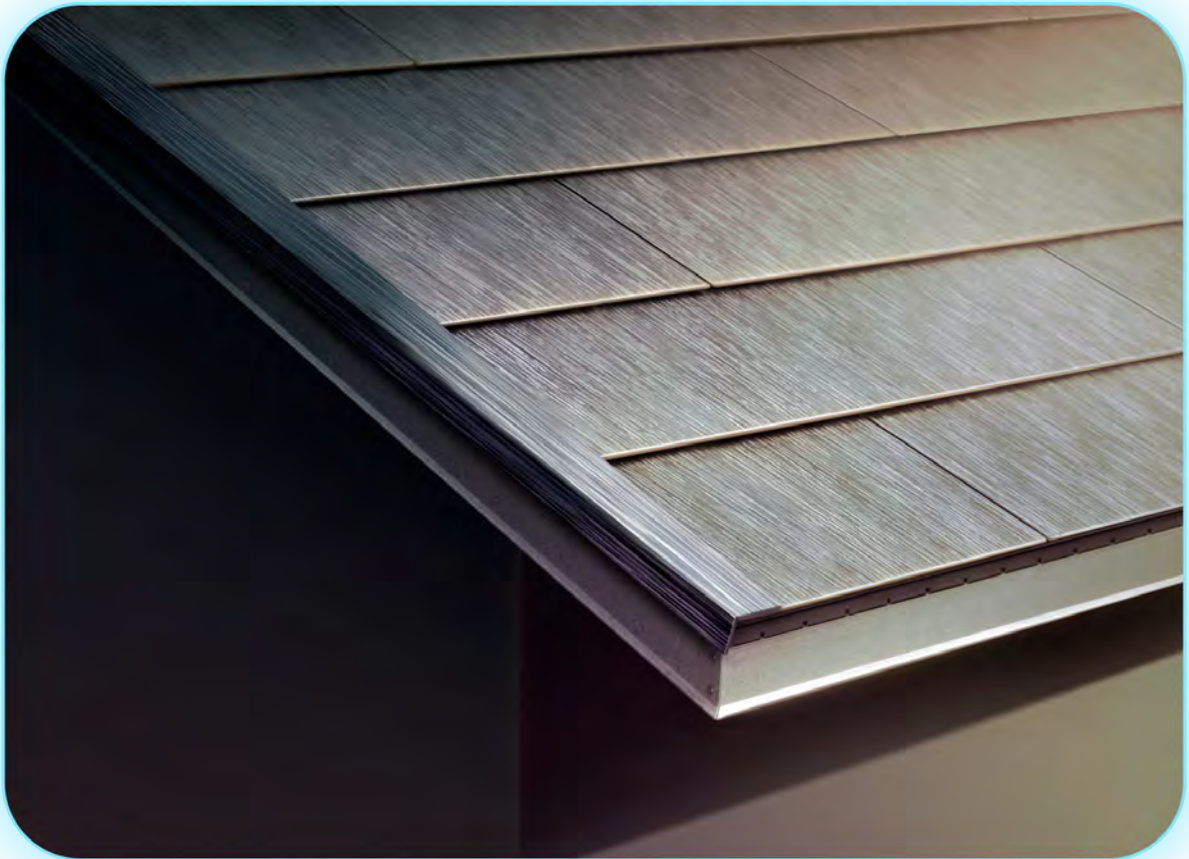




SOLAR ROOF INSTALLATION MANUAL



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WHAT'S NEW

DISCLAIMER

This document is updated as often as possible, but some sections may become outdated as a result of rapid, unforeseen changes in the service development process.

Latest Changes to This Manual

Date	Changes
March 27, 2026	Initial release.



DISCLAIMER OF LIABILITY, NOTICES, CONTACT INFORMATION

Disclaimer of Liability

Tesla Incorporated ("Tesla") and its subsidiaries are not liable for any damages caused by failure to follow the instructions and guidelines found in this manual, or from inappropriate use or maintenance of the Solar Roof system. This includes, without limitation, any damages, losses, and expenses caused by non-observance of the instructions of this manual, as well as damages, losses, and expenses caused by, or in connection with, products of other manufacturers.

Notices

The information in this manual is believed to be reliable, but does not constitute an express or implied warranty. Tesla reserves the right to make changes to its Solar Roof Tiles and other products, their specifications, or this manual without prior notice.

The documentation shall state that artificially concentrated sunlight producing a PV module's current above the value reported on the nameplate shall not be directed onto the front side or the back side of the PV module.

This manual applies to Solar Roof PV Tiles, Metal Tiles, the flashing system, and electrical wiring elements manufactured by Tesla. It is explicitly written for qualified professionals ("Installer" or "Installers").

Contact Information

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Tesla, Inc

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Palo Alto, CA 94304 U.S.A.

ISSUE DATE: TBD



IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE IMPORTANT SAFETY INSTRUCTIONS

All instructions must be read and understood before attempting to install, wire, operate, or maintain a PV system. Failure to read and comply with any of the limitations noted herein can result in property damage, serious bodily injury, or death.

Abide by local, regional, and national statutory regulations when installing the system, and obtain a building permit if necessary. Consult your local authority for guidelines and requirements for building or structural fire safety.



DANGER: NOTE TO TRAINED PROFESSIONALS

Tesla Solar Roof requires specialized skills and knowledge. Use qualified personnel for installation. The installer assumes the risk of all injury that might occur during installation, including, without limitation, the risk of electric shock.

Tesla Solar Roof is slippery when wet and is a fall hazard. Only access a Solar Roof with appropriate safety equipment and while wearing personal fall protection equipment. Use fall protection when working from heights of 6 feet (183 cm) or above. Follow Occupational Safety and Health Act (OSHA) or local governing safety regulations regarding Fall Protection.

An approved and safe walking platform should be used when accessing the roof to prevent falls, and damage to the roof. In addition, skylights, roof openings and light transfer panels must be covered with approved covering to prevent falls.

Tesla Solar Roof is engineered to safely withstand applicable live loads required by building code for steep slope applications. However, to ensure safety and maintain maximum roof life, walking on a Solar Roof should be avoided except by trained Tesla Solar Roof installation professionals and first responders. This is a common recommendation for other high-end roof types, including slate, clay, concrete, and composite tile products.

In the event of a fire at the premises, rapid shutdown equipment in the array will reduce voltages and control the hazard for firefighter operations. Nevertheless the array wiring should be treated as potentially dangerous, especially if it is damaged by heat or flames. Inform the fire crew about the particular hazards from the PV system, and stay away from all elements of the PV system during and after a fire until the necessary steps have been taken to make the PV system safe.

When replacing lightweight roofing materials such as architectural shingles, metal, synthetic, or other roof coverings, it may be necessary to evaluate the existing structural framing and lateral system. In these instances, the installer shall consult with a registered design professional prior to installation of Solar Roof.



IMPORTANT SAFETY INSTRUCTIONS



DANGER: ELECTRICAL SAFETY PRECAUTIONS

- **Use equipment, connectors, and wiring suitable for solar electric systems.** Use insulated tools that are approved for working on electrical installations. Do not open electrical connections or unplug connectors while the circuit is under load.
- Do not use PV Tiles near equipment or in places where flammable liquid, gases, or other hazardous materials are located.
- **Work under dry conditions and use dry tools.** Do not handle Solar Roof PV Tiles under wet conditions unless wearing appropriate protective equipment or attempt to make an electrical connection with wet, soiled, or otherwise faulty connectors.
- **Prevent damage to Solar Roof Tiles.** Wear non-slip gloves when carrying Tiles and exercise caution when transporting and installing Tiles. Do not lift any PV Tiles by the Tile's junction box or electrical leads. Do not drop Tiles or allow objects to fall on Tiles. Do not leave a Tile unsupported or unsecured. A damaged Tile cannot be repaired and must not be used. Do not use a PV Tile with broken glass.
- **Do not disassemble or modify PV Tiles in any way.** Do not apply paint or adhesive to any PV Tile top surface or backsheet. Doing so may degrade performance or cause irreparable damage and will void any applicable warranties.



DANGER: OPERATION CONDITIONS

- The operating temperature of PV Tiles must be within -40°C (-40°F) to 85°C (185°F).
- Do not install PV Tiles above 13,120 ft (4,000 m) altitude above sea level.

A PV Tile may experience conditions that produce more current and/or voltage than reported at standard test conditions. Follow the requirements of the National Electrical Code (NEC) in Article 690 to address these increased outputs. In installations not under the requirements of the NEC, multiply the values of I_{sc} and V_{oc} marked on the Solar Roof PV Tiles by a factor of 1.25 when determining component voltage ratings, conductor capacities, overcurrent device ratings, and size of controls connected to the PV output.



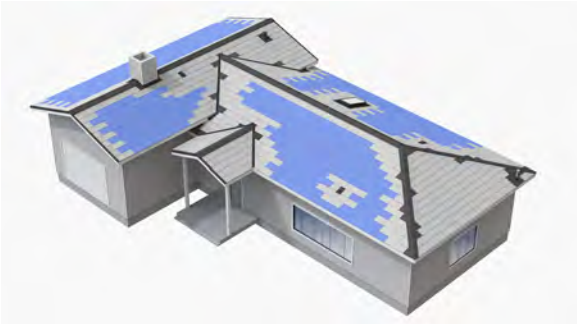
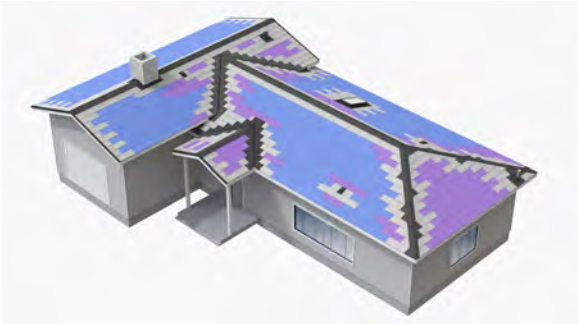
INTRODUCTION TO SOLAR ROOF

Solar Roof is a building-integrated photovoltaic (PV) system that is an aesthetically unparalleled solar energy solution. The seamless combination of power-producing and non-power-producing tiles allows a Solar Roof to be fully integrated and customizable to various roof shapes and sizes.

A Solar Roof functions in fundamentally the same way as traditional roof-mounted PV systems. Sunlight is converted to DC electricity at each individual module. Individual modules are connected in series to form a complete PV "string." One or more strings connect in parallel at a typical string inverter to convert power to AC.

Solar Roof features include:

- PV Tiles
- Tempered glass
- Silicon cells
- Glass-reinforced composite & encapsulant
- J-boxes, PV wire and Listed connectors
- Series strings below 600 V
- DC - AC inverters
- Rapid shutdown

Base / Fortified System		High Velocity Hurricane Zone (HVHZ) System	
Key Components Overview		Key Components Overview	
			
Legend		Legend	
PV Tiles		PV Tiles	
Metal Tiles		Metal Tiles	
Metal Flashings		Metal Flashings	
		Glass Tiles	



INTRODUCTION TO SOLAR ROOF

System Specifications

Mechanical Loading and Operation Parameters		
Tile Reveal and Coverage		15.4 in x 45.5 in (4.86 sqft)
Roof Pitch Limit		Minimum: 2:12 slope (9.46°)
Wind Rating		D3161 Class F
Impact Resistance Rating		UL 2218 Class 4
Fire Rating		UL 7103/UL 790 Class A
Safety Class		Class II
Roof Snow Load		Up to 9.576 kPa 200 psf surface-normal
		Up to 4.417 kPa 92 psf shear
PV Tile Power Output Tolerance		-0 /+5 %
Operational Temperature		-40 °C / -40 °F up to 85 °C / 185 °F
System Certifications and Compliance		
UL 7103/UL 790 Class A (UL Listed)	TAS100 (PRI Listed)	California Cool Roof Compliant
UL 61730 (UL Listed)	UL 7103 (UL Listed)	IBHS Fortified Roof Compliant
UL 1741 (UL/ETL Listed)	UL 9703 (UL Listed)	WUI Compliant Roof Assembly
UL 3741 (ETL Listed)	ASTM D1970 / ICC AC188 (ETL, PRI Listed)	Florida Building Code Approved
UL 790 Class A (UL Listed)	ASTM D3161 Class F (UL Listed)	High Velocity Hurricane Zone Approved

Warranty Information

Please find the latest warranty information on [this Partner Portal page](#).



Decking Requirements

Substrate and Sheathing Requirements

Decking for Solar Roof shall be a code-compliant wood structural panel conforming to DOC PS-1 or DOC PS-2, rated Exposure 1 or Exterior Grade; or code-compliant closely-fitted solid sheathing boards. Refer to **Thickness Requirements** below to determine the governing thickness based on fire classification and required wind resistance.

Sheathing and supporting framing shall be free of damage, defects, or decay which could impact strength, serviceability, or fastener performance.

Thickness Requirements	
Material	Minimum Deck Thickness for Fire Classification
	Class A, Class B
Plywood	15/32 in
OSB	7/16 in
Boards	¾ in

The roof deck surface needs to be free from loose or protruding nails or staples, dust, dirt, debris or any other protrusions. Lifted fasteners may compromise the new underlayment. Hammer down or remove nails and staples so they are flush to the deck. Ensure that the work surface is clean, smooth, and dry for your team's safety and convenience. Do not install over the following conditions:

- Widely spaced sheathing boards (sometimes referred to as "skip sheathing") or sheathing that is less than the required minimum thickness
- Areas where the sheathing is not installed correctly, for example leaving gaps greater than ¼ in
- Areas with water damage, dry rot and/or mold
- Pest damage such as termites

Where the existing sheathing does not meet these requirements, use one of the following remediation routes:

- Sheathing overlays, where permissible by the Authority Having Jurisdiction, shall be provided such that the net embedment of all roofing fasteners is not less than ¾ in.
- Sheathing replacement, with a performance class in compliance with all applicable code requirements, shall be performed, with a minimum thickness greater than or equal to those specified above.

Do not install Tesla Solar Roof over widely-spaced sheathing boards (sometimes referred to as "skip sheathing"). Retrofitting the existing structure with solid sheathing would be necessary. Verify the capacity of the existing structure to carry this additional load. As this procedure is beyond the scope of this manual, contact Tesla for engineering support prior to such modification.



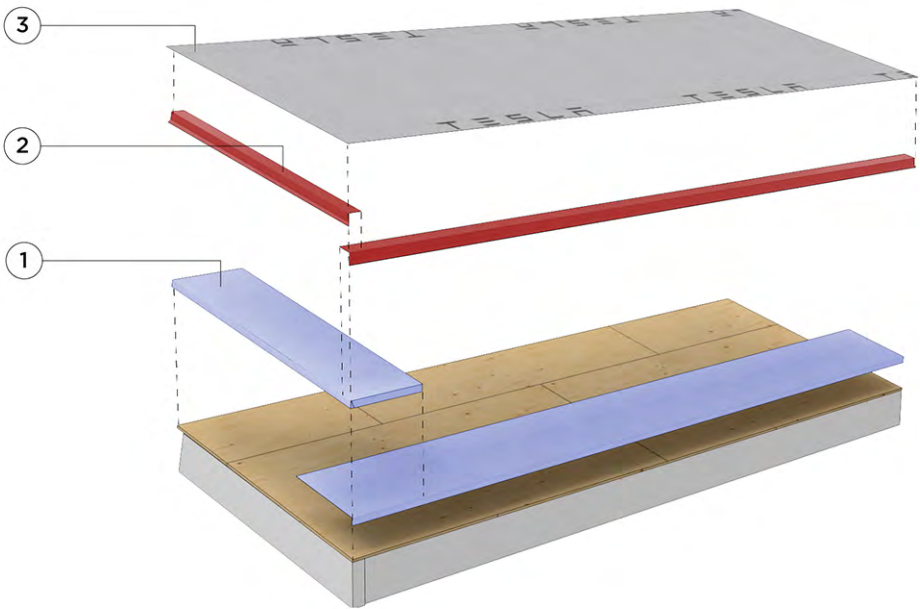
Underlayment Overview

Model Number	SR-SAUL-1
	SR-SAUL-2
	SR-SAUL-3

SR-SAUL-1, SR-SAUL-2, and SR-SAUL-3 is a self-adhering peel and stick roofing underlayment designed for sloped roof applications to help protect against water infiltration from ice dams and wind-driven rain. It is installed with Solar Roof as a single layer application.

Certifications
ASTM D1970/ICC AC48
ICC AC188
ASTM E108 Class A when installed with the Solar Roof system

Underlayment Installation and Layering Order
1. Detail Roll 2. Drip Edge 3. Underlayment





Tile Overview

PV Tile Overview

Model Number	SR86T3R
Principal Materials	Glass, Polymers, Fiberglass and Silicon
Dimension	417 mm x 1150 mm x 6.2 mm 16.41 in x 45.27 in x 0.25 in
Tile Reveal	Fixed: 15.4 in
Height from Deck	35.3 mm 1.375 in
Roof Covering Weight	13.56 kg/m ² 2.778 psf
Validated to	UL 61730, UL 9703, UL 1741, UL 3741, UL 790 Class A, UL 7103

PV Tile Overview

1. Footlap

2. Foot

3. Backer

4. Junction Box

5. PV Wires

6. PV Tile Hooks

Top View

Bottom View

Solar Roof Installation Manual

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INTRODUCTION TO SOLAR ROOF

Electrical Characteristics	
	SR86T3R Model
Test Method	STC
Max Power, P_{MAX}	86 W
Open Circuit Voltage, V_{OC} per diode	26.60 V
Short Circuit Current, I_{SC}	4.06 A
Max Power Voltage, V_{MP}	22.51 V
Max Power Current, I_{MP}	3.79 A
STC	1000 W/m ² , 25°C, AM 1.5 spectrum
Temperature Rating (STC)	
Temperature Coefficient of I_{SC}	0.0449 % / K
Temperature Coefficient of V_{OC}	-0.2806 % / K
Temperature Coefficient of P_{MAX} (W)	-0.367 % / K
Operation Parameters	
Operational Temperature	-40 °C / -40 °F up to 85 °C / 185° F
Power Output Tolerance	-0 /+5 %
Max System Voltage	DC 1000 V (IEC/UL) for installations above 2000 m but below 3000 m the system voltage is 877 V
Max Series Fuse Rating	20 A
Safety Class	Class II
Mechanical Parameters	
Cells	13
Junction Box	IP68, 2 diodes
Cable	12 AWG PV Wire 800 mm 31.5 in length
Connector	Staubli MC4 type PV-KST4/6II-UR or type PV-KST4-EVO2 (male) and Staubli MC4 type PV-KBT4/6II-UR or type PV-KBT4-EVO2 (female)

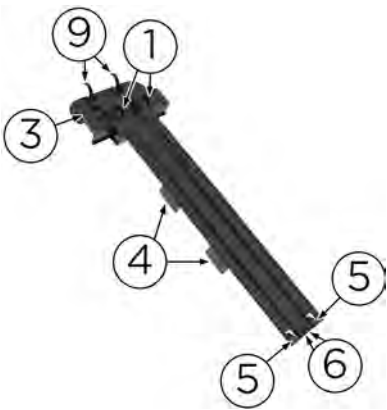
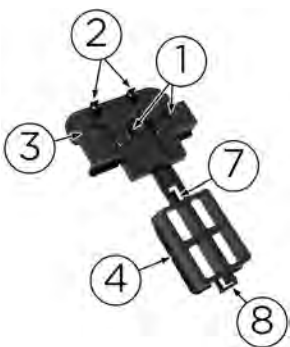


INTRODUCTION TO SOLAR ROOF

Mounting Hardware

The PV tile comes pre-assembled with mounting hardware: the foot and footlap. These components also have features that aid in fastening, tile alignment and wire management.

Name	Model Number	Image
Foot	2204567-00-A	
Footlap	2204566-00-A	

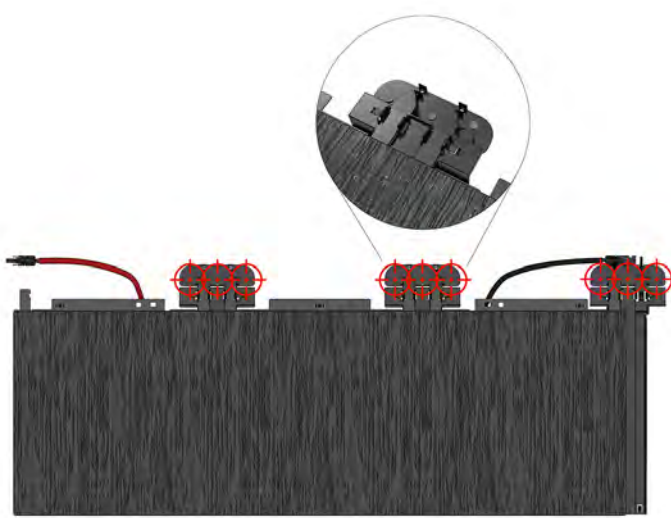
Foot / Footlap Hardware Overview	
1. Engagement Clips 2. Home Run / Jumper Cable Management Slots 3. Target Holes 4. Supports 5. Footlap Interference Prevention Tabs 6. Alignment Marks 7. Junction Box Wire Slots 8. Wire Management Slot 9. Connector Management Slot	 



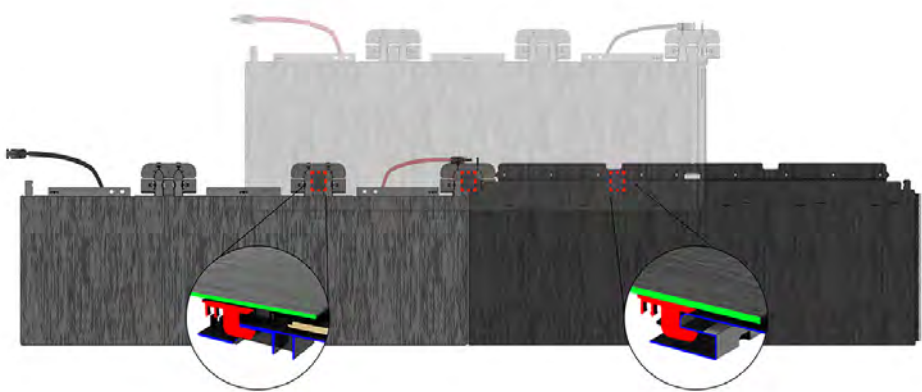
INTRODUCTION TO SOLAR ROOF

Fastening Hardware

 **NOTE:** Refer to the [Fastener Schedule on page 86](#) for fastener specifications.

Foot / Footlap Target Holes	
Description	Target holes that define PV tile fastening locations.
Image	

Interlocking / Alignment Hardware

PV Tile Hook	
Description	Built-in hooks that engage with the foot and footlap dedicated slots and metal tile shoulder to secure the PV tile into place.
Image	



PV Tile Hook





INTRODUCTION TO SOLAR ROOF

Metal Tile Overview

Metal tiles can be installed in place of PV tiles as well as below, adjacent to, or over PV tiles. Metal tiles can also be installed anywhere on the roof that requires tile cutting or modification.

