

# Why Solar Panel Frame Material Matters

Durability, weight, and the science of panel longevity.

**Content Partner: J. v. G. technology GmbH**

*Turnkey solar module production lines — since 1997*

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# Technical Overview: Frame Material Selection



Created as part of the PVKnowHow Knowledge Network



Prepared by J.v.G. Technology GmbH



European specialists in turnkey solar module production  
lines

# What Is Solar Panel Framing?

## Definition

- Framing encloses the laminated solar module in a rigid aluminum profile
- The frame protects module edges from mechanical damage and moisture ingress
- Provides mounting interface for racking, trackers, and structural fixings

## Position in the Line

- Framing is the final major assembly step before testing and packaging
- Follows lamination, trimming, and junction box attachment
- Frame integrity directly determines module bankability and field lifetime

# Why Frame Material Matters

## Structural Role

- Frame must withstand wind, snow, and mechanical load across a 25–30 year service life
- Poor material choice leads to corrosion, delamination, and warranty claims
- Frame stiffness prevents glass flexion that causes cell microcracks
- Corner joint integrity is critical — a weak joint can allow frame separation under load

## Quality Impact

- Material grade and surface treatment determine long-term corrosion resistance
- Dimensional tolerances affect bonding quality and weatherseal performance
- Consistent profile geometry is essential for automated framing line operation
- Frame failure in the field is difficult and expensive to remediate

# Aluminum as the Industry Standard

## Alloy Grades: 6063 and 6005

- 6063 alloy: preferred for extrusion precision and surface finish quality
- 6005 alloy: higher strength — used where structural load requirements are elevated
- Both grades offer excellent corrosion resistance and low weight-to-strength ratio

## Why Aluminum?

- Lightweight — reduces module weight and simplifies mounting system design
- Extrudable into precise, complex profiles at industrial scale
- Fully recyclable — aligned with circular economy requirements in solar

## Profile Design

- Frame profiles include a glass channel, sealant groove, and mounting slot
- Wall thickness and web geometry engineered to IEC structural load standards
- Custom profiles allow compatibility with specific cell sizes and module formats

# Surface Treatment: Anodized vs. Powder-Coated

Criterion	Anodized	Powder-Coated
Process	Electrochemical oxidation — surface converted to hard alumina layer	Electrostatic polymer powder baked onto the profile surface
Corrosion Resistance	Excellent — integral to the metal, cannot peel or chip	Good — dependent on coating adhesion and edge coverage
Appearance	Metallic finish; standard silver or grey	Wide color range — black frames common for aesthetic modules
Durability	Highly durable; resistant to UV, abrasion, and salt spray	Can degrade under prolonged UV or mechanical abrasion
Industry Use	Dominant in utility-scale and standard commercial modules	Preferred for BIPV and architectural / aesthetic applications

# Key Machine Components in a Framing Station

## Module Handling System

- Conveyor and robot handling transport the laminated module to the framing station
- Gentle clamping prevents glass stress during pick, place, and press operations
- Orientation verification ensures correct frame-to-module alignment before bonding

