Advancing PV Reliability Together:

Trinasolar's Approach to Glass Quality, Testing, and O&M Practices

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PV ModuleTech
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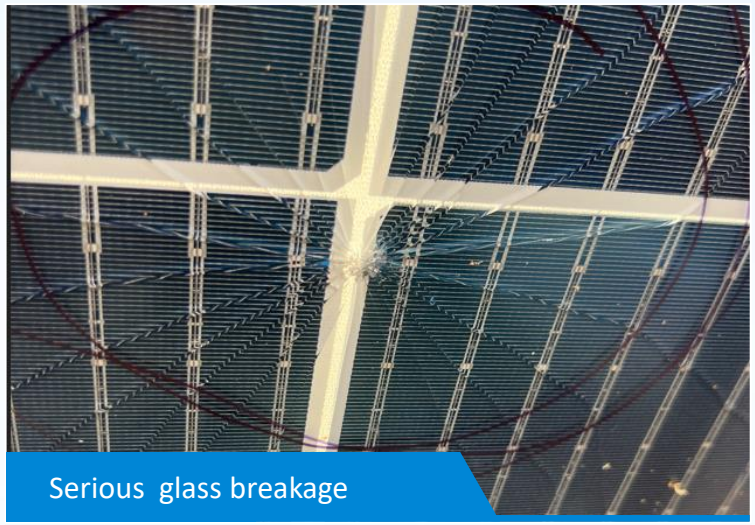
Contents

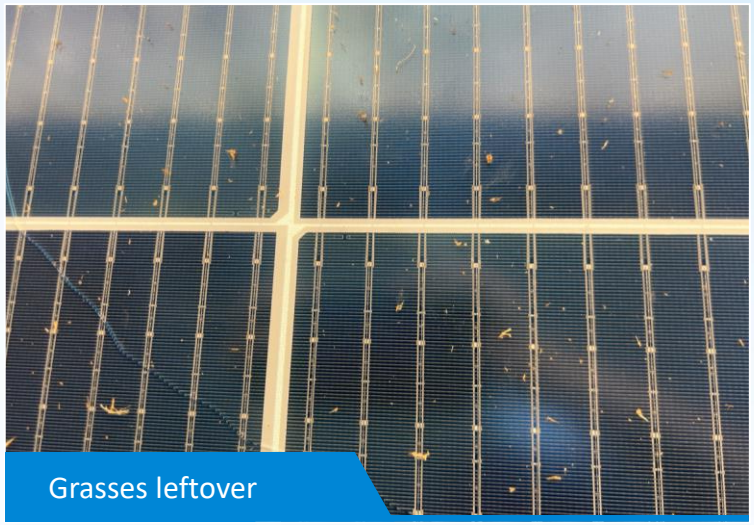
Intense Focus on Glass Breakage

Trinasolar

Phenomena of module glass breakage



Serious glass breakage



Grasses leftover

Glass crack

Multiple third-party institutions involved in research

kiwa

NREL

DNV

Fraunhofer ISE

fotovoltaica ufsc

Trinasolar has long focused on glass breakage and conducted its own research

Main Causes of PV Module Glass Breakage

Wrong installation

Incorrect installation, such as twisting mounting structure can cause module deformation. Over time, the module may become more visually bent or damaged

Installation process

During installation, improper manipulation can cause damage to the glass

Weeding operations

If the mower operates without proper protection, it may strike rocks or debris on the ground, potentially causing the glass to crack or break due to external impact.

