



Perma-Clean Solar 2.0 Application Manual

Version 1.0.0 – Revised September 2018

DryWired® Perma-Clean Solar 2.0

Application Manual

Version 1.0.0 - Revised August 2018

Product Description

DryWired® Perma-Clean Solar 2.0 is an transparent, single-step coating designed to increase the efficiency of solar panels. Perma-Clean Solar 2.0 alters the electrical resistance of a surface to give it antistatic properties preventing dust and debris build up. In addition, the coating exhibits a hydrophilic, self-cleaning property that allows surface contaminants to be easily removed with only water. These properties not only allow for an increase in photovoltaic efficiency, but also reduce the amount of maintenance required.

Prior to Application

Calculating Volume

The amount of Perma-Clean Solar 2.0 required for the project must be calculated prior to application in order to determine the volume required for the project. The first step in this process is to determine the total square footage of the area in which the coating will be applied. The coverage of the material is 10 grams to 20 grams per square meter. The consumption of the product can vary based on the temperature of the surface to which the coating is being applied, the temperature of the environment where the coating is being applied, and the number of times the microfiber cloth is changed during application. The higher temperatures will result in the solvent of the material to evaporate more quickly, using more material during application. The more often the microfiber cloth is changed, the more solution will be absorbed by each cloth. The coverage assumption should be made based on this information.

Example:

There are 12 solar panels to be coated. The solar panels being coated are on a residential unit with a width of 39 inches (0.991 meters) and a length of 65 inches (1.651 meters). The density of the mixed solution is always 880 grams per Liter. Assume a consumption of 15g/m².

$$\text{Square Meters of a Single Panel} \times \text{Number of Panels} \times \text{Consumption} \times \frac{1}{\text{Density of Mixed Solution}}$$

$$\frac{(0.991 \text{ meters} \times 1.651 \text{ meters})}{\text{panel}} \times 12 \text{ panels} \times \frac{15 \text{ grams}}{\text{square meter}} \times \frac{1L}{880 \text{ grams}}$$

$$\frac{(1.636 \text{ square meters})}{\text{panel}} \times 12 \text{ panels} \times \frac{15 \text{ grams}}{\text{square meter}} \times \frac{1L}{880 \text{ grams}}$$

0.335L Perma – Clean Solar 2.0

Order Quantity: 1L Perma-Clean Solar 2.0

For this example, about one-third of a liter of Perma-Clean Solar 2.0 will cover the 12 panels, however the minimum order quantity is 1 liter. Therefore, 1L is the order quantity.

Equipment

Perma-Clean Solar 2.0 is easily applied with a squeegee and microfiber cloth. Clips are used to hold the microfiber cloth in place during the coating process. It is recommended to use a metal tray to hold the coating solution and transfer the coating solution to the squeegee. If a metal tray is not available, aluminum foil will work. Ensure all equipment is available prior to application.

Required Equipment			
Squeegee	Microfiber Cloth	Aluminum Foil/Metal Tray	Clips
			

Table 1. Required Equipment Specification Guide

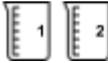
Suggested Equipment			
Scale	Closed Container	Open Container (2)	Spray Bottle
			

Table 2. Suggested Equipment Specification Guide

Surface Preparation

Surface preparation is key to achieve a uniform coating. A surface degreaser absent of detergents, such as DryWired® Glass Cleaner, can be used to clean heavily soiled surfaces. If

glass is not heavily soiled, a basic alcohol such as an isopropyl alcohol (IPA), can be used to wipe the surface using lint-free cloth. Cleaned surfaces should demonstrate hydrophilic properties. A hydrophilic surface will show a water-sheeting effect. *Table 3.* depicts a hydrophobic surface (unclean) that has been coated versus a hydrophilic surface (clean) that has been coated.

 <p style="text-align: center;">Hydrophobic Surface</p>	 <p style="text-align: center;">Dried Film on a Hydrophobic Surface</p>
 <p style="text-align: center;">Hydrophilic Surface</p>	 <p style="text-align: center;">Dried Film on a Hydrophilic Surface</p>

Table 3. Hydrophobic/Hydrophilic Film Application Depiction

During application, cool environmental conditions are favorable. The substrate itself should remain at a temperature less than 86°F (30°C) during application. If higher temperatures are unavoidable, it is recommended to slightly increase the amount of coating liquid per square meter to ensure a uniform application. Cool water can be poured over the substrate to lower surface temperature as well, however, ensure a completely dry surface before the coating is applied. An alternative method is to cool the coating solution by placing the tightly sealed container into a bucket of ice prior to application. The higher the temperature when applying, the faster the solvent will evaporate. Cool surfaces will yield a more uniform finish. Additionally, for these reasons it is also recommended to not apply in direct sunlight.

Application

Mixing Calculation

Perma-Clean Solar 2.0 2-Part Solution	
Perma-Clean Solar 2.0: Liquid	Perma-Clean Solar 2.0: Base
	

Table 4. 2-Part Perma-Clean Solar 2.0 Solution

Pema-Clean Solar 2.0 is a two-part solution that requires mixing prior to application.