Model Number	SRMTT3R
Principal Materials	PVDF Coated 24 Gauge Galvalume
Dimension	459 mm x 1150 mm x 11 mm 18.07 in x 45.28 in x 0.46 in
Tile Reveal	Adjustable: 15.15 in to 15.65 in
Height from Deck	35.3 mm 1.375 in
Roof Covering Weight	8.40 kg/m2 1.72 psf
Validated to	UL 1897, UL 7103, UL 790 Class A, ASTM D3161 Class F, TAS100

Metal Tile Overview

1. Engagement Tab, Metal Tile Nose

2. Nominal / Max Reveal Marks

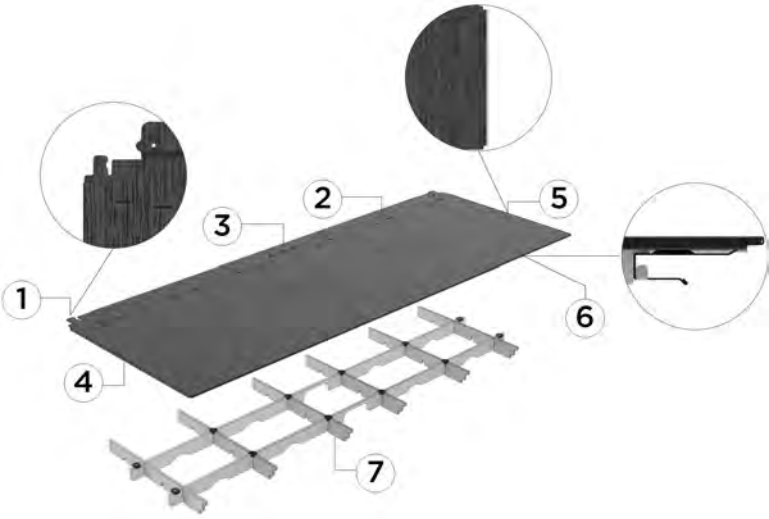
3. Tile Timing Marks

4. Left Side Open Hem

5. Right Side Open Hem

6. Lower Engagement Hook

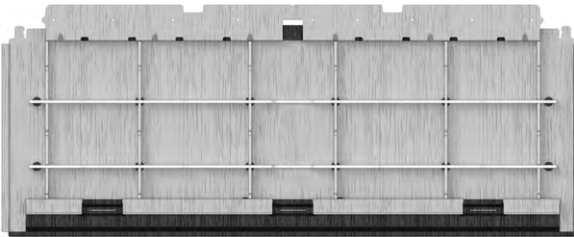
7. Lattice for Structural Support



Top View



Bottom View



Solar Roof Installation Manual

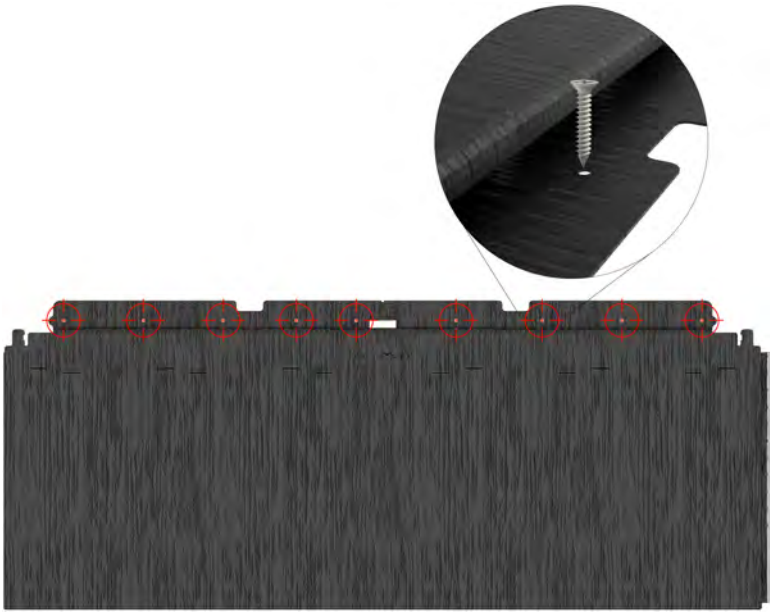
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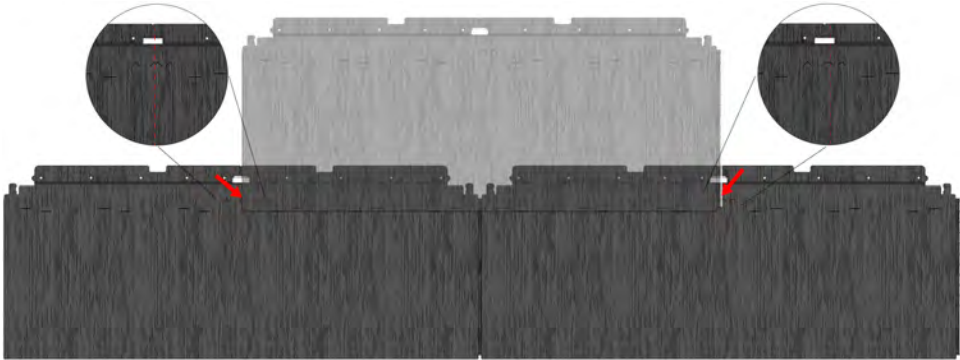
INTRODUCTION TO SOLAR ROOF

Fastening Hardware

 **NOTE:** Refer to the [Fastener Schedule on page 86](#) for fastener specifications.

Metal Tile Target Holes	
Description	Optional target holes located on the metal tile shoulder that can guide fastening (fastening directly through these target holes is not required).
Image	 A diagram showing a row of dark metal tiles. Red dashed circles are marked along the top edge of the tiles, indicating target holes for fasteners. A circular inset provides a close-up view of a screw being driven into one of these target holes on the shoulder of a tile.

Interlocking / Alignment Hardware

Metal Tile Timing Marks	
Description	Vertical marks that set proper tile stagger during installation.
Image	 A diagram showing two rows of dark metal tiles. Red arrows point to vertical alignment marks on the tiles. Two circular insets provide close-up views of these marks, showing how they are used to align the tiles for proper interlocking and stagger.



INTRODUCTION TO SOLAR ROOF

Metal Tile Nominal / Max Reveal Marks	
Description	Horizontal marks that determine the tile max (1) and nominal (2) reveal.
Image	
Metal Tile Horizontal Alignment Features	
Titles / Description	• Engagement Tabs (1): Installed into the footlap engagement clips to ensure alignment • Bump Out (2): Aligns with the footlap edge • Tile Top Edge (3): Coincides with the top edge of the footlap
Image	
Metal Tile Open Hem	
Description	Adjacent metal tiles lock into each other through the open hem along the water channel. The tile slides down from the top until it reaches the nominal reveal line.
Image	



Metal Tile Lower Engagement Hook	
Description	When installing metal tiles over each other, the upper metal tile's lower engagement hook engages with the lower metal tile's nailing shoulder.
Image	
Metal Tile Cutting Marks	
Description	The metal tile sides feature marks at 1 in increments to guide cutting.
Image	



Glass Tile Overview

Non-electrical tempered glass tiles buffer the solar array at all edge conditions and are installed in High Velocity Hurricane Zones (HVHZ). Glass tiles can be installed in place of, below, adjacent to or over PV tiles. Glass tiles can also be installed against metal trim and flashings.

Model Number	SRNFT3R
Principal Materials	Glass, Polymers and Fiberglass
Dimension	417 mm x 1150 mm x 6.2 mm 16.42 in x 45.28 in x 0.24 in
Tile Reveal	Fixed: 15.4 in
Height from Deck	35.3 mm 1.375 in
Roof Covering Weight	11.07 kg/m ² 2.26 psf

Glass Tile Overview

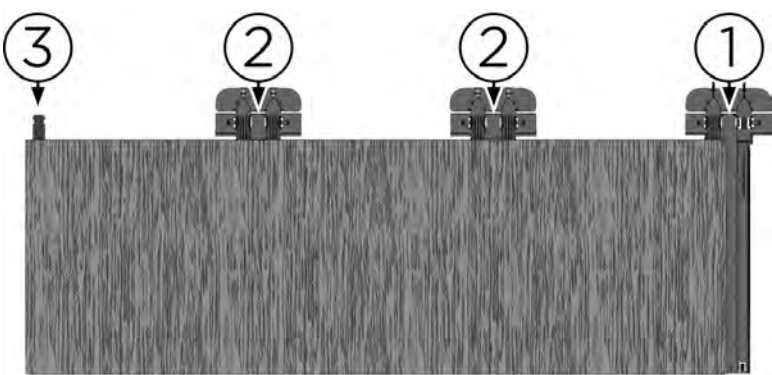
1. Footlap

2. Foot

3. Backer

4. Glass Tile Hooks

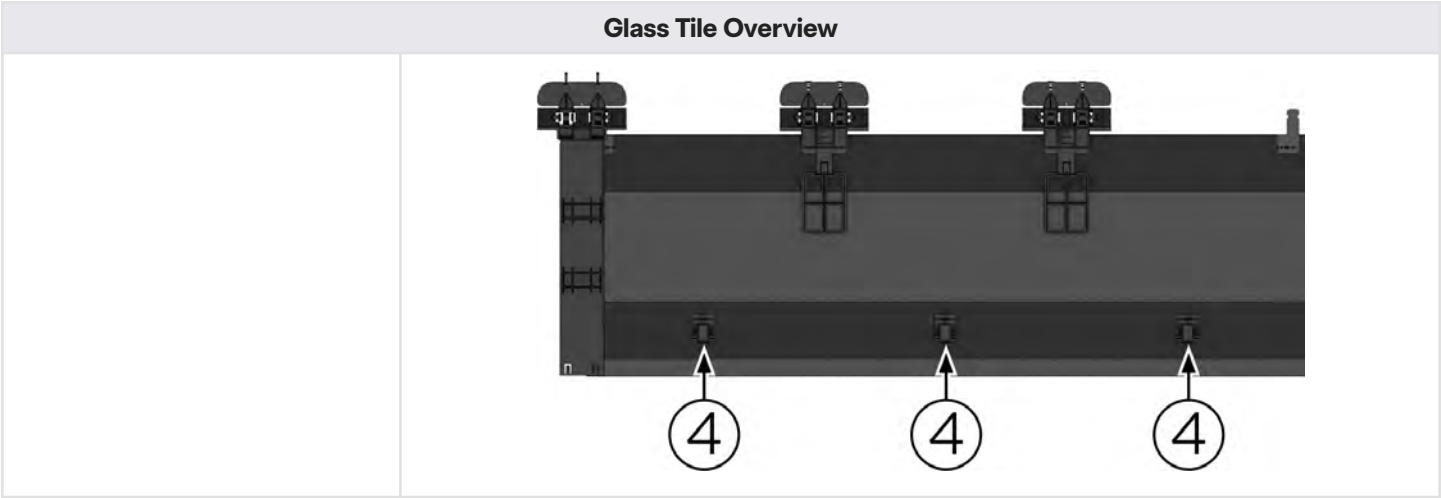
Top View



Bottom View



INTRODUCTION TO SOLAR ROOF

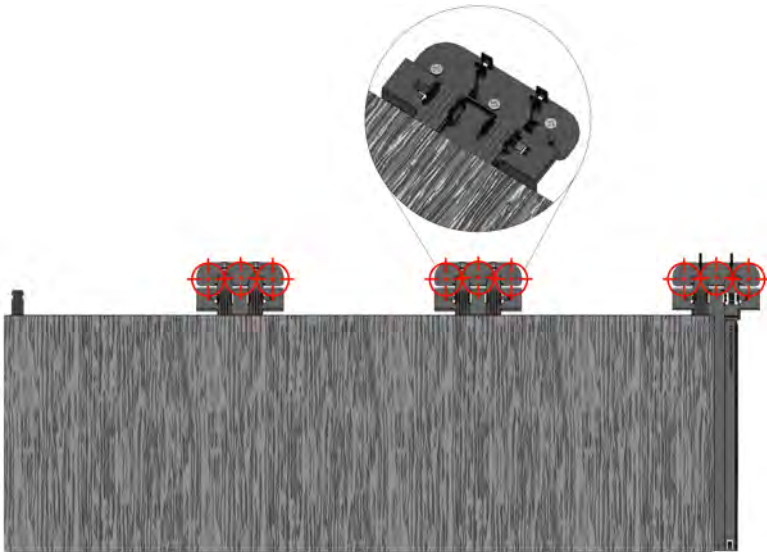




INTRODUCTION TO SOLAR ROOF

Fastening Hardware

 **NOTE:** Refer to the [Fastener Schedule on page 86](#) for fastener specifications.

Foot / Footlap Target Holes	
Description	Target holes that define glass tile fastening locations.
Images	

Part Catalog

 **NOTE:** Please note that the letter "X" at the end of all part numbers signifies a generalized letter that replaces the most up to date letter. When ordering, ensure that the numerical part number is accurate in Partner Portal.

Tiles

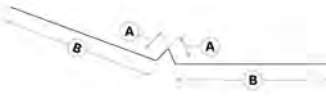
Part	Description	Part Number
PV Tile 	The photo-voltaic (PV) tile is the power producing component of the roof. the tile is rated for [X] Watts. [UL Listing] Tile Dimensions including the feet and footlap (LxWxH): 48in x 20in x 1.3in	3330000-00-X
Metal Tile 	Metal tiles are used where PV tiles are not, with the exception of HVHZ zones. [UL Listing] Part Dimensions (LxWxH): 46in x 20in x 1.2in	2200153-01-X
Glass Tile	Non photo-voltaic tempered glass tiles buffer the solar array at all edge conditions and are installed in High Velocity Hurricane Zones (HVHZ).	2205539-00-X



INTRODUCTION TO SOLAR ROOF

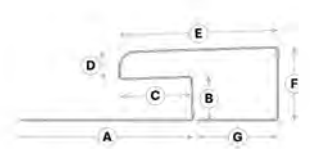
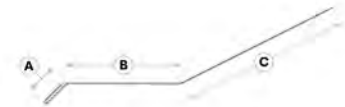
Part	Description	Part Number
	[UL Listing] The Tile Dimensions including the feet and footlap (LxWxH): 48in x 20.3in x 1.2in	

Dry In and Perimeter

Part	Description	Part Number
Underlayment 	The Underlayment is a self-adhered weatherproofing membrane protects the roof against water intrusion and provides a Class A or Class C fire rating. Class A Dimensions (unrolled LxW): 75ft x 33"	Class A 1613738-03-X 1947922-00-X Class C 1751844-00-X
Detail Roll 	The Detail Roll is a weather-proofing membrane that creates a full roof perimeter and is used at features and details. Part Dimensions (unrolled LxW): 107ft x 9"	1636403-10-X
Wall Flashing 	Wall Flashing is the flashing used at wall intersections. Part Dimensions (LxWxH): 10ft x 10in x 4in  • (A) – 4in • (B) – 10in	1813367-02-X
Valley Pan 	The Valley Pan is the flashing used in valleys. Part Dimensions (LxWxH): 10ft x 15in x 1in 	1809953-02-X

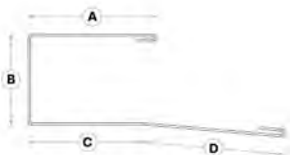
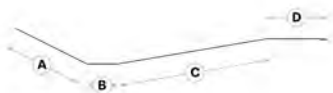
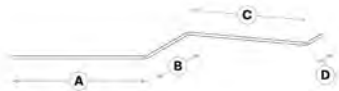


INTRODUCTION TO SOLAR ROOF

Part	Description	Part Number
Surface Mount Counter Flashing 	The Surface Mount Counter Flashing is the Surface Mount Masonry and Stucco Counter Flashing. Part Dimensions (LxWxH): 10ft x 5.3in x 0.3in 	1145837-05-X
Reglet 	The Reglet is the counter flashing for brick features. Part Dimensions (LxWxH): 10ft x 12.5in x 0.9in 	1145809-08-X
Vented Riser 	The Vented Riser is used to provide airflow and support at the eaves, ridges, and valleys. Part Dimensions (LxWxH): 10ft x 4in x 1.3in 	1854532-04-X
Drip Edge 	The Drip Edge is used at the eaves and rakes to divert water away from the fascia cover. Part Dimensions (LxWxH): 10ft x 5in x 1.5in 	1849932-02-X
Channel Flashing	The Channel Flashing accepts cut tile edges at rakes, hips, and other details.	1818864-02-X



INTRODUCTION TO SOLAR ROOF

Part	Description	Part Number
	Part Dimensions (LxWxH): 10ft x 5in x 2in	
		
Transition Flashing 	Transition Flashing is used to transition from deck-level to tile-level at the details. Part Dimensions (LxWxH): 10ft x 15.6in x 1.8in	1810487-03-X
		
Cleat 	The Cleat is used to create attachment to the roof without exposing fasteners. Part Dimensions (LxWxH): 66in x 3.5in x 0.5in	1849921-00-X
		
Deck Vent 	The Deck Vent is always paired with a Tile Vent to support ventilation within the mounting plane. Part Dimensions (LxWxH): 21.7in x 15in x 0.5in	1606873-00-X
Black Sealant 	Black Sealant is used on metal-to-metal junctions and corners on both features and details around the roof.	1784898-00-X
Flex Flashing Roll	A Flex Flashing Roll is used for details that may not be highly visible	1776371-01-X



INTRODUCTION TO SOLAR ROOF

Part	Description	Part Number
	Part Dimensions (unrolled LxW): 16.4ft x 11"	
Wire Mesh 	A Wire Mesh is used to complete Wildland Urban Interface (WUI) compliance – this is accomplished by closing any gaps greater than ¼ in. Part Dimensions (unrolled LxW): 25ft x 6"	1460521-00-X
Ridge Roll 	A Ridge Roll is used to mitigate against water ingress at the ridge vent. Part Dimensions (unrolled LxW): 20ft x 7"	1893856-00-X
DWV - Deck Boot, 1-1/4 to 4 in 	The Drain Waste Vent is used for dry in at the deck level on plumbing vents. Part Dimensions (LxWxH): 16in x 15in x 2.7in	1856360-13-X
Heat Vent - Deck Boot, 3 to 8 IN 	The Heat Vent is used for dry in at the deck level. Part Dimensions (LxWxH): 24in x 20in x 4in	1719372-00-X

Tile Level Flashings

Part	Description	Part Number
Tile Skin 	Tile skins are used to cover gaps, allow access or damage in the system. Use cases: link Part Dimensions (LxWxH): 45.7in x 16.3in x 0.3in	2204415-01-X



INTRODUCTION TO SOLAR ROOF

Part	Description	Part Number
Tile Vent 	Tile vents are used to provide attic ventilation where venting at the ridge or when soffit is not available. Part Dimensions (LxWxH): 45.75in x 19.75in x 4.75in	2204024-00-X
Flat Stock 	The Flat Stock is paint matched and used for custom metal fabrication. Part Dimensions (LxWxH): 66in x 24in x 0.02in	1843746-03-X
DWV - TILE BOOT-1/4 to 4 in 	The Drain Waste Vent is used at the tile level to aesthetically complete the detail. Part Dimensions (LxWxH): 29.5in x 15in x 2.7in	1856360-13-X
Heat Vent - Flashing, 4 in, High Pitch 	A Heat Vent paired with a 4in cap is used at the tile level to aesthetically complete the detail Part Dimensions (LxWxH): 31.9in x 17in x 9.7in	1820727-03-X
Heat Vent - Flashing, 8 in, High Pitch 	A Heat Vent paired with a 8in cap is used at the tile level to aesthetically complete the detail Part Dimensions (LxWxH): 37.5in x 20.9in x 9.7in	1820727-13-X
Heat Vent - Flashing, 4 in, Low Pitch 	A Heat Vent paired with a 4in cap is used at the tile level to aesthetically complete the detail Part Dimensions (LxWxH): 31.9in x 17in x 5.9in	1820726-03-X
Heat Vent - Flashing, 8 IN, Low Pitch	A Heat Vent paired with a 8in cap is used at the tile level to aesthetically complete the detail Part Dimensions (LxWxH): 37.5in x 20.9in x 11in	1820726-13-X



INTRODUCTION TO SOLAR ROOF

Part	Description	Part Number
		
Heat Vent Cap, 4 in 	A Heat Vent Cap is used at the tile level and is combined with a same-sized Heat Vent Flashing.	1666803-04-X
Heat Vent Cap, 8 IN 	A Heat Vent Cap is used at the tile level and is combined with a same-sized Heat Vent Flashing.	1666807-04-X
Cap 	A Cap is used at ridges, hips, and junctions. Part Dimensions (LxWxH): 19.6in x 15.5in x 2.1in	1812163-02-X
Right Adjustable Trim Cover 	A Trim Cover that covers cut tile edges. Part Dimensions (LxWxH): 26.6in x 14.9in x 1.3in	2204000-00-X
Left Adjustable Trim Cover 	A Trim Cover that covers cut tile edges. Part Dimensions (LxWxH): 26.6in x 14.9in x 1.3in	2203997-00-X
Shingle Flashing	A Shingle Flashing is used for small mounting planes not connect to the main roof surface. Part Dimensions (LxWxH): 44.9in x 13.1in x 0.2in	1877905-02-X



INTRODUCTION TO SOLAR ROOF

Part	Description	Part Number
		
Coil Stock 	Coil Stock is paint that is used for custom metal fabrication.	1472512-05-X

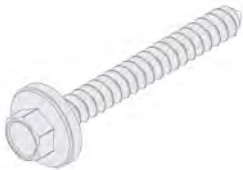


INTRODUCTION TO SOLAR ROOF

Fasteners



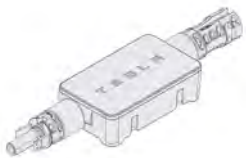
WARNING: Only use approved fasteners. Do not substitute without Engineering approval.