Strength problems with purlins

The strength of purlin is not enough to support the weight of the module

Nature damage

Natural disasters, such as hurricanes, hail, etc., can cause damage to the module glass

Glass breakage


Trinasolar
As a PV module manufacturer,
we support enhanced industry standards for PV module glass quality

Trinasolar PV Module Glass Strength Control

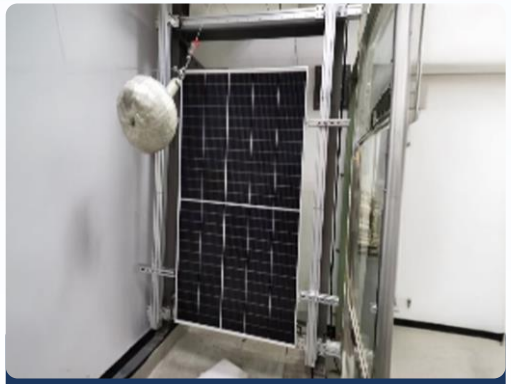
Mechanical Stress Resistance

Surface Stress & Basic Material Inspection

Mechanical Impact Resistance Test

Hail Impact Resistance Test (Front & Back)

Four-Point Bending Test



Crash Impact Resistance Test

Mechanical Load & Dynamic Load test

Thermal Stress Resistance

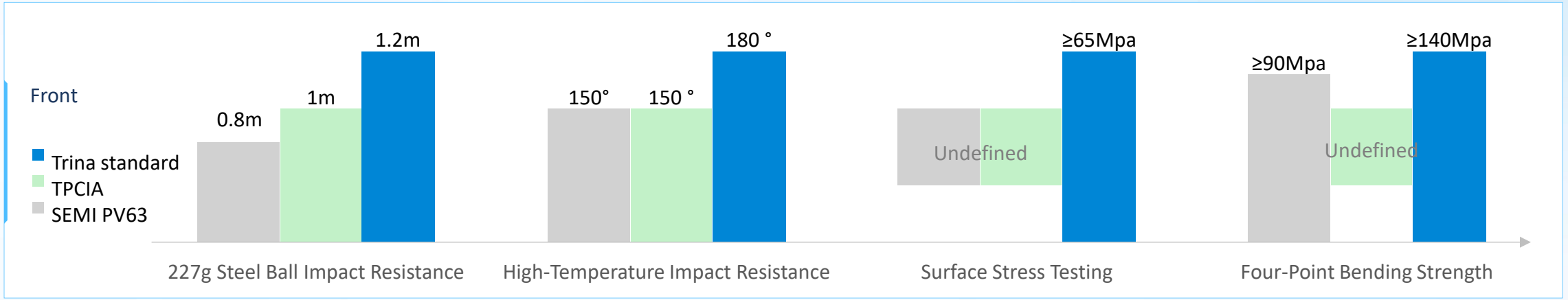
Outdoor Shading Hot-Spot Test

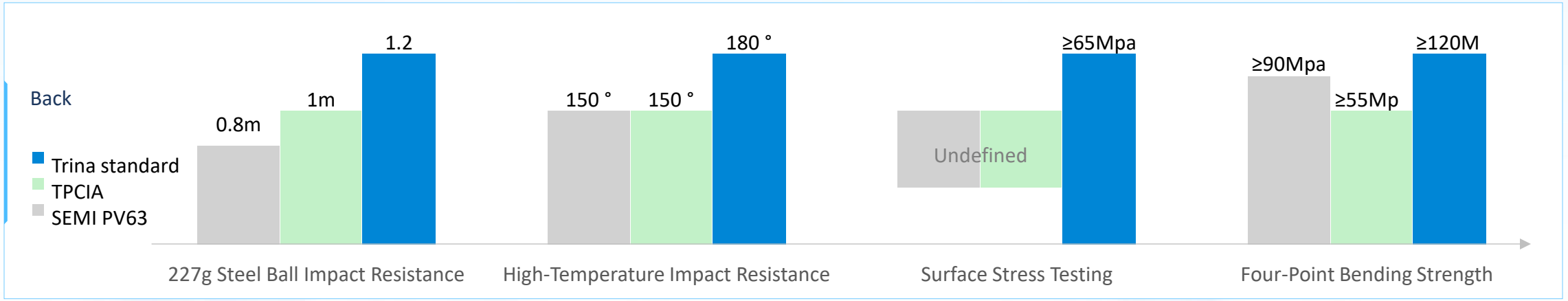
Thermal Shock Resistance Test

Trinasolar PV Module Glass Inspection Standards

The current PV module glass standards, including SEMI PV63 (led by Trinasolar) and the TCPIA series specifications, have gradually formed a comprehensive system covering requirements for anti-reflection coatings, ultra-thin glass, and dual-glass modules.

