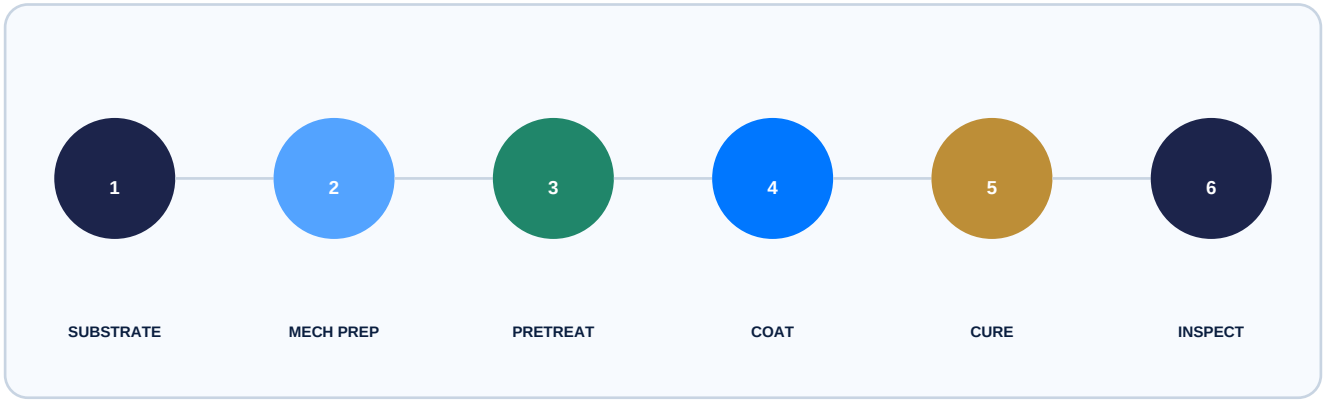
Version 1.0 | September 2026 | Metric-first

Conceptual finish panels - not approval samples

00 Control the finish chain

Powder coating and mechanical finishing are linked: the substrate and preparation remain visible in the delivered result.



Layer	Design decision	Evidence
Substrate	Alloy, temper, product form, welds and cosmetic faces	Material/route identification
Mechanical finish	Brushing direction, polishing level, edge treatment and protected features	Production-equivalent sample
Pretreatment	Approved aluminum preparation compatible with powder system	Controlled process and records
Powder	Chemistry/performance class, color, gloss, texture and film range	Certificate and approved sample
Acceptance	Zones, viewing conditions, tests, sampling and packaging	Inspection report and release

SCOPE This guide is DFM guidance, not a finishing recipe. Process chemistry, exposure class, safety, environmental compliance and acceptance must be agreed with the qualified finisher and project authority.

01 Choose the finish by function

Separate appearance, protection, cleaning, wear and dimensional needs before selecting a process.

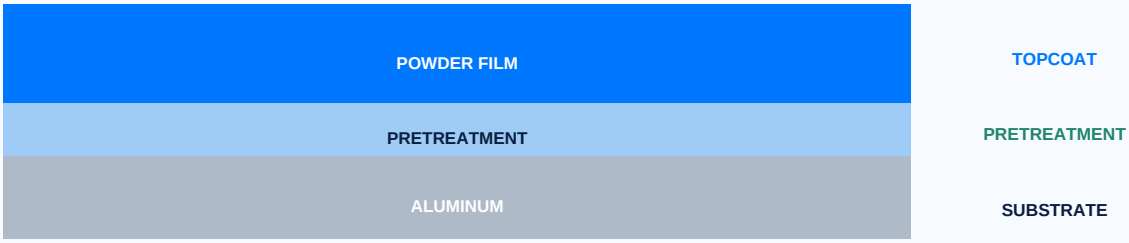
Need	Questions	Selection effect
Appearance	Color, gloss, texture, grain direction, show zones and adjacent-part match?	Physical sample and cosmetic standard
Environment	Interior/outdoor, UV, salt, humidity, chemicals, cleaners and temperature?	Powder chemistry, pretreatment and performance class
Mechanical	Abrasion, impact, sliding, handling and repair?	Film/mechanical finish suitability and validation
Geometry	Sharp edges, holes, cavities, welds, threads and drainage?	Edge design, mask/rack plan and coverage
Dimensions	Fits, datums, threads and coating allowance?	Mask or compensate; final inspection state
Lifecycle	Target life, cleaning, touch-up and packaging?	Durability tests and maintenance plan

SYSTEM CHOICE

Brushing or polishing changes texture but does not by itself provide a durable corrosion barrier. Powder coating adds protection but hides some metallic character and adds thickness.

