SOLAR PV TILES

Installation Instructions for Redland Plain Tile Solar PV Tiles

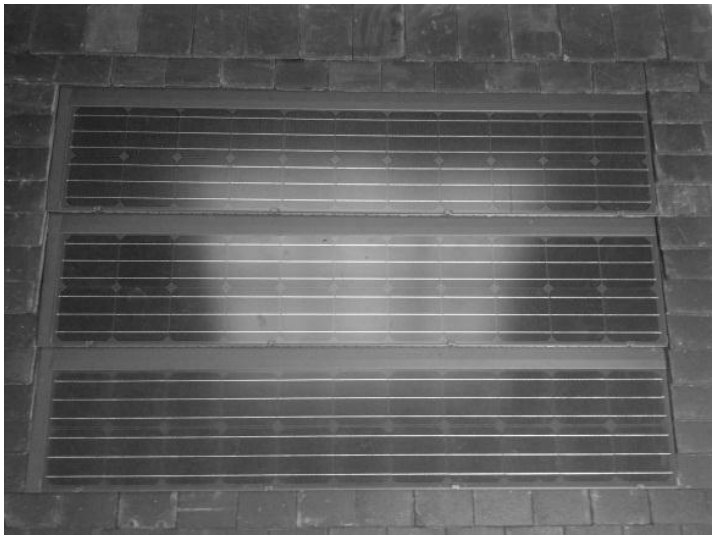

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TABLE OF CONTENTS

1 INTRODUCTION

It is highly recommended that you read all the guidance and installation notes before starting the installation to ensure that the Redland Solar PV tiles and system are installed safely.

1.1 HEALTH & SAFETY

1.1.1 GENERAL GUIDANCE

- Ensure most up to date Construction (Design and Management) Regulations (CDM) and general construction site training are followed.
- Any person handling PV tiles should be trained in correct manual handling practice. Please note also that PV tiles can have sharp edges and so appropriate safety gloves should be worn when handling panels.
- All appropriate Health and Safety regulations should be followed correctly.
- Avoid installing the system in poor weather conditions, including strong wind, rain, ice or snow.
- Do NOT walk on the PV tiles at any time.
- The slating and tiling should be carried out in accordance with the current version of British Standard BS 5534, Code of practice for slating and tiling (including shingles) and current Redland Solar PV tile fixing instructions.
- Install all components as specified within this guide to ensure weather-tightness and wind uplift security.

1.1.2 ELECTRICAL HAZARDS

Photovoltaic (PV) tiles do not present a risk as long as appropriate safety practices are followed at all times during installation. In particular, you must be aware of the following:

- PV tiles produce a DC voltage whenever exposed to light. This voltage cannot be switched off.
- All work must be carried out with the system disconnected from the main electrical supply.
- PV tiles are pre-wired with insulated connectors to prevent an electrical shock during general handling. However, care must be taken not to cut or damage PV tile cable insulation or expose bare wire.
- Ensure all PV tile cable connectors are dry and free of dirt before making connections.
- Ensure no PV tile cable ends are left exposed to the weather during pauses in the work schedule or after completion of the works.

1.1.3 INSTALLATION PREPARATION

Follow the guidance below to ensure the Redland PV tiles are installed and handled correctly:

- Use this installation guide alongside your PV tile layout and circuit diagram to determine the location and layout of the Redland Solar PV tiles and associated PV tile cables on the roof.

- Keep the Redland PV tiles in a weatherproof environment prior to installation.
- Carry the Redland PV tiles with both hands by the frame, avoiding touching or scratching the face of the panels.
- Only load as many Redland PV tiles onto the roof as you expect to install during the work session.
- Secure or remove any uninstalled PV tiles before leaving the roof to avoid possible wind damage or theft.
- Do not leave tools or unsecured materials above the Redland PV tile installation area, to avoid potential damage to the PV tiles.

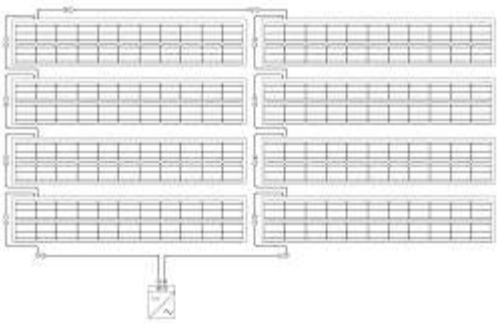
1.2 EQUIPMENT REQUIRED

- Screwdriver or hand-held power screwdriver with pozi-drive head.
- Voltmeter to check PV tile cable connections (Note: It is recommended to test the voltage across every 4 connected PV tiles as the installation proceeds to check the integrity of the PV tiles and their electrical connections).