Part Name	Description	Part Number
Ring Shank Nail, 1.25-IN, SS 	A Ring Shank Nail is used for securing tiles and flashings to the roof – 1.25in SS.	1549330-00-X
Hi-Lo Screw+WSHR, 3/16x2-IN, SS+EPDM, BLK 	A Hi-Lo Screw and Washer are used as masonry screws – 3/16x2in, SS+EPDM, BLK.	1877425-00-X
Wood Screw, 10-13x2.375-IN, SS, BLK 	A Wood Screw is used to secure a riser at a ridge – 10-13x2.375in, SS, BLK.	1917819-00-X
Deck Screw, 1-in 	A Deck Screw (Phillip Buglehead DK #8x1 IN Coated) is used for securing tiles and flashings to the roof; it is used instead of nails in HVHZ.	1470351-00-X
Self-Tap Screw+WSHR, 8-18x0.75-IN, SS, BLK 	A Self-Tap Screw and Washer are used to secure flashings to tiles and other components. A gasket prevents vibrations from loosening screws – 8-18x0.75in, SS, BLK.	1916307-00-X



INTRODUCTION TO SOLAR ROOF

Rooftop Electrical

Part	Description	Part Number
ASY, MCI-2 	Tesla's rapid shutdown solution, which is compatible with Tesla power electronics. Listed to UL 1741	1879359-15-X
MC4 Y Connector 	An MC4 Y Connector is used for creating parallel connections between strings.	1578537-00-X (socket) 11578538-00-X (plug)
Combiner Box 	A Combiner Box provides terminal blocks to make parallel connections and transition wire. Connects directly to the Tesla Groove. Listed to UL 1741	1571739-00-X
Pass-Through Box 	A Pass-Through Box is used for transitioning strings from roof surfaces to an attic or lower wall.	1713348-00-X
Jumpers 	Pre-sleeved Jumpers in 1, 3, and 5x tile length are used not only to connect strings around obstructions but also to run lines from the end of a string across the span of a roof and around metal tiles and flashings.	1705337-41-X (1x Jumper, pre-sleeved, length: 59.8 inches) 1705337-43-X (3x Jumper, pre-sleeved, length: 150 inches) 1705337-45-X (5x Jumper, pre-sleeved, length: 240.1 inches)



INTRODUCTION TO SOLAR ROOF

Accessories

Part	Description	Part Number
Footlap 	A Footlap is used between photo-voltaic (PV) tiles to create a water channel. A Foot lap is also used between metal tiles to attach PV or Glass tiles above the metal tile. Part Dimensions (LxWxH): 20.25in x 5.5in x 1.4in	2204566-00-X
Assisted Access Point 	An Assisted Access Point is used to establish safe access to the roof and egress – use to establish a fall protection anchor or use to leave the roof after removing a fall protection anchor.	1683151-00-X
Accessory Bracket Kit, Box of 5 	An Accessory Bracket Kit is used to mount accessories, especially when they need structural connections to framing (e.g., snow fences or chimney struts).	1877133-00-X
Solar Roof Yard Sign 	A Solar Roof Yard Sign is used to show the neighborhood that this house underwent a Solar Roof installation.	1650144-00-X
Paint Pen 	A Paint Pen is used to touch up small scratches that are not beyond the primer on metal tiles and flashings.	2192490-00--X

Custom Tools

Part	Description	Part Number
Carabiner	A Carabiner is used to attach traction mats, glass hooks, and hammerhead hooks.	1606894-00-X

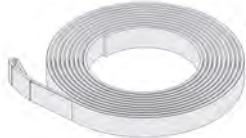


INTRODUCTION TO SOLAR ROOF

Part	Description	Part Number
		
Glass Hook, Traction Mat 	A Glass Hook is used to attach a traction mat to either a Glass or PV tile.	1606892-00-X
Hammerhead Hook 	A Hammerhead Hook is used to attach a traction mat to a Metal tile.	1874380-00-X
Robin Jig 	A Robin Jig is used for multiple layout features around the roof.	1900190-00-X
Roof Bracket Adapter 	A Roof Bracket Adapter is used to attach Roof Jacks over tiles.	1738051-00-X
Roof Rack Straps 	A Roof Rack Strap is used to attach Roof Racks to traction mats, hammerhead hooks, glass hooks, etc.	1874559-01-X
Retrofit Roof Rack 2.0	A Retrofit Roof Rack proves a rooftop staging option for PV modules prior to installation. It also connects directly to Rafters or roof rack straps, securely holding up to 12 Metal tile bundles and 14 PV tile bundles.	1555870-00-X



INTRODUCTION TO SOLAR ROOF

Part	Description	Part Number
		
Tile Trimmer 2.0 	A Tile Trimmer is used to efficiently cut Metal tiles.	1947389-00-X
Traction Mat, Solar Roof 	A Traction Mat is used to stabilize an area over wet or slippery surfaces.	1606891-00-X
Up & Over Jig 	An Up & Over Jig is used to template stagger on up and over features.	2292084-00-X
Webbing, Traction Mat 	Traction Mat Webbing is used to connection traction mats on top of tiles.	1607148-00-X
Anchor, Traction Mat, Solar Roof 	An Anchor is used to attach ladders and traction mats to rafters.	1607147-00-X

Replacement Parts

Part	Description	Part Number
Sub Assembly, Link, Tile Trimmer 2.0	The Link sub-assembly item is a replacement part for the Tile Trimmer 2.0.	2221492-00-X



INTRODUCTION TO SOLAR ROOF

Part	Description	Part Number
		
Sub Assembly, Saw Plate, Tile Trimmer 2.0 	The Saw Plate sub-assembly item is a replacement part for the Tile Trimmer 2.0.	2220454-00-X
Rubber Strip, Right, 4.0", Tile Trimmer 2.0 	The Rubber Strip sub-assembly item is a replacement part for the Tile Trimmer 2.0.	1948342-02-X



SOLAR ROOF INSTALLATION

[*Solar Roof Installation Basics Video*](#)

Installation Basics



Installing PV Tiles

Overview

This section covers the primary use cases and features of PV tiles. For an in-depth overview of wire and cable management practices, see Wire Management.

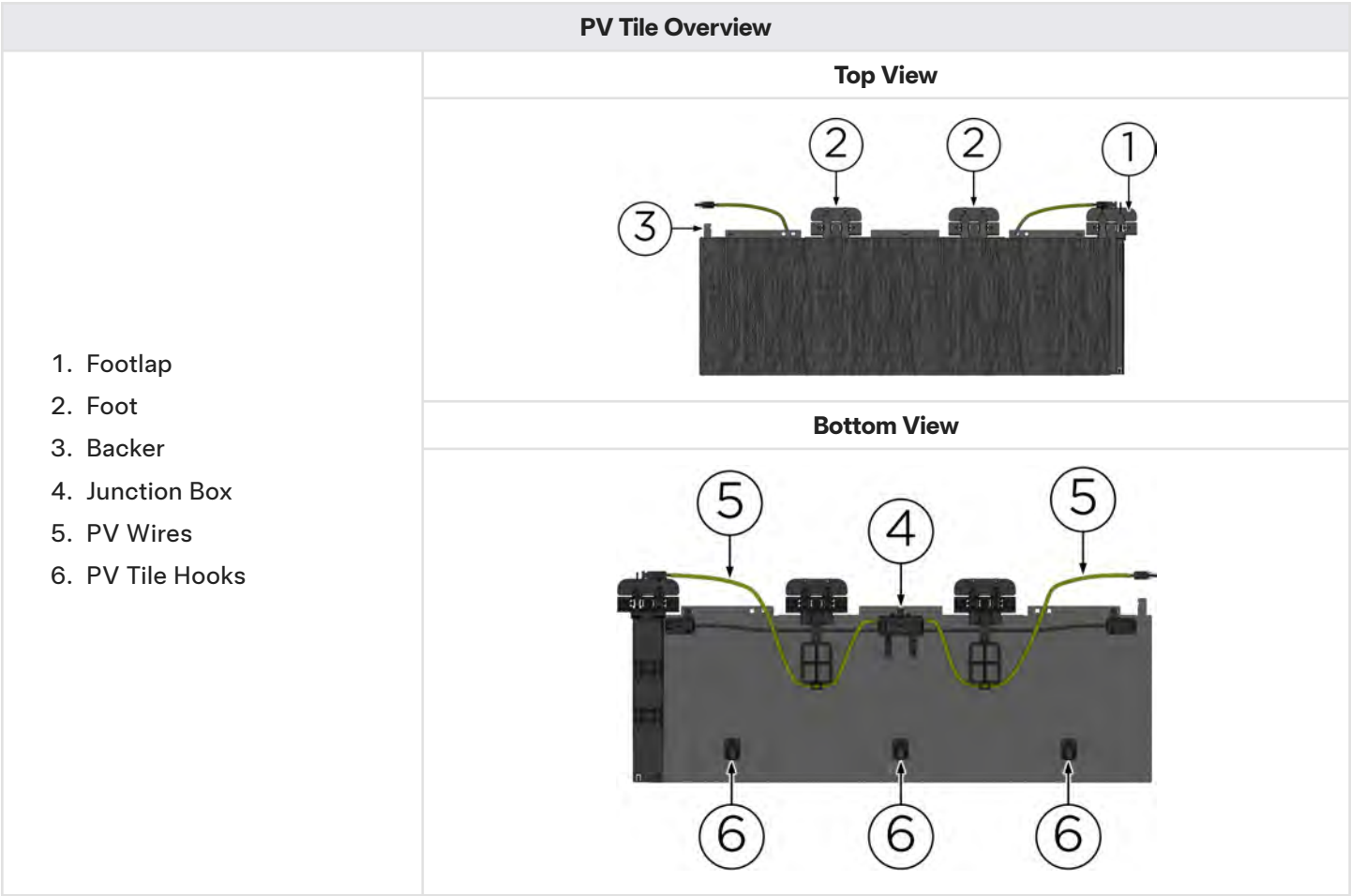
Tools and Equipment

- Foot
- Footlap
- PV tiles
- MCI (Mid Circuit Interrupter)
- Cordless Roofing Nailer

PV Tile Hardware

PV tiles consist of solar cells between textured glass and a fiberboard backer. Each PV tile comes pre-assembled with mounting hardware: the foot and footlap. These components also have features that aid in fastening, tile alignment and wire management.

See [Part Inscription Identifier on page](#) for an in-depth list of foot/footlap features.

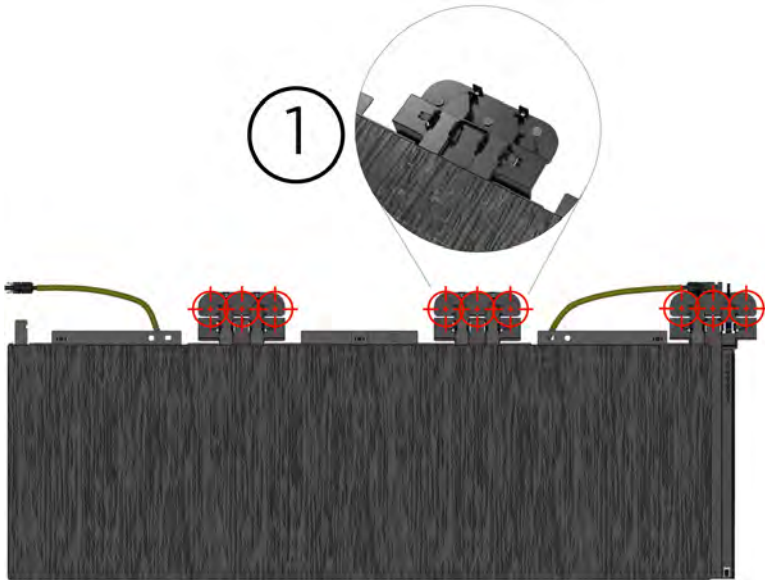




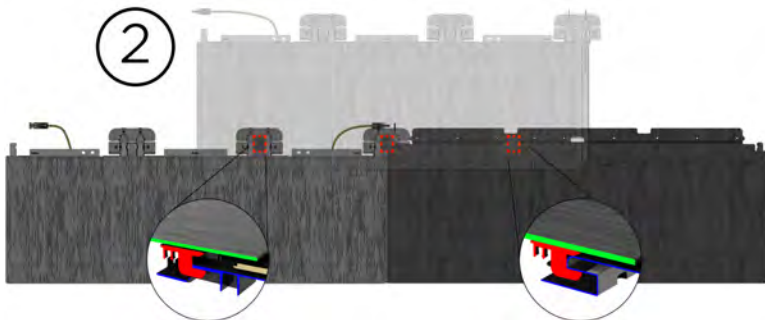
SOLAR ROOF INSTALLATION

Fastening and Aligning PV Tiles

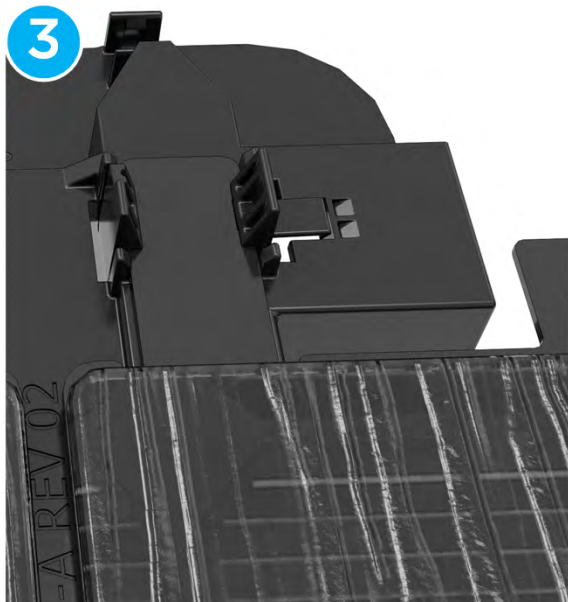
PV tiles are fastened to the deck through the target holes on the feet/footlap **(1)** in accordance with the applicable wind tier in the [Fastener Schedule on page 86](#).



The PV tile hooks fit into vented risers, metal tile shoulders and the feet/footlaps of other PV tiles **(2)**. PV tiles installed next to each other will share a footlap.



Ensure the tabs on the top of the fiberboard are pushed fully into position in the foot/footlap engagement clips so they are locked into place **(3)**. This ensures tiles will maintain proper alignment.

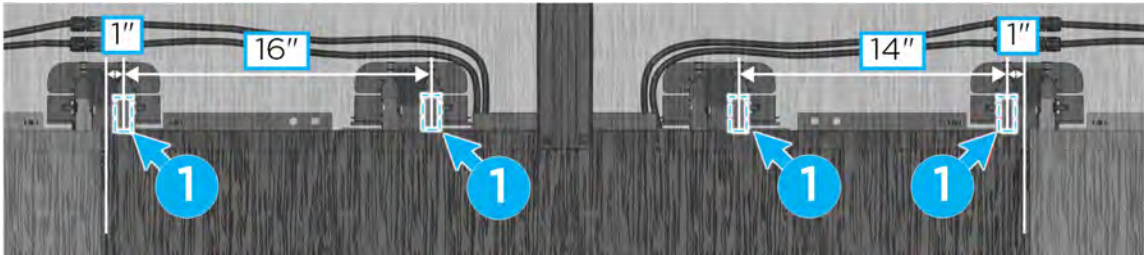




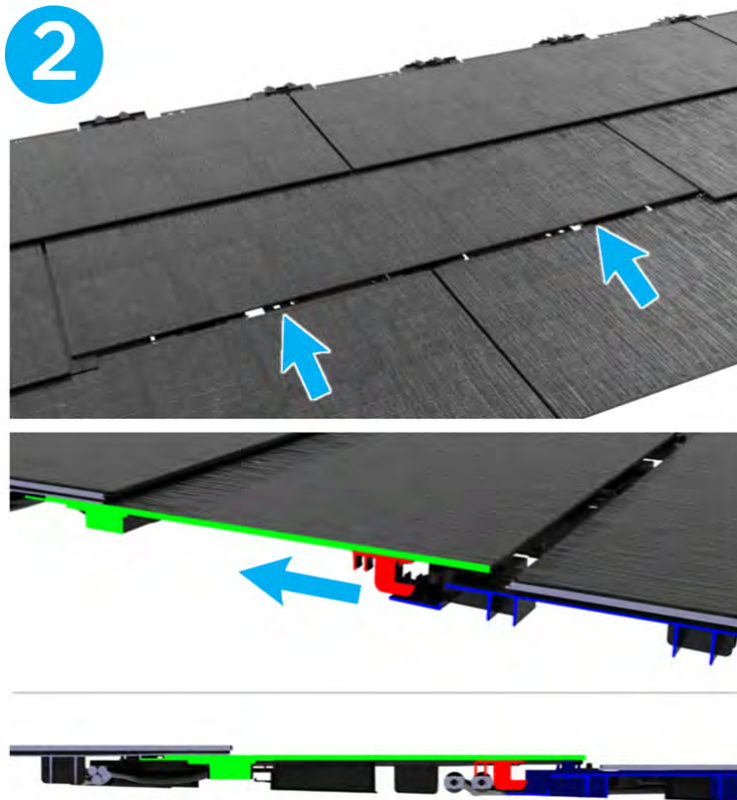
SOLAR ROOF INSTALLATION

Removing PV Tiles

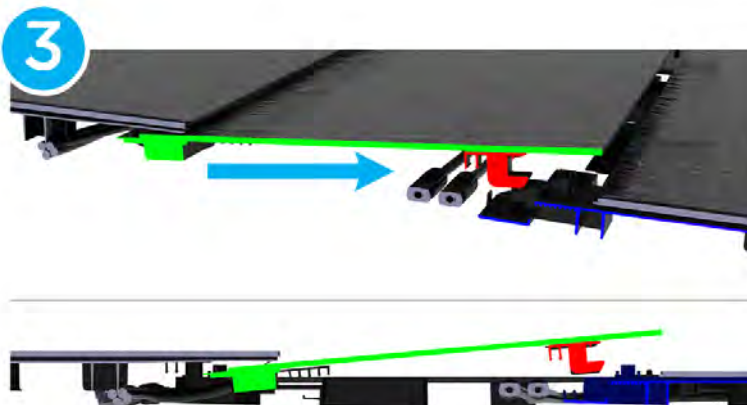
To remove an installed PV tile, the foot/footlap engagement clips holding the tile in place must be shifted into the open position by placing enough even force on the PV tile from the bottom. For reference, the clips are located 1 in away from either edge of the PV tile, 14 in away from the tile's right edge and 16 in away from the tile's left edge **(1)**.



With the engagement clips unlocked, push and slide the PV tile up roof so that the tile's lower hooks disengage from the tile(s) below it **(2)**.



Finally, tilt the tile up and pull it away from the feet/footlaps so that the tabs fully exit the engagement clips **(3)**.

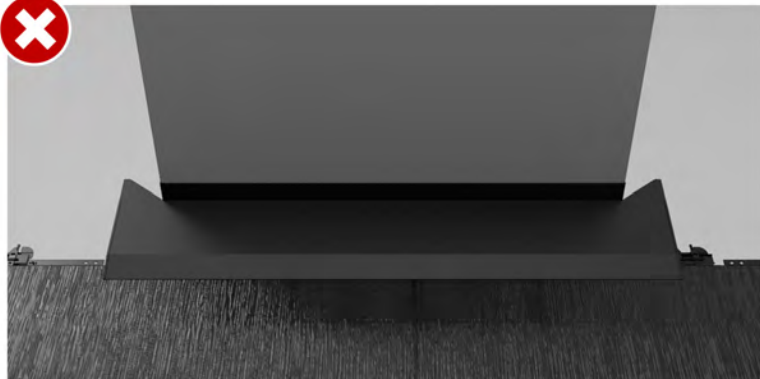




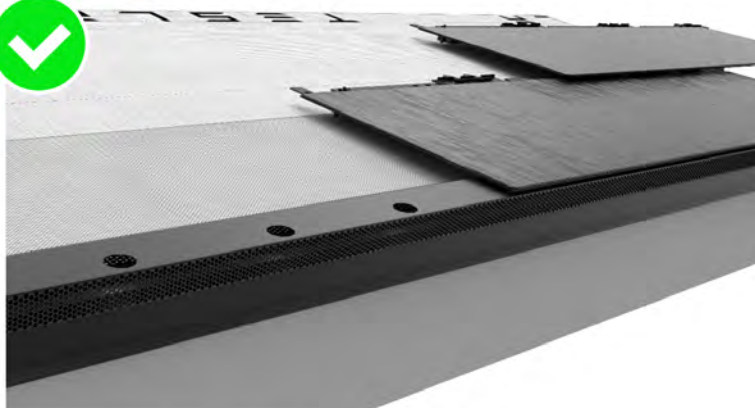
SOLAR ROOF INSTALLATION

Additional PV Tile Installation Guidelines

It is safe to install metal tiles above, below, and to the sides of PV tiles. However, **never install metal flashings over PV tiles**. This will block the production of solar energy.