02 Build the powder-coating system

Durability comes from the complete stack, not the powder name alone.



System element	Specify	Failure if omitted
Aluminum substrate	Alloy/temper/form, weld/casting condition and cleanliness	Variable pretreatment and appearance
Pretreatment	Approved aluminum process compatible with powder and exposure	Loss of adhesion or underfilm corrosion
Powder chemistry	Performance class, exterior/interior duty and qualified product	Fade, chalk, chemical or weathering mismatch
Application	Target/range, difficult zones and electrostatic access	Thin edges/recesses or excessive build
Cure	Qualified time/metal-temperature window and part compatibility	Under-cure, over-cure or heat damage
Inspection	Appearance, thickness, adhesion and environmental evidence	Unverifiable release

REFERENCE ISO 18768-1:2022 defines methods for specifying decorative and protective powder coatings on aluminum with performance tied to the application and environmental aggressiveness.

03 Select powder performance

Color code and resin family do not by themselves define a compliant coating system.

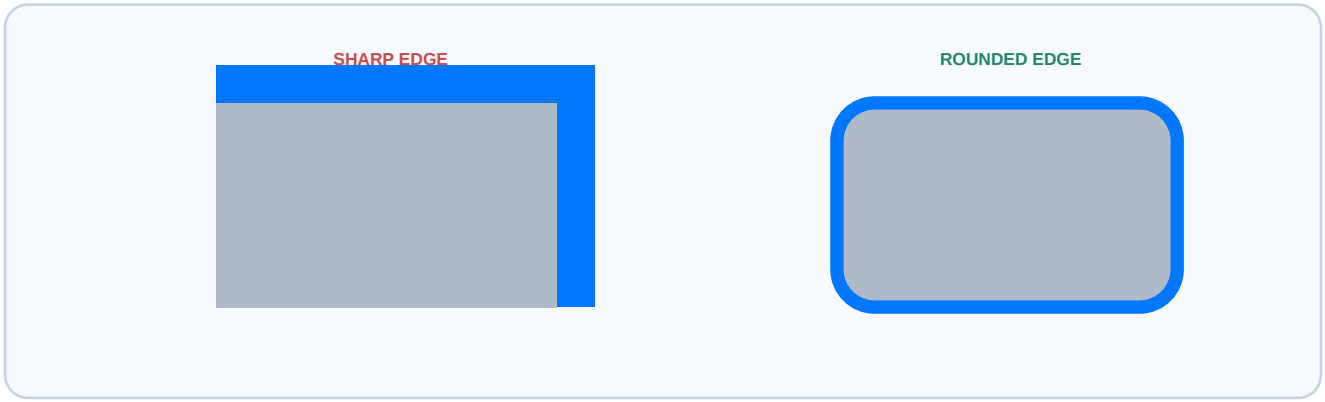
Decision	Define	Verify
Exposure class	Indoor, sheltered/outdoor, UV and corrosivity	Adopted performance specification and approved product
Color retention	Required change after specified exposure	Test method, duration/cycles and limit
Gloss retention	Initial range and weathering retention	Measurement geometry and exposure method
Adhesion	Substrate/pretreatment/powder system	Method, conditioning and acceptance
Chemical resistance	Actual cleaners, oils, coolants or process chemicals	Contact condition, dwell, temperature and rating
Impact / flexibility	Forming after coating or in-service impact?	Applicable test on representative substrate
Repairability	Factory recoat or field touch-up allowed?	Approved material, preparation, zone and appearance rule

ARCHITECTURAL CLASSES

The 2026 FGIA finish bundle includes AAMA 2603-26, 2604-26 and 2605-26. Use the class adopted by the project and approved applicator/system - not a generic 'AAMA quality' note.

04 Design edges, holes and recesses

Electrostatic deposition and geometry make film build nonuniform; edge shape is part of coating performance.