2 PRELIMINARIES

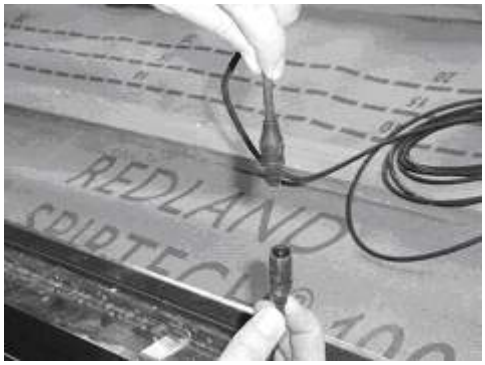
2.1 CIRCUIT DIAGRAM & LAYOUT

Before starting please check the circuit diagram to confirm the required layout of the PV tile array and the associated electrical connections between PV tiles and also back to the DC to AC Inverter. Redland Solar PV tiles are connected in electrical series in strings with each string having its own connections back to the inverter. The PV tile connectors and cables provided must be used for the series connection of the PV tile columns. PV tiles come with pre-wired connectors for tile-to-tile connections within a PV column. Additional PV tile cables are available in two lengths – 2 m cables for tile-to-tile connections between columns and 10 m cables for tile-to-inverter connections. A circuit diagram showing the recommended cabling plan (not to scale) for a single string array of 8 PV tiles is shown below.



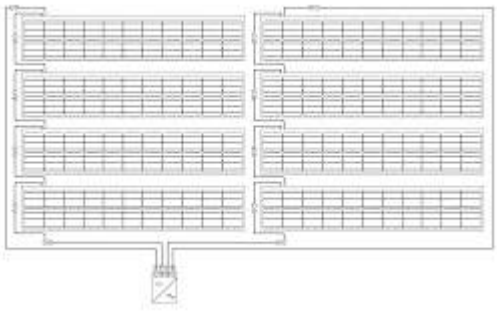
For Redland Solar PV tiles, the recommended direction of cabling within a string is in column fashion, from bottom to top, then top to bottom in adjacent column, and then bottom to top again, and so on as you work across the PV array with the PV tile columns running from right to left. The pre-wired connectors attached to the PV tiles should be used for all the electrical connections up or down a column. 2 m cables should be used for connecting PV tile columns to each other; connections between adjacent PV tile columns should be made top-to-top, then bottom-to-bottom, then top-to-top, and so on as you work across the PV array. The 10 m cables should be used to connect the first and last PV tiles in the string to the inverter. As a rule of thumb, the 10m cables should be long enough for the connections to the inverter for PV tile arrays up to 4 columns of PV tiles wide; for wider PV tile arrays it may be necessary to use longer inverter cables. Monier Limited can also supply 25m inverter cables if required.

Note that for all electrical connections the pre-wired connectors and cables are used to connect from the + terminal to the - terminal in electrical series.



Additional strings of PV tiles connected in electrical series can be connected to the inverter using the other sets of + and – inputs available on the inverter box. Note the maximum number of PV tiles that can be connected to the inverter is only limited by the capacity of the inverter. Check that the inverter has sufficient capacity for the size of the array being connected. For large projects more than one inverter may be required.

The circuit diagram below shows the recommended cabling plan (not to scale) for 2 strings of 4 PV tiles each connected to a single inverter.



2.2 FELT & BATTENS

Felt and batten the roof in the normal manner ensuring the roofing underlay is laid with an approximate 10mm drape between rafters and that the tiling battens are laid at the appropriate gauge for the PV tile type to be used (see relevant section to follow for the specific PV tile being installed).

2.3 MARKING POSITION

To make sure the PV tile array is installed in the correct position of the roof, it is recommended that you first mark out the area where the PV tiles are to go before you begin. It is also recommended that the position of the inverter(s) within the building in relation to the PV array is (are) identified.