Based on these existing standards, Trinasolar has established its own unique set of more stringent, comprehensive, and industry-leading corporate standards.





Trinasolar PV Module Glass Quality System

Supplier Qualification and Management

High Entry Threshold

Establishing stringent entry requirements with over 30+ required documents and reliability tests

Strict Standards

Key reliability tests exceed industry standards

DH3000h
(standard: DH1000h)

Hot-spot test with irradiance of 1300 W/m²
(standard: 1000 W/m²)

Dynamic load test

1000 Pa, 2,000 cycles

Standard

1000 Pa, 1,000 cycles

Comprehensive Evaluation

Implementing a 6-stage introduction and control process, covering audits on supplier systems, processes, and products to achieve full assessment of supplier capabilities

Change Management

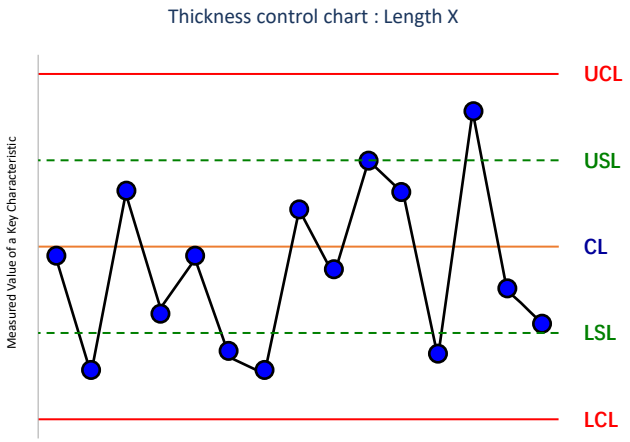
For any changes, such as raw materials, dimensions/thickness, or manufacturing sites, trigger focused evaluation of relevant reliability test items

Daily Quality Monitoring

Incoming Material Inspection

Conduct 19 routine inspection items for daily incoming materials, implement real-time SPC monitoring, and continuously track and alert on key test items.

SPC Example

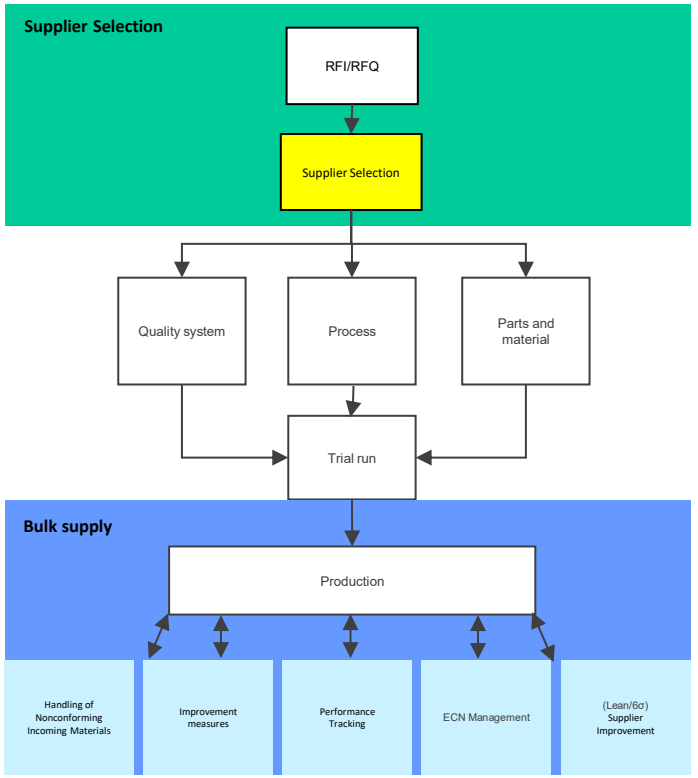


Ongoing Module Quality Monitoring

Implement a regular sampling program conducted twice a year, covering new production lines, new materials, and cost-reduction materials, following the full-sequence IEC 61215 tests to ensure consistent quality.

