

1. Product Overview

1.1 Product Identifier

Product Name: Ballesta® Adjustable Solar Louvers

Product Code: ASL-[BladeWidth]-[ControlType] (e.g., ASL-300-AUTO)

Ballesta adjustable solar shading louvers bring intelligence to building envelopes. Unlike fixed louvers that maintain a single angle, adjustable louvers dynamically change blade orientation throughout the day and across seasons to optimize the balance between solar control, natural daylight, and outward visibility. Powered by precision AC or DC motors with remote control, wall switch, or fully automated sensor-based operation. Field-verified 4-5°C indoor temperature reduction with 5-15% annual HVAC energy savings. Blades rotate 0-120 degrees for adaptive sun response. The system integrates with standard Building Management Systems (BMS) via BACnet, Modbus, or KNX protocols, providing real-time sensor feedback from sun (pyranometer), wind (anemometer), and rain sensors for fully autonomous operation.

2. Technical Specifications

Material	AA3003 H24 Aluminum Alloy with precision motor drive system	GB/T 3190-2020, ASTM B209
Blade Thickness	1.0 mm – 2.0 mm (substrate, depending on blade profile and span)	ASTM D7091
Blade Width	150 mm – 600 mm (custom per project)	ISO 128, Project specification
Blade Profile Options	Flat, Airfoil, U-Channel, Aerofoil (custom)	Project specification
Max. Blade Length	2000 mm – 5000 mm (wind load dependent)	Structural calculation per project
Blade Rotation Range	0° to 120° (continuous)	Project specification

	positioning)	
Motor Type	AC synchronous motor or DC stepper motor, 24V DC / 230V AC	Motor manufacturer spec
Control Options	Wall switch, Remote control, Auto sensor (sun/wind/rain), BMS integration	Project specification
Control Protocols	BACnet, Modbus, KNX, 0-10V, Dry Contact	BACnet, Modbus, KNX standards
Coating Type	PVDF Fluorocarbon (70% Kynar 500® resin), 25-35 µm	AAMA 2605
Color Options	RAL standard colors, custom metallic, mica, or specified architectural finish	Visual standard
Fire Resistance	A1 – Non-combustible	EN 13501-1, GB 8624
Weather Protection	IP65 rated motor enclosure with weatherproof cable glands	IEC 60529
Adhesion Strength	5B (0% removal) in cross-hatch tape test	ASTM D3359
Color Difference	$\Delta E^*_{ab} \leq 0.5$ (batch-to-batch)	ISO 7724-1
Salt Spray Resistance	≥1000 h, no blistering, corrosion, or creepage from scribe	ASTM B117
Tensile Strength	145–180 MPa (AA3003 series)	ASTM E8 / GB/T 3880

3. Manufacturing Process

3.1 Aluminum Substrate Cutting:

Precision cutting of AA3003 H24 aluminum alloy sheet to specified blade dimensions using high-accuracy CNC shearing equipment. Material sourced with full mill certification. Dimensional tolerances: Length $\pm 2\text{mm}$, Width $\pm 0.5\text{mm}$, Thickness $\pm 0.04\text{mm}$. All incoming coils undergo verification of chemical composition per GB/T 3190-2020 and ASTM B209.

3.2 Roll Forming & Profile Bending:

Pre-cut aluminum blanks are roll-formed or press-bent into the specified adjustable blade profile (flat, airfoil, U-channel) using precision CNC roller dies or press brake tooling. The blade profile includes integrated pivot bearing channels and linkage connection points for motor drive assembly. Profile dimensions, fold angles ($\pm 1^\circ$), and edge geometry are verified at 100% inspection rate to ensure consistent blade rotation and smooth linkage operation across the entire facade.

3.3 Surface Pretreatment:

Blades undergo comprehensive multi-stage pretreatment including alkaline degreasing, acidic etching, and chrome-free conversion coating (Cr(VI)-free per RoHS/REACH). This process removes surface oxides, ensures optimal coating adhesion, and provides initial corrosion resistance. Bath chemistry is monitored hourly; adhesion test per ASTM D3359 is performed on each production batch before coating.

3.4 PVDF Coating Application:

High-performance PVDF fluorocarbon coating (70% Kynar 500® resin) is applied via electrostatic spray in a controlled-environment spray booth. Standard two-coat system: primer (5-8 μm) + color topcoat (25-35 μm total). For high-durability or metallic finishes, a three-coat system (primer + color + clear topcoat) is applied. Coating thickness is measured in real-time per ASTM D7091. Gloss level: 15-30° (matte) or 30-60° (semi-gloss) per customer specification. Color consistency: $\Delta E^*_{ab} \leq 0.5$ per ISO 7724-1.