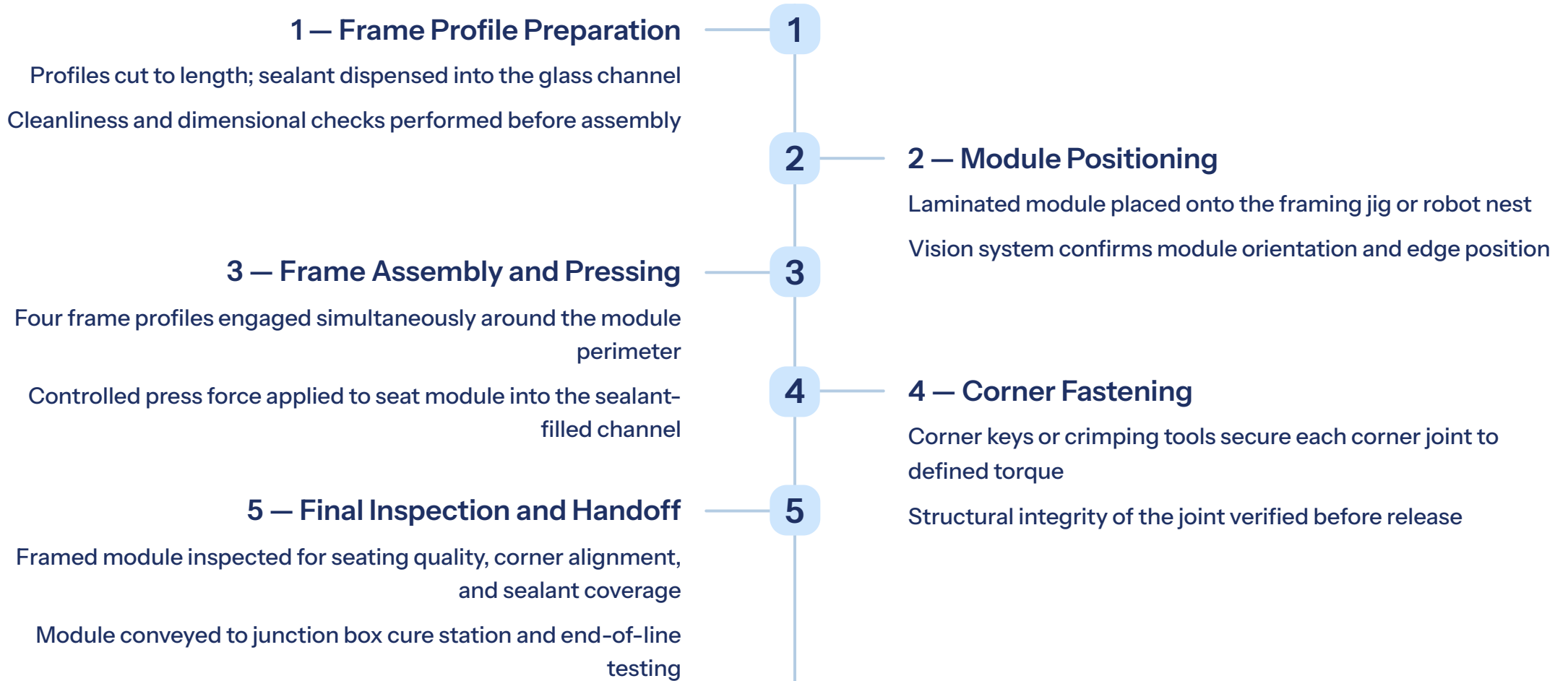
## Alignment and Pressing Unit

- Four-sided press ensures simultaneous, even frame engagement around the module perimeter
- Servo-controlled press force maintains consistent sealant compression
- Corner brackets or crimping tools lock frame profiles at each corner joint

## Bonding and Inspection

- Sealant (typically silicone or butyl) applied to the frame channel before module insertion
- Vision system verifies frame seating, corner gaps, and sealant coverage
- Out-of-tolerance modules are flagged and diverted from the main line

# Step-by-Step Framing Process



# Importance for Durability and Performance

## Mechanical Protection

- Frame absorbs edge impacts during transport, installation, and field operation
- Prevents glass edge chipping — a primary cause of early module failure
- Structural stiffness reduces glass bending stress under wind and snow loads

## Environmental Sealing

- Sealant in the frame channel blocks moisture ingress at the module edge
- Prevents delamination and potential-induced degradation (PID) linked to edge moisture
- Thermal cycling performance depends on sealant adhesion quality and frame tolerance

## Long-Term Reliability

- Framing quality is assessed under IEC 61215 and IEC 61730 certification testing
- Poor framing is a frequent root cause of field warranty claims
- Consistent automated framing eliminates hand-assembly variation across module batches

# Efficiency Drivers: Automation, Precision, and Integration

1

## Automation

Fully automated framing eliminates manual variation in press force, sealant volume, and corner torque — ensuring batch-to-batch consistency

2

## Precision

Servo-controlled alignment and pressing achieve sub-millimeter frame-to-module tolerances — critical for downstream mounting system compatibility

3

## Line Integration

Framing station throughput must match laminator and tester output — line balancing is a core consideration in turnkey factory design

- ❏ An integrated framing station linked to upstream lamination and downstream flash testing enables continuous flow production — reducing buffer inventory and work-in-progress losses.

# Cost and Operational Considerations

## Capital and Procurement Factors

- Framing stations vary in cost based on automation level and format flexibility
- Semi-automated lines suit lower-volume or multi-format production environments
- Fully automated framing is preferred for high-volume gigawatt-scale factories
- Turnkey procurement integrates framing with lamination, testing, and packaging

## Operational Economics

- Automated framing reduces direct labor cost per module significantly
- Lower reject rates at framing reduce downstream scrap and rework cost
- Sealant consumption controlled precisely — minimizing material waste
- Flexible format changeover supports multiple module sizes on one line

# Key Project Data

## Fully

### Automated Option

Semi- or fully automated framing — scalable to production volume and format requirements

## 6063

### Alloy Grade

Industry-standard aluminum alloy for solar frame extrusion — proven corrosion resistance

## IEC

### Certification Basis

Framing process aligned with IEC 61215 / IEC 61730 module qualification standards

## 90+

### Factory Projects

Delivered worldwide by an experienced European turnkey provider

📄 Process: Solar panel framing · Output: Integrated module assembly · Automation: Semi / fully automated · Cycle focus: Precision + consistency · Role: Structural integrity + quality assurance · Source: PVKnowHow / J.v.G. Technology GmbH

# Conclusion: Framing as a Quality and Reliability Determinant

1

## Structural Foundation

Frame quality defines module mechanical reliability — the primary determinant of long-term field performance and bankability

2

## Process Consistency

Automated framing eliminates assembly variation — essential for high-volume production with repeatable quality across every module

3

## Turnkey Integration

A proven turnkey manufacturing concept integrates framing expertise into a complete, validated production line — reducing risk for new factory entrants

- ❏ An experienced European turnkey provider delivers framing know-how as part of a fully integrated production line — from factory planning and equipment supply through operator training and commissioning. Source: PVKnowHow / J.v.G. Technology GmbH

# About the Content Partner

## **J. v. G. Technology GmbH** – The DESERT Company

Founded in 1997 in Bavaria, Germany. Family-owned engineering company specializing in turnkey solar module production lines.

More than 90 factory projects delivered worldwide. On-site team training included – no prior manufacturing experience required.

### **Key areas:**

Turnkey PV manufacturing lines | DESERT Technology® | TÜV-certified module designs  
| Factory planning to production

[www.jvg-thoma.com](http://www.jvg-thoma.com)

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