Systematic Management

Reinforce supplier oversight through annual system audits and quality agreements.
Drive ongoing enhancement of supplier performance and capabilities.



Recommendations for PV Module Glass Protection

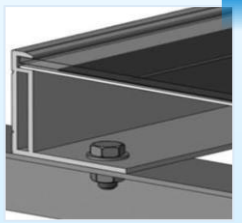
Trinasolar's Recommendations for PV Power Plant Operation and Maintenance & Installation

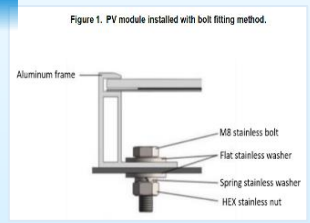
01 **Follow the** Installation Manual

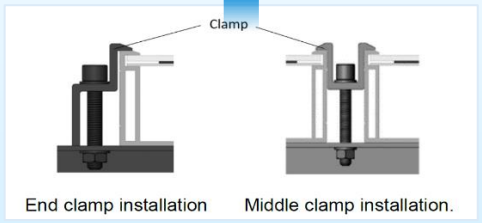
02 **Consult Pre-sales team for special installation designs or harsh environments**

03 **Apply scenario-based solution in harsh environments**

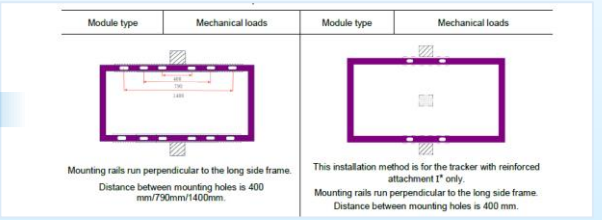
Utility/Rooftop







Utility

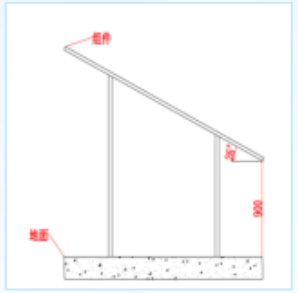


Third-party simulation tests found that improper weeding methods can lead to glass damage

The experiment set up the same module arrangement as the project site and carried out weeding operations around it. The results show that the glass damage of the simulation test is the same as the glass damage of the project site

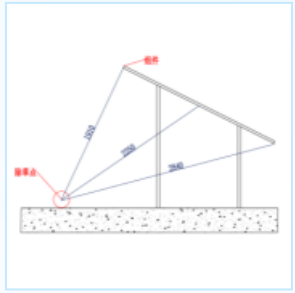
All samples were taken clear photos before and after this experiment.
See below pictures for details:

Installation



Installation illustration

Weeding process



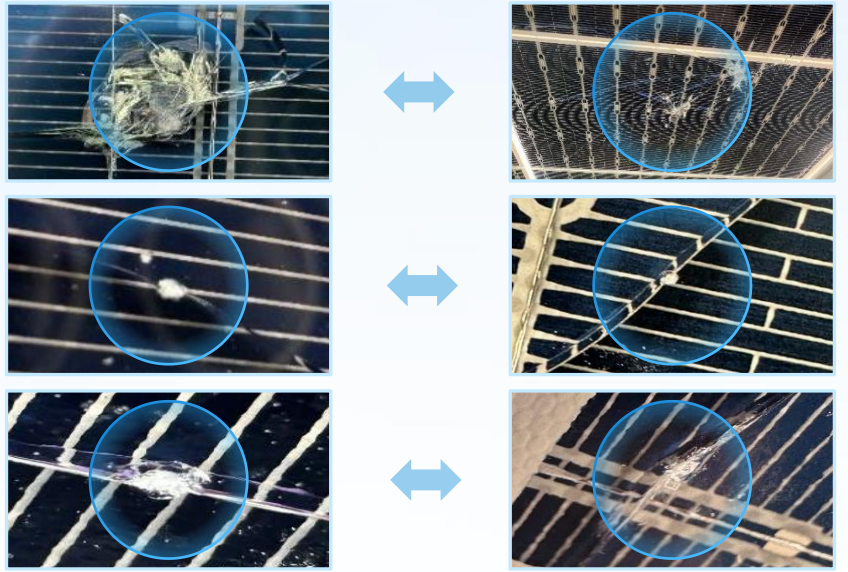
Sandstone position

Weeder

Nylon rope

Sandstone

The simulated glass damage patterns were exactly the same as those found on project site. Therefore, it can be confirmed that these types of damage were caused by external forces.