3.5 Motor Mount & Linkage Assembly:

Each blade is fitted with precision-machined pivot brackets and control arm linkage points at calculated intervals. AC synchronous or DC stepper motors are mounted to the support structure with vibration-dampening brackets. The linkage system is assembled and tested for smooth 0-120° rotation range with consistent torque distribution. Limit switch calibration ensures precise start/stop positions. Manual override crank ports are integrated into each drive group.

3.6 Control System Integration & Testing:

Control wiring (low-voltage CAT5/STP for 24V DC systems, armored cable for 230V AC systems) is terminated at weatherproof IP65 junction boxes with sealed cable glands. Each motor group undergoes functional testing: full rotation cycle test (3 cycles), limit switch verification, torque consistency measurement, and sensor feedback validation. BMS communication protocols (BACnet, Modbus, KNX) are tested for command-response accuracy. Manual override function is verified on 100% of drive groups. System is shipped with wiring diagram and commissioning documentation.

4. Application Scope

Ballesta adjustable solar louvers are designed for exterior building facade applications requiring dynamic solar heat gain control, occupant comfort optimization, and intelligent building automation integration.

- Corporate headquarters and intelligent office buildings requiring dynamic sun control with BMS integration
- Airport terminal curtain walls, glazed atria, and large-span public building facades
- Government and civic building exterior shading with automated seasonal adjustment
- Commercial tower facades with individual zone control for occupant comfort and energy optimization
- Green-certified buildings (LEED, BREEAM), healthcare facilities, university campuses, and hotel exteriors

5. Compliance Standards

- GB/T 5237 — Wrought Aluminum Alloy Extrusion Profiles for Building
- GB/T 3190-2020 — Chemical Composition of Wrought Aluminum and Aluminum Alloys
- ASTM B209 — Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- AAMA 2605 — Superior Performance Organic Coatings on Architectural Aluminum
- EN 13501-1 — Fire Classification of Construction Products and Building Elements — Class A1
- GB 8624-2012 — Classification for Burning Behavior of Building Materials (Grade A)
- ASTM B117 — Standard Practice for Operating Salt Spray (Fog) Apparatus ($\geq 1000\text{h}$)
- ISO 7724-1 — Paints and Varnishes — Colorimetry — Part 1: Principles

6. Packaging & Storage

Packaging: Each louver blade is individually interleaved with protective PE film to prevent surface scratches and coating damage. Blades are bundled in stacks (max 10 blades per bundle) with foam interlayers and corner protectors. Motor units, control panels, sensors, and brackets are packed separately in padded cartons with anti-static protection. All crates and cartons are labeled with product code, quantity, color, batch number, and installation manual reference.

Storage: · Store in a dry, ventilated and rainproof warehouse, avoid direct sunlight exposure to packaging. Stacking height shall not exceed 3 crates to prevent blade deformation. Motor and electronic components stored in climate-controlled area ($15\text{-}30^{\circ}\text{C}$, $\text{RH} < 70\%$).

· Avoid contact with sharp objects, chemicals and corrosive substances that may damage the coated surface or electronic components.

· Louver blades should be stored horizontally on flat, level racks to prevent distortion.

Brackets and hardware stored in clean, dry containers. Do not stack other items on top of

blade bundles.

- The storage site shall be kept away from fire sources to meet fire safety regulations for aluminum product storage. Electronic components have an additional static discharge (ESD) precaution requirement.

7. Quality Assurance

All adjustable louver systems undergo strict multi-item quality inspection before delivery, including material certification verification, dimensional tolerance check (blade width, length, straightness, flatness), coating thickness measurement (magnetic induction per ASTM D7091), color consistency check ($\Delta E^*_{ab} \leq 0.5$ per ISO 7724-1), adhesion test (cross-cut / tape pull per ASTM D3359), motor functional test (full rotation cycle, limit switch calibration, torque consistency), sensor calibration validation (sun, wind, rain), BMS communication protocol test, manual override verification, and visual inspection under standard lighting conditions.

Ballesta provides a standard warranty of 15 years for the aluminum structure and 20 years for the PVDF coating finish (under normal outdoor use conditions and compliance with correct installation and maintenance practices). Motor and electronic components carry a 5-year warranty. The warranty covers coating integrity (no peeling, cracking, or excessive fading), structural performance (no corrosion perforation or deformation), and motor/control system functionality within the warranty period. Warranty is subject to proper storage, installation, operation, and periodic maintenance as outlined in the installation manual.