Geometry	Risk	Design response
Sharp edge	Reduced effective coverage or visual highlight	Add practical radius/break and specify edge acceptance
Deep recess	Faraday-cage effect and low deposition	Open geometry, provide access or define reduced-coverage zone
Blind hole	Trapped pretreatment/rinse, outgassing or unwanted build	Vent/drain, mask or redesign
Thread	Film changes fit and torque	Mask/plug, chase or produce after coating; final gauge
Weld seam	Spatter, porosity/outgassing and profile show through	Clean/prepare, approve sample and define contour
Double layer / lap	Crevice chemistry and poor drainage	Seal intentionally or provide open drainage

EDGE TEST

A flat coupon does not represent corners, recesses or welds. Use a representative part/coupon for coating qualification and appearance approval.

05 Specify color, gloss and texture

A named color plus 'matte' is not a complete cosmetic requirement.

COLOR + GLOSS + TEXTURE REQUIRE A PHYSICAL SAMPLE

MATTE LOW SATIN SEMI GLOSS

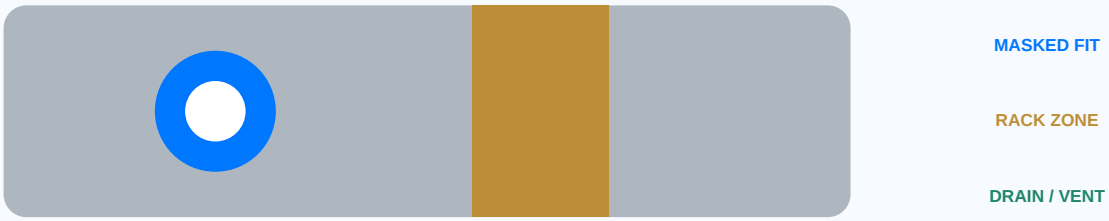
Control	Define	Caution
Color	Color system/reference plus master and boundary samples	Screen/RGB/HEX values cannot approve production color
Gloss	Measurement method/geometry and range on a suitable zone	Texture and curvature can invalidate readings
Texture	Smooth, fine/coarse texture or approved product/sample	Texture changes perceived color and cleanability
Metallic / effect	Orientation, lot and spray pattern controls	Directional flop and part geometry affect appearance
Lot match	Which parts are adjacent and processed as a set	Separate batches can show acceptable but visible variation
Viewing	Light, distance, angle, background and time	Uncontrolled inspection creates inconsistent rejects

GLOSS METHOD

ISO 2813:2014 (confirmed 2025) specifies 20, 60 and 85 degree gloss measurement for non-textured coatings on plane opaque substrates. Confirm suitability before assigning it.

06 Plan masking, racking and drainage

Every coating route needs contact, support, flow and handling; give those witness marks a designed home.



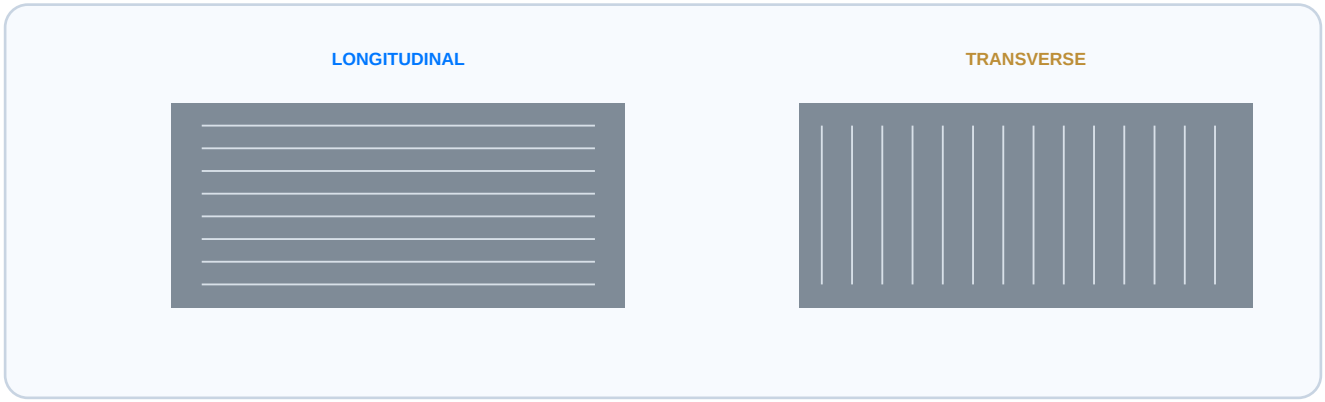
Zone	Define	Reason
Precision fit	Mask boundary, final size and plug witness	Film build changes clearance
Thread	Mask/plug/chase route and gauge timing	Coating changes fit and torque
Ground / bond	Bare area, position, boundary and corrosion sealing	Organic film electrically insulates
Rack / hook	Allowed contact location and maximum witness	Handling and electrical support leave marks
Drain / vent	Orientation and open paths through pretreatment/cure	Prevents traps, stains and outgassing
Cosmetic face	No-contact zone and packaging protection	Avoids hook, clamp and rub damage

DRAW IT

Use a finish map with dimensioned mask boundaries and allowed rack points. 'Mask critical areas' is not a controlled instruction.