2.4 RAFTER PITCHES & LENGTHS

For Cambrian Slate, Mini Stonewold, Mockbond Mini Stonewold, Landmark Double Pantile, Grovebury, Landmark Double Roman, 50 Double Roman, DuoPlain, Richmond 10, Saxon 10, Landmark Slate 10, MockBond Richmond 10, Natural Slate and Plain Tiles (including Rosemary Clay Plain Tiles) follow the appropriate PV tile installation instructions in following sections. The maximum rafter lengths for flat interlocking tiles and slates at minimum rafter pitch is 10 m (9 m for Natural Slate in moderate exposure areas, 6 m in severe). Please contact Technical Solutions for further advice on rafter lengths. Note that the minimum and maximum rafter pitch for use of each of the Redland Solar PV tiles is shown in the table below:

REDLAND SOLAR PV TILE	RAFTER PITCH° (MIN - MAX)
Natural Slate (500 x 250 mm)	25 - 69
Cambrian	25 - 69
Richmond 10	22.5 - 69
Saxon 10	22.5 - 69
Landmark Slate 10	22.5 - 69
MockBond Richmond 10	27.5 - 69
Mini Stonewold	22.5 - 69
Mockbond Mini Stonewold	22.5 - 69
Landmark Double Pantile	20 - 69
Grovebury	20 - 69
Landmark Double Roman	20 - 69
50 Double Roman	20 - 69
DuoPlain	25 - 69
Plain Tiles (incl. Rosemary Clay Plain Tiles)	35 - 69

2.5 FIXING

The fixing instructions in the following sections are those that apply where the supporting rafters/frame or tiling batten supports are spaced at no more than 600mm centres and the tiling battens used are 50 x 25 mm (38 x 25 mm for Plain Tiles (incl. Rosemary Clay Plain Tiles)) in dimension. For other configurations please contact Redland Technical Solutions (Tel. 08708 702595) for advice before proceeding.

Please note that in all cases the perimeter slates/tiles adjacent to the PV tile array must as a minimum be screw-fixed in all the available nail-holes using the screw specified for the

slate/tile. The only exception is centre-nailed Natural Slate which can be fixed in the standard way with two nail fixings, apart from the cut slate course directly below the bottom course PV tiles, which must be secured using slate hooks. Slate hooks can also be used around the sides and top of the PV tile array if so required .

2.6 INSTALLATION

Note that all Redland Solar PV tiles are fully integrated with the slates/tiles and as such are designed to be installed from right to left (see instructions below). Redland Solar PV tiles are designed to integrate with at least one slate or tile at the perimeter of the PV tile array to ensure weather-tightness of the installation; this integration is achieved either directly by interlocking with the slate/tile in the case of interlocking roof slates/tiles, or indirectly via special proprietary soakers in the case of double lapped natural slates or plain tiles. Information on the layout and positioning of the proprietary soakers for the Natural Slate and Plain Tile PV tiles respectively is given at the start of the relevant sections that follow.

3 PLAIN TILES (including ROSEMARY CLAY PLAIN TILES)

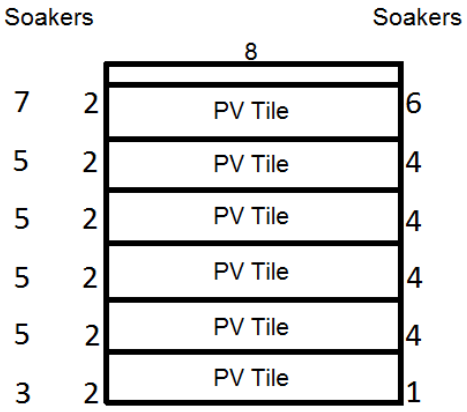
Each Plain Tile PV tile is approx. 11 Plain Tiles wide. It is important to note that the instructions below relate to the PV tile array and any special detailing required around the array. Everywhere else on the roof the standard fixing instructions for Plain Tiles (incl. Rosemary Clay Plain Tiles) should be followed. For Plain Tiles (incl. Rosemary Clay Plain Tiles) when installing Redland Solar PV tiles the tiling battens should first be set out with spacing (gauge) of 100 mm (+0 mm, -5 mm) only. If the PV tiles are set out at a gauge less than this it is possible that some PV cells will be partially covered or shaded by the PV tiles in the course above.

3.1 PLAIN TILE PV TILE SOAKER LAYOUT & POSITIONING

Before starting take a moment to familiarise yourself with the layout of the proprietary soakers supplied and their positions in relation to the PV tiles. All soakers are numbered, as shown below.

