

## **Semi-flexible solar panels (EFLX series)**

# **HANDLING AND FITTING MANUAL**

Thank you for purchasing this product. The following guidelines apply only to EFLX series semi-flexible solar panels with ETFE coating and back-contact solar cells. This manual should not be used for any other solar panel of a different series, material or solar cell type.

Any work should follow the required safety standards and applicable regulations. The product should be handled and installed by professionals or appropriately qualified persons. Suitable precautions and safety measures should be taken in all cases.

## **I. Delivery**

Please remember to examine the condition of the box(es) containing the solar panel(s) immediately upon delivery. If you notice that the package has incurred any form of damage; i.e. it is deformed, punctured, torn, stained etc, you must sign for the delivery as “damaged”. This will be essential to the post-incident investigation with the courier, in the case that the contents of the box are also damaged.

Place the box containing the solar panel on a flat level surface, and open it carefully, without removing the solar panel from the foam packaging. Examine the surface of the solar panel and the condition of each black solar cell for any signs of damage (creases or cracks in the solar cell). Keep the solar panel flat in the packaging while performing this visual inspection. Do not put any pressure on the solar panel (i.e. do not press down on the solar panel with your hands when checking for damage). Slight discolouration of solar cells or remnants of glue on top of the surface are permissible and are not classed as damage, as neither of these factors will affect the performance of the solar panel.

If you detect any cracks in the solar cells or creases in the plastic surface coating, along with corresponding damage to the carton box, please contact your supplier immediately with photographic evidence for assessment.

Before removing the solar panel from its packaging, please check the dimensions and confirm that the solar panel fits in the required space.

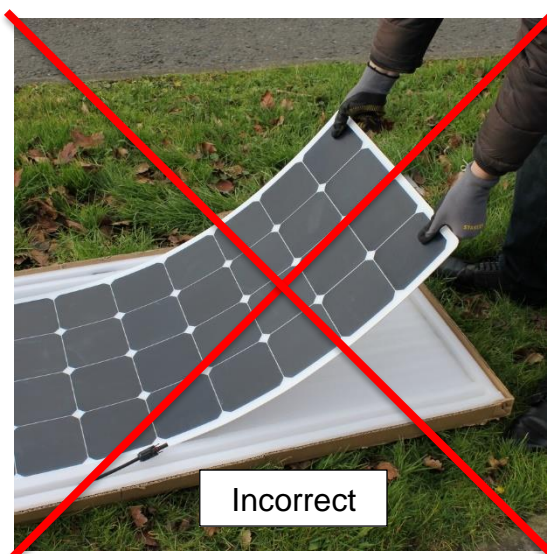
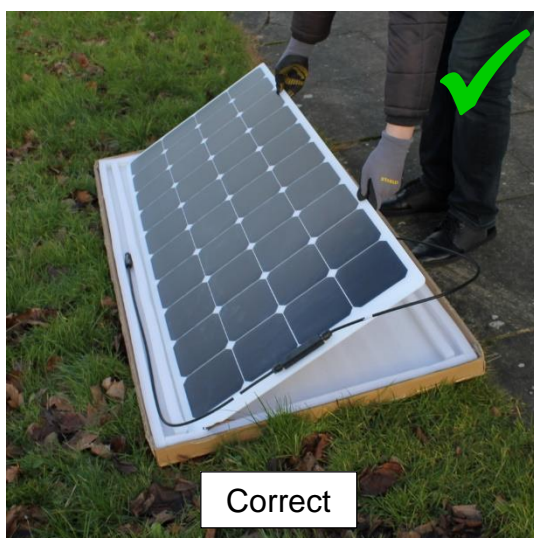
## II. Handling

This product must be handled with care at all times. Detailed guidance on handling is provided below.

Even though this solar panel is semi-flexible, **it is designed to be bent only once**: upon permanent mounting to a curved surface. It is not designed to be repeatedly flexed (for example, it cannot withstand constant movement in the wind like a sail). It should not be suspended in the air; it must be fixed to a rigid surface.