07 Specify brushing direction

Brushing is directional; part orientation and edge transitions determine whether an assembly looks intentional.



Control	Drawing input	Inspection
Grain direction	Arrows on every cosmetic face; define part orientation in assembly	Compare to approved sample in matching orientation
Process family	Abrasive type/grit family, belt/wheel/manual route as appropriate	Supplier-controlled route plus sample
Start / stop	Allowed blend zones and boundaries	No uncontrolled swirl or cross-grain in Zone A
Edges / corners	Wrap grain, stop at edge or finish separately	Boundary sample for transitions
Welds / repairs	Permitted blending and contour restoration	Reinspect texture, geometry and weld requirement
Protected features	Fits, seals, lettering and sharp functional edges	Mask/fixture plan before brushing

ROUGHNESS

Surface-texture parameters can support function, but do not fully define visual grain. Use the ISO 21920 series for profile-texture indication/parameters plus a physical cosmetic standard.

08 Specify polishing level

Polishing controls reflectivity and visible waviness; a mirror-like surface amplifies geometry and handling defects.

Requirement	Define	Risk
Reflectivity / image quality	Approved sample and instrumental method if needed	'Mirror polish' has no universal numerical meaning
Surface texture	Functional parameter and evaluation length where relevant	One Ra value does not control waviness or appearance
Edge retention	Minimum radius/chamfer and no-thinning zones	Aggressive polishing rounds edges and erases detail
Flatness / waviness	Functional limit before/after polishing	High-gloss reflection reveals panel waviness
Defect removal	Maximum stock removal and protected dimensions	Chasing scratches can create low spots
Cleanliness	Residue-free condition and protective packaging	Compound transfer, fingerprints and stains

SAMPLE ROUTE

Approve the complete sequence - machining, weld blending, brushing/polishing, cleaning and optional coating - on representative geometry.

09 Write cosmetic standards

Zone-based, measurable rules prevent hidden surfaces from carrying show-surface cost.

Zone	Typical role	Acceptance
A - primary show	Directly visible in normal use	Tight color/texture/defect rules under controlled viewing
B - secondary	Visible at angle or during handling	Moderate allowance and transition rules
C - hidden	Not visible after assembly	Coverage, corrosion and cleanliness only
D - functional	Fit, seal, bond, ground or wear	Dimensional/functional requirement overrides cosmetics
Edge / transition	Boundary between finish or visibility zones	Specific grain, coverage and blend rule

Defect families

- Substrate: dents, pits, porosity, tool marks, die lines and waviness.
- Mechanical finish: cross-grain, swirl, belt splice, burn, low spot and edge rounding.
- Powder: thin coverage, pinhole, crater, inclusion, orange peel, sag, color/gloss variation and rack mark.
- Handling: scratch, rub, fingerprint, stain, protective-film residue and packaging print-through.

VIEWING CONDITIONS Define illumination, distance, angle, orientation, background and inspection time before setting size/count limits or boundary samples.

10 Coordinate welds and mixed substrates

Powder can hide color differences but not poor contour, porosity, outgassing or abrupt texture transitions.

Condition	Appearance / process risk	Design response
Weld bead	Profile, spatter and heat tint telegraph through coating	Define as-welded or blended contour and acceptance
Weld porosity / cavity	Outgassing causes pinholes or craters	Clean, design drainage and validate representative cure
Cast aluminum	Porosity and surface chemistry vary	Pre-bake/route only if qualified; approve cast sample
Extrusion + sheet	Texture and fabrication marks differ	Use mechanical prep or accept zoned variation
Steel/stainless insert	Pretreatment/cure/galvanic incompatibility	Finish before assembly or validate mixed assembly
Sealant / adhesive / plastic	Cure temperature and chemistry incompatibility	Install after coating unless qualified otherwise

PROCESS ORDER

Choose when to weld, blend, machine, brush/polish, pretreat, coat and assemble. Late changes can invalidate masks, appearance samples and cure compatibility.

