

# JinkoSolar Photovoltaic Modules Cleaning Manual

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## 1 Introduction

The amount of electricity generated by a PV module is proportional to the amount of light captured, and a module with shaded cells will generate less energy, moreover, dirt or foreign objects like bird droppings and leaves left on the front side of the module will cause safety risks, such as hot spot issues, therefore, it is important to keep PV modules clean.

This manual covers the requirements for the cleaning procedures of Jinko PV modules. Professional installers should read these guidelines carefully and strictly follow them. Failure to follow these instructions may result in serious consequences, such as injury or property damage. Damages induced by inappropriate cleaning procedures will void the Jinko Solar warranty.

If this manual conflicts with other technical documents from Jinko, please contact Jinko technical support for confirmation. The Jinko technical team will evaluate the terms of use based on the project's specifics.

## 2 Safety Rules

Before starting any work, please respect all the safety standards. Make sure that you always strictly comply with all health and safety laws and regulations applicable in the territory where the PV modules are installed. The following are some general recommendations that we would like to share with cleaners, provided such recommendations shall not be regarded as a substitute for the prescriptions of any applicable law or regulation, the compliance with which shall always prevail in all cases:

- Always wear a safety helmet, insulated gloves, insulated rubber shoes, and other protective measures.
- All tasks described in this manual are aimed to be carried out and protocolized by experienced and trained technicians.
- Do not apply excessive force or objects on the module surface, do not impact, and do not twist the module frame to prevent cell damages and/or cell cracks.
- Before starting the cleaning operation, please ensure the system is disconnected or the modules are open-circuited to guarantee electrical safety.
- When cleaning the PV module, please do not wear metal rings, watches, and other metal products to prevent from electric shock danger or damage to the modules.
- Do not clean the module when the surface is hot, as burning risk as well as glass breakage risk will increase.
- Do not touch the PV module with bare hands during cleaning. The glass surface and the frame may be hot. There is a risk of burns and electric shock. Use the standard safety tools and equipment when cleaning the modules.
- PV modules generate DC electrical power when exposed to sunlight or other light sources. Direct and indirect contact with active parts of modules such as terminals can result in burns, sparks, and lethal shock.
- Due to the risk of electrical shock, any work cannot be performed if the terminals of the PV module are wet.
- During the operation, do not use sharp or metal tools to wipe the Back sheet and/or Glass. It will leave scratches on the module and potentially hinder its operational capability and/or limit the benefit of the Warranty.
- Never disconnect the PV Module connectors under load.

- Do not cut the wires while the module is under load.
- Do not open Fuse Switch Disconnectors if they do not have protection to mitigate electrical arcing.

### 3 Site Condition

For details on the recommended installation environment for the modules, please refer to the Jinko module installation manual. To prevent issues that cannot be resolved by regular cleaning, please take note of the following conditions when installing modules:

- Avoid installing in scenarios where there is shadow coverage.
- Avoid using modules in environments prone to corrosion, such as air containing acidic gases (e.g., chlorine), alkaline gases (e.g., ammonia), or organic compounds.
- Avoid installing modules in environments with a high concentration of dust, especially near chimneys, exhaust pipes, chemical plants (e.g., steel mills, cement plants), and similar settings. In case this cannot be avoided, please increase the cleaning frequency.
- Modules are not suitable for use in environments where there is a large aggregation of birds that may leave significant amounts of bird droppings.

It is recommended to adhere to these scenario requirements, which will help avoid serious damage to the modules or the need for cleaning methods beyond those specified in the cleaning manual.

### 4 Visual Inspection

It is recommended to do a visual inspection of the modules on a monthly basis, and for dusty regions or sites with extreme climate conditions, a visual inspection shall be done more frequently.

During the visual inspection, pay special attention to the following:

- Whether there is any shading appearing on the module.
- Whether there is any foreign object on the module, such as bird droppings or leaves, and clean it if there is any.
- The dust condition on both sides of the module.
- Any abnormal defect that may appear on the module or any of its components such as junction box, cables, connectors, etc.

## 5 Requirements for Cleaning Time and Frequency

### 5.1 Cleaning Time

Do not clean the modules around noon time of the day to avoid the high irradiation level. It is recommended to do the cleaning on early morning, late afternoon, overcast days, or during the hours when the irradiation is no higher than 200W/m<sup>2</sup>.

The cleaning of the modules should be carried out during cooler hours of the day to avoid thermal stress and risk of damage. Avoid cleaning when the modules are hot or under direct sunlight to prevent rapid water evaporation and potential damage.