PV tiles can also be installed at the first course over the vented riser.





Installing Metal Tiles

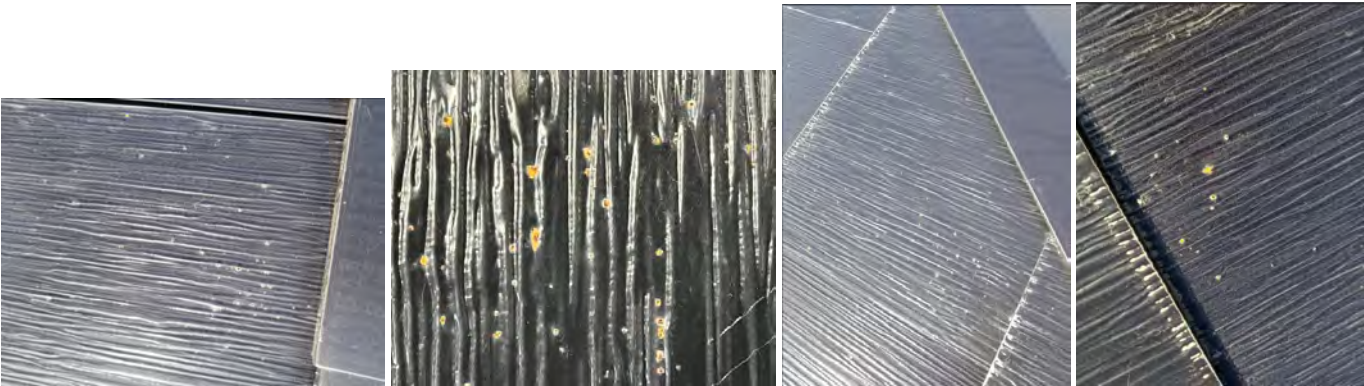
Overview

This section covers the primary use cases and features of metal tiles. Metal tiles can be installed in place of PV tiles as well as below, adjacent to, or over PV tiles. metal tiles can also be installed anywhere on the roof that requires tile cutting or modification.

**CAUTION:** Cutting tiles on the roof produces shavings on the roof that leads to rust and potential damage to the underlayment.

**NOTE:** Metal shavings left on the roof can rust or discolor over time. **Ensure all metal shavings are cleared off the roof once installation is complete.**

Pictured: Tiles with rusted metal shavings on top of them.



Tools and Equipment

- Metal Tile
- Offset metal snips

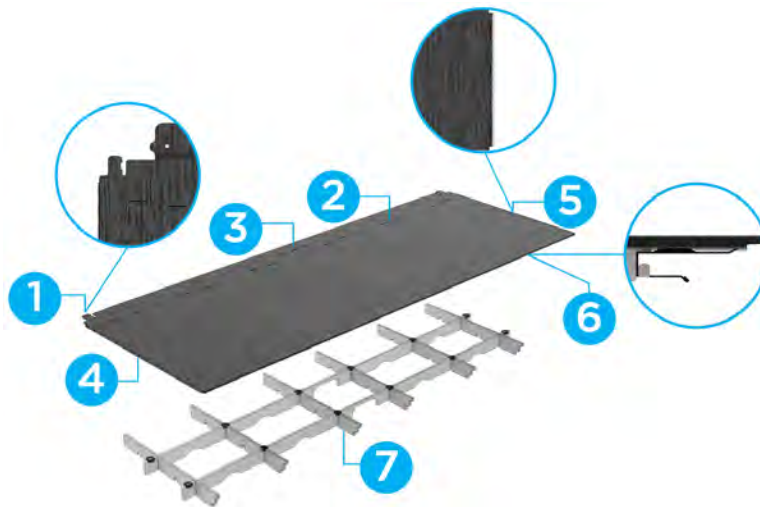
Metal Tile Hardware

See [Part Inscription Identifier on page](#) for descriptions of metal tile features and their use cases.

(1)	Engagement Tab, Metal Tile Nose
(2)	Nominal / Max Reveal Marks
(3)	Tile Timing Marks
(4)	Left Side Open Hem
(5)	Right Side Open Hem
(6)	Lower Engagement Hook
(7)	Lattice for Structural Support



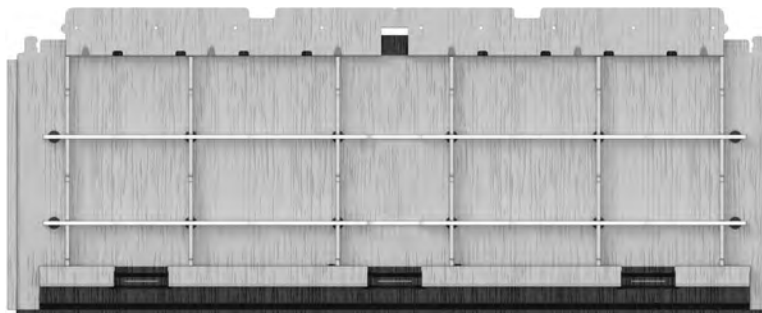
SOLAR ROOF INSTALLATION



Front of Tile



Back of Tile

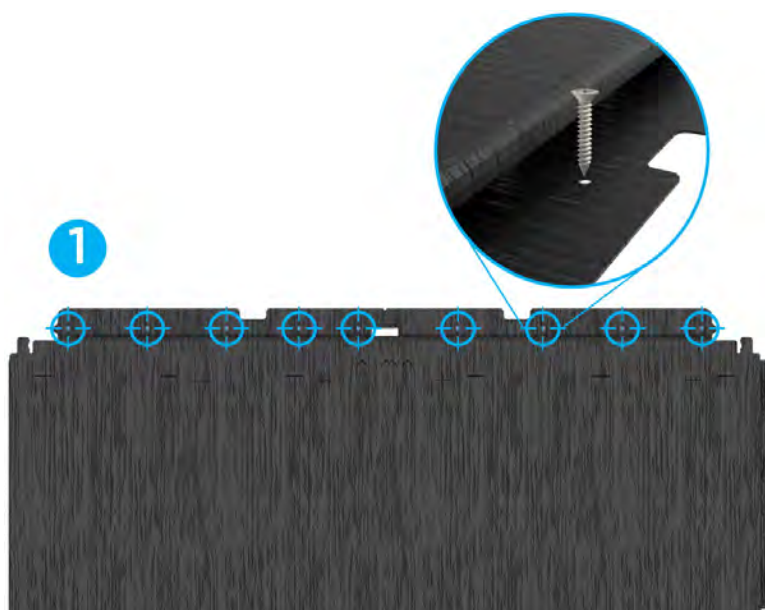


Fastening and Aligning Metal Tiles

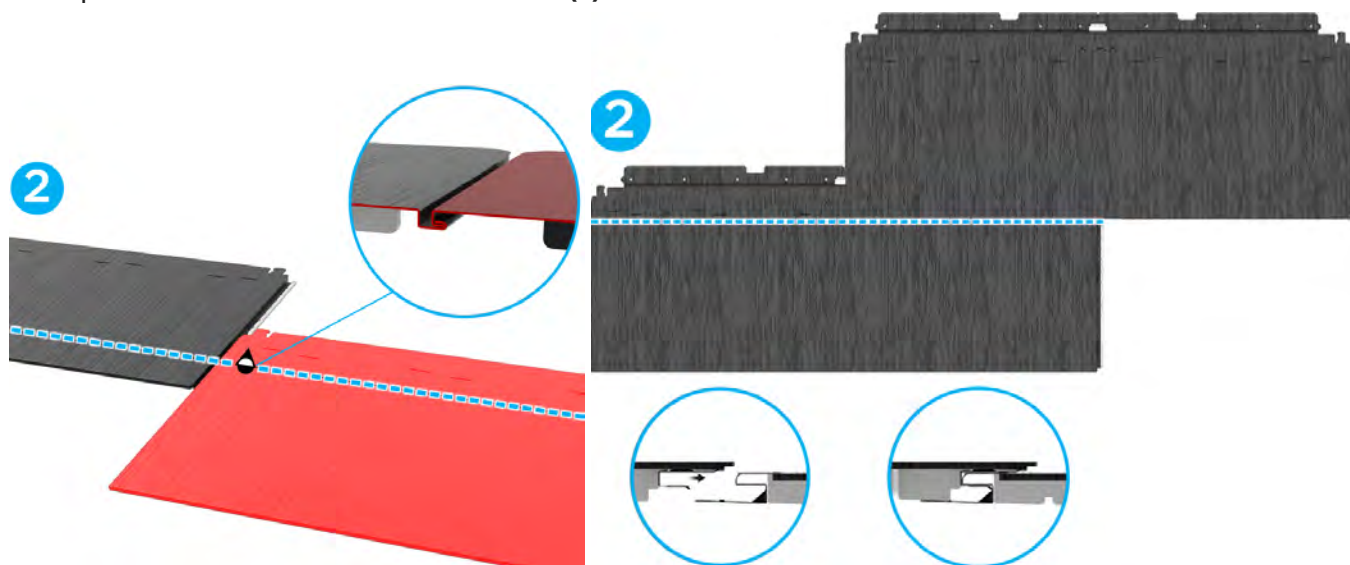
Metal tiles are fastened to the deck through the target holes on the upper flange (1).



SOLAR ROOF INSTALLATION



Adjacent Metal Tiles lock into each other through the open hem along the water channel. The tile slides down from the top until it reaches the nominal reveal line (2).



OPTIONAL: If needed, set the minimum reveal by bending the lower engagement hook tabs down flat to increase the overlap (3). There are a total of eight tabs along the hook.



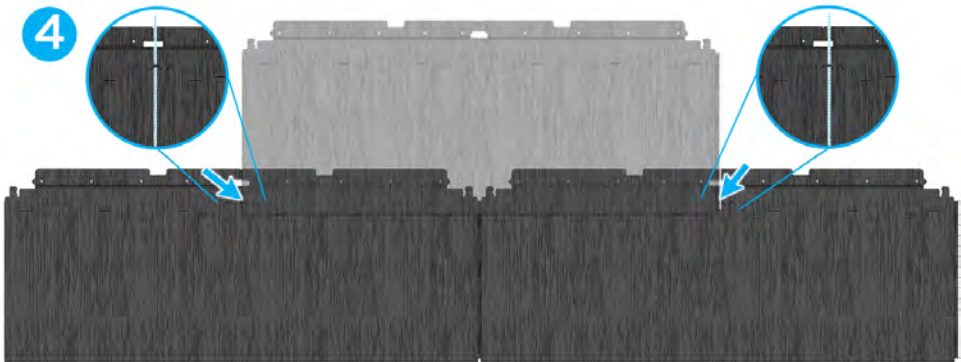


SOLAR ROOF INSTALLATION



(3.1)	Maximum Reveal
(3.2)	Nominal Reveal

Rows of tile are installed with a half-tile width stagger, so the edges of the upper course are aligned with the middle arrows along the top of the tiles in the course below (4).





Tile Interactions

Overview

This section outlines the basic practices for installing PV tiles next to metal tiles.

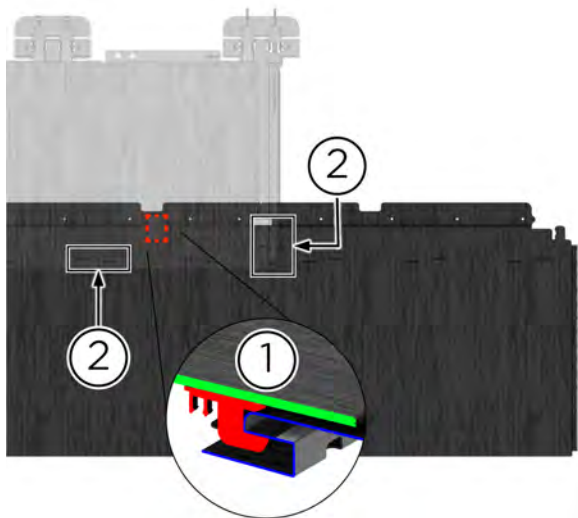
Tools and Equipment

- Metal tile
- PV tile
- Foot
- Footlap

See [PV Tile Overview on page 36](#), [Metal Tile Overview on page 40](#) and [Part Inscription Identifier on page](#) for descriptions of tile features and their use cases.

Work Instruction

PV tiles are installed over metal tiles by engaging the PV tile hooks with the metal tile shoulder (1). The PV footlaps are also aligned with the center of the outermost metal tile timing marks. Finally, the correct reveal is determined by aligning the PV tile with the metal tile nominal reveal marks (2).



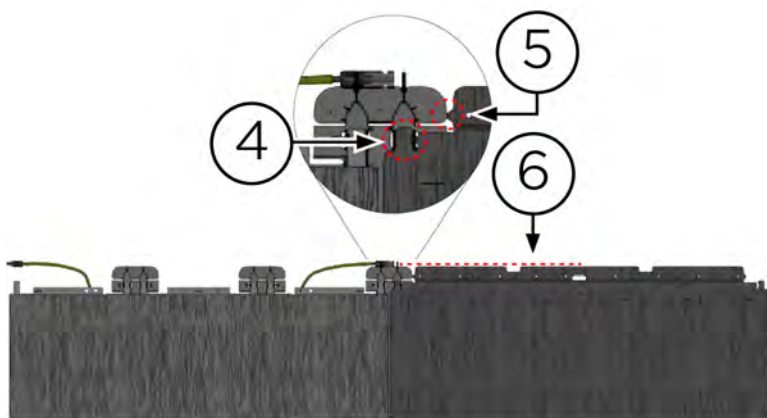
When installing a PV tile above two metal tiles, a cut foot must be placed at the water channel of the metal tiles. This provides more support for the PV tile hook engagement (3).



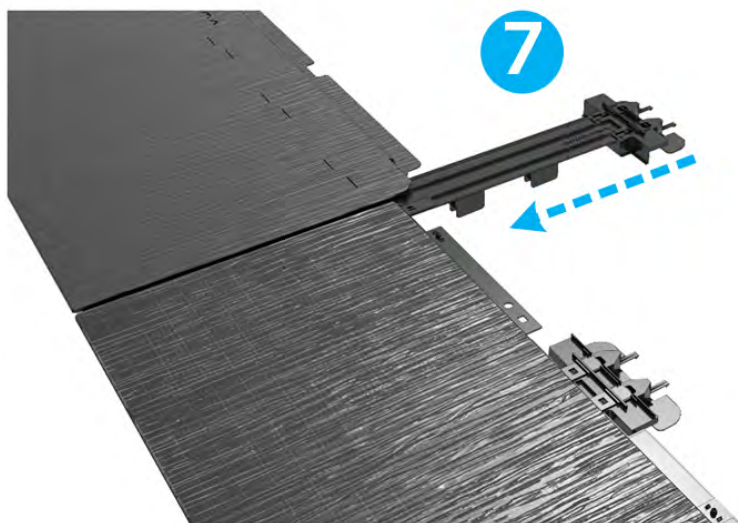
When PV tiles are installed next to metal tiles, the metal tile engagement tabs are installed into the footlap engagement clips to ensure proper horizontal alignment (4). Proper alignment is also confirmed by the metal tile bump out aligning with the footlap edge (5) and the metal tile top edge coinciding with the top edge of the footlap (6).



SOLAR ROOF INSTALLATION



It is best practice to install the footlap last when installing PV tiles next to metal tiles **(7)**. This will help the metal and PV tiles interlock more easily.



Cut and Tuck

Overview

This section provides guidance for cutting and tucking tiles into channel flashing at square roof features.

Tools & Equipment

- Measuring tape
- Digital angle finder
- Channel flashing
- PV tiles
- Metal tiles

Work Instruction

Rake and Channel Flashing

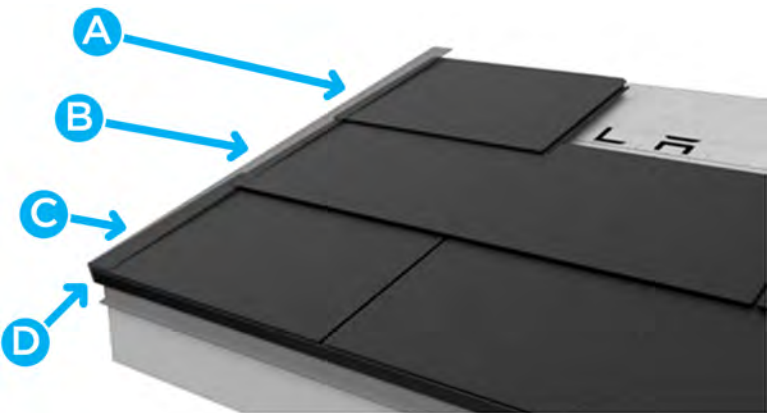
Please take note of the following rules:



SOLAR ROOF INSTALLATION

- When cutting tiles for tucking purposes, measure such that tiles are 1 in off the channel flashing wall, except for the first course, which must be 1 in longer than normal so that it is touching channel the wall and blocking off the hole in the channel flashing.
-  **NOTE:** The 1 in gap ensures that there is placement buffer for the tiles if the rake is not perfectly square, eliminating the need to trim full tiles to fit.
- Example:** Starting a plane with a rake:
 - When starting a rake with half-tile stagger, the first cut tile will need to be 23 ½ in, which is one additional inch on the half tile to help fill in the gap between the top of the riser and the channel flashing due to the setback.
 - For the rest of the half tile courses, cut the tiles perfectly in half at 22 ½ in, install ensuring a 1 in setback from the inner edge of the channel flashing.

(A)	Cut tile - 1 in
(B)	Full tile
(C)	Cut tile + 1 in
(D)	Closed gap





SOLAR ROOF INSTALLATION

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Solar Roof Calculators

⋮

V3R Cut Calculator

Edge Type *

Rake

Edge Angle: *

90

Edge Angle Used in Calculations: 90

Measure short edge of first course tile in inches (bottom edge for valley, top edge for hip) *

20

Edge length from eave to ridge (in) *

45

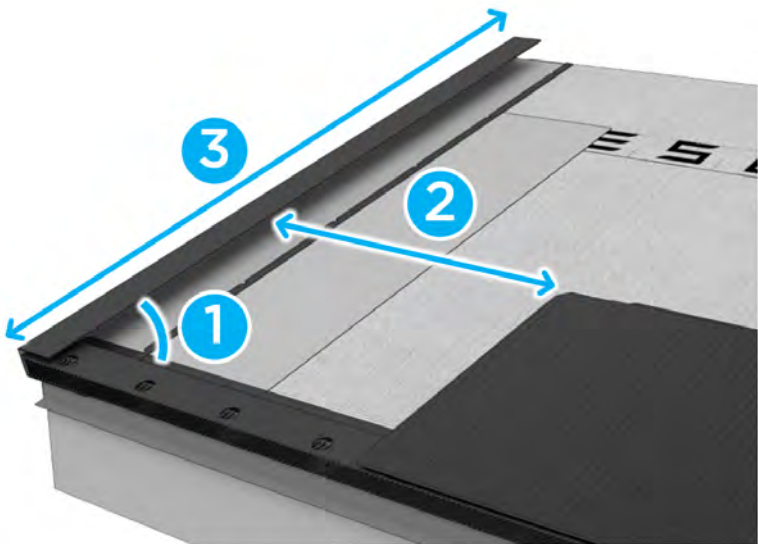
Cut Angle is 1.571 radians

Lower limit is 22.563 in

Upper limit is -228637350944735140 in

Course 2 Cut Tile Length 42.5 in

Course 3 Cut Tile Length 19.875 in



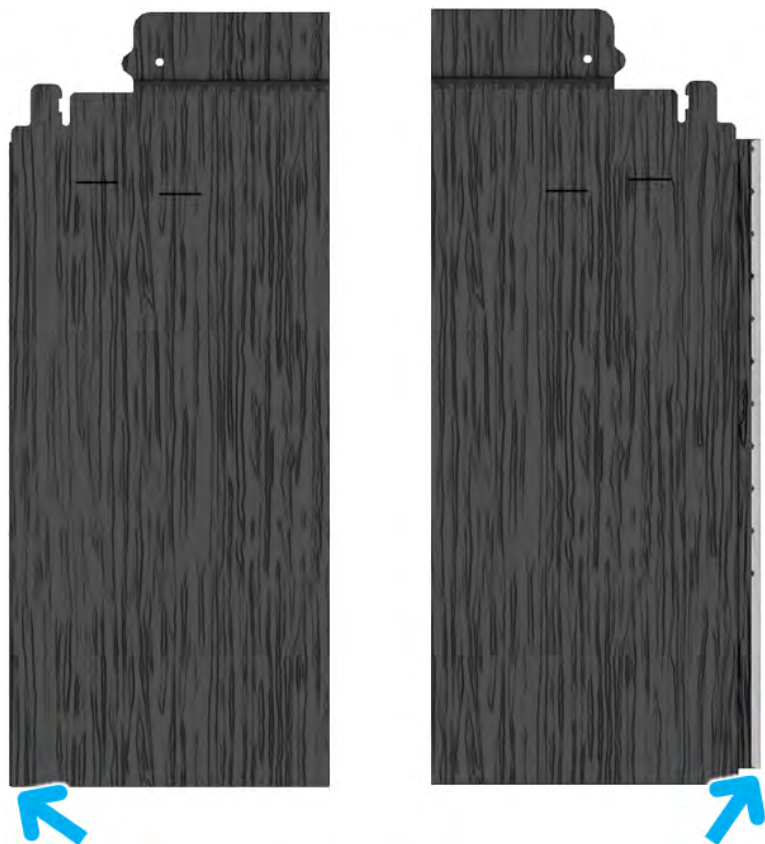
Pictured: Water channel on PV tile / footlap



Pictured: Water channel on metal tile



SOLAR ROOF INSTALLATION



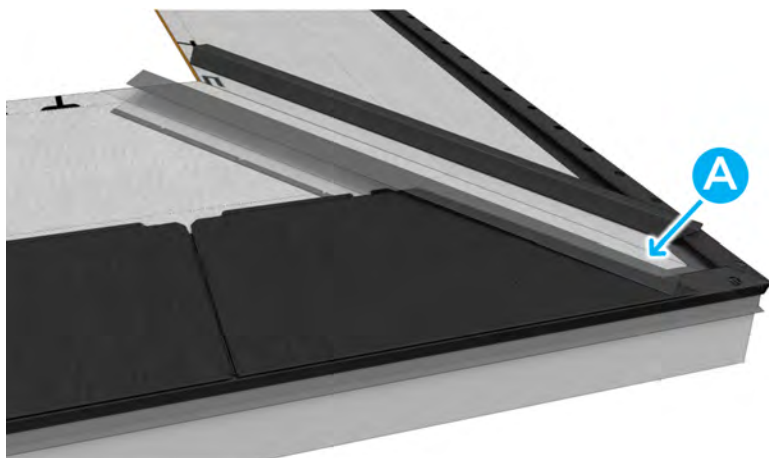
Hip

Cut tiles to size by measuring from the water channel to the inside of the channel flashing, minus an inch.