Soaker Reference Numbers

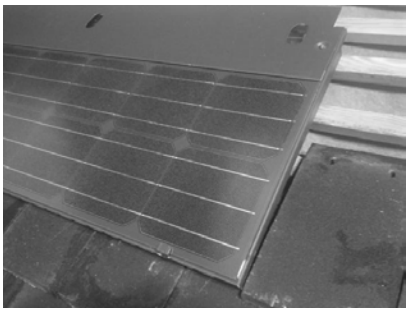
1. Bottom Right Hand Corner Soaker
2. Cover Soaker For Left Hand Side Of PV Tile
3. Bottom Left Hand Corner Soaker
4. Right Hand Centre Soaker
5. Left Hand Centre Soaker
6. Top Right Hand Soaker
7. Top Left Hand Soaker
8. Top Cover Soaker



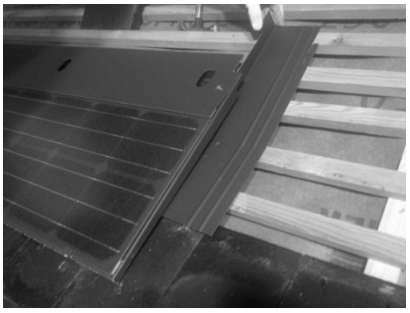
i. The course of plain tiles below the first PV tile course must be screwed. The fixing bracket must be positioned above the head of the plain tiles and positioned approx. 40 mm offset from the adjacent plain tile in the course above, as shown.

ii. The fixing bracket is then screw-fixed into place using the screws supplied.

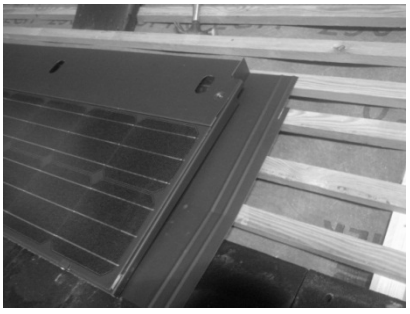
iii. Offer the PV tile into position and engage the clip on the rear of the PV tile into the head of the fixing bracket below. Ensure also the PV tile nibs hang on the top of the tiling batten. Screw fix the PV tile to the tiling batten in the 4 fixing points at the head of the PV tile.



iv. Slide soaker number 1 under the right hand side of the PV tile down until it is level with the bottom of the PV tile. It is advisable to loosen the outermost PV tile fixing screws to allow the soaker to slide down easier.

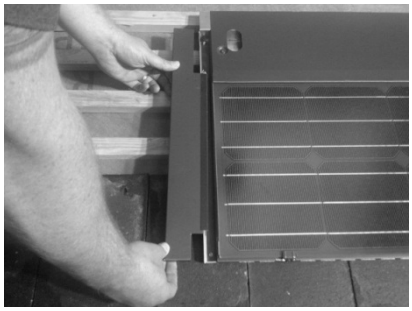


v. When Soaker number 1 is in its correct position bend the tab at the top of the soaker over the tiling batten to secure it in place.



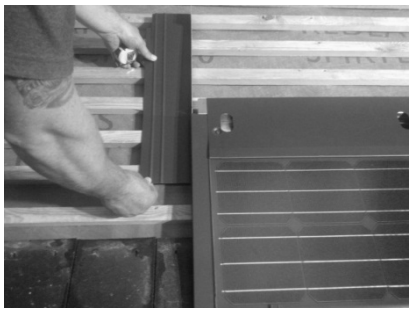
vi. Screw fix the plain tiles adjacent to the PV tiles as shown above. It will be necessary to remove all or part of the tile nibs in order for the plain tiles to sit flat without kicking up. Use tiles, and tile and halves to maintain the correct bond at the edge of the PV tile array.

vii. Offer up Soaker number 2 and locate under the PV glass ensuring it is level with the bottom of the PV tile as shown.

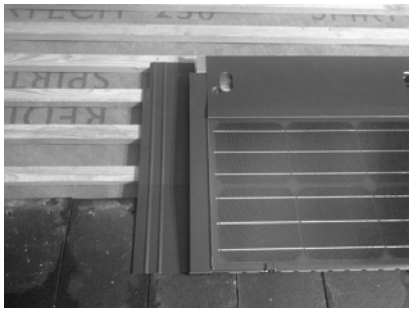


viii. Photo showing Soaker number 2 correctly installed.

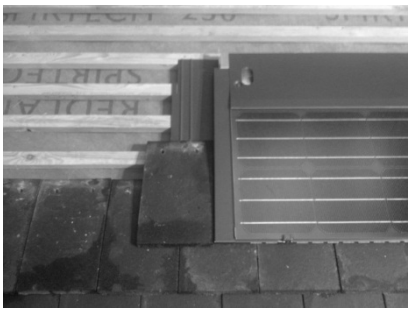
ix. After Soaker number 2 has been installed slide Soaker number 3 in from the top and ensure it goes under Soaker number 2 at the bottom left hand corner of the PV tile array.



