

DOWSIL™ PV-9001 Backsheet Coating

Technical Manual

Application and testing instructions for DOWSIL™ PV-9001 Backsheet Coating

DOWSIL™

silicones by DOW

Product description

DOWSIL™ PV-9001 Backsheet Coating is a one-component silicone elastomer designed to restore insulation resistance in photovoltaic modules suffering from cracked backsheets. The silicone material is applied on the surface as a thin layer and cures into a soft coating with shiny finish. This document is intended to provide application and testing instructions for DOWSIL™ PV-9001 Backsheet Coating.

Substrate compatibility

DOWSIL™ PV-9001 Backsheet Coating is designed to develop adhesion on polyamide-based backsheets, stabilized PET, and some grades of backsheets featuring fluoropolymers without requiring any primer, and with minimal surface cleaning.

Colors

DOWSIL™ PV-9001 Backsheet Coating is available in white (22 kg pail, 220 kg drum).

Shelf life

DOWSIL™ PV-9001 Backsheet Coating has a shelf life of 12 months from date of manufacture. Storage conditions must be between –10 °C (14 °F) to 30 °C (86 °F) to prevent degradation of the material.

Application

General description

DOWSIL™ PV-9001 Backsheet Coating was developed for protective and repair applications of photovoltaic modules. DOWSIL™ PV-9001 cures in ambient conditions into a highly durable elastomer, building up chemical adhesion and acting as an electrical insulator. After curing, it provides restored insulation and protection against water ingress and ultraviolet light.

Temperature and humidity

DOWSIL™ PV-9001 can in principle be used year-round, including in the middle of winter. However, at temperatures below the dew point or freezing point, there is a risk of condensation or frost on the substrate surface. Cold temperature application is best done when humidity is low. Do not apply the coating in rain, freezing rain, snow, or heavy fog. Do not apply the coating if the substrate is visibly wet or shows the presence of frost. Apply a tissue to the substrate surface prior to the coating application to determine if liquid moisture is present. It should be noted that at colder temperatures, DOWSIL™ PV-9001 will cure at a much slower rate than at room temperature. Yet, ultimately, the coating will achieve full physical properties. If the coating application is to spray through a spray nozzle powered by a pump system or compressed air, freezing temperatures should be avoided because of potentially inadequate atomization.

DOWSIL™ PV-9001 should not be applied when the ambient air temperature or the substrate temperature is above 50°C. At these temperatures, the coating may form bubbles at the bond line between the coating and the substrate during curing, which can have a detrimental effect on the adhesion and protection performance. To minimize risk in hot climates, coating application may need to be performed in the early morning, in the evening, or at night. Also, particularly in hot climates, ensure that the material is stored in a cool environment.

Surface preparation/cleaning

The type of cleaning depends on the extent of soiling and type of backsheet degradation. In general, the following cleaning procedure is adequate: wipe the backsheet surface with a damp cloth followed by a dry cloth. Use clean, soft, and lint free cloths. Preferably wipe in a single direction to avoid second contamination by repeated wiping. If the soiling is an accumulated grease-like hydrophobic substance, alcohol can be used to remove the contamination. If the contaminant accumulated on the backsheet is difficult to remove, other proper cleaning and preparation methods should be discussed with a Dow technical representative based on the quantity and type of contaminant. In any case make sure that the panel is dry to the touch before coating. If needed, use a dry cloth to remove any remaining traces of liquid on the surface.

Safety

Consult safety datasheets of DOWSIL™ PV-9001 prior to starting to work with the material. If spraying is used to apply the material, always ensure appropriate ventilation and respiratory protection. Entry into the environment must be avoided by using protective foil where applicable.

Squeegee application

Workplace configuration

Coating by squeegee is preferably performed in a permanent workshop but can potentially be performed in a mobile workshop close to a solar park. The module to be repaired should be placed horizontally sunny face down, for instance on a table. If the coating process is carried out manually, attention should be given to ergonomics. The module should be at a comfortable height so that the operation does not require bending and crouching.



Coating

The coating material is dispensed along an edge of the module. If the application is manual, a beaker can be used to measure the right amount and then it can be poured on the backsheet. For a coating of about 400 µm on a 1.6 m^2 module, an effective amount of 0.9 kg should be applied. The material is spread with a squeegee to create a layer that is as uniform as possible. Ensure the material reaches the junction box, if necessary, using a smaller device.

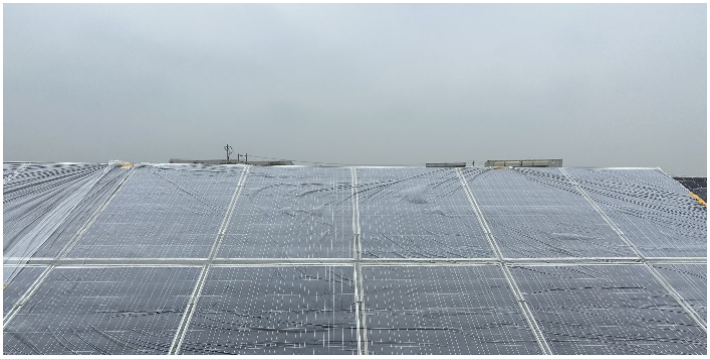
Spray application in the field

Modules with degraded backsheets can create safety hazards to workers due to the loss of electrical insulation. Therefore, it is very important to make sure the solar panels are powered off and that the solar cells are not at a high voltage during repair.