NOTE: For hip-to-hip courses, place a full tile in the middle and build out to the cut metal tiles.

Pictured: Cut tile - 1 in (A)





SOLAR ROOF INSTALLATION

< Solar Roof Calculators

V3R Cut Calculator

Edge Type *

Hip

Edge Angle: *

90

Edge Angle Used in Calculations: 90

Incorrect edge angle entered for this edge type! Correct angles are:

Rake = 90

Valley > 90

Hip < 90

Measure short edge of first course tile in inches (bottom edge for valley, top edge for hip) *

20

Edge length from eave to ridge (in) *

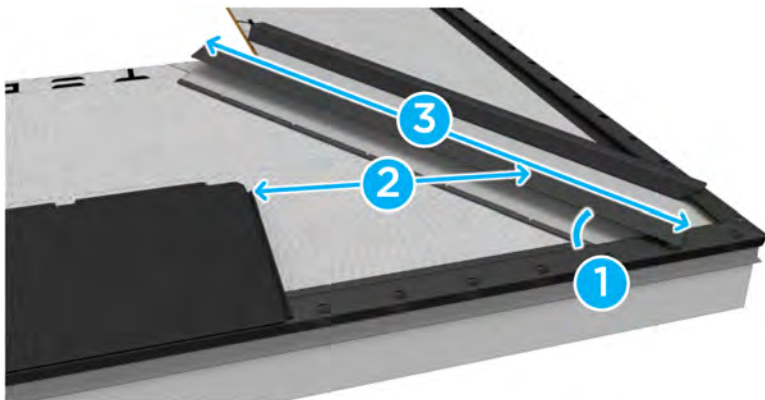
45

Cut Angle is 1.571 radians

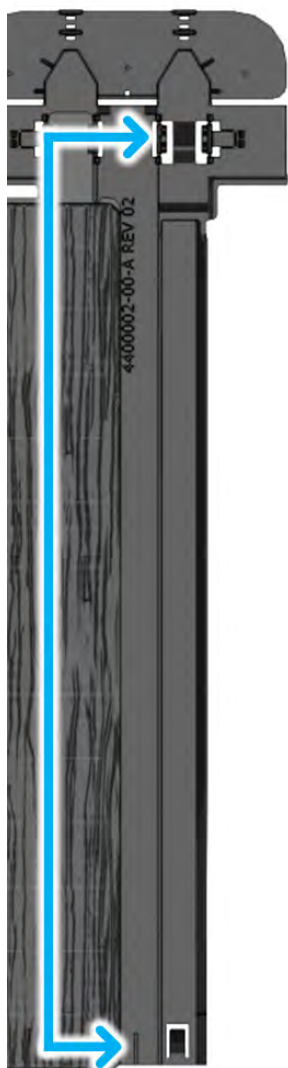
Lower limit is 22.563 in

Upper limit is -228637350944735140 in

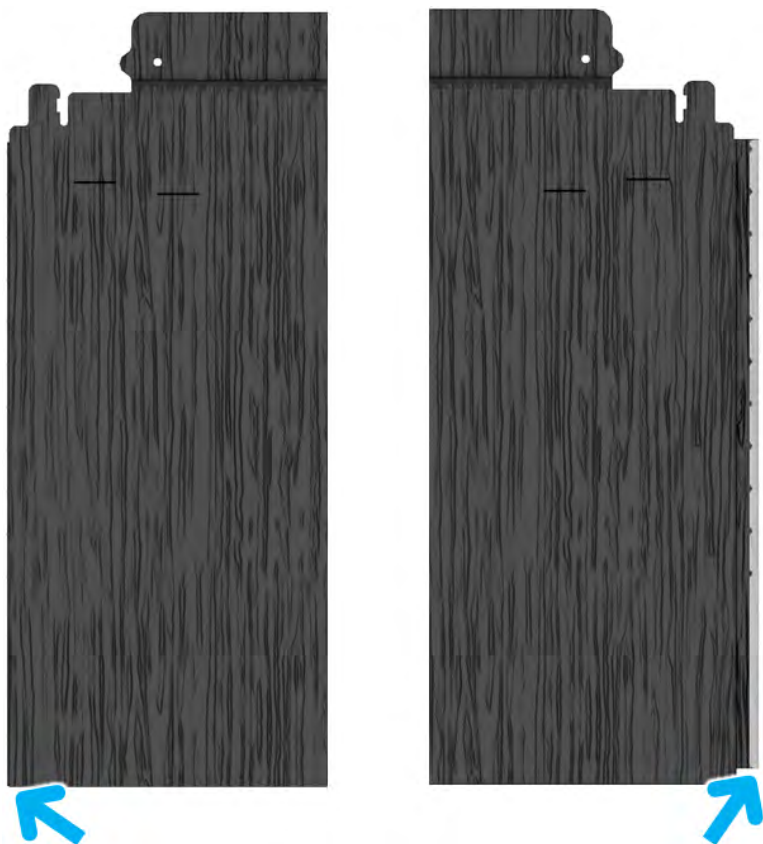
Reminder: if any of the cut lengths below are less than 5 inches, use a skin!



Pictured: Water channel on PV tile / footlap



Pictured: Water channel on metal tile



Rake and Sidewall Dead Zones

Overview

This section provides instructions for eliminating dead zones at rakes and sidewalls using tile skins (both of these roof features share the same procedure). These instructions display the steps at a sidewall. See [Tile Skin in the Part inscription Identifier on page](#) for descriptions of all tile skin features.

Tools & Equipment

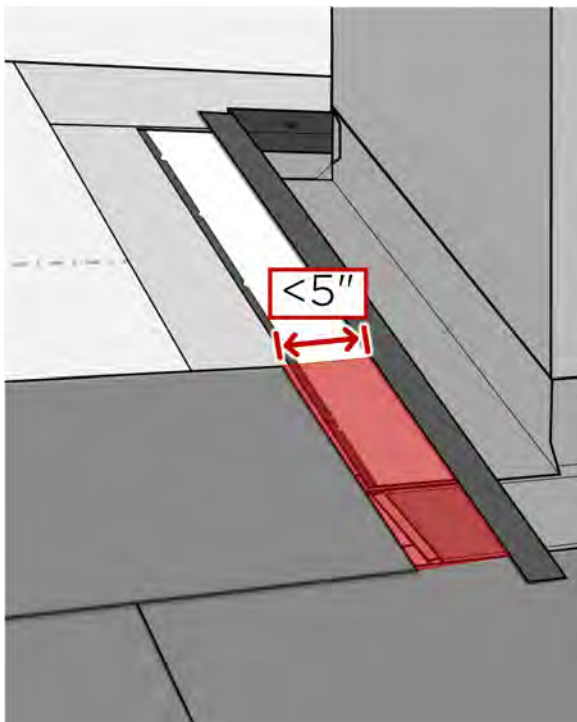
- Tile skin
- Metal snips

Work Instruction

A dead zone will appear at rakes and sidewalls if the distance between a course's last tile and the channel flashing is less than 5 in. Since this is less than the allowed metal tile cutting threshold, a tile skin must be used to eliminate the dead zone.

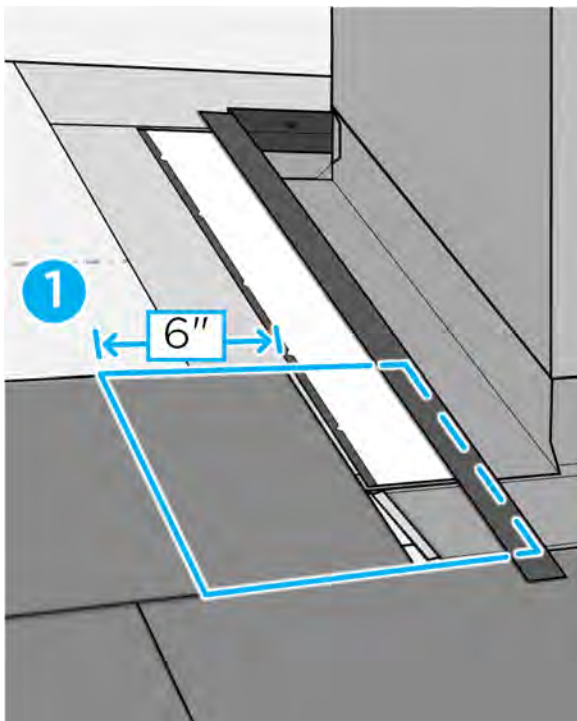


SOLAR ROOF INSTALLATION



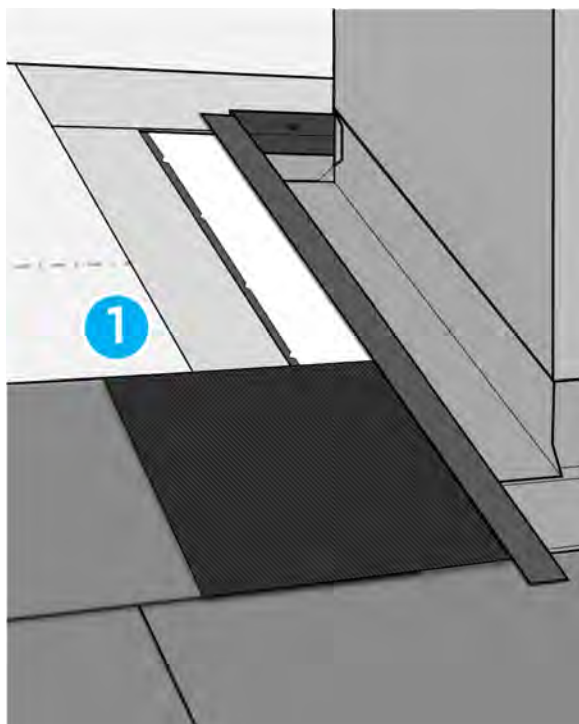
Cut and install tile skin with the following parameters **(1)**:

- The tile skin overlaps the uproof edge of the metal tile 6 in from the edge of the tile
- The tile skin extends towards the wall of the channel flashing
- The downroof edge of the tile skin fully engages with the downroof edge of the metal tile

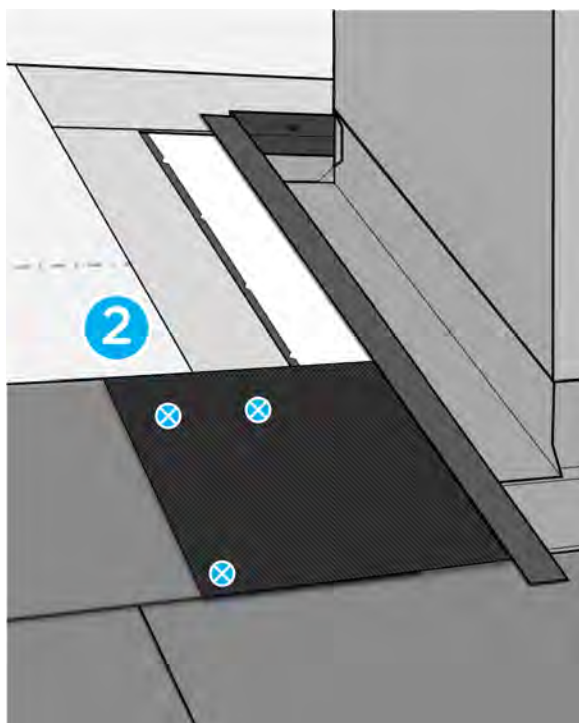




SOLAR ROOF INSTALLATION



Fasten the tile skin according to the applicable wind tier in the [Fastener Schedule on page 86 \(2\)](#). Leave these fasteners exposed.



Hip Dead Zone

Overview

This section provides instructions for installing tile skin to eliminate dead zones at the hip. See [Tile Skin in the Part Inscription Identifier on page](#) for descriptions of all tile skin features.

Tools & Equipment



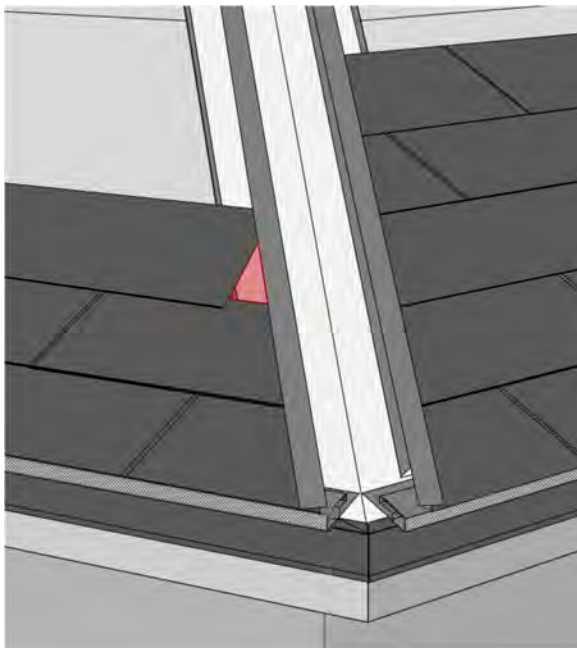
SOLAR ROOF INSTALLATION

- Tile skin
- Vented riser
- Metal snips

Work Instruction

Smaller Hip Dead Zones

A hip dead zone will appear if the upper edge of a tile can be tucked into the channel flashing, but the lower edge falls short.

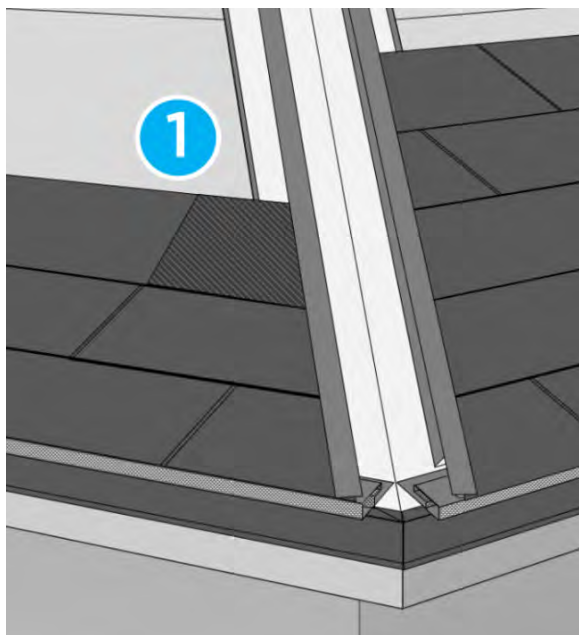
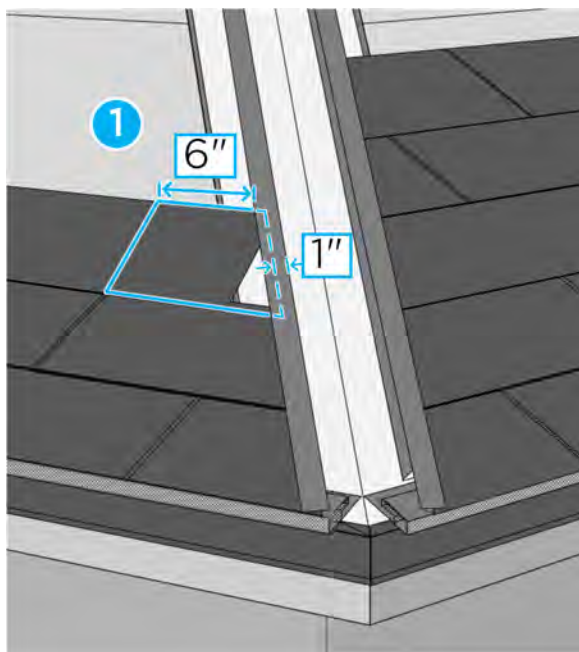


Cut and install the tile skin with the following parameters **(1)**:

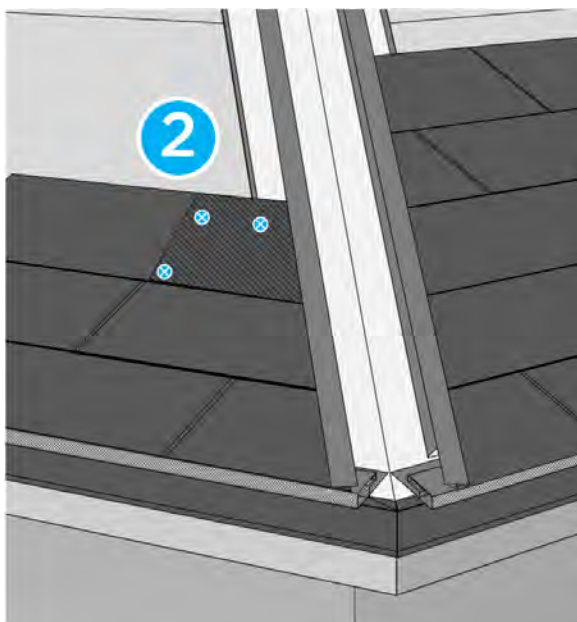
- The tile skin overlaps the uproof edge of the metal tile 6 in from the channel flashing
- Inside of the channel flashing, there is a 1 in gap between the tile skin and the channel flashing wall (this will prevent hip cap fasteners from reaching the tile skin, which would push the tile skin down and create a gap)
- The nose of the tile skin fully engages with the downroof edge of the metal tile



SOLAR ROOF INSTALLATION

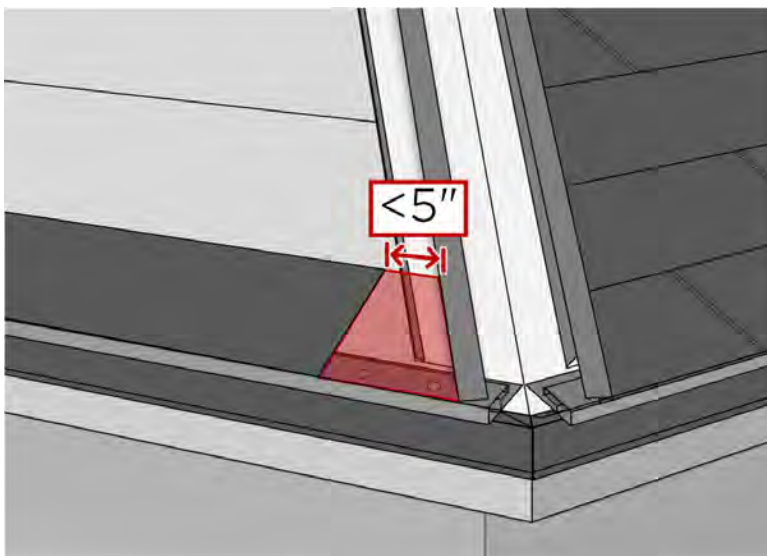


Fasten the tile skin according to the applicable wind tier in the [Fastener Schedule \(2\)](#). Leave these fasteners exposed.



Larger Hip Dead Zones

Larger dead zones can also appear at the hip as long as the distance between a course's last tile and the channel flashing is less than 5 in. Since this is less than the allowed metal tile cutting threshold, a tile skin must be used to eliminate the dead zone.