If using an entire a liter of solution:

Simply **shake the Perma-Clean Solar 2.0: Liquid in its container**. Once shaken, pour the Perma-Clean Solar 2.0: Liquid in the Perma-Clean Solar 2.0: Base. Please proceed to the “Mixing Process” portion of the document.

Mixing 1 Liter of Perma-Clean Solar 2.0	
	
Shake Perma-Clean Solar 2.0: Liquid	Pour Perma-Clean Solar 2.0: Liquid into Perma-Clean Solar: Base

Table 5. Mixing 1 Liter of Perma-Clean Solar 2.0

If using less than a liter of solution:

If using less than a liter of solution, a calculation is required to determine how much of the Perma-Clean Solar 2.0 solution needs to be mixed. This is the same calculation as referenced on Page 2, therefore, please reference that calculation when determining how much solution to mix. We will base our example off of the calculated 0.335 liters of Perma-Clean Solar solution.

The ratio of mixing Perma-Clean Solar: Base to Perma-Clean Solar: Liquid is a **7:3 ratio by weight**. This means 7 parts Perma-Clean Solar: Base to 3 parts Perma-Clean Solar: Liquid measured by their weights. The solutions are different densities, therefore, measuring the volumes of the components will not result in the correct mixing ratio.

Example:

Continued from Page 2

Of the calculated 0.335 liters of Perma-Clean Solar solution, 70% by weight will be Perma-Clean Solar: Base and 30% by weight will be Perma-Clean Solar: Liquid. The density of Perma-Clean Solar: Base is 0.889 g/ml and the density of Perma-Clean Solar: Liquid is 0.876 g/ml.

Volume of Total Solution × Density of a Single Solution × Weight Percent = Weight of Single Solution

$$335 \text{ ml} \times \frac{0.889\text{g}}{\text{ml}} \times 0.70 = \text{Weight of Base}$$

208.47 grams = *Weight of Base*

$$335 \text{ ml} \times \frac{0.876\text{g}}{\text{ml}} \times 0.30 = \textit{Weight of Liquid}$$

88.03 grams = *Weight of Liquid*

Mixing Less Than 1 Liter of Perma-Clean Solar 2.0			
			
Measure Perma-Clean Solar 2.0: Base and pour into Container 1.	Shake Perma-Clean Solar 2.0: Liquid.	Measure Perma-Clean Solar 2.0: Liquid and pour into Container 2.	Pour the measured amounts of Perma-Clean Solar 2.0: Liquid and Perma-Clean Solar 2.0: Base into a closed container. Shake. Wait 6 hours or until cool to apply.

Table 6. *Mixing Less Than 1 Liter of Perma-Clean Solar 2.0*

Once the amounts of the two solutions have been calculated, it is time to measure. **Measure** the solutions in two different containers. As depicted in *Table 6*, first measure the Perma-Clean Solar 2.0: Base. Set aside. Second, **shake** the Perma-Clean Solar 2.0: Liquid in its container before measuring the solution. Once shaken, **measure** the Perma-Clean Solar 2.0: Liquid.

Pour the Perma-Clean Solar 2.0: Base into a bottle, or another container that can be closed. Gradually **pour** Perma-Clean Solar 2.0: Liquid to Perma-Clean Solar 2.0: Base. Place the cap on the bottle and gently **shake** bottle to mix the solution. It is not recommended to mix and store the solution in an open container, even if only for the reaction time. The reaction between the Perma-Clean Solar 2.0: Base and the Perma-Clean Solar 2.0: Liquid is slightly exothermic, meaning it gives off heat, so there will be a slight increase in temperature. The reaction time of the solution can take up to 6 hours. **Wait** to use the solution until the 6-hour period has passed or until the solution has cooled to room temperature.

Process

Prepare the squeegee by cutting a piece of the microfiber cloth about four times the width of the top of the squeegee. Fold the microfiber cloth in half and clip onto the top of the squeegee. The clips should be far enough away from the tip of the squeegee that they do not touch the substrate during the coating process.

If using tin foil, shape the tin foil to be slightly larger than the squeegee and deep enough to hold the Perma-Clean Solar 2.0 solution. If using a metal tray, ensure the squeegee can be dipped flat into the solution.

Pour small amounts of the solution at a time. The cloth will absorb about 10 grams of the solution. If you have a small scale, you can measure the weight of the solution and pour in 10 gram increments. The solution will evaporate quickly so do keep this in mind when pouring the solution if a scale is not available.

During application, the top of the squeegee should be kept horizontal as depicted in *Table 7*.

Correct	Incorrect
	

Table 7. Squeegee Orientation

The motion of the squeegee for application should move from top to bottom. Once the squeegee has reached the bottom of the area, pick up the squeegee and place it at the top of the next area where the coating is to be applied, as depicted in *Figure 1*.