Environment and Adjacent Area Masking

Prior to coating application, masking tape may be used to keep excess coating from contacting areas adjacent to the backsheet, including junction box, grounding wires, and connectors between panels. Plastic films can be used to cover the front side of the PV panels and/or the ground if the surrounding environment needs to be protected.





Pump Preparation

Note: Do not thin or cut back DOWSIL™ PV-9001 Backsheet coating.

Spraying DOWSIL™ PV-9001 requires high pressure pumping systems to provide a consistent coat. Several pumping systems have been tested and proved effective with this product. These were gasoline-powered pumps, reaching at least 450 bar (6500 PSI) of pressure, and compatible with pail/drum setup to avoid humidity ingress. Examples of suitable models are Graco GH933 and Wagner Titan HydraX 7230. Consult with the equipment manufacturers for operating instructions.

A large cross-section supply hose should be chosen to avoid pressure loss: e.g. a ¾ inch (1.9cm) diameter high pressure hose, with up to 50 ft (15m) length. The longer the hose, the larger the pressure drop will be.

In order to direct the spray easily, a manipulation hose should be connected to the supply hose, for instance a ½ inch (1.25cm) diameter high pressure whip hose, up to 8 ft (2.5m) length. The thinner hose allows moving the spray gun according to the desired spray pattern. The spray gun should be an airless spray gun capable of withstanding the pump pressure. Examples of suitable models are Graco XHF Airless Spray Gun or Wagner AG-19 Airless Spray Gun.

The spray nozzles should be selected depending on the desired coating thickness and spray distance. Satisfactory spray results have been obtained with nozzle grades ranging from 623 to 629, but it is recommended to contact the equipment manufacturer for the best spray nozzle selection for the specific system.

After a spraying job, the system is either 1) conditioned to prevent any moisture entering pump and hose, or 2) purged and cleaned, depending on the time until the next spraying campaign. It is not recommended to store Dowsil PV-9001 inside the pump circuit for extended periods of time, because of the risk of cured particles forming in the system.

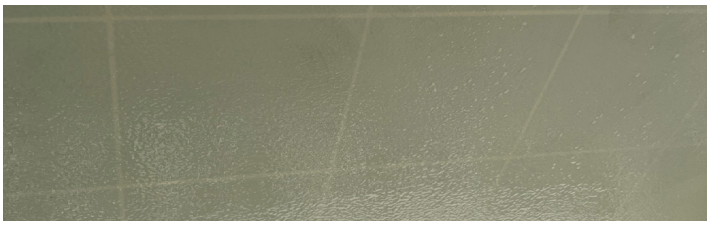
Suitable products for purging and cleaning should be selected according to manufacturer recommendations and chemical resistance of the chosen components. A convenient purging material is standard viscous PDMS such as XIAMETER™ PMX-200 Silicone Fluid, 30 000 cSt.

After a spraying job, the spray head and tip should be disconnected from the hose and cleaned with the cleaning agent recommended by the spray head supplier.

Coating Application

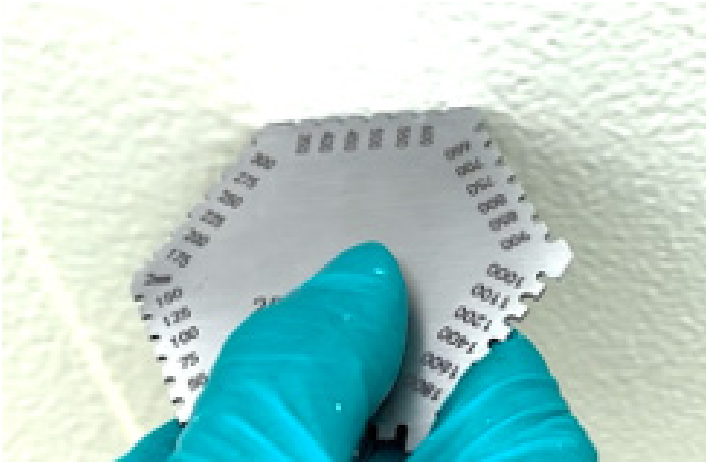
Load the pail or drum of DOWSIL™ PV-9001 and install the proper spray nozzle for pre-spray. Adjust the pump pressure and spray into an empty bucket until the desired atomization is achieved and adjustments are complete. When the required spray quality has been achieved, the repair can start. First, spray on the perimeter area of the backsheet, along the frame, and then spray in the central area. It is recommended to apply a first coat in a horizontal pattern and then follow up with a second coat in a vertical pattern to reduce the chances of uncovered areas. No waiting is required between multiple coats. The distance between the sprayer and surface can be optimized to achieve the desired spray amplitude on the substrate. For areas with large cracks, it is recommended to spray over the zone more than once, to fill the gaps properly and improve coverage of the region.