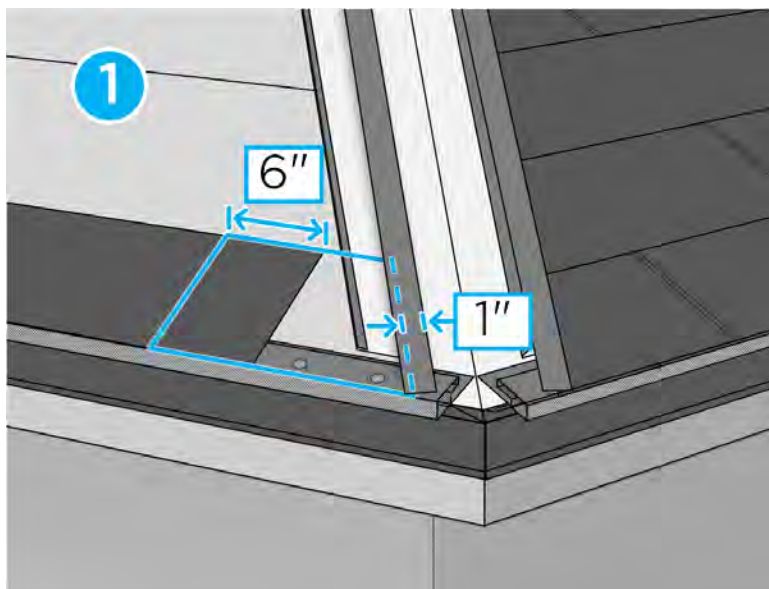


Cut the tile skin with the following parameters **(1)**:

- The tile skin overlaps the uproof edge of the metal tile 6 in from the edge of the tile
- Inside of the channel flashing, there is a 1 in gap between the tile skin and the channel flashing wall (this will prevent hip cap fasteners from reaching the tile skin, which would push the tile skin down and create a gap)
- The downroof edge of the tile skin fully engages with the downroof edge of the metal tile

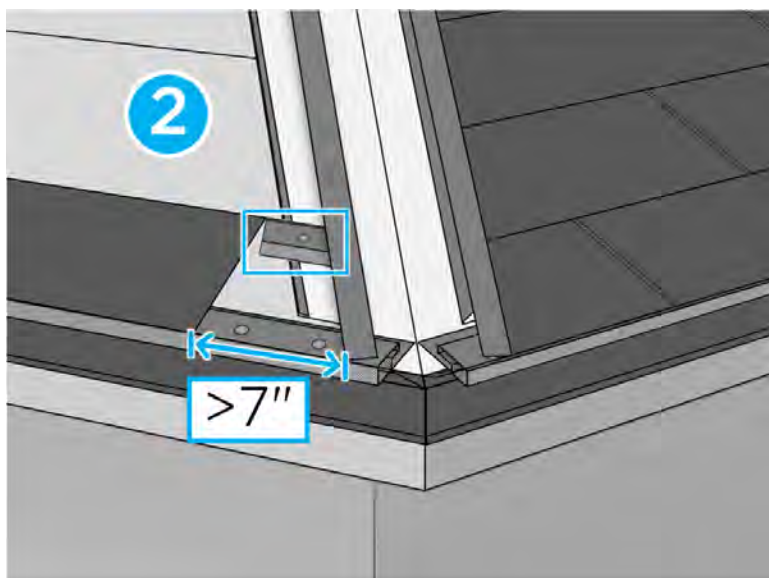


SOLAR ROOF INSTALLATION



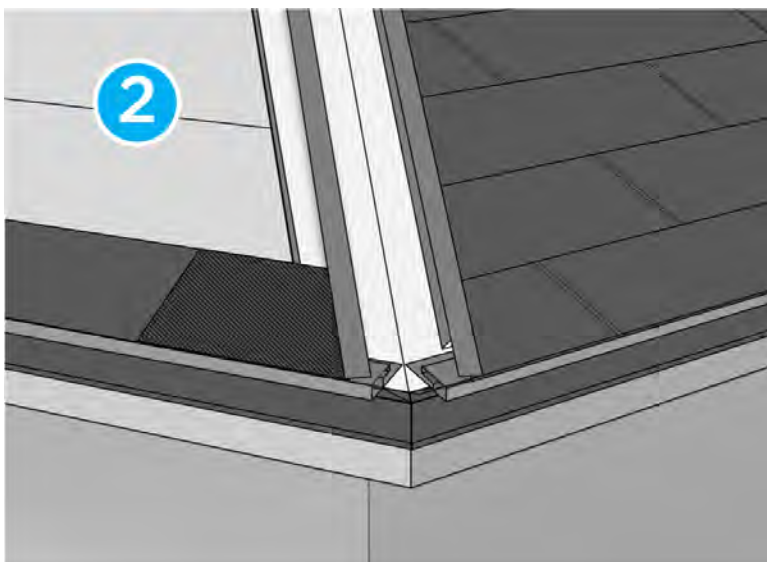
Measure the dead zone. If the dead zone measures larger than 7 in horizontally, install a piece of vented riser aligned with the tile shoulder. This riser will support the tile skin. **(2).** Proceed to install the tile skin.

PRO TIP: Keep 6 in cuts of vented riser stocked to help speed up installations and reduce bottlenecks at the cutting station.

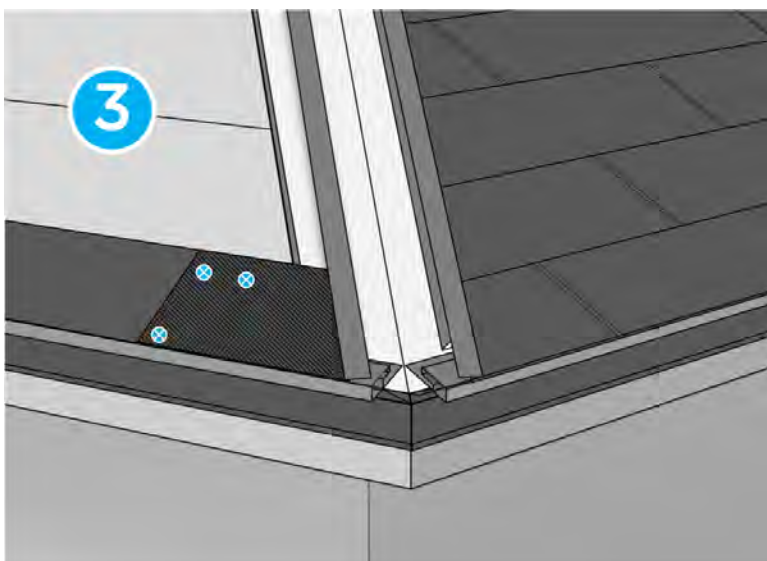




SOLAR ROOF INSTALLATION



Fasten the tile skin according to applicable wind tier in the [Fastener Schedule \(3\)](#). Leave these fasteners exposed.



Cut and Trim

Overview

This section provides instructions for installing adjustable trim covers at standard valleys and rakes angled between 90 - 135°. See [Adjustable Trim Covers in the Part Inscription Identifier on page](#) for descriptions of all adjustable valley trim cover features.

Tools and Equipment

- Adjustable trim cover
- Vented riser
- Bolt cut calculator
- Measuring tape



SOLAR ROOF INSTALLATION

Work Instruction

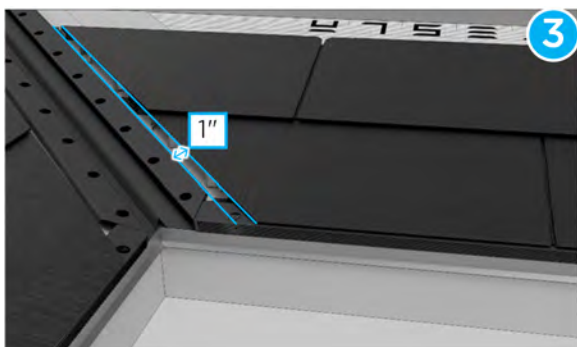
Before installing the final tile of a valley course, use the Bolt cut calculator to determine whether a valley dead zone will appear. Refer to [Using the Cut Calculator in Bolt on page](#) for general guidance on accessing and using the cut calculator.

If the cut calculator calls for installing two cut tiles at the course, a valley dead zone will appear. Proceed to cut and install only one metal tile followed by a piece of vented riser aligned with the tile shoulder **(1)**. Then, install an adjustable trim cover over the remaining dead zone (see steps 4 – 5).



If the calculator calls for standard valley tile installation, proceed to measure and cut a metal tile at the valley riser **(2)**. Ensure there is a 1 in gap between the riser and the cut metal tile **(3)**.

 **NOTE:** Ensure the angle does not exceed the range for the adjustable trim flashing. See the [Angle Reference Chart on page 61](#).

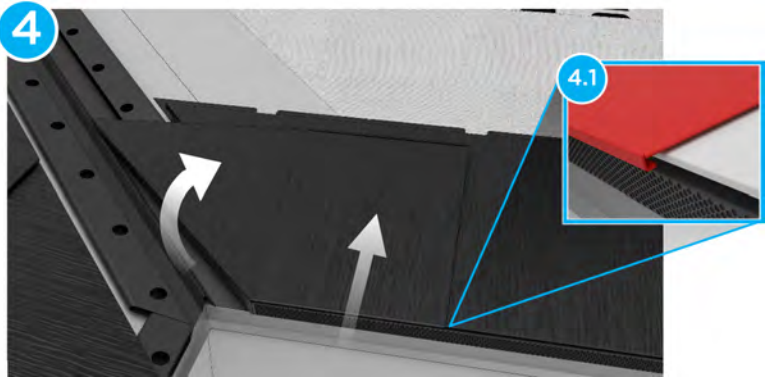


Place the adjustable flashing over the cut tile ensuring it hooks at the bottom and swing the side piece to the vertical face of the vented riser at the valley **(4)**.

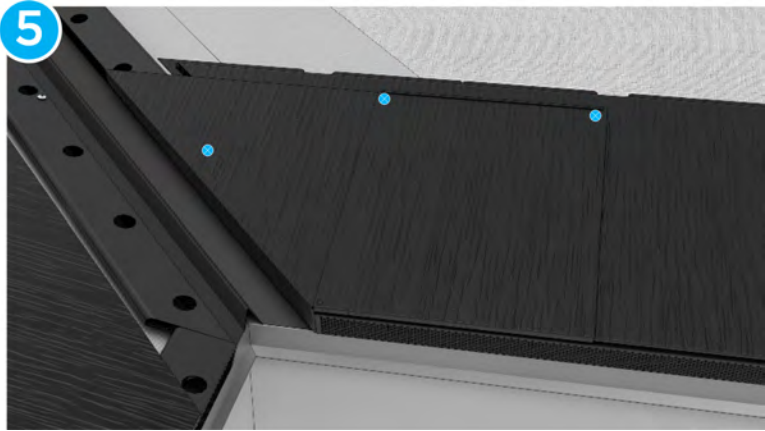
Pictured: Hook engagement **(4.1)**



SOLAR ROOF INSTALLATION



Secure the flashing to the cut metal tile and the vented riser in accordance with the applicable wind tier in the [Fastener Schedule](#) at the marked pilot holes **(5)**.

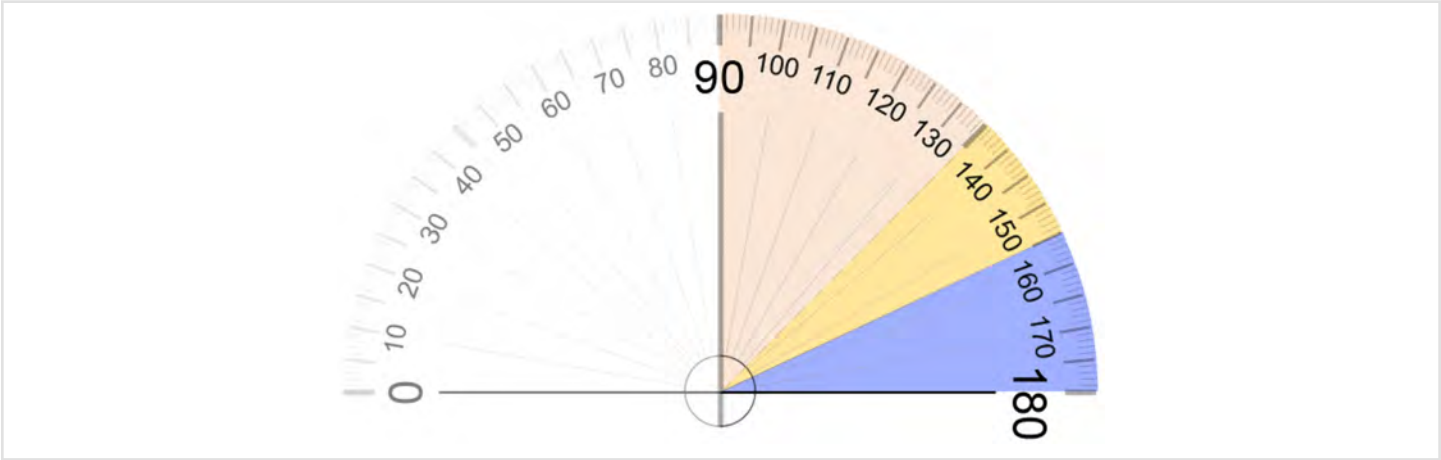


Angle Reference Chart

	1+ Piece Tile Skin	
	1- Piece Tile Skin	
	Adjustable Trim Cover	



SOLAR ROOF INSTALLATION



On Roof Electrical Wiring

Wire Management Requirements

Cabling should comply with a bending radius of ≥ 2.36 in (60 mm) to prevent mechanical stress.

Pictured: Radius less than 2 3/8 in (60 mm) **(1)** and radius of 2 3/8 in (60 mm) **(2)**



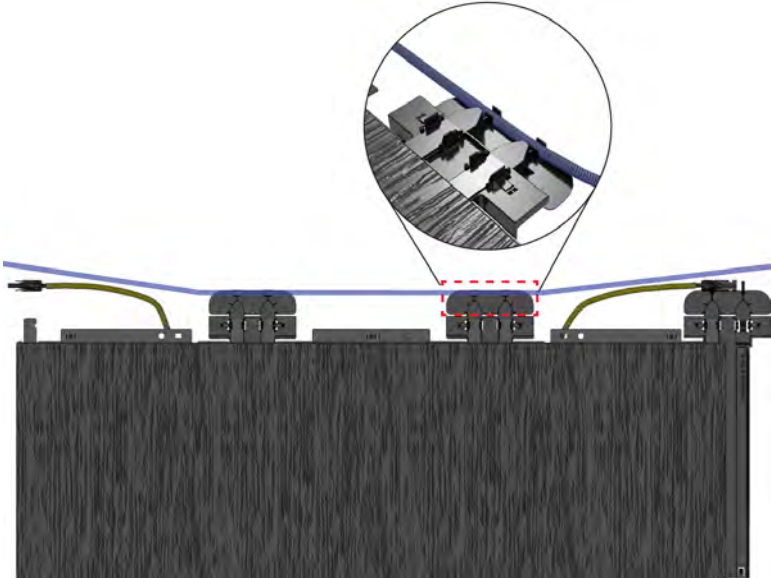
Split braided sleeves may be used to manage wires around metal flashings at transitions across hips and ridges. All sleeving that is installed underneath the tile needs to be rated to 95° C (203° F). Blue carbon sleeves or liquid-tight sleeves are not rated for Solar Roof applications and can lead to early system failures.



NOTE: Only sleeved wires / cables can sit underneath metal, all unsleeved wires must sit underneath PV Tiles.

Braided Sleeve, Split	
PUSG-17B, 171 ft	

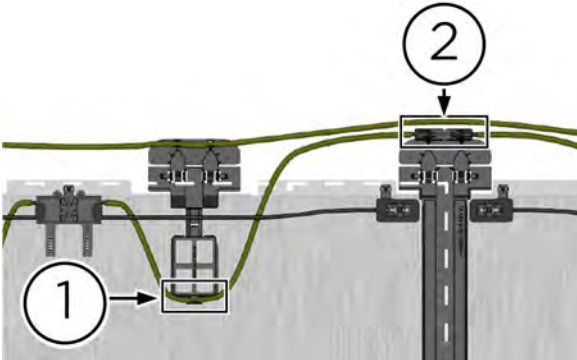
Wire Management Hardware

Foot Home Run / Jumper Cable Management Slots	
Description	Cable management slots that hold home run and jumper cables to the deck, preventing cables from being pinched between the tile hook and foot when another tile is installed above it.
Image	



SOLAR ROOF INSTALLATION

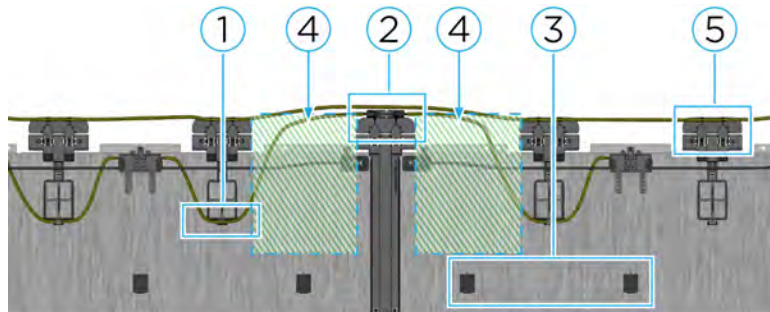
Foot Wire Management Slots and Footlap Connector Management Slots

Description	Wire management slots that hold PV tile wires and guide wire routing (1) and connector management slots that hold connectors to the deck (2) .
Image	 A cross-sectional diagram of a roof deck showing the installation of PV tiles. Two specific components are highlighted with numbered callouts: (1) points to a 'Foot Wire Management Slot' which is a rectangular slot in the deck designed to hold and guide PV tile wires; (2) points to a 'Footlap Connector Management Slot' which is a similar slot designed to hold the electrical connectors that attach the PV tiles to the roof deck.

PV Tile Wire Management with Metal Tiles

The following wire management practices are performed throughout PV tile installation:

- Wires are routed through the foot wire management slots **(1)** while home run and jumper cables are routed through the cable management slots **(5)**
- Connected leads are held to the deck by the footlap connector management slots **(2)**
- Wires and home run cables can also be routed through the dedicated clips on the PV tile hooks to route away from metal tiles **(3)**
- Excess wiring is tucked into the dedicated wire stow areas **(4)**



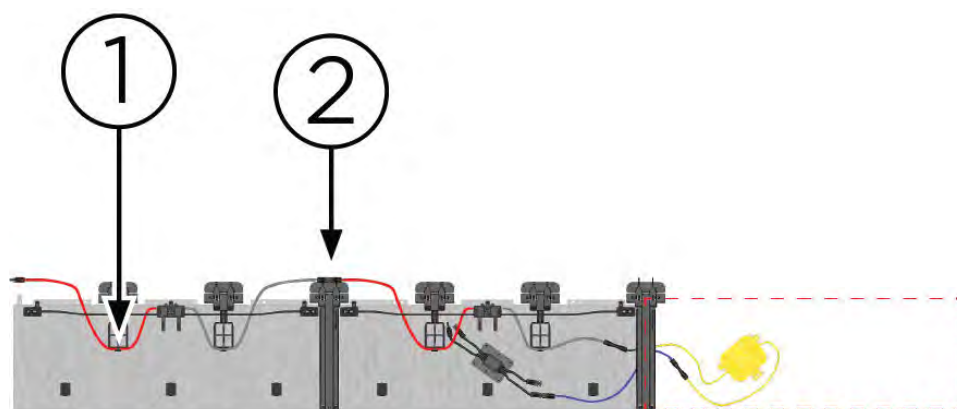
- MCIs are placed underneath "service tiles" (a combination of cut metal tiles and tile skins created to cover the MCI)



NOTE: MCI-1 shown below. This also applies to MCI-2.



SOLAR ROOF INSTALLATION



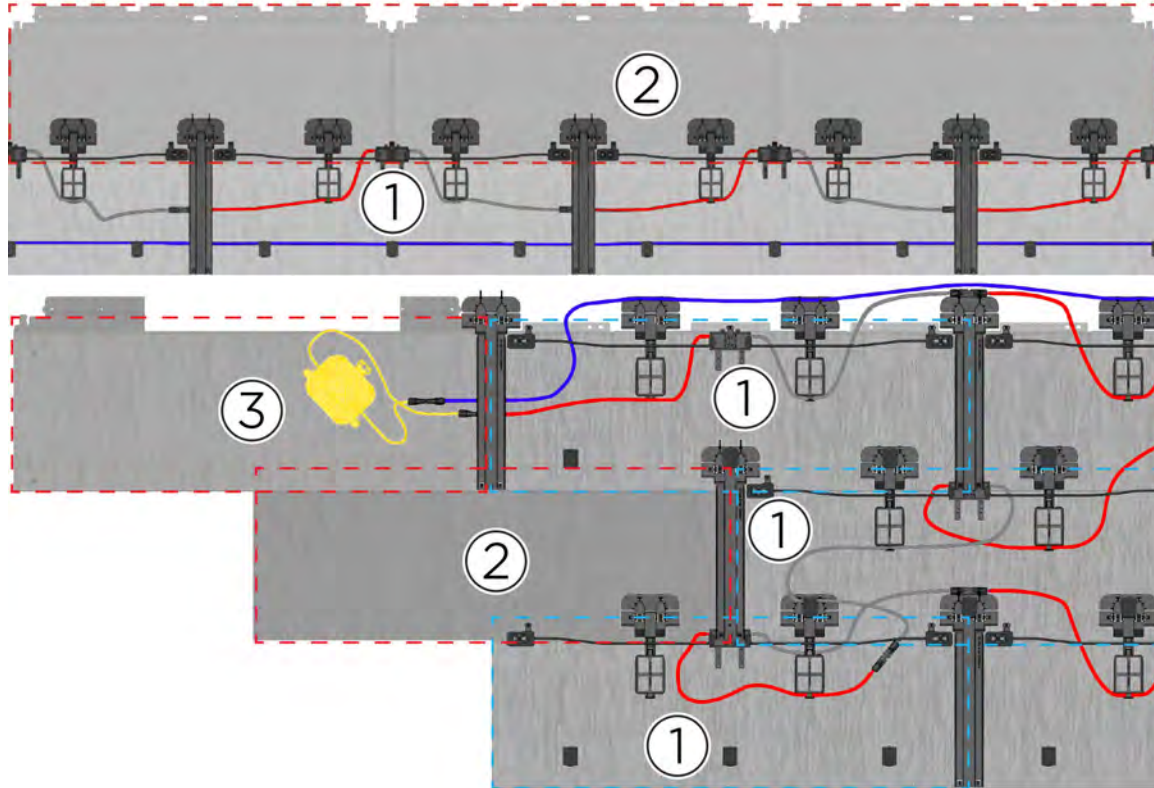


SOLAR ROOF INSTALLATION

- Spans of PV tiles **(1)** are pre-planned such that connectors and do not land underneath metal tiles **(2)** and MCIs are placed underneath "service tiles" **(3)** (allowing for future serviceability)
- Unsleeved wires are routed away from metal tiles and through PV tiles



NOTE: MCI-1 shown below. This also applies to MCI-2.