Coordinate fabrication, extrusion, machining and finishing as one route.

11 Account for dimensional effects

Mechanical stock removal and coating build act in opposite directions and can compound at functional interfaces.

Feature	Mechanical finish effect	Powder effect	Release requirement
Bore / shaft	Polishing may enlarge/reduce stock locally	Film reduces/increases clearance	Final size and mask/post-machine route
Thread	Brushing may damage lead or crest	Film changes class/torque	Mask/plug and final gauge
Datum face	Polish can alter flatness	Coating changes contact plane	Delivered-state datum definition
Sharp edge	Brushing/polishing rounds edge	Coverage may be weak/nonuniform	Edge radius and final inspection
Engraving / marking	Finish can soften or erase contrast	Powder can fill shallow detail	Minimum geometry and approved sample
Repair / strip	Additional stock loss	Recoating adds build and cure cycle	Maximum cycles and engineering disposition

STACK IT

Separate substrate tolerance, permitted stock removal, coating-thickness variation and final functional tolerance. Do not add finish notes to a closed fit.

12 Design for durability and cleaning

The delivered finish must survive the actual environment, maintenance products and handling pattern.

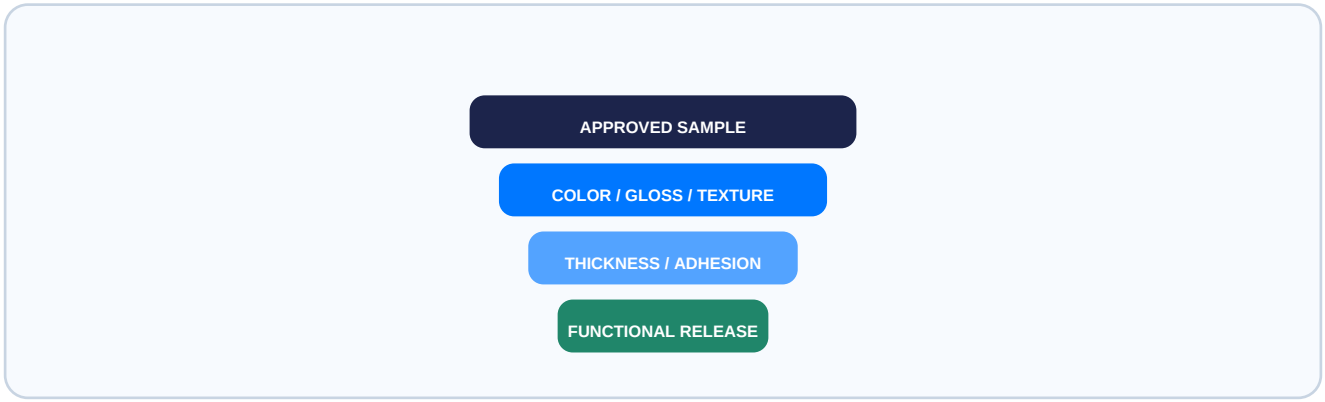
Exposure	Define	Validate
Outdoor UV	Climate, orientation, target color/gloss retention and life	Adopted performance class and exposure method
Salt / humidity	Corrosivity, crevices, edges and damage condition	Pretreatment/system corrosion test and rating
Cleaners	Product chemistry, concentration, temperature and frequency	Spot/immersion test with appearance/adhesion criteria
Abrasion	Contact material, load, motion, debris and cleaning	Representative system wear test
Impact	Energy, location and substrate thickness	Applicable impact/flexibility test
High-touch cosmetic	Oils, fingerprints, disinfectants and rub	Cleaning protocol and sample approval
Thermal cycle	Operating range and dissimilar expansion	Adhesion, cracking and color/gloss after cycling

NO LIFE CONVERSION

Accelerated test hours do not automatically equal years in service. Use the test as a comparative acceptance tool within a qualified system.

13 Inspect powder coating

Method, measurement location, conditioning, sample count and acceptance limit must travel together.