Sometimes small pinholes can appear when air is trapped under the coating or in regions where the coating thickness was insufficient. On other occasions, the cracks may seem insufficiently covered. For minor cracks, a film thickness of 400 microns is effective to bridge the cracks. For severe cracks, a thicker layer may be applied to ensure complete coverage. While increasing the thickness of the coating layer is a way to solve this problem, redistributing the coating material with a paint roller or a squeegee can provide an effective fix for those regions.

Thickness of the material can be easily measured in the field by using a wet film thickness gauge to ensure consistent application. Simply place on the backsheet and read where the coating touches the gauge to understand the thickness applied in that region. Wipe off with a clean cloth after the reading is complete.



After coating, remove masking tape and protective films.

Chemical Contaminated Waste Handling

The chemical contaminated waste shall be handled properly according to local waste treatment regulation.

Suggested Personal Protective Equipment (PPE)

Personal Protective Equipment selection is based on the operation, the requirement of handling equipment and chemicals.

Minimum PPE consists of safety glasses, safety shoes, gloves and workwear.

Other PPEs should be used according to various operations:

- Cut-resistant gloves for operations with knife and sharp edge materials.
- Respiratory mask for handling solvent, spray cleaner and DOWSIL™ PV-9001 spray.
- Face shield for DOWSIL™ PV-9001 spray

Consult the safety datasheets of DOWSIL™ PV-9001 and of any purging or cleaning material for more safety recommendations.

Handling after coating

After coating with a 400 µm layer, modules can be moved immediately. Do not touch the coating and make sure that the cables, connectors or any other object do not touch the coating either. If the layer is very thick, it is recommended to wait for the coating to be cured before putting the module in a vertical position.

In any case, wait for 12 hours before powering the module up again (before solar cells get under high voltage).

Disposal

See the Safety Data Sheet (SDS) for disposal information.

Adhesion test procedure

Adhesion testing is recommended on the backsheet of a representative module to ensure the coating is properly adhering to the substrates to be repaired.

This test is mandatory for a warranty, and must be recorded in the QC logbook of the repair campaign if a product warranty will be requested.

No less than 2 panels should be tested per repair campaign. In extensive reparations, 2 of the first 20 panels repaired should be tested, followed by 2 of the next 80 panels, and 1 extra panel every 100 reparations.

The recommended test procedures are a 180° manual peel test, as described in Table 11 notes of ETAG 02 part 1, or the adhesion evaluation methode by knife, described in ASTM D6677. If the former method is used, 100% cohesive failure must be obtained. If the latter method is used, the adhesion rating must not be lower than 4. Record the result in the QC Workbook.

If adhesion is successful, repair the tested zone by removing the damaged coating parts and applying a new layer of Dowsil™ PV-9001 coating with a syringe, a spatula or a similar small-scale tool to a minimum of the original thickness of the coating.

Adhesion development takes longer than curing and requires mild temperature and humidity levels.

On standard atmospheric conditions (20°C 50% R.H.) final adhesive performance is achieved 21 days after application.

Longer times may be required at low temperature or humidity conditions.

Typical reasons for insufficient adhesion are poor surface cleaning, use of expired material, application under improper weather conditions or an atypical backsheet material. Check the paragraph on “Substrate compatibility” for a guide on tested substrates.

Repair effectiveness testing

Repair effectiveness can be tested by insulation resistance measurement under wet leakage conditions (IEC 61730 MST 17). Alternatively, a simplified measurement designed to identify the presence of current leakage can be envisaged. Watch out, a measurement under dry conditions may not identify remaining current leakage problems. Proper testing of individual modules has to involve measuring the insulation resistance between cells and frame while wetting the repaired backsheet. If measurements are carried out in the field, special attention has to be taken to ensure the electrical safety of the technician carrying out the measurement.

If each module cannot be measured for practical reasons, a sampling strategy needs to be implemented where some modules are randomly selected for testing. During installation of the repaired modules, any remaining leakage current problems can be identified using troubleshooting procedures described in IEC 62446-2:2020.



Daily QC Logbook

Date		Temperature & Humidity	
Project Name & Location			
Applicator			
Dispensing Pump			

Time	Sequential module number	Identification (Manufacturer, model)	Serial number	Backsheet type	Cleaning Method	DOWSIL™ PV-9001 Batch number	Skin Formed After 1h	Coating Thickness

Project Adhesion Logbook

Project name & location	
Inspector	

Sequential module number	Date of repair	Date of evaluation	Evaluation method	Type of failure (adhesive/ cohesive)	Comments

Limited warranty

Dow provides a product warranty on DOWSIL™ PV-9001 to customers that request it and commit to follow Dow's application recommendations. Contact your Dow representative to learn about the details of the warranty.

For more information

Learn more about Dow's full range of photovoltaic solutions, including service and support, at dow.com/solar.

Dow has sales offices, manufacturing sites, and science and technology laboratories around the globe. Find local contact information at dow.com/contactus.

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