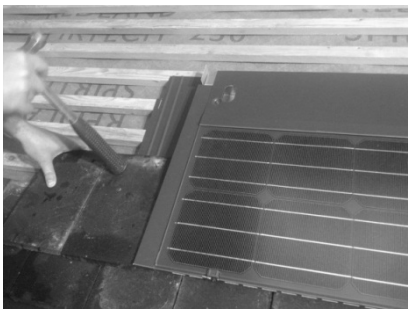
x. Photo showing Soaker number 3 correctly installed at bottom left hand corner of PV tile array.



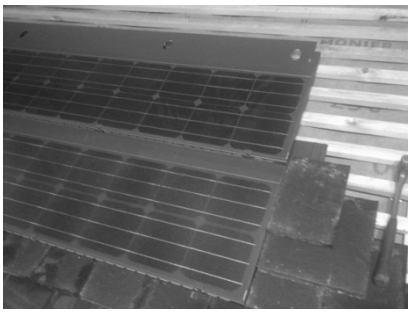
xi. Continue plain tiling at bottom left hand corner and left hand edge of PV tile array.



xii. Tile up to the PV tile as normal using tiles and tile and halves, removing tile nibs and screw fixing the tiles. The plain tiles may need to be cut to maintain the correct half bond.

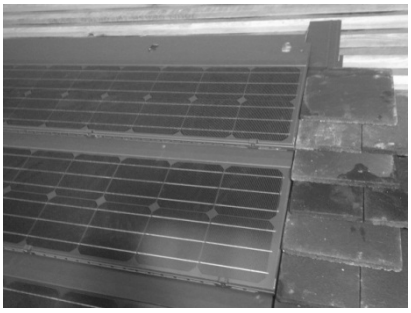


xiii. Install the next PV tile in straight bond making sure to engage the retaining clip at the bottom of the PV tile with the top edge of the PV tile below. Secure each PV tile with the 4 fixing screws supplied.

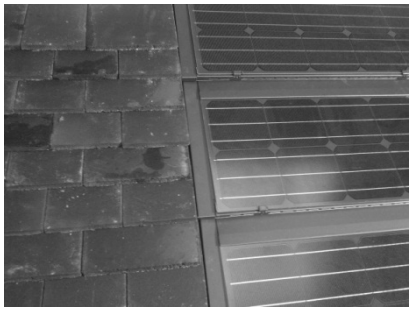


xiv. Slide Soaker number 4 (Soaker number 6 if it's the last PV tile course in the PV tile column; see soaker diagram) into place as with Soaker number 1 at right hand edge (corner) of PV tile array. The soaker is easier to install if you loosen the right hand head fixing screw of the PV tile. Once installed in correct position bend the tab at the top of the soaker over the tiling batten as with previous soakers.

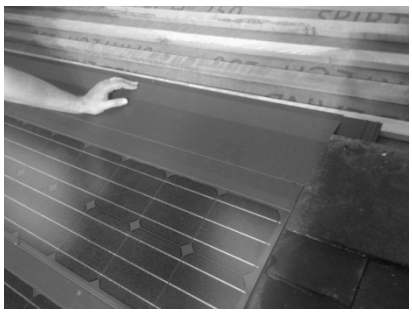
xv. Continue plain tiling up the right hand edge all the way to the top of the PV tile array using tiles and tail and a halves as required.



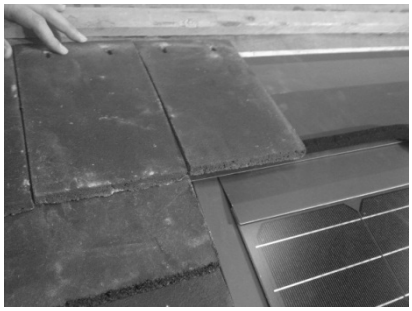
xvi. Continue fitting the correct soakers both at the right hand and left hand edge of the PV tile array as per the soaker diagram finishing with Soaker numbers 6 and 7 at the top right hand and top left hand corners of the PV tile array respectively.



xvii. At the top of the PV tile array Soaker number 8 (Top Cover Soaker) must be installed. To establish the correct position of the top soaker follow the instructions below. First locate Soaker number 8 across the top of the PV tiles as shown above.