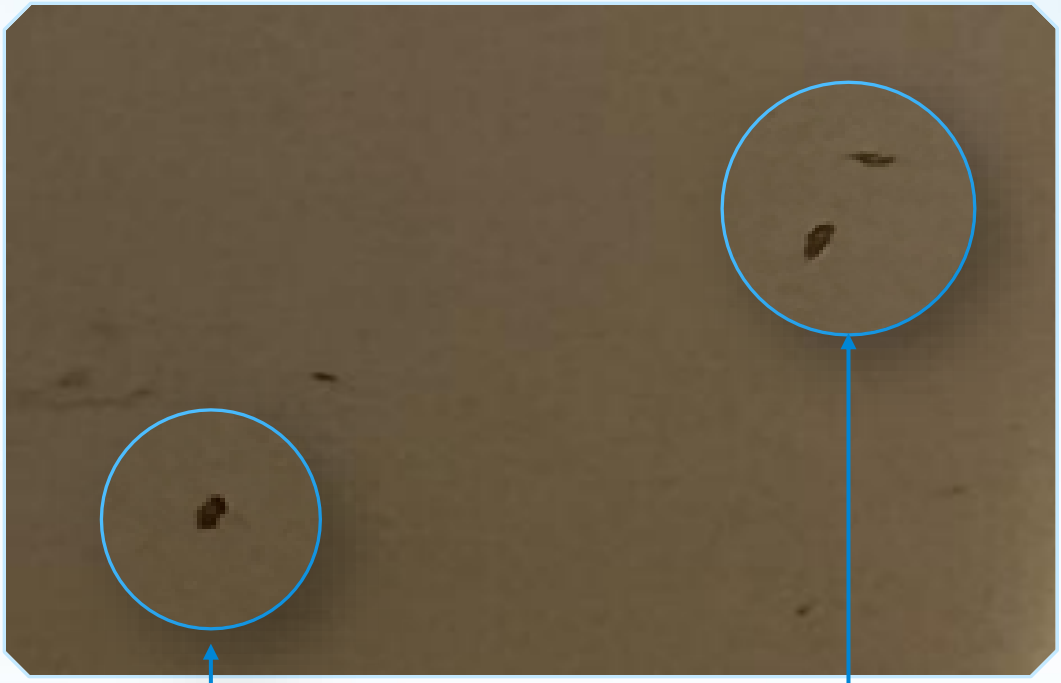


TÜV Test

On-site

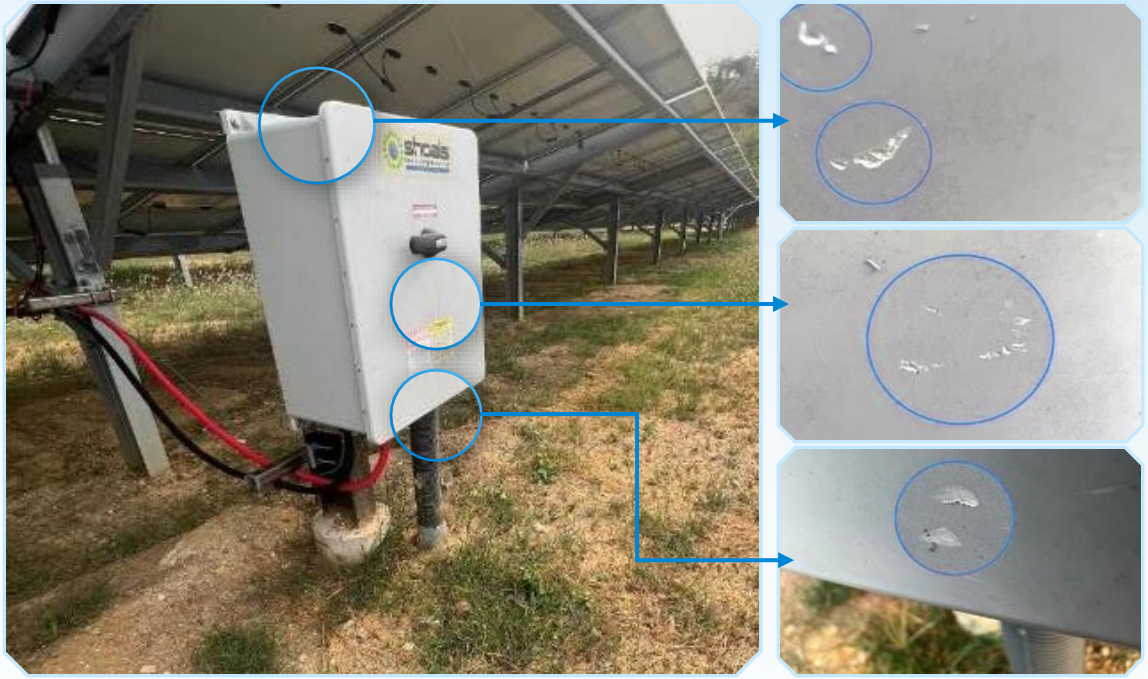
Improper weed control can also cause damage to backsheet modules and other equipment in the power plant.

Backsheet module condition



Obvious damage/dents on back-sheet caused by external force (stone)