Characteristic	Typical method family	Specify
Appearance	Controlled visual comparison	Zones, viewing setup, master/boundary samples and defect rules
Color / gloss	Instrumental and visual	Method/geometry, limits, locations, orientation and lot grouping
Film thickness	Non-destructive gauge where suitable	Calibration substrate, range, locations and edge/recess exclusions
Adhesion	Cross-cut/tape or specified system test	Method version, conditioning and rating
Cure	Qualified cure records and/or agreed verification	Metal temperature/time window and evidence
Corrosion / weathering	Specified exposure and rating	Specimen, duration/cycles, scribe, evaluation and limit
Function	Fit, thread, ground, bond or assembly test	Final-state setup and acceptance

METHOD LIMITS

ASTM D3359-22 rates adhesion by tape test but does not create a universal product requirement. ISO 2360:2017 covers eddy-current thickness measurement where suitable.

14 Inspect brushing and polishing

Visual and texture measurements must use the same direction and evaluation area as the approved standard.

Characteristic	Control	Common error
Grain direction	Drawing arrows and oriented physical sample	Rotating sample and reference differently
Uniformity	Controlled illumination, distance and scan pattern	Judging under point light only
Cross-grain / swirl	Zone-based boundary samples and defect limits	Using a roughness value as the sole appearance criterion
Reflectivity / image clarity	Approved method on flat suitable area	Measuring curved or textured surfaces with an unsuitable method
Surface texture	ISO 21920 indication/parameter where functional	Omitting filter/operator/evaluation details
Geometry retention	Dimensions, edge radius, flatness and protected features	Accepting cosmetic blend that violates function
Cleanliness	Residue, fingerprints, embedded media and packaging transfer	Inspecting before final clean or after uncontrolled handling

DUAL STANDARD

Use a measurement for function and a physical sample for appearance. Neither replaces the other when both matter.

15 Package without damaging the finish

A conforming surface can be rejected after shipment if packaging abrades, prints, stains or traps moisture.

Risk	Packaging control	Verify
Part-to-part rub	Individual sleeves, separators or fixtures at non-show zones	Transport simulation / arrival inspection
Protective film print	Qualified film/adhesive, cure time and removal window	No residue, staining or gloss change
Foam / paper imprint	Compatible material and controlled pressure	Witness sample after storage/temperature
Moisture trap	Dry packaging, desiccant/barrier where justified, ventilation strategy	No condensation or corrosion
Fingerprints	Clean gloves and no-touch cosmetic zones	Final visual before pack
Sharp hardware	Separate fasteners/tools from finished faces	Pack audit
Label adhesive	Place on bag/fixture or approved hidden zone	Residue-free removal

RELEASE CONDITION

Define whether protective film remains at customer receipt, who removes it, and the allowed storage time/temperature before removal.

16 Drawing and RFQ checklist

Give the finisher a controlled system definition rather than a color name and a roughness note.

Gate	Required input
Part definition	Controlled CAD/drawing, revision, alloy/temper, product form, weld/casting condition
Finish route	Mechanical finish, pretreatment, powder product/class, cure and assembly sequence
Appearance	Cosmetic zones, grain direction, color/gloss/texture samples and viewing conditions
Mask / rack	Dimensioned boundaries, permitted contacts, drain/vent and protected faces
Dimensions	Stock-removal allowance, film build, final fits/threads/datums and gauge timing
Performance	UV/corrosion/chemical/adhesion/wear duties and adopted test methods
Inspection	Measurement zones, sampling, acceptance, reports and sample retention
Commercial	Quantity, batch/adjacent sets, FAI, tooling, rework, packaging and schedule

RFQ RESPONSE

Ask the supplier to list assumptions, texture route, achievable film/color/gloss range, rack marks, mask capability, exclusions, tooling charges and non-recurring samples.

Request a joint review through BAOSONG Engineering Support.

17 References and BAOSONG contact

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

Reference	Guide use	Link
ISO 18768-1:2022	Specifying decorative/protective powder coatings on aluminum	Official ISO page
ISO 2813:2014	Gloss value at 20, 60 and 85 degrees; confirmed 2025	Official ISO page
ISO 21920-1:2021	Indication of profile surface texture	Official ISO page
ISO 21920-2:2021	Terms, definitions and profile surface-texture parameters	Official ISO page
ISO 2360:2017	Eddy-current coating-thickness measurement	Official ISO page
ASTM D3359-22	Rating adhesion by tape test	Official ASTM page
AAMA finish bundle 2026	Includes AAMA 2603-26, 2604-26 and 2605-26	Official FGIA store

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

REQUEST A REVIEW	Send CAD, alloy, quantity, exposure, mechanical finish, powder class/color, mask map, tests and schedule.
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