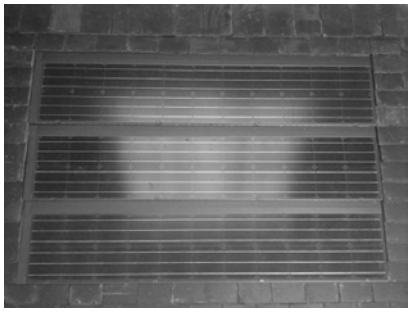


xviii. Before fixing the Top Cover Soaker offer up a plain tile and use the foam strip provided to establish the optimum position of the top soaker and foam for the tiles to sit in an even and level plane with plain tiles adjacent.



xix. Once the optimum position of the Top Cover Soaker is established it must be screw fixed into the tiling batten as shown.

xx. Finish plain tiling around the PV tile array.



4 CONNECTIONS TO INVERTER

For safety reasons it is very important that the electrical connections from the inverter to the PV tile array are made as per the following instructions.

Normally the inverter is located within the roof sub-structure (e.g. loft space) in the immediate proximity of the PV tile array so as to keep the length of cable on the DC side of the system to a minimum. The cabling from the inverter to the PV tile array inside the roof structure must be properly secured throughout its length using clips or cable ties as appropriate. The inverter should always be mounted vertically on the wall on a non-combustible base or board fixed to the roof structure and in a location that is easily accessible for servicing and testing.

A DC switch should always be installed between the PV tile array and the inverter. Many inverters contain an integrated DC switch but it is possible that your inverter may not have an integrated switch. Check the technical specifications of the inverter and local regulations before installation.

As per the circuit diagram at either end of each string of PV tiles (connected in series) the + and – pre-wired connections must be connected to the correct inputs of the DC to AC inverter. These electrical connections are made as follows:

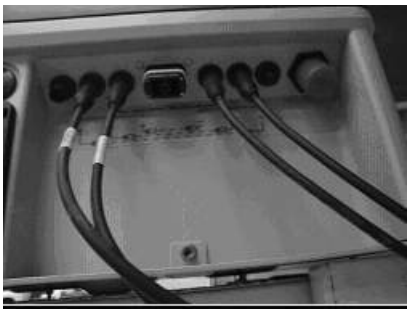
i. The 10 m cables supplied are used to make the electrical connections from the first and last PV tiles in each string back to the inverter. It is recommended that these cables are routed between the underlay and tiling battens and fed through a horizontal lap in the underlay near the apex of the roof into the roof space below (and ultimately to where inverter is located).

ii. Before the cables from the inverter are connected to the pre-wired connectors of the PV tile array it is essential that they are first properly secured by wrapping around a batten-rafter junction as shown above. This relieves any strain on the connectors and prevents the inverter cables detaching from the PV tile connectors.

iii. Once the inverter cable has been secured as in step (ii) then it can be connected to the pre-wired connectors of the PV tile array as shown.

iv. The + and – connections from each end of the string of PV tiles are connected to the + and – inputs of the inverter as per the circuit diagram.

v. Additional strings of PV tiles connected in electrical series can be connected to the inverter using the other sets of + and – inputs available on the box. Note the maximum number of PV tiles that can be connected to the inverter is only limited by the capacity of the inverter. Check that the inverter has sufficient capacity for the size of the PV tile array being connected. For large projects more than one inverter may be required.



5 REPLACING A PV LAMINATE

If a Redland Solar PV tile becomes damaged due to vandalism or for any other reason it will need to be replaced. It is possible to replace individual PV tile laminates for Natural Slate, Richmond 10, Saxon 10, Landmark Slate 10, MockBond Richmond 10, Mini Stonewold / Mockbond Mini Stonewold, Landmark Double Pantile / Grovebury, Landmark Double Roman / 50 Double Roman, Plain Tiles (inc Rosemary Clay) and DuoPlain without stripping off the installed PV tile array as follows.

i. First remove the damaged laminate by unscrewing the small brackets at the leading edge of the damaged PV tile and sliding the laminate out of the frame.
ii. Cut the pre-wired connector of the PV tile above the damaged PV tile so that the plug connection is removed.
iii. Wire a new plug to the pre-wired cable of the PV tile above.
iv. Insert new PV laminate into frame securing with screwed brackets at leading edge.
v. Connect new PV laminate pre-wired connector to new plug of PV tile above.

FIXING INSTRUCTIONS ISSUED BY REDLAND TECHNICAL SOLUTIONS:
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