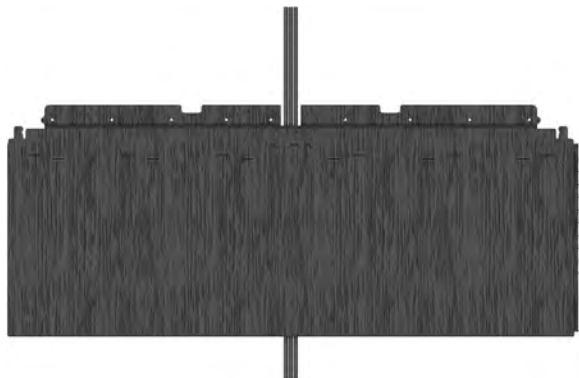


SOLAR ROOF INSTALLATION

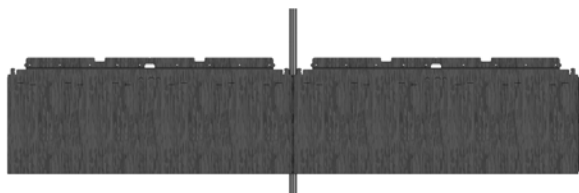
Metal Tile Cable Management

Sleeved home run and jumper cables can be routed through metal tiles in the following configurations:

- Vertically through the middle of a metal tile after a notch is cut out of the nailing flange



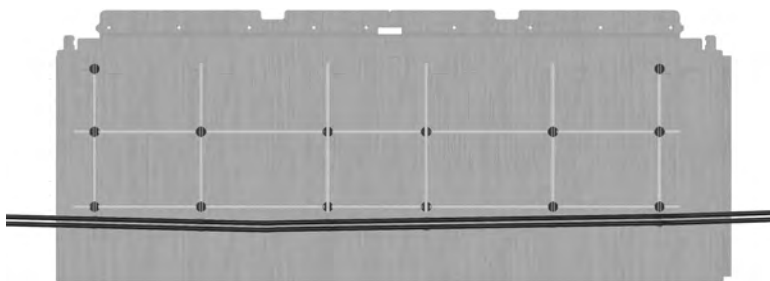
- Vertically through the water channel between adjacent metal tiles



- Vertically through channel flashing



- Horizontally through the bottom channel after a raceway is cut out of the metal tile support



Side view of horizontal wiring in metal tiles:

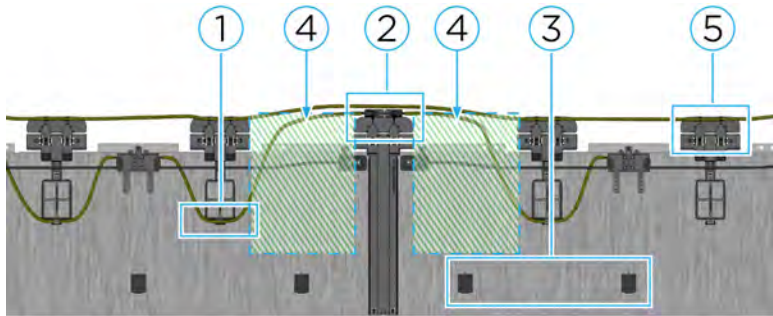




SOLAR ROOF INSTALLATION

PV Tile Wire / Cable Management with Glass Tiles (HVHZ Installations)

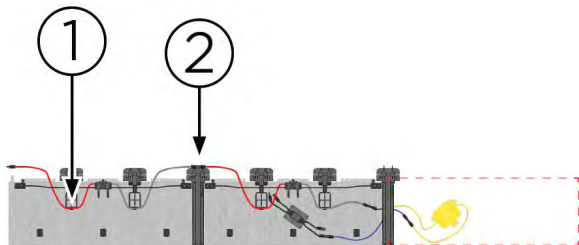
- Wires are routed through the foot wire management slots (1) while home run and jumper cables are routed through the cable management slots (5)
- Connected leads are held to the deck by the footlap connector management slots (2)
- Wires and home run cables can also be routed through the clips on the PV tile hooks (3)
- Excess wiring is tucked into the dedicated wire stow areas (4)



- MCI-1 is placed underneath "service tiles" (a combination of cut metal tiles and tile skins created to contain MCI-1)



NOTE: MCI-1 shown below. This also applies to MCI-2.



- Home Run and Jumper cables are held to the deck by the foot / footlap cable management slots
 - Sleeved cables can be routed vertically through channel flashing



- Unsleeved wires are only routed through PV and glass tiles, never through metal

Weather Considerations

Region	Temp Type	Value	US Examples, Approx. Values	Source
Very Cold	Extreme Min (Max String Calc)	-20° C (-4° F)	Minneapolis, MN: $\cong$ -26° C Chicago, IL: $\cong$ -20° C (-4° F)	ASHRAE Handbook – Fundamentals (2021 ed., Ch. 14)



SOLAR ROOF INSTALLATION

Region	Temp Type	Value	US Examples, Approx. Values	Source
Very Warm	Extreme Min (Max String Calc)	15° C (59° F)	Phoenix, AZ: $\cong 2^{\circ}$ C (35.6° F) Miami, FL: $\cong 10$ -15° C (50-59° F) Honolulu, HI: $\cong 15$ -18° C (50-64.4° F)	ASHRAE Handbook – Fundamentals (2021 ed., Ch. 14)
Very Warm	Extreme Min (Max String Calc)	45° C (113° F)	Phoenix, AZ: $\cong 44$ -46° C (111.2-114.8° F) Las Vegas, NV: $\cong 43$ -45° C (109.4-113° F)	ASHRAE Handbook – Fundamentals (2021 ed., Ch. 14)



SOLAR ROOF INSTALLATION

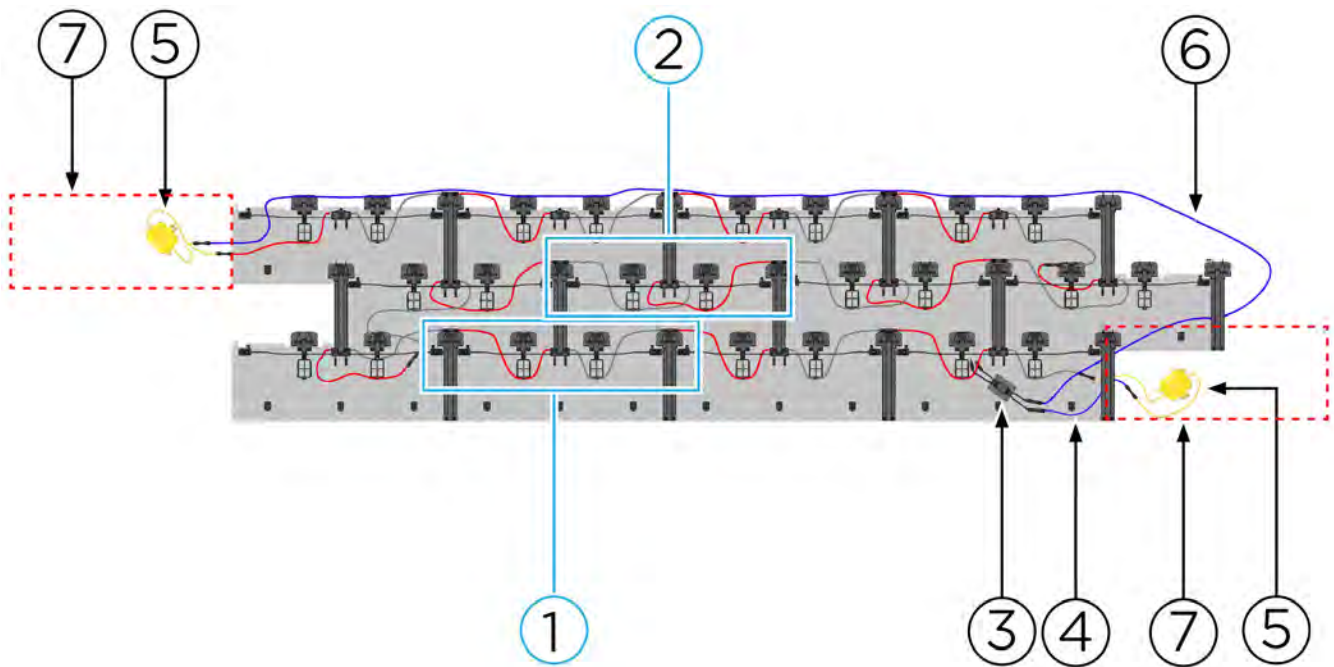
Wiring Summary

Wiring a string of PV tiles on a mounting plane is accomplished by switching positive and negative lead orientation row-to-row. Two wire management styles are used: Regular (1), and Cross (2). Regular wire management keeps the positive and negative lead on the side of the junction box they come out of. Cross wire management sends the positive and negative leads to the opposite side of the module. Wire management style will alternate row to row in order to eliminate return jumpers. Positive lead will travel right on one row, and then jump up to travel left on the next, repeating until string termination at the pass through box.

After a crossed connection course is completed, the remaining leads are connected with the remaining leads from the nearby non-crossed connection course, creating a closed loop.

Strings of PV tiles are completed by connecting **pass through boxes (3)** to the string via **home run cables (6)** (each pass through box can accommodate up to two strings). Branch plugs and sockets are used to make parallel connections between PV strings before entering a pass through box.

An **MCI (5)** must be connected directly to the positive and negative ends of every completed string. MCIs must be connected to pass through boxes via **jumper (4)**. MCIs may be located adjacent to the pass through box and underneath "service tiles" composed of cut metal tiles and tile skins. However, MCIs must be connected to each individual string before strings are connected in parallel with branch plugs and sockets.



Where using MCI-2, the total number of MCI-2s required in the string is dependent on the string voltage, as each individual MCI-2 has a voltage rating of 165 V but in combination (connected in the same string) their voltage ratings are additive. MCI-2s may be connected together in series at the end of the strings as needed to reach the desired string voltage rating. Two methods may be used to determine the MCI-2 count:

1. Where cold weather Voc is already calculated for each string in project design drawings, the MCI-2 count is calculated as:

$$\text{MCI-2 Count} = \text{String Voc (cold weather)} / 165$$

(rounded up to the nearest whole number)

2. Using a conservative cold weather multiplier (1.15), MCI-2 counts are as follows:



SOLAR ROOF INSTALLATION

When connecting multiple MCI-2s at the ends of the strings, connect one MCI-2 on each side of the first / last module as needed, as shown in the tables below.

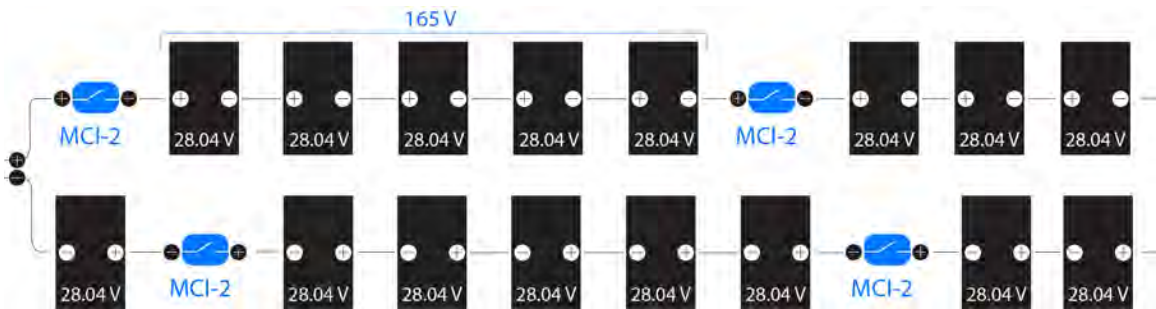
	Cold Weather	Very Warm Weather
VOC	30.72	28.04
165V Limit	5 Modules	5 Modules
600V Limit	19 Modules	21 Modules
Minimum String Size	3 Modules	3 Modules

Number of Modules	Number of MCIs
1-5	1
6-10	2
11-15	3
16-20	4
21	5

165V Restricted Wiring Strategy

 **NOTE:** No more than 2 strings in parallel are supported. An MCI-2 is required for every 165V within the string.

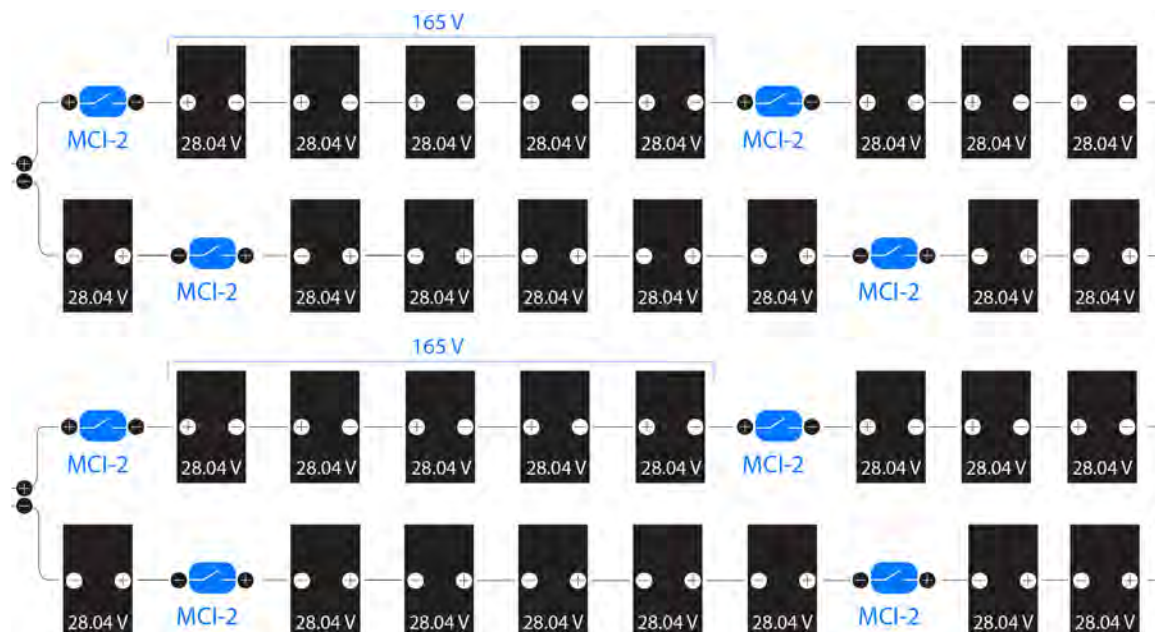
Single String



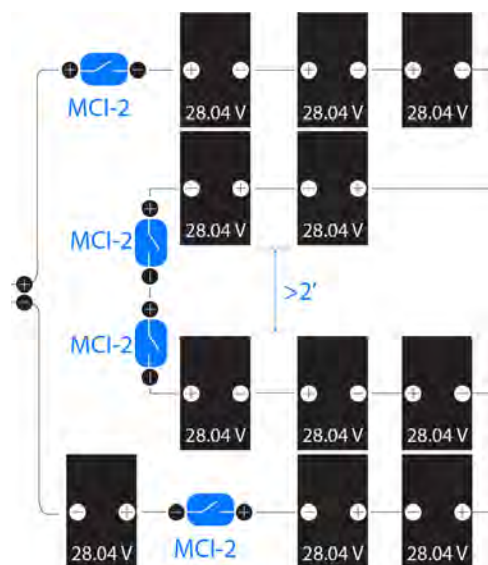


SOLAR ROOF INSTALLATION

Parallel Strings



String Spans Across 2 Mounting Planes

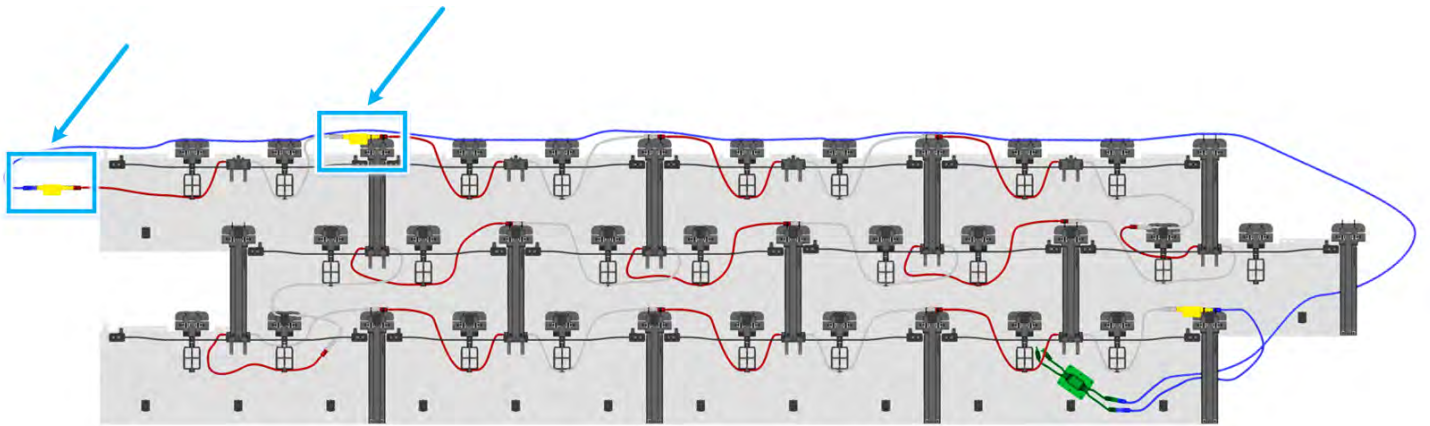


If a string spans 2 arrays on different mounting planes: install an MCI2 for every 165V and on each end of the jumper that connects the arrays.

The figure below shows an example of MCI-2s connected on each side of the first module to achieve the desired MCI-2 count.



SOLAR ROOF INSTALLATION





Stringing Example Layouts

Example Layout 1													
	<table><tr><th colspan="2">Legend</th></tr><tr><td>(A):</td><td>Array1</td></tr><tr><td>(B):</td><td>Array 2</td></tr><tr><td>(C):</td><td>Y Connector, Plug (Male)</td></tr><tr><td>(D):</td><td>Y Connector, Socket (Female)</td></tr><tr><td>(E):</td><td>Pass Through Box</td></tr></table>	Legend		(A):	Array1	(B):	Array 2	(C):	Y Connector, Plug (Male)	(D):	Y Connector, Socket (Female)	(E):	Pass Through Box
Legend													
(A):	Array1												
(B):	Array 2												
(C):	Y Connector, Plug (Male)												
(D):	Y Connector, Socket (Female)												
(E):	Pass Through Box												
Example Layout 2													
	<table><tr><th colspan="2">Legend</th></tr><tr><td>(A):</td><td>1x Jumper</td></tr><tr><td>(B):</td><td>3x Jumper</td></tr><tr><td>(C):</td><td>5x Jumper</td></tr><tr><td></td><td>Obstruction</td></tr></table>	Legend		(A):	1x Jumper	(B):	3x Jumper	(C):	5x Jumper		Obstruction		
Legend													
(A):	1x Jumper												
(B):	3x Jumper												
(C):	5x Jumper												
	Obstruction												

Underlayment and Drip Metal

Overview

This section outlines the standard underlayment and drip edge metal installation procedure.

Tools and Equipment

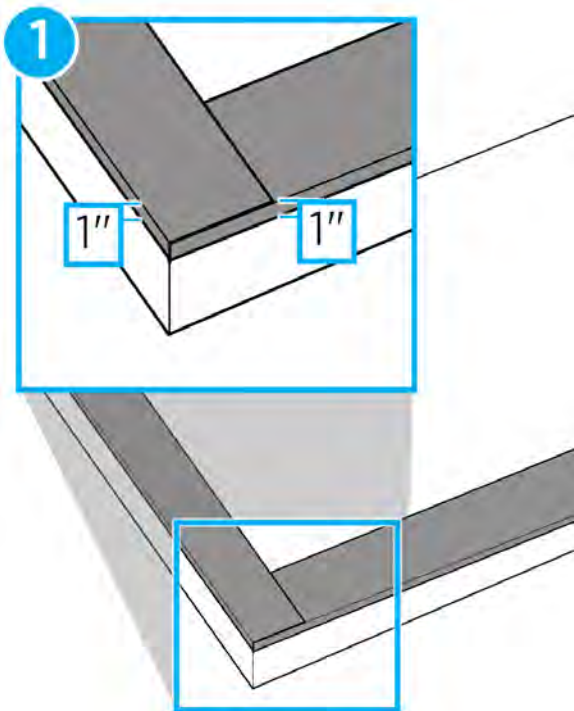
- Roller
- Underlayment
- Detail roll
- Drip edge
- Fasteners



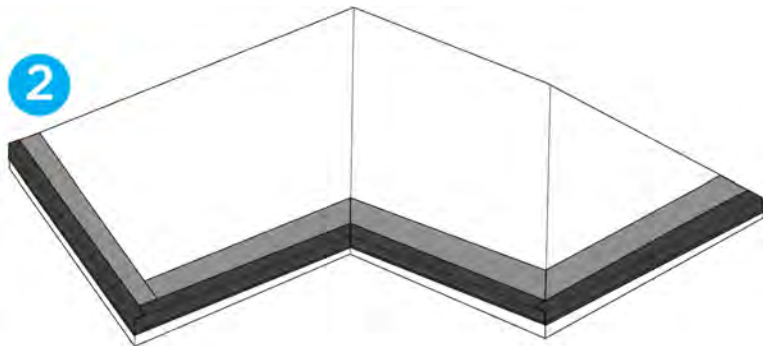
SOLAR ROOF INSTALLATION

Work Instruction

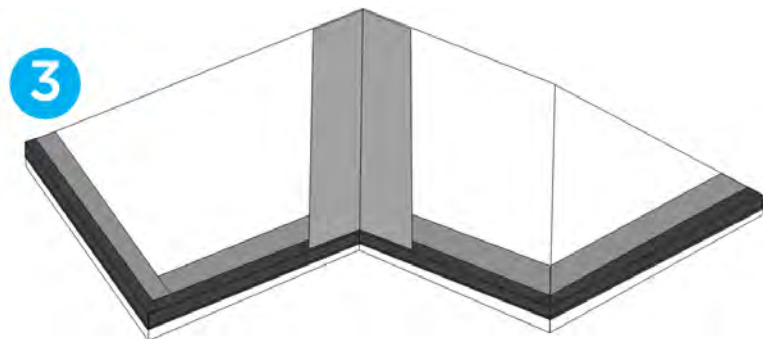
Apply detail roll along eaves and rakes, lapping 1-inch over the fascia **(1)**.