## 5.2 Cleaning Frequency

The cleaning frequency depends on the local environment. Generally, it is recommended to clean the modules at least once a month, but adjust the schedule based on specific environmental conditions and module performance. In regions with high dust, pollution, or significant bird droppings, more frequent cleaning may be necessary.

For modules with a smaller installation tilt, dust accumulation tends to be more severe. Therefore, it is recommended to increase the cleaning frequency based on the cleanliness of the module surface after visual inspection.

If snow accumulates on Jinko modules, it is recommended to remove the snow as soon as the snowfall has stopped.

## 6 Requirements for Cleaning Water and Detergent

### 6.1 Water Quality Requirement

Municipal domestic water can be used to clean PV modules, and Jinko suggests using it as a standard for cleaning.

If other sources of water are used, please ensure that the following requirements for water quality met:

- a. The water should be neutral, pH: 6.5-8;
- b. Water hardness:  $\leq 450$  mg/L;
- c. Chloride or salinity:  $\leq 1000$ mg/L;
- d. Total dissolved solids:  $\leq 1000$  mg/L.

Water must be free of floating oil or other immiscible liquids, floating debris, and excessive turbidity.

It is not recommended to use water with a high mineral content, because the minerals in the water will deposit on the glass surface as the water evaporates. Long-term accumulation can lead to obscuring of the glass, reducing light transmittance, and further causing a decrease in the power generation of the modules. In severe cases, it may pose a risk of corrosion.

The temperature difference between water and module cannot exceed 10°C. Do not clean the module when the ambient temperature is lower than 5°C to avoid freezing and cracking of the glass.

If using pressurized water flow for cleaning, it is recommended that the water pressure do not exceed 3500 kPa (35 bar), and the nozzle is kept at a distance of at least 0.5 meters from the panel. If using a hose or backpack-style pressure set, we recommend a water pressure less than 675kPa.

### 6.2 Detergent Requirement

It is recommended to prioritize cleaning only with water. Mild and non-corrosive cleaning agents can be used as an auxiliary measure when water washing is not effective or cannot solve the problem. Commercial glass cleaning agents (including detergents, surfactants, and degreasers) that are neutral or mildly acidic, common organic acids (such as citric acid or oxalic acid, with oxalic acid diluted at a 1:50 ratio with water), and conventional organic solvents (like ethanol or methanol) can be used for cleaning.

If common cleaning agents cannot solve the cleaning problem, and you need to use special cleaning agents (such as sodium carbonate decahydrate), please contact our local technical support.

Do not use corrosive chemical agents such as nitro thinner, or strong acidic like hydrofluoric acid and strong alkaline substances like sodium hydroxide for cleaning. Do not use abrasive cleaning agents like abrasive powders, scrubbing

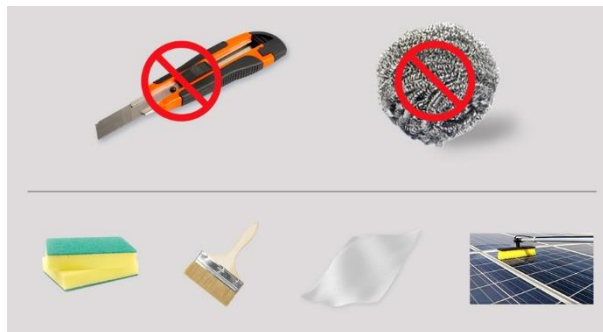
cleaners, or polishing agents. Avoid using alkanes, aromatic hydrocarbons, and organic solvents that are difficult to evaporate for cleaning. If the cleaning team confirms that extreme cleaning methods are indeed necessary, please contact the Jinko Solar after-sales team for confirmation of the cleaning method.

After using any cleaning agents, a final rinse with water is required to avoid any residue.

### 7 Requirement for Cleaning Tools and Equipment

During the cleaning process, it is recommended to wear cleaning gloves to avoid leaving fingerprints and dirt on the glass. Do not touch the surface of the glass without gloves.

Do not use tools or materials that will scratch the surface of modules, such as blades, scouring wire, metal tools, and other abrasive materials.



Various soft foam materials, non-woven fabrics, brooms, soft sponges, soft brushes, and brushes with nylon thread that have a diameter of 0.06-0.1mm can be used.

Modules can be cleaned with automatic cleaning equipment. During the cleaning process, the requirements for the use of automatic cleaning equipment must be followed, and modules must be protected from damage.

### 8 Common Cleaning Method

#### Method A: Wet Manual Cleaning (Recommended)

##### Cleaning Process

Routinary cleaning work is recommended to be completed through the following processes: Pre-Rinse, Sweep, Scrap, Rinse and Squeegee.