- Do NOT bend the solar panels unnecessarily. When gripping the solar panel, ensure that your fingers do not cause any local stress or curving of the material.
- Do NOT step on the solar panel or put any pressure on it until it is securely mounted on to a rigid surface. No pressure should be applied if there is any void space underneath the solar panel.
- Do NOT rest the solar panel on any of its corners or edges as this will cause the panel to bend under its own weight.
- Do NOT apply unnecessary force to the solar panel (i.e. do not throw it or mishandle it in any way, even if it is still packaged).
- Do NOT puncture the solar panel.
- Do NOT lean the solar panel on sharp or angular objects.
- Do NOT use the junction box or the connection cable as a handle.
- Do NOT stack the solar panels once they have been removed from their original foam and cardboard packaging (the sharp edges of the junction box may damage the front surface of another module).
- Do NOT install or handle the solar panels in windy weather.

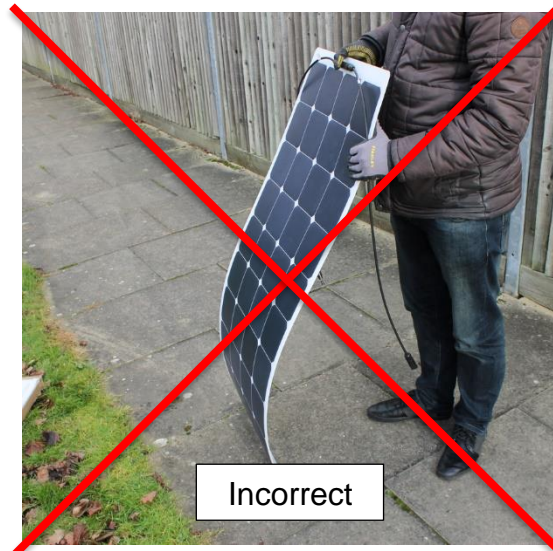
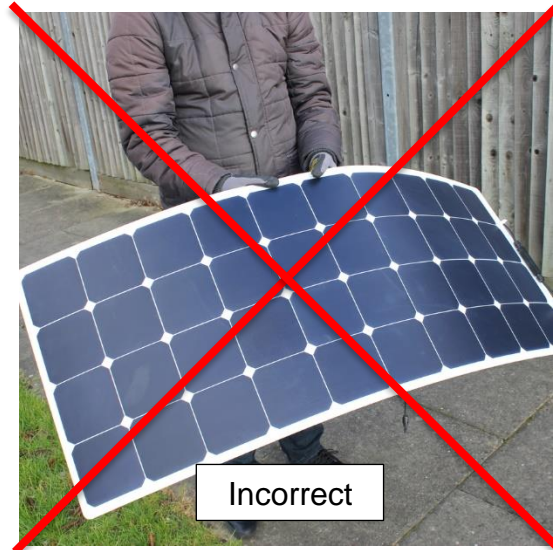
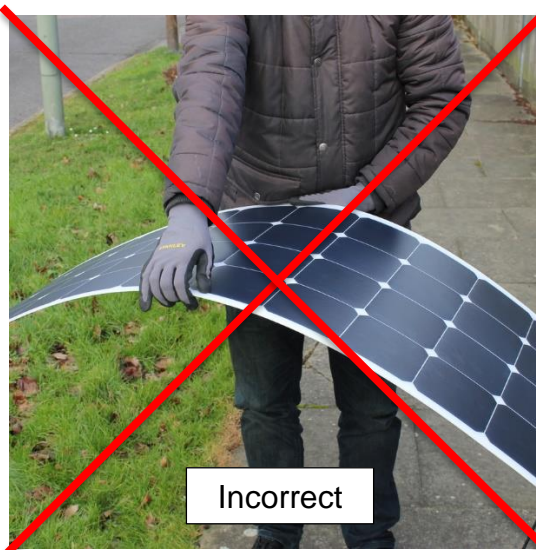
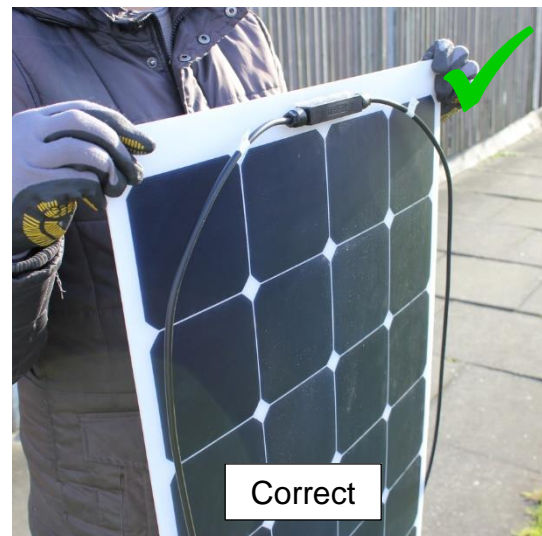
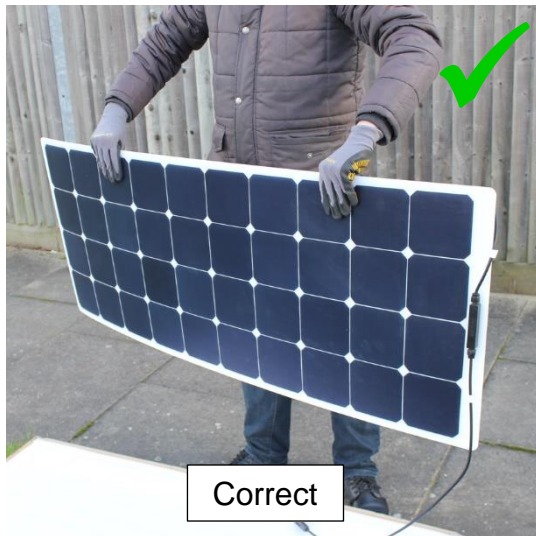
Keep the solar panel **as straight as possible at all times** until it is installed in place. When removing the solar panel from the box, always grip the longer edge of the solar panel. Lift the panel upwards, keeping it constantly flat (as if handling a sheet of plywood): and lift it upwards without bending:



To carry the solar panel safely, always ensure that the solar panel is perpendicular to the ground and remains unbent in your hands. The best way to do this is to hold the solar panel along the long edge (keeping this edge in a straight line), allowing the solar



panel to straighten itself naturally, as shown in the photos below. **Do not** carry the solar panel in a horizontally oriented plane (parallel to the ground) as this may cause the panel to bend under its own weight and become damaged. **Do not** rest the solar panel on the ground so that it begins to bend. **Do not** handle or install the solar panel in windy weather.



Never attempt to test the “local flexibility” of the solar panel by bending the material of the solar panel near the edges or in the corners. This can easily cause solar cell cracks.

When handling or installing the solar panel, ensure that your grip does not pinch the solar panel in such a way that causes the panel to bend.

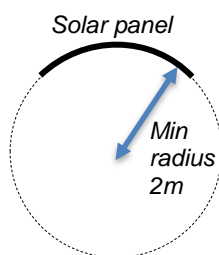


### III. Maximum curvature

This solar panel is **semi-flexible**; which means that it can be curved to a certain degree, but cannot be rolled up or folded.

The maximum allowed curvature for this solar panel corresponds with the **minimum bending radius** of 2000 mm. In other words, once curved, the solar panel must follow part of a hypothetical circle with a radius of **at least 2m**. This implies that the solar panel curve will be distributed uniformly across the full length of the solar panel (avoiding “sharp” bending angles or corners)





In practice, the minimum radius rule translates into the following requirement: when the solar panel is mounted on a curved surface, there is a **maximum arch height** that the installation must not exceed (when measured against a straight horizontal line).



The maximum height of the arch of a bent solar panel will depend on the length of the solar panel. The table below provides some examples.

Length of the panel (cm / ft)	Maximum height of the arch (mm / in)
50 cm / 1.6 ft	16 mm / 0.6 in
80 cm / 2.6 ft	40 mm / 1.6 in
100 cm / 3.3 ft	62 mm / 2.4 in
120 cm / 3.9 ft	89 mm / 3.5 in
140 cm / 4.6 ft	121 mm / 4.8 in
150 cm / 4.9 ft	139 mm / 5.5 in
170 cm / 5.6 ft	178 mm / 7.0 in
200 cm / 6.6 ft	245 mm / 9.6 in

Excessive bending must be avoided when handling or installing the solar panels. The maximum arch height examples provided above are for the one-time bend of the solar panel, upon permanent mounting onto a curved surface. **Do not** mount the solar panel on any surface which may alter the solar panel curvature (i.e. surfaces which are insufficiently rigid).

**Important!** The surface curvature must be distributed uniformly across the entire length of the solar panel. Punctural bending may cause permanent damage to the solar cells.



