Solar P.V. Module Lamination Membranes - Optimising Performance
Content

Executive Summary 3
What is Solar P.V. Module Lamination 4
Lamination Process 5 - 6
Membranes 6
Problems with Elastomer Membranes 6 - 7
VAC-SIL® Membranes – The Answer to the Problems 8
Why Use J-Flex 9
About J-Flex 10
About The Author 10
Executive Summary

J-Flex has updated its white paper “Solar P.V. Module Lamination Membranes” originally issued in June 2016.

The revised guide aims to help producers optimise Membrane performance by use of approved Membranes, as well as adapting best manufacturing practice.

Whatever your Membrane needs, J-Flex can help you define the parameters; specify it and manufacture it for you. We can help from the initial concept with potentially sample trials, through to the manufacture of that Membrane.
What is Solar P.V. Module Lamination?

Whilst this maybe fairly obvious to many readers involved in module production, we aim to help everyone understand the extreme demands and standards of this industry.

Solar modules need to be able to withstand outdoor exposure in all types of climate for periods of 25 years and more. Solar modules need to convert sunlight to electricity at an acceptable cost throughout their lifetime.

One key factor in guaranteeing solar module performance and indeed longevity is the lamination process responsible for making them.

This process encapsulates solar cells in between a number of substrate layers including top and bottom protective layers. These layers are known as a “lay-up” and this methodology has been successfully employed for over 20 years.

One of the most common module lay-ups is tempered glass as the transparent top layer; followed by a layer of encapsulant; the interconnected solar cells; another layer of encapsulant and finally a layer of UV stable film as the bottom layer.

The encapsulant is traditionally made from Ethylene Vinyl Acetate (EVA). There have been many improvements made to this bonding material due to the very aggressive outgassing created as a bi-product of the continual lamination process.
**Lamination Process**

The lamination process involves evacuating the air out of the panel lay-up in a vacuum chamber; heating the layers to melt the encapsulant; pressing the layers together with a highly flexible elastomer Membrane (AKA Diaphragm) to embed the solar cells in encapsulant and adhere the front and back layers. Optimal adhesion ensures the lay-up is moulded into a homogenous mass providing high integrity sealed panels.

Module laminators consist of a large area of a heated platen within a vacuum chamber. Typical laminators operate at temperatures of 150°C (302°F). The top of the laminator opens for simple loading and unloading of modules. The flexible Membrane is attached by clamping or bolting to the top of the vacuum chamber.

Laminators are available with two types of top cover opening systems - Clamshell/Oyster Press and Vertical Upstroke Press.
As can be seen in the clamshell/oyster design the top cover is hinged at the back of the laminator. This means you can access the laminator on three sides making it very easy to load and unload modules manually.

Vertical upstroke presses can be belt fed automatically, thus reducing the production cycle time. As a result most high volume module lines use vertical upstroke presses.

Membranes

Membranes need to be:

- Flexible to draw down to the exact shape of the lay-up
- Be strong enough to stretch repeatedly under vacuum conditions
- Be temperature resistant (150°C typical)
- Good release properties for smooth production conditions
- EVA resistant
- Cost effective for this essential consumable

Problems with Elastomer Membranes

It is the general perception that when the Membrane fails before the anticipated number of life cycles, that the Membrane is at fault.

Based on experiences and many technical visits made world-wide, we understand that factors beyond our control have, in many cases contributed to Membrane failure. J-Flex have looked very carefully at these issues and identify some of the most common problems, that if avoided could seriously help customers optimise Membrane performance.

- Glass breakage
- EVA outgassing
- Heavy EVA deposits
- Exposed open areas during lamination
- Overstretching Membranes
- Under stretching Membranes
- Sharp Edges due to tight clamping
These are set out below in more details.

1. **Glass breaking** during lamination will not only pierce the PTFE (Teflon) sheet, but also seriously puncture the Membrane with disastrous results.

2. Without a doubt the major problem faced by Membranes is the harmful effects of chemical attack created through **EVA outgassing**.

3. **Heavy EVA deposits** adhering to PTFE protection sheets then permeates into Membranes – the chemical attack manifests itself in cracks at key stress points leading to premature failure.

4. **Exposed open areas during lamination** – this happens when the PTFE sheet does not have support to hold it onto the laminator platen, so when the laminator top cover is closing the PTFE sheet bends leaving no protection for the Membrane from EVA attack.

5. **Overstretching the Membrane** making it too tight can lead to early tearing.

6. **Under stretching** should be avoided – if the Membrane sags it risks exposing it to outgassing leakage.

7. **Over enthusiastic clamping (i.e. too tight)** – can result in the Membrane being cut at the corners.

As can be seen many of these issues can affect the life expectancy of the Membrane – so J-Flex have tried hard to ensure that all VAC-SIL® Smart Membranes are manufactured with premium grade materials and are fully conditioned to best practice.

