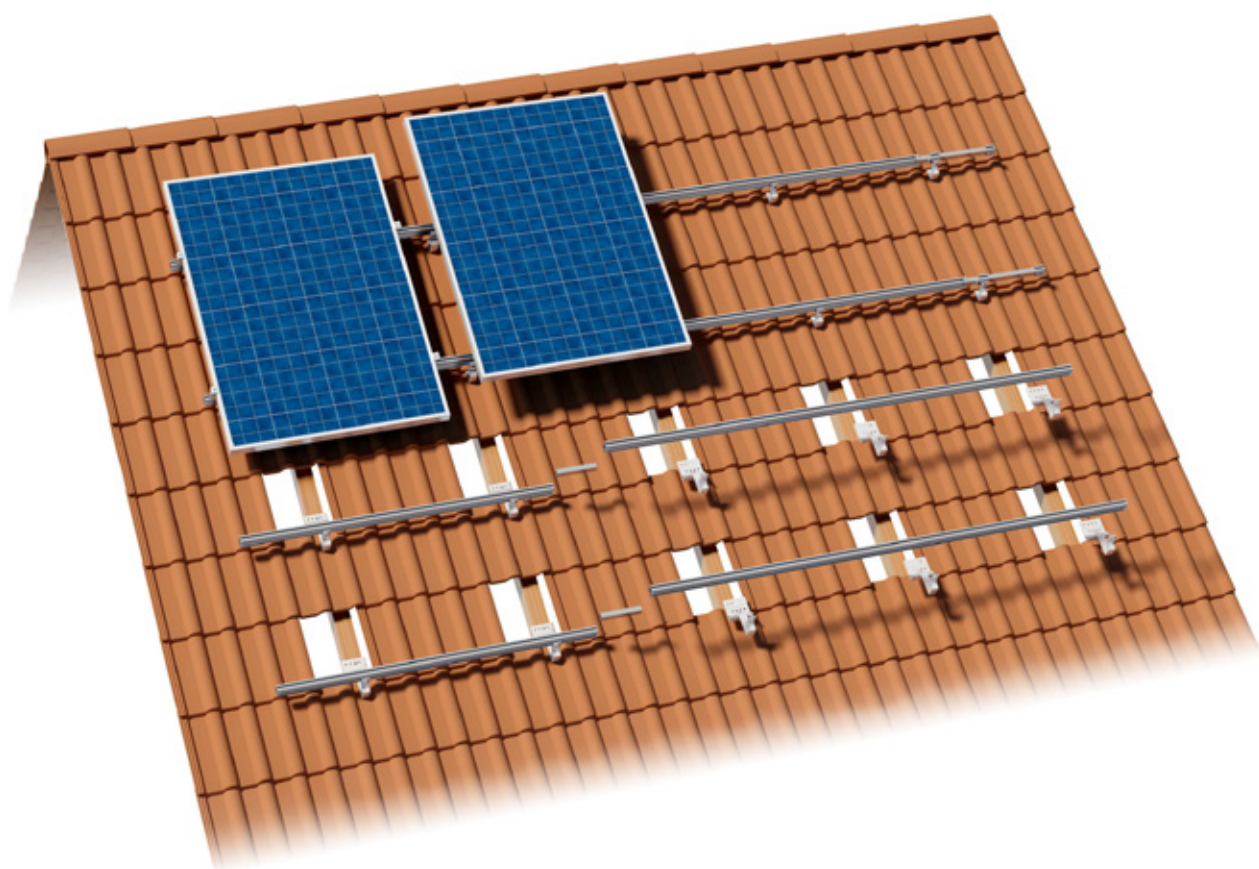
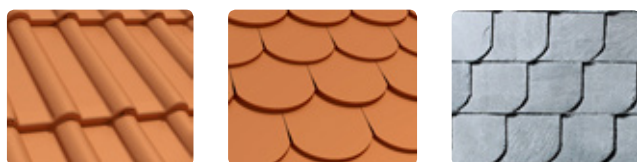




## Assembly Instructions

### PITCHED ROOF

for roofing tiles, plain tiles and slate



## 1 Introduction

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The S:FLEX PV mounting system for pitched roofs with roofing tiles, plain tiles and slate roofing is a fastening system for the installation of PV modules. It includes mounting rails, roof hooks and all necessary small parts required to fasten the PV modules on to the mounting rails, to connect the components to each other and to fix on to the roof substructure (RS). It is possible to both horizontally and vertically mount the modules using the S:FLEX mounting system. Both single layer installation and double layer installation are possible.