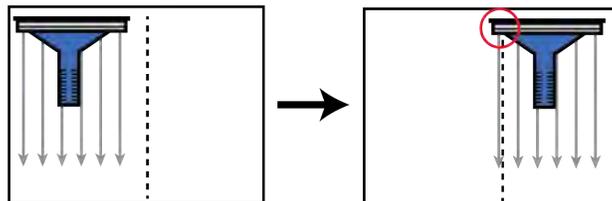


Figure 1. Application Method

Coating should be applied at a slow, steady rate with the squeegee flush against the substrate. The pressure of the squeegee against the surface should be minimal. Too much or too little pressure can result in a non uniform coating. Coating too quickly may leave uncoated areas and can result in a non-uniform finish. If irregularities occur from applying the coating too quickly, re-coating is acceptable. Keep this minimal. Minimize recoating on each motion; only slightly overlap the last coated area. Pay attention to when more solution needs to be added to the microfiber cloth.

Coating Demonstration

The coating should exhibit a hydrophilic self-cleaning property as well as an antistatic property. To check the self-cleaning property of the coating, using a spray bottle, spray water on the surface. The water should spread out or “sheet” on the surface. It is recommended to try this before coating application as well to see how the coated surface compares to an uncoated surface. To check the antistatic property of the coating, use a surface resistivity meter, which will read the antistatic property of the coating. The resistivity meter should read a value on the order of 10^8 ohms/square, indicating that the surface is within the static dissipative range. If in high humidity, the reading may vary 1-2 orders of magnitude, this is okay and the coating is functioning. If the meter reads $\sim 10^{12}$ ohms/square, the coating is not functioning correctly. In this case please refer to the troubleshooting section at the end of this document.

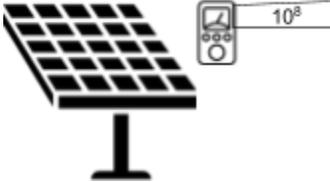
Measuring Hydrophilicity	Measuring Resistivity
	

Table 8. Coating Demonstration

Dry Time

The coating will completely dry in about 2 minutes.

Cure Time

The coating will fully cure in about 14 days.

Storage

When stored according to recommended conditions the safety data sheets, shelf life is six (6) months from date of manufacture. Once the 2 parts have been mixed, the solution will not last more than a couple of weeks depending on storage conditions. If the solution appears gel-like, it is no longer usable.

Removal

Immediate removal of the coating can be accomplished by wiping with water and a cloth. If coating needs to be removed after drying, it is recommended to use DryWired Glass Cleaner, or another abrasive glass cleaner like cerium oxide or aluminum oxide.

Clean-up

The squeegee can be rinsed with water immediately after use to remove any remaining coating solution. Aluminium foil and microfiber cloth should be disposed of and should not be reused.

Troubleshooting

Below, in *Table 9*, are a list of possible scenarios which can be encountered when applying Perma-Clean Solar 2.0. A list of solutions are available with the associated potential problems. If there are additional questions, please do not hesitate to reach out to the DryWired Team by phone at 1-800-581-4528, by sending an email to sales@drywired.com, or by visiting our website at www.drywired.com/contact/.

Problem	Solution	Explanation
The coating solution is running and leaving streaks on the substrate when drying.	Remove the coating using the isopropyl alcohol. Follow recommended surface preparation procedure. Reapply following recommended application procedure.	Too much pressure is being applied to the squeegee during the coating process.
The coated surface does not exhibit hydrophilic/self-cleaning properties.	Remove the coating using the isopropyl alcohol. Follow recommended surface preparation procedure. Reapply following recommended application procedure.	The surface was not thoroughly cleaned or too little of the coating solution was applied.
The coating leaves a slight “rainbow” appearance on the surface.	Remove the coating using DryWired® Glass Cleaner. Follow recommended surface preparation procedure. Reapply following recommended application procedure.	The coating is not uniform. Pay specific attention to avoid overlap of the previously coated area when applying from top to bottom.
The coated surface does not exhibit antistatic properties.	Remove the coating using the isopropyl alcohol. Follow recommended surface preparation procedure. Reapply following recommended application procedure.	The surface was not thoroughly cleaned or too little of the coating solution was applied.

Table 9. Troubleshooting Guide

All statements, technical information and recommendations contained in this document are based upon tests or experience that DryWired believes are reliable. However, many factors beyond DryWired's control can affect the use and performance of a DryWired product in a particular application, including the conditions under which the product is stored or used and the time and environmental conditions in which the product is expected to perform. Since these factors are uniquely within the user's knowledge and control, it is essential that the user evaluate the DryWired product to determine whether it is fit for a particular purpose and suitable for the user's method of application. No warranty or condition, expressed or implied, is given regarding the accuracy of the statements, technical information or recommendations contained in this document. Except to the extent prohibited by law, DryWired will not be liable for any losses or damages arising in any way from the DryWired product including, without limitation, any direct, indirect, special, incidental or consequential damages, regardless of the legal theory asserted, including warranty, contract, negligence or strict liability. For questions, contact DryWired, LLC at +1-800-581-4528.