J-Flex have produced a useful guide – “VAC-SIL® Quality Membrane Installation Guide and FAQ’s”. In brief the following points may help you optimise longer life for your valuable Membranes.

**Longer life for the Membranes can be achieved by:**

- Protecting the working face with a PTFE/Fabric Sheet between the Membrane and the module
- Regularly cleaning the EVA deposits away
- Avoid sharp edges protruding into the Membrane
- Install strictly in accordance with the manufacturer’s instructions – do not cut corners – installation is a precise function
- Tension sympathetically – do not overstretch
- Re-tensioning the Membrane regularly can alleviate the stresses that normally attack the usual corner / side weak points.
- Ensure the vacuum in top and bottom chambers is appropriate
VAC-SIL® Smart Membranes – The Answer to the Problems

VAC-SIL® Smart Solar Membranes have been specifically designed to be used as vacuum membranes for Solar P.V. module lamination.

VAC-SIL® Smart Solar Membranes have been polymer engineered to give users excellent thermal and mechanical properties with good chemical resistance - leading to optimum service life.

VAC-SIL® Smart Solar Membranes bring many other positive advantages including:

- One piece seamless membrane width up to 3850mm in continuous lengths
- VAC-SIL Pro® - most popular and economically priced
- Good reusability when exposed to elevated temperatures
- Excellent release properties
- Extraordinary drawdown strength and resilience
- For added EVA resistance – try VAC-SIL® Lamin8 / Lamin8 Lite
- Unique hybrid composite with Black gas side and fabric reinforcement
- All VAC-SIL® Membranes are fully post-cured to maximise mechanical properties
- EX-STOCK availability
- A 9 point Quality Plan for each and every VAC-SIL® Membrane supplied
- Whatever your criteria – cost or uptime – there is VAC-SIL® Membrane for you
Why use J-Flex?

- Excellent range of quality products specifically developed for the Solar Panel Manufacturer – VAC-SIL® Membranes; PTFE / Glass Belts and Sheets; PU Squeegee Blades (for cell manufacturing) + Vacuum Seals
- Expertise to help you find the best solution for you
- Exceptional customer service
- On-going and continuous product development and product improvement
- Continuous process and quality improvements as standard
- Exceptional support information:-
  - Download now at www.j-flex.co.uk
  - FAQ’s and Installation Guide
  - All Material Specifications
  - Plus our White Papers;
    - Reducing the Total Ownership of a Solar / P.V. Laminator
    - A Guide to Solar Module Lamination Membranes
    - A Guide for Optimising Membrane Performance

We supply customers in over 50 countries.

For more information and to place orders please contact us directly on +44 1777 712400 or email lance@j-flex.co.uk or michelle@j-flex.co.uk and we will be in touch.
About J-Flex

Established in 1984, J-Flex has over 35 years’ experience in the manufacturing and distribution of High End Elastomer Sheet Products.

Our production facilities are laboratory controlled and in addition our Quality Management System is accredited to ISO9001:2015.

VAC-SIL® Membranes are exported to many countries world-wide including Germany; Austria; Switzerland; France; India; Bangladesh; South Korea; Malaysia; Australia; Spain; South Africa; Jordan; Poland; Czech Republic; Lithuania; Singapore; United Arab Emirates; Mexico; and Canada USA.

Check out the download area of our website - www.j-flex.co.uk - for further information, data sheets and more including:

* VAC-SIL® brochure
* Installation Guide
* FAQ’s
* VAC-SIL® Interactive Digital Brochure

Please contact us and we will do our very best to help you make the right decision.

About the Author

John Kirk set up J-Flex in 1984 and is the Chairman of the company. As an industry veteran, with over 45 years’ experience in the rubber industry, John relishes the opportunity to help customers with solutions to their industrial rubber engineering challenges.

Travelling worldwide on a regular basis, John is able to tap into his extensive network of contacts to drive the J-Flex business forward to the benefit of customers.

With a strong customer focus, John is also keen to develop new products to meet customer requirements.

John is eager to ensure the rubber industry as a whole meets the quality standard customers expect which is one of the reasons for writing this White Paper.

Accreditations, Product Testing and Association Memberships

We are accredited to BS: EN: ISO 9001: 2015 and are members of the official Chemours Viton™ Licensee Programme.

We also ensure where appropriate that our products are tested and approved by the relevant authorities, and will provide relevant certifications on request.

J-Flex is also a member of the UK Gasket & Sealing Association.

J-FLEX
High Performance Elastomer Sheetings & Manufactured Components

Units 1 & 2, London Road Business Park, Retford, Nottinghamshire, DN22 6HG, United Kingdom  www.j-flex.co.uk
tel: +44 (0) 1777 712400 fax: +44 (0) 1777 712409
e-mail: lance@j-flex.co.uk or michelle@j-flex.co.uk

J-Flex is the trading name of Clockpress Ltd - Registered in England & Wales No.02448048.