Install drip edge along eaves and rakes. Splice the drip edge and create aesthetic corners as needed **(2)**. Fasten according to the applicable wind tier in the [Fastener Schedule](#).



Install a full width sheet of underlayment centered in the valleys **(3)**.



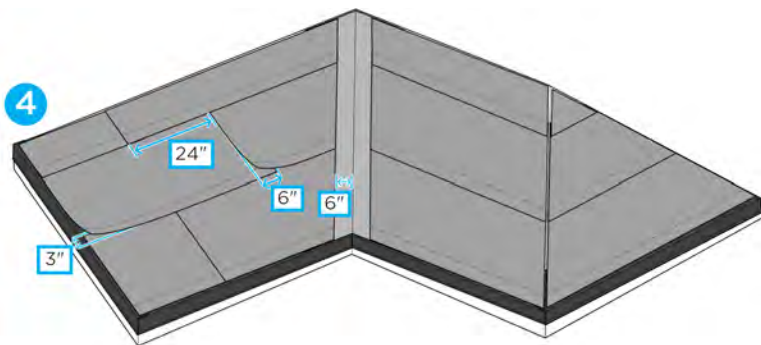
Install courses of underlayment following all lapping requirements **(4)**:

- 6-inch offset from valley centers
- 3-inch minimum side laps
- 6-inch minimum end laps



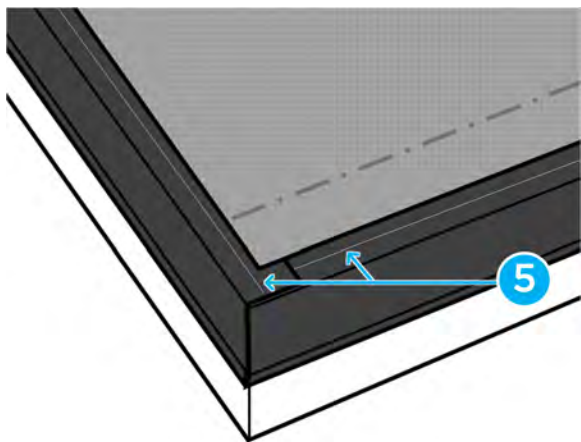
SOLAR ROOF INSTALLATION

- 24-inch minimum spacing between end laps



Along eaves and rakes edges, lap underlayment 2-to-3-inches on to the drip edge. Ensure that the drip edge fasteners are concealed. Do NOT install underlayment beyond the 1-inch score marks on the drip edge.

Pictured: Score mark (5).

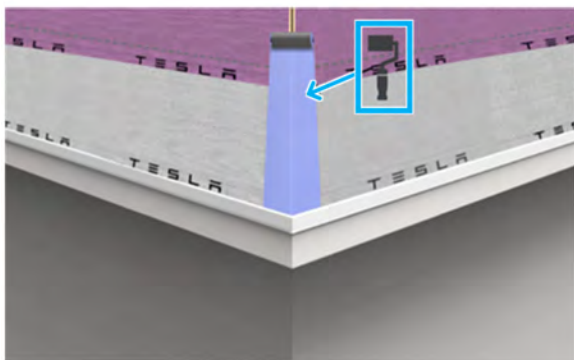
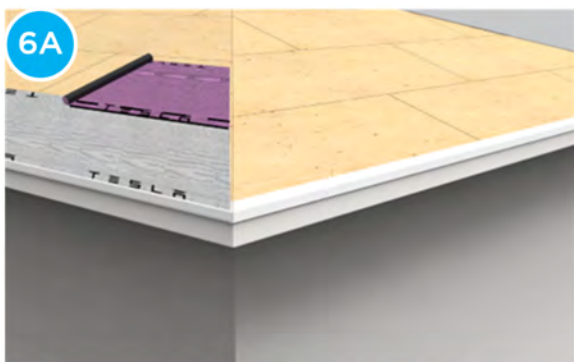


Install underlayment at hips following either method below (**6A** or **6B**):

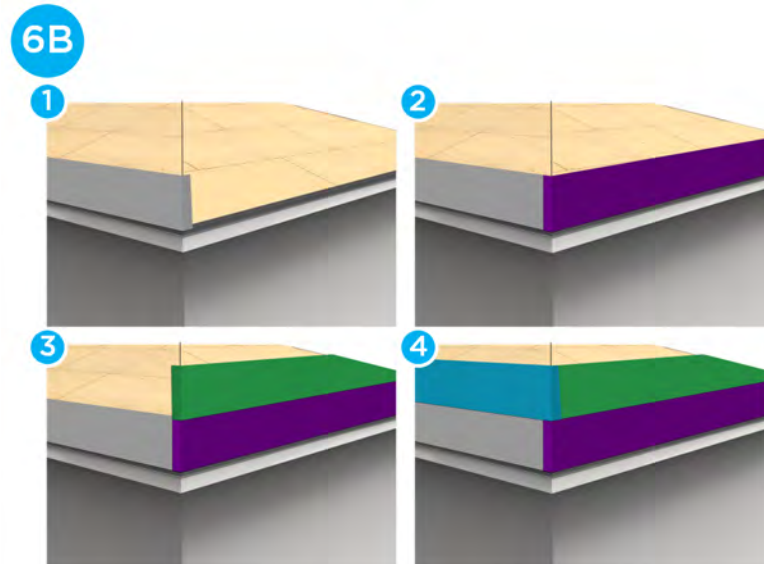
6A: Cut courses of underlayment within 2-inches of the hip, then cap the hip with the detail roll.



SOLAR ROOF INSTALLATION



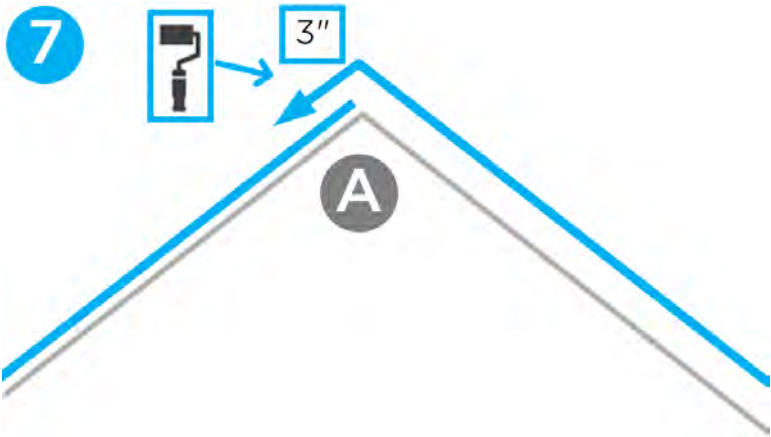
6B: Weave courses of underlayment over hips. Underlayment courses must lap a minimum of 3-inches over the hip.



At ridges, lap underlayment a minimum of 3-inches over the ridge **(7)**.

 **NOTE:** If the ridge is vented, underlayment will need to be cut back from the vented areas before installing ridge rolls and caps.

Pictured: Ridge **(A)**





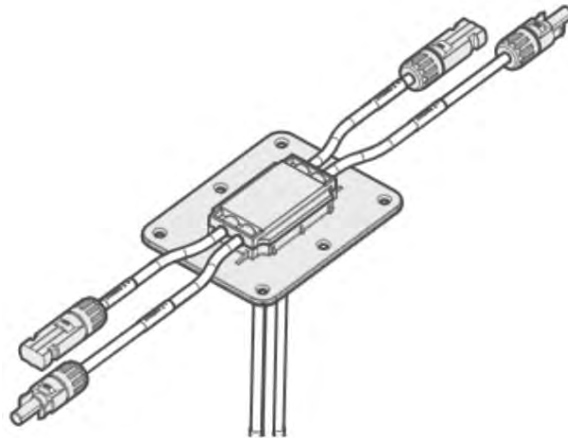
ELECTRICAL OVERVIEW

Electrical Components

Title		Model Number	Certifications	Image
Jumper		#SR-BJ2X, #SR-BJ3X, #SR-BJ4X and #SR-BJMini	UL 9703	
Jumper Description	Jumper Length			
1x	59.8 in			
3x	150 in			
5x	240.1 in			
Y Connector Socket, (Female)		#PV-AZB4	UL 6703	
Y Connector, Plug (Male)		#PV-AZS4	UL 6703	



Pass Through Box (PTB) Specifications

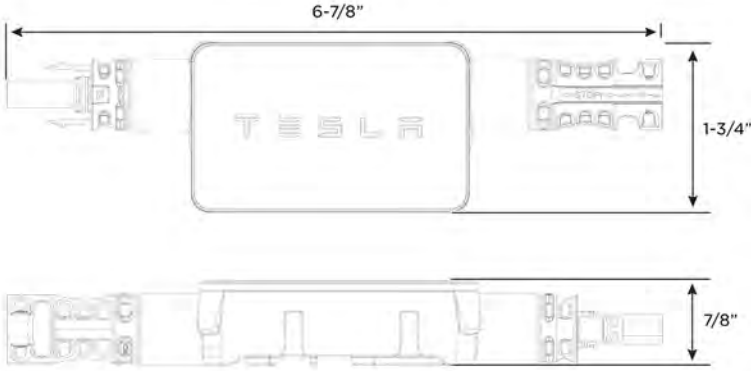
Model Number		SRPTB-4
		
Certifications		
UL 1741, File #E318357		
Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources		
Mechanical Parameters		
Cable Type	10 AWG PV Wire (ZKLA)	
Connector	Staubli MC4 type PV-KST4/6II-UR or type PV-KST4-EVO2 (male) and Staubli MC4 type PV-KBT4/6II-UR or type PV-KBT4-EVO2 (female)	
Housing	Plastic	
Environmental Specifications		
Max System Voltage		DC 600 V
Fastening Specifications		
Verify transition location on plan set. Install Pass Through Box using wiring methods and materials that comply with Article 690 and Chapter 3 of the NEC and local regulations.		
Fasten the Pass Through Box to the deck using six Buglehead Screws. Use Tesla approved fasteners only. Use of unapproved fasteners may invalidate warranty.		



Mid-Circuit Interrupter (MCI) Specifications

Certifications (MCI-2)	
UL 1741 PVRSE	
UL 3741	

MCI-2

Model Number	MCI-2, #1879359
	

Electrical Characteristics	
Enclosure Rating	NEMA 4 /IP65
Max Input Short Circuit Current, I _{SC} (A)	17 A
Nominal Input Current, I _{MP} (A)	13 A

Mechanical Parameters	
Connector	Staubli MC4 type PV-KST4/6II-UR or type PV-KST4-EVO2 (male) and Staubli MC4 type PV-KBT4/6II-UR or type PV-KBT4-EVO2 (female)
Housing	Plastic
Weight	120 g 0.26 lb
Dimension	173 mm x 43 mm x 22 mm
	6.88 in x 1.75 in x .88 in

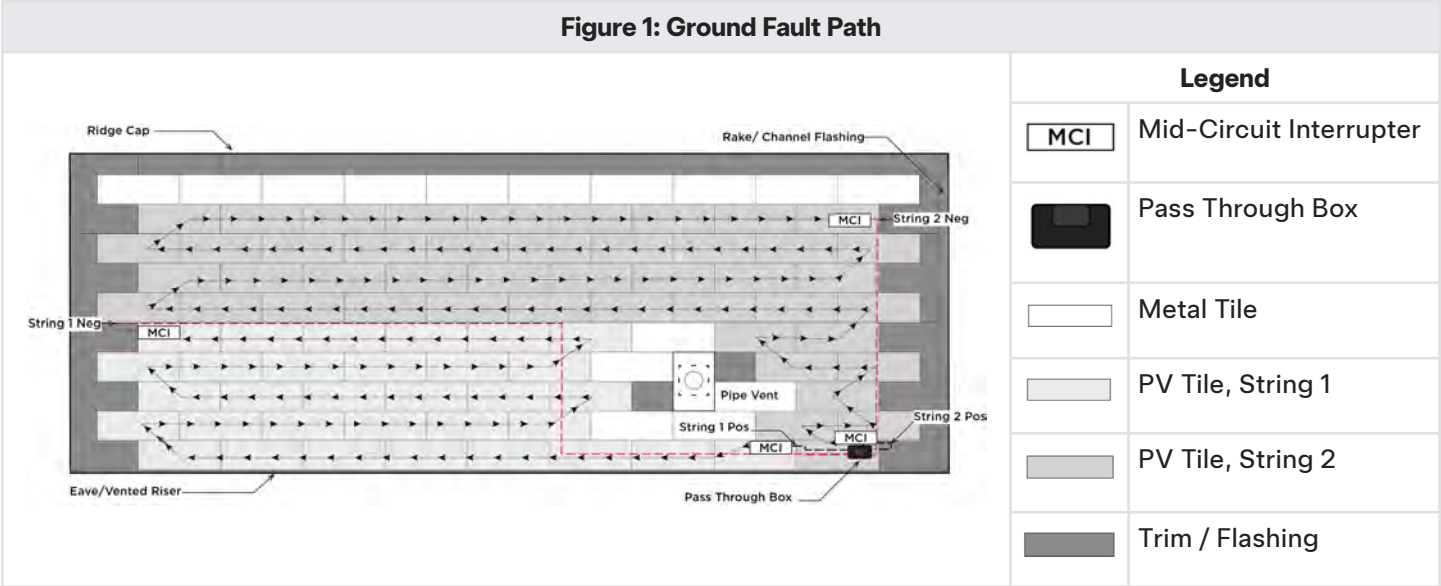
Environmental Specifications	
Ambient Temperature	-40 °F up to 158 °F -40°C to 70°C
Max System Voltage	DC 1000 V



Ground Fault Path

Ground fault paths for Solar Roof systems exist only for the DC circuit conductors as they exit the roof surface into the attic or under an eave or soffit via pass-through assemblies, as shown in the figures below. The PV tiles have no conductive external parts. Circuits exit the pass-through assemblies into conventional junction boxes or conduit couplings, where equipment ground conductors and conduit ground bushings are employed to ensure a continuous EGC path to the solar inverter ground bus in accordance with the National Electrical Code (NEC), ANSI/NFPA 70.

See [On Roof Electrical Wiring Overview on page 63](#) for descriptions of Solar Roof electrical components installation and layout.





ELECTRICAL OVERVIEW

Solar Roof PV Hazard Control System

UL 3741 PVHCS

PV RAPID SHUTDOWN ARRAY



WARNING: To reduce the risk of injury, read all instructions.

PV Hazard Control System (PVHCS) Equipment and Components Certification Standards | BIPV

Function	Manufacturer	Model No.	Firmware Versions and Checksums	Certification Standard
PV Module	Tesla	SR86T3R	N/A	UL 61730 / UL 7103
PVRSE Mid Circuit Interrupter (MCI)	Tesla	MCI-1, MCI-2	N/A	UL 1741 PVRSE
Inverter, Powerwall+, or Powerwall 3	Tesla	7.6 kW: 1538000 ¹ 3.8 kW: 1534000 ¹ 7.6 kW: 1850000 ¹ 11.5kW: 1707000 ¹	V4, 6558D2BD V4, FF7BE4E1 V4, 6558D2BD V1, 0x3282A18C	UL 1741, 1998 PVRSS/PVRSE
PVHCS Initiator (PV Inverter)	Dedicated PV system AC circuit breaker or AC disconnect switch, labeled per NEC 690.12 requirements.			N/A
PVHCS Initiator (Powerwall+, Powerwall 3)	Emergency stop device (NISD)- Listed "Emergency Stop Button" or "Emergency Stop Device" or "Emergency Stop Unit"			UL 508 or UL 60947 Parts 1, 5-1 and 5-5
PVHCS Initiator (Powerwall 3)	On/Off Enable switch located on Powerwall 3, when labelled as Rapid Shutdown initiator per NEC 690.12 requirements			UL 1741

¹ Applies to variations of this part number with suffix of two numbers and one letter.



NOTE: PVHCS installation requirements may reduce the effective equipment and component ratings below the individual equipment and component PVRSE ratings in order to achieve PVHCS shock hazard reduction requirements.

PVHCS Installation Requirements

Max System Voltage	600 V _{DC}
PVHCS Maximum Circuit Voltage (Array Internal Voltage After MCI Rapid Shutdown Initiation)	165V _{DC} (cold weather open circuit)



ELECTRICAL OVERVIEW

Other Installation Requirements

1. MCIs must be connected at both the positive and negative ends of each series-connected string to satisfy NEC 690.12 requirements for circuits exiting the array to the inverter or Powerwall. MCI-2s have additional installation requirements, as described in this manual.
2. Where a single series-connected string spans across two mounting planes, an additional MCI shall be connected at one end of the connection between mounting planes.
3. Verification that MCIs are installed at the ends of each string and (if applicable) in between mounting planes shall be documented for inspection, via photographs and/or as-built string layout diagrams.
4. For Powerwall+ or Powerwall 3: The PVHCS emergency stop initiator shall have the following minimum ratings: Outdoor (Type 3R or higher), 12V, 1A, and shall be installed in accordance with NEC requirements. The specific part shall be identified on the as-built system drawings. Refer to the Powerwall installation manual for further details.

PVHCS Components

Title	Model Number	Certifications	Image
PV Tile	Model #SR86T3R	UL 61730 UL 3741 UL 7103 UL 790 Class A ASTM D3161 Class F TAS100	
Mid-Circuit Interrupter (MCI)	Model #MCI-1, 600 V, 13 A Model #MCI-2, 1000V, 13A	UL 1741 PVRSE	
Inverter	7.6 kW: #1538000 3.8 kW: #1534000	UL 1741 PVRSS/PVRSE, 1998	
Powerwall+, Powerwall 3	PVRSS/PVRSE	UL 1741, 1998	



REFERENCES



Fastener Schedule



NOTE: See [Fasteners in the Part Catalog on page 29](#) for fastener part numbers.

Installation Phase	Component	Base 0 - 120 MPH		Fortified 121 - 180 MPH	
		Fastener	Pattern	Fastener	Pattern
Dry In	Drip Edge	Roofing nail	12 in O.C.	Roofing nail	4 in O.C. staggered
	Wall Flashing	Roofing nail	12 in O.C.	Roofing nail	12 in O.C.
	Valley Pan	Roofing nail	12 in O.C.	Deck screw	12 in O.C.
Tile Install	Riser at Eave	Roofing nail	6 in O.C.	Deck screw	6 in O.C.
	Riser at Valley	Roofing nail	6 in O.C.	Deck screw	6 in O.C.
	Riser at Ridge	Wood screw (2.375 in)	12 in O.C.	Wood screw (2.375 in)	6 in O.C.
	Channel at Rake, Sidewall, Hip and Peakwall	Roofing nail	6 in O.C.	Deck screw	6 in O.C.
	Channel to Metal Tile at Peakwall	Self-tap screw (0.75 in)	6 in O.C.	Self-tap screw (0.75 in)	6 in O.C.
	PV and Glass Tile	Roofing nail	9 EA. (3 per foot)	Deck screw	9 EA. (3 per foot)
	Metal Tile	Roofing nail	9 EA. (5 in O.C.)	Deck screw	9 EA. (5 in O.C.)
	Metal Tile, with vertical cut	Roofing nail	5 in O.C.	Deck screw	5 in O.C.
	Ripped Metal Tile (when nailing flange removed)	Wood screw (2.375 in)	9 EA. (5 in O.C.)	Wood screw (2.375 in)	9 EA. (5 in O.C.)
	Tile Skins	Self-tap screw (0.75 in)	6 EA. (8 in O.C.)	Self-tap screw (0.75 in)	11 EA. (4 in O.C.)
	Adjustable Trim Covers	Self-tap screw (0.75 in)	3 EA.	Self-tap screw (0.75 in)	4 EA.
	Caps	Self-tap screw (0.75 in)	4 EA. (into cleat pilot holes)	Self-tap screw (0.75 in)	6 EA. (4 into cleat pilot holes, 2 into body dimples)
	Transition Flashing	Deck screw	8 in O.C.	Deck screw	4 in O.C.
	Shingle Flashing	Roofing nail	6 EA. (1 per cleat)	Deck screw	6 EA. (1 per cleat)



Metal Overlap

Component	Overlap	Pattern	Splice	Sealant
Drip Edge	3 in	2 per lap	✓	X
Valley Pan	12 in	2 per lap	X	✓
Wall Flashing	6 in	12 in O.C.	X	✓
Transition Flashing	6 in	Base: 8 in O.C. Fortified: 4 in O.C.	✓	✓

Special Install Cases

See the table below for additional fastening / installation guidance in special cases.

Florida HVHZ	IBHS Fortified
- Follows the same Fastener Schedule as Fortified - Glass roofing tiles (see Glass Tile Overview on page 19) - Special drip edge installation (see Underlayment Overview on page 9) 4 in overlap - Sealant on overlap	- No reuse of existing flashings - Use stainless screws for roofs within 3000 ft of saltwater - Additional decking and documentation requirements - See the IBHS Fortified Roof program site