##### Step 1: Pre-Rinse

Begin by performing a pre-rinse with water to loosen surface dust, dirt, and debris. This helps prepare the module for further cleaning by softening any particles, making it easier to remove them in the following steps.

##### Step 2: Sweep

After the pre-rinse, gently sweep away loose debris such as dust or fallen leaves using a soft brush or cloth. Carefully inspect the module's surface to ensure it is free from visible obstructions. This step clears away any loose dirt, making it easier to identify areas needing more attention.

##### Step 3: Scrap

For stubborn residues such as dirt, bird droppings, or any sticky substances firmly adhered to the module that won't budge with sweeping, use a plastic scraper or gauze for a more thorough scrubbing treatment. This step is crucial for removing anything that clings tightly to the module's surface, ensuring a deep clean.

#### Step 4: Rinse

When cleaning photovoltaic modules, start with a simple water flush for clear surfaces. If dust is present, flush first, brush gently, and then rinse. For stubborn stains like plant juices, combine water with a soft brush for effective cleaning, followed by a thorough rinse.

#### Step 5: Squeegee (optional)

To achieve better cleaning results, we recommend using a squeegee to remove excess water from the surface after rinsing. This ensures that no water stains are left on the module. This step helps the module dry quickly and prevents mineral deposits from the water, which could otherwise remain on the surface as the water evaporates and negatively impact the module's performance.

If there is any oil or oily substance at the glass, use alcohol for spot treatment—let it penetrate, then brush away the grime. In cases where dirt persists, consider a commercial glass detergent with a non-woven cloth for a final clean, and remember to rinse well to remove any residue.

For bifacial modules, ensure both the front and back are cleaned using the same methods. Take care not to directly wash the junction box with water and always keep connectors clean and dry to prevent electrical hazards.

### **Method B: Air Cleaning**

Jinko Solar recommends using this method to clean the soft dirt (like dust) on modules. This technique can be applied if the method is efficient enough to clean the modules considering the on-site conditions.

Choose cold air, do not use hot air to clean the module, 10 cm away from the clean area of the module, turn on the cleaning equipment switch, adjust the air pressure to 0.4-0.7 MPa, and clean at a speed of 0.1 m/s, and repeat until the module is clean.

### **Method C: Special Cleaning - Accumulated Snow**

While Jinko modules can withstand high snow loads (refer to the installation manual), snow can affect the module's power generation performance and may cause ice formation on the surface. Therefore, Jinko recommends timely snow removal to enhance the output power. When snow removal is necessary, please use tools that will not damage the module surface, such as a brush or mop, to gently clear all snow and prevent any localized snow accumulation on the PV modules.

Furthermore, it is strictly prohibited to use hot water to melt snow or ice on the module surface, as it may cause a thermal shock and possible glass breakage. The use of forceful methods or destructive tools to remove snow or ice that is frozen on the module surface is also strictly forbidden.

## **9 Visual Inspection After Cleaning**

After cleaning, it is necessary to inspect whether the PV modules are thoroughly cleaned, ensuring there is no residual dust or stains on the surface of the modules. Additionally, a visual inspection of the PV modules should be performed to confirm that there are no obvious scratches or signs of damage caused by cleaning activity.

Furthermore, the modules and their associated components should be checked to ensure there is no damage, such as broken glass, a damaged backsheet, frames that are twisted or deformed, cable damage, connectors that are disconnected or broken, junction boxes that are damaged, or brackets that are tilted or bent. If any of the aforementioned issues are detected, it is crucial to immediately inform the power station's O&M staff for professional intervention.

### 10 Warnings

- For monofacial module, backsheet cleaning is not necessary.
- When cleaning the back surface of the bifacial module, avoid any sharp objects that may cause damage or penetrate the base material. Other cleaning requirements are the same as those for the front side cleaning.
- Cracked or broken modules represent an electric shock hazard due to leakage currents, and the risk of shock is increased when modules are wet. Before cleaning, thoroughly inspect modules for cracks, damage, and loose connections. If modules encounter the aforementioned abnormal situations, do not clean them and contact Jinko Solar after-sales team immediately.
- Do not immerse the module, partially or totally, in water or any other cleaning solution.
- Do not use such lubricants and organic solvents to clean the connectors.
- Do not clean modules under the weather conditions of wind more than 4 class (in Beaufort scale), heavy rain, or heavy snow.
- When cleaning the modules, it is forbidden to inject water into the backside of the modules or cables. Please ensure that the connectors are clean and dry to prevent electric shock and fire hazards.
- Do not use a steam cleaner.
- Do not walk, stand, or sit on the modules while cleaning.



- Note that if the cleaning of an array cannot be completed within a day, it should be planned and carried out on an inverter unit basis to avoid mismatching.



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