The S:FLEX PV mounting system for pitched roofs with roofing tiles, plain tiles and slate roofing is characterised by a high degree of pre-assembly. The patented and proven click technology allows a maximum reduction in fitting times. All components are manufactured from aluminium and stainless steel. The high corrosion resistance guarantees a maximum lifespan and provides the possibility of complete recycling.

## 1.1 Intended use

The S:FLEX PV mounting system for pitched roofs with roofing tiles, plain tiles and slate roofing is a fastening system for the installation of PV modules. It is exclusively designed to accommodate PV modules.

Any use that deviates from this must be regarded as not the intended use. In particular, the observation of the information in these installation guidelines counts as intended use.

S:FLEX GmbH is not liable for damages that result from not observing the installation guidelines or from the improper and not intended use of the product.

## 1.2 About the document

These installation guidelines describe the installation of the pitched roof frame on roofing with tiles. For this, the S:FLEX PV mounting system offers suitable solutions for fastening to the existing roof substructure without any difficulty. In the framework of these installation guidelines, the installation options for conventional tile roofing are described separately:



**Tiles**



**Plain tiles**



**Slate**

The document shows the installation guidelines for:

*Single layer installation with framed PV modules, vertically mounted*

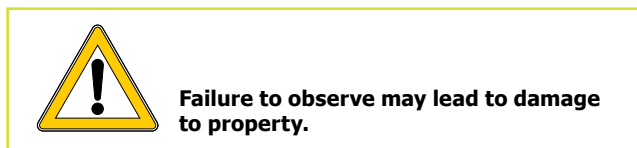
*Double layer installation with framed PV modules, vertically mounted*

*Double layer installation with framed PV modules, horizontally mounted*

It is to be ensured that only the current and complete installation guidelines are used for the installation.

### 1.3 Warnings

The warning notices used in these installation guidelines indicate safety related information. They are:



### 1.4 General information

Before starting work on the roof, it must be verified that all currently valid accident prevention regulations are observed and that adequate protection is provided against falling parts (e.g. occupational health and safety regulations of the German national association of roofers (ZVDH)).

Before installation, the PV system maker must ensure that the existing roof substructure is suitable for the occurring additional loads. The condition of the roof substructure is to be examined by the maker (e.g. quality and strength of the rafters and roof battens, quality of the roofing).

Installation should only be carried out by skilled workers who work in accordance with the rules of the German national association of roofers (ZVDH).

Before the installation of the substructure, it must be verified that the module manufacturer's specifications regarding module clamps (e.g. width and type of clamp, mounting guidelines for the clamp on the module) are observed. If this is not the case, the customer must obtain a declaration of consent from the module manufacturer before the installation, or the frame must be adjusted according to the module manufacturer's specifications.

The requirements for the protection of PV mounting systems against lightning and surges are to be met in accordance with the DIN and VDE regulations (e.g. DIN EN 62305-1.4, DIN V VDE V 0100 Part 534, VdS guidelines 2010). The specifications of the relevant power supply company are to be observed.

During installation, fire protection regulations are to be observed, e.g. no firewalls are to be overbuilt.

If the roofing is altered, the manufacturer's guidelines are to be observed. During and after the installation, the frame components may not be stepped on or be used as a climbing aid. There is a risk of falling and the roofing underneath it could be damaged.

## 1.5 Installation

The installation guidelines are for the installation of the S:FLEX PV mounting system on pitched roofs with roofing tiles, plain tiles and slate roofing. The installation guidelines are intended for a group of people with relevant qualifications and who have been instructed by the operator of the PV system.

The installation of S:FLEX PV mounting systems on roofs with plain tiles and slate roofing requires comprehensive professional knowledge on the part of the installer, therefore contacting a specialist roofing company for this installation is recommended.