## IV. Fitting to the surface

Whilst fitting the solar panel, the installer must adhere to the appropriate safety guidelines at all times, including those for safety at work, electrical installation and equipment usage, and construction, along with all other regional and national legislation.

The solar panel can be installed in a landscape or portrait orientation, and fixed in place by gluing, screwing or riveting.

The mounting surface for the solar panel should be smooth and even. If the surface is uneven, it must be suitably prepared prior to installation, with all gaps being filled in. For example, spaces between ridges on a vehicle roof must first be filled in before the solar panel is mounted.



In case of bonding the solar panel, always ensure that your chosen adhesive forms a good bond with both the solar panel and the substrate surface.

Before applying any adhesive to the underside of the solar panel, place the panel gently on a non-abrasive flat surface which will not cause any damage to the front side of the solar panel (e.g. its original carton box or foam packaging). Keep the solar panel as straight as possible whilst doing this (handle the solar panel like a sheet of plywood).



## ***Gluing with double-sided tape***

We recommend an industrial grade porous (“foam”) tape for this application. Applying the tape across the entirety of the underside of the solar panel will improve the bond quality.

When gluing with double-sided tape:

- Apply the tape onto the solar panel first, by “unrolling” it on the solar panel. Use a soft cloth or a roller to gently apply pressure onto the tape (protective film side) to dispel all air from between the tape and the solar panel. Take care not to force the solar panel to bend underneath.
- If the length / width of the tape exceeds the solar panel, cut the tape carefully around the edges of the solar panel.
- Remove the protective film and stick the solar panel down on a clean and dry surface, **keeping the solar panel as straight as possible** up until the final moment when it takes the curved shape of the mounting surface. While sticking it down, gently apply pressure on the solar panel with a soft cloth or a roller to ensure that no air is trapped underneath the solar panel (2 people are recommended for the installation).
- Observe the required application temperature for the double-sided tape and the time for the glue to dry.

**Warning!** Double-sided adhesive tape forms a very strong immediate bond with the contact material and does not allow for repositioning. Attempting to remove the solar panel, even if only partially attached, can seriously damage the solar cells.

## ***Gluing with adhesive***

Your chosen adhesive should be suitable for both the solar panel and the mounting surface. It should also be designed for outdoor applications (with a wide temperature range, UV light protection etc). Pay attention to the application temperature and drying time requirements.

The mounting surface must be even, clean (use a degreasing agent) and dry. The installation must be carried out with care and precision, as this permanent method does not allow for repositioning.

**Warning!** Although preparing the roof surface for better adhesion is permitted (if required, e.g. by removing the old paint, grinding, using a primer etc), you must not use any sand paper or other sharp or abrasive tools on the underside of the solar panel.

One of the most important things to bear in mind when gluing the solar panel using adhesive is to ensure that **there are no pockets of trapped air underneath the solar panel**, i.e. no void spaces with air that are sealed all the way around with adhesive. If you leave trapped air under the solar panel (no matter whether it is between beads of adhesive or in various slots and holes of the uneven roof surface), such air will inevitably warm up when the solar panel is receiving good sunlight. When the air gets hot, it will significantly expand in volume, causing upward pressure to the solar panel surface and possible bulging of the solar panel during hot weather. This can result in permanent damage to the solar cells.

Even a small amount of trapped air can result in premature reduction in solar panel output, or a complete failure of the solar panel, due to the constant warming and cooling of the air each day and night, which increases surface tension and stretches the surface material. This may also contribute to the development of dry solder joints between the solar cells.

To illustrate the danger of trapped air underneath the solar panel, the following picture shows an incorrect solar panel installation on a ridged van roof, where the spaces between the ridges were not filled in prior to the installation. The edges of the solar panels were mistakenly sealed; trapping air under the solar panel. In hot sunny weather, the pressure of the hot air in gaps between the ridges increased so much that the solar panels bulged, cracking the solar cells and causing permanent failure of the panels.