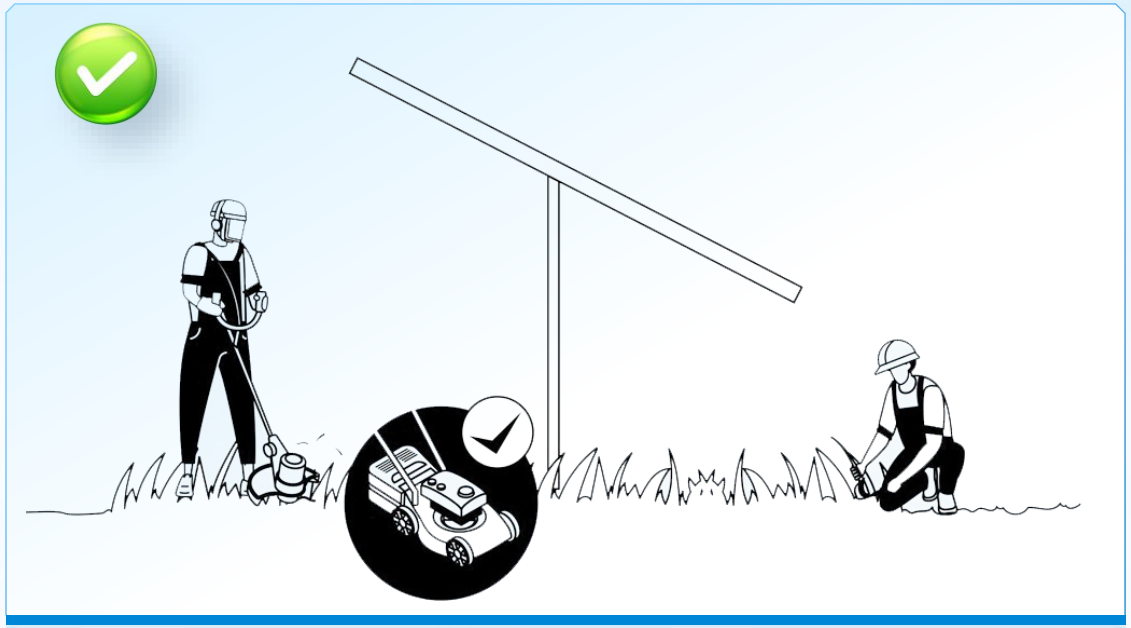
The inverter condition



Inverter box checking

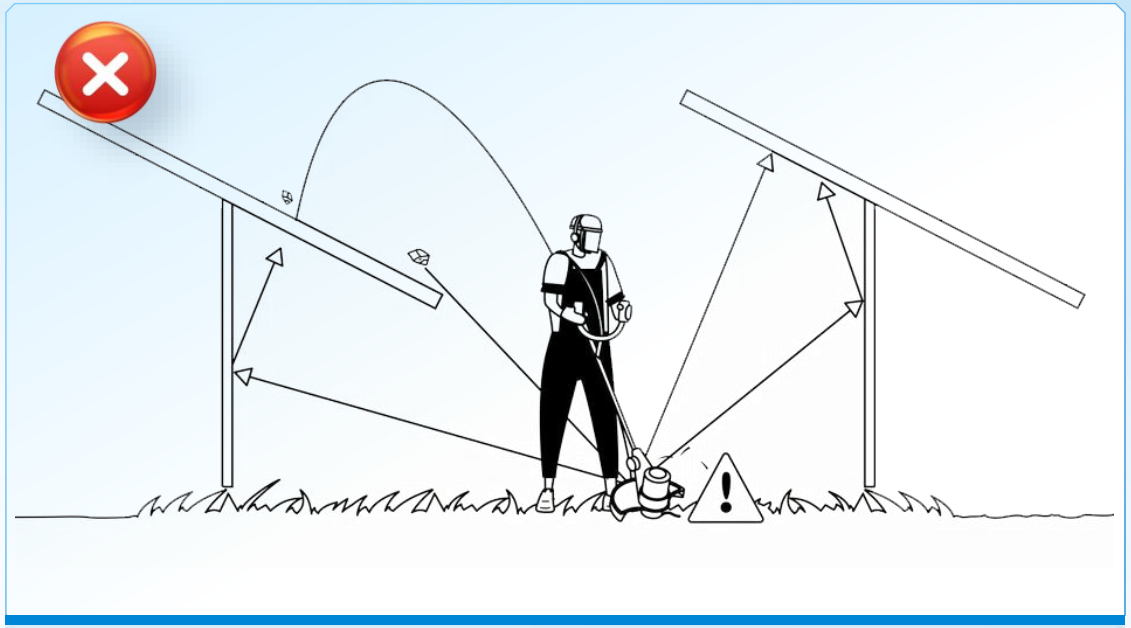
Even with metal protection, we found damage points caused by external forces

Trinasolar's Recommendations for Power Plant Project Operations and Maintenance — Weed Control Suggestions



DO’s and DON’Ts

- Consider weeding less frequently if vegetation height does not affect the normal operation
- Use the weeding machine with reliable protective devices
- Have mower manufacturers test whether the weeding process causes stone ejection and optimize design
- Sheep grazing under solar panels



DO’s and DON’Ts

- Let the machine touch the ground to avoid stones striking the glass

Trinasolar calls on the industry to prioritize glass quality and application standards.

By focusing on materials, processes, testing, and O&M, we can jointly enhance PV plant reliability and long-term value.