**Please note: The installation should only be carried out by skilled workers who work in accordance with the rules of the German national association of roofers (ZVDH). System components (roof hooks, mounting rails) are not to be used as step ladders; the modules must not be stepped on.**

## 1.6 Standards and guidelines



These installation guidelines are based on current technology and many years of experience of how our systems can be installed on site. As individual project-related specifics must be considered for every roof, expert advice must always be sought before installation.

Before installation, the maker of the photovoltaic system must ensure that the existing roof substructure is suitable for the occurring additional loads.

To do this, contact structural engineers locally.

Every photovoltaic system must be mounted in accordance with the structural requirements of the location and the installation situation while observing the specifications in these installation guidelines.

It must be ensured that only current and complete installation guidelines are used for the installation and that a printout of the installation guidelines is kept in the immediate vicinity of the system.

Subject to technical modifications.

While installing the PV system, the module manufacturer's mounting instructions, the corresponding standards, accident prevention regulations as well as any further regulations and provisions must always be observed.

The documents listed in the following are information from S:FLEX GmbH and make no claim to be exhaustive. Every person who installs the S:FLEX PV mounting system has to independently inform themselves of all rules and guidelines for the technically correct planning and installation and observe them during the installation. This also includes obtaining the current version of the rules and guidelines.

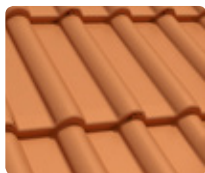
<b>BGV A2:</b>	<b>Electrical systems and equipment</b>
<b>BGV C22:</b>	<b>Construction work</b>
<b>BGV D36:</b>	<b>Ladders and step stools</b>
<b>BGV A1:</b>	<b>Accident prevention regulations</b>
<b>ZVDH:</b>	<b>Guidelines of the German national association of roofers (ZVDH)</b>
<b>Eurocode 0 (DIN EN 1990):</b>	<b>Basis of structural design</b>
<b>Eurocode 1 (DIN EN 1991):</b>	<b>Actions on structures</b>
<b>Eurocode 5 (DIN EN 1995):</b>	<b>Design of timber structures</b>
<b>Eurocode 9 (DIN EN 1999):</b>	<b>Design of aluminium structures</b>
	<b>Execution class according to Eurocode and EN 1090, Part 1 and 3: EXC 2</b>
<b>DIN EN 1090-3:</b>	<b>Execution of steel structures and aluminium structures - part of aluminium structures</b>
<b>DIN EN 62305-1-4:</b>	<b>Protection against lightning</b>
<b>DIN EN 62305-3:</b>	<b>2011 Protection against lightning Part 3:</b>
	<b>Physical damage to structures and life hazard</b>
<b>DIN 18299 VOB Part C:</b>	<b>General technical specifications in construction contracts (ATV) -</b>
	<b>General rules applying to all types of construction work</b>
<b>DIN 18338 VOB Part C:</b>	<b>General technical specifications in construction contracts (ATV) -</b>
	<b>Roofing work</b>
<b>DIN 18451 VOB Part C:</b>	<b>General technical specifications in construction contracts (ATV) -</b>
	<b>Scaffolding work</b>
<b>DIN V VDE V 0100 Part 534:</b>	<b>Devices for protection against overvoltage</b>
<b>VDE 0100 - 712 ; IEC 64/1736:</b>	<b>Low-voltage electrical installations</b>
<b>VDE 0185 Series, IEC 81/335:</b>	<b>Protection against lightning</b>

## 1.7 Description of the system

### Adjustable roof hooks

The S:FLEX PV mounting system offers suitable roof hooks for pitched roofs with roofing tiles, for easy fastening to the existing roof substructure. In the framework of these installation guidelines, a difference is made between the conventional tile roofings:

#### Tiles



**Roof hook Alu**



**Roof hook Vario**

#### Plain tiles



**Roof hook Plain tile**

#### Slate



**Roof hook Slate**

Depending on the type, the roof hooks are suitable for both the horizontal and vertical installation of the mounting