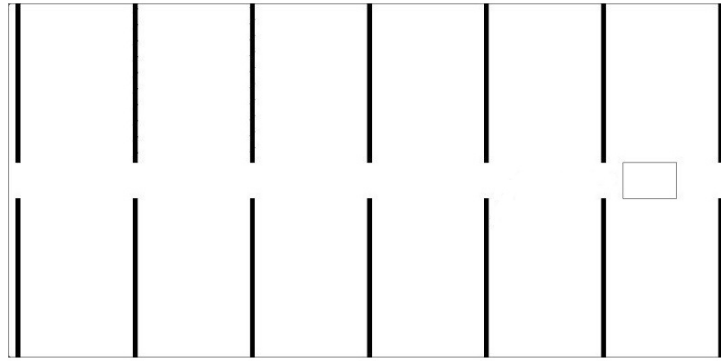
To avoid these problems, there are two main mounting options:

- 1) Cover the entire underside of the solar panel with a layer of adhesive, spreading it evenly with a trowel or a similar tool.
- 2) Apply the adhesive to the underside of the solar panel in parallel beads but do not seal the edges of the solar panel. This will make the solar panel breathable.

The second option is recommended, as it is also good for temperature expansion / contraction of the mounting surface material itself (particularly common in metal roofs).

Apply thick 8-10mm adhesive beads on the rear of the solar panel, in parallel to each other, as shown in the diagram below:





If your solar panel width (and the length of each adhesive line) is greater than 600 mm, break the adhesive lines in the middle of the solar panel with a gap of 30-40 mm to allow for additional escape routes for air and rain water.



The adhesive lines should be positioned at a distance of 40mm - 150mm between them. In general, most applications would benefit from having the adhesive lines as close to each other as possible but making sure they don't touch each other when the solar panel is placed on the mounting surface. This way, when the solar panel is mounted, the space between adhesive lines will form clear breathable channels open on both sides, allowing the air to escape from underneath the solar panel. At the same time these channels and the distance between the adhesive lines should not be too wide, to minimise the additional uplift wind pressure on the solar panel between the adhesive lines, particularly for high speed applications like vehicles.

To minimise the wind impact on the solar panel, position the adhesive lines across the most likely wind direction and make sure that the first and the last line are as close to the edge of the solar panel as possible.

To adhere the solar panel to the mounting surface:

- It is recommended to use two people, particularly for large solar panels.
- Minimise bending of the solar panel when attaching it to the surface, keeping it as straight as possible.
- When pressing down the solar panel to the mounting surface, we recommend

using a cotton cloth or a hand-roller to evenly distribute the compacting pressure.

- If not using a cloth or roller, use a flat hand to distribute the pressure (no point load) and press the solar panel gently in a wiping motion.

**Important!** For difficult shaped roofs where a rebounding motion of the solar panel is likely, use other means to secure the solar panel in place while the adhesive dries. This may involve using weights (distributed evenly across the solar panel) or tape. If you decide to use tape, ensure that no residual glue is left on the solar panel surface after you remove the tape.

After bonding with adhesive, **do not seal the edges of the solar panel**. The solar panel must be kept breathable underneath to allow any air to escape.

If multiple solar panels are mounted on the same surface, or if the edges of the solar panel are close to other objects (such as a roof skylight), leave a gap between the solar panels (or between the solar panel and nearby objects) of at least 2mm to compensate for the linear expansion of material under different temperatures.

**Important!** If mounting a solar panel on a non-horizontal façade or a difficult mounting surface (e.g. glass, wood, concrete, brick, canvas etc.) the instructions provided above are not applicable. Please seek special guidance for installations of this nature.

### ***Drilling, screwing and riveting***

Mounting by self-tapping screws or securing the solar panel with fasteners via mounting holes are both good methods of fitting the solar panel which help eliminate the risk of trapped sealed air under the solar panel. To secure a solar panel using one of these methods:

- Mounting holes can be drilled into the corners of the solar panel and along the long edges in gaps between the solar cells corners.
- Holes should be positioned at least 8 mm away from the solar cells.
- Holes should be sealed with an adhesive after mounting to avoid the risk of future delamination of the solar panel material.

### ***Mounting with Velcro tape***

Fitting the solar panel using strips of Velcro tape helps avoid the risk of trapped sealed air underneath the solar panel. However this method is not recommended for vehicles and speedboats due to the wind drag which might force the solar panel to detach.

Once the solar panel has been mounted with Velcro tape, it should be treated as a permanent installation. Attempting to remove the solar panel, particularly if a large part of or the entire back surface is covered with Velcro, can seriously damage the solar panel.

### ***Fitting a solar panel with the rear junction box***

If your solar panel features the junction box on the underside (JBB sub-series), we do not recommend using a double-sided adhesive tape to mount it, especially on uneven

surfaces with irregularities. This is because it will be harder to ensure that the cable entry hole under the solar panel is fully waterproof. Please use a suitable adhesive instead.

To fit a solar panel with a rear junction box:

- Most rear junction box solar panels come with a round junction box. Drill a round, appropriately sized hole into the mounting surface (typically 30 mm) so that the rear junction box fits well.
- Place the solar panel on a soft, non-abrasive surface with the rear side facing upwards, and apply the adhesive in beads as described above.
- Apply a thick adhesive ring (at least 12mm line diameter) around the junction box to form a closed seal around it, and bond the solar panel to the surface.
- Two people are recommended to perform this installation.

As per the guidance above, to avoid trapped air forming underneath the panel, **do not seal the edges of the solar panel** with adhesive.

## V. Electrical connection

**Warning!** This product generates electrical current when the front side is exposed to light. Even if the voltage and current from a single solar panel is low, multiple solar panel connected in the same circuit can have a much greater voltage and current. Touching the terminals or wiring may cause an electric shock or burns. To avoid risks, fit an isolator switch for solar panels or cover them during the installation.

When connecting the solar panel(s) to a solar charge controller, remember that most solar charge controllers require a battery connection first, so that they can detect the battery voltage and condition, before they start taking power from the solar panel. So the solar panel(s) should be connected to the solar charge controller after the battery connection has been made live.

Always observe general safety standards, specifications and manuals of the connected equipment, as well as the installation advice below:

- Do not use different types or sizes of solar panels in the same system, unless your installation has been preapproved by your supplier or another qualified person.
- Do not modify the electrical connections of the solar panels. In particular, do not open or remove the junction box.
- Do not cut or pierce the solar panels, as this may cause live components to become exposed and/or damaged.
- Any installation or maintenance of solar panels must take place in dry weather on dry surfaces.
- Use tools with insulated grips only.
- Do not use damaged solar panels (including damages received in transit or during the installation).
- Do not apply any protection covers, coating, paint or varnish to the solar panels.
- Do not drop heavy or sharp items onto the solar panels.
- Do not concentrate sunlight (e.g. from mirrors or lenses) or other sources of artificial light on the solar panels.



- Do not install solar panels in locations where they may be submerged in water for lengthy periods.

Keep the maximum system voltage that can flow through your semi-flexible solar panel(s) to a minimum. In a solar system with **multiple semi-flexible solar panels**, the preferred method of connection is in parallel (rather than in series). It is recommended that no **more than 2 semi-flexible solar panels are connected in series** in a single string, and that the maximum open circuit voltage is kept **within 50V per string**, with multiple strings of the same power and voltage connected in parallel.

In addition, if your system includes multiple semi-flexible solar panels, for any parallel connection either of individual solar panels or strings of panels, fit suitable **blocking diodes** to ensure that the system delivers the highest output in any shading conditions. For a single solar panel system connected via a solar charge controller, a blocking diode is typically not required.

When installing the solar panel, always check that the cabling is not under stress. Do not bend the solar cables below the minimum bending radius of 40 mm. Ensure that the cables are not tight or stretched when mounting the solar panel.

## VI. Cleaning and care

Due to the special ETFE surface of these solar panels, dirt and grime will usually be washed away by the rain. Nevertheless, if the solar panel is fully or partially shaded by dirt or debris, this must be cleaned to prevent loss of performance.

Clean the front side of the solar panel gently using a soft cloth (dry or moist, with lukewarm water). **Do not use brushes, scrapers, metal tools, or any high-pressure water tools**. Do not use any cleaning substances and do not allow contact of the surface of the solar panel with any chemicals.

If the solar panel has been used in marine conditions and the surface is covered in sea salt, remove the buildup very carefully, ensuring that the salt crystals do not scratch the solar panel surface.

In areas with low winter temperatures, remove any snow and ice without force (e.g. with a very soft broom) in order to avoid damage to the protective layer of the solar panel.

Inspect the solar panels at least once a year to ascertain that all connections and fixings are tight and corrosion free. Examine the solar cells to confirm that they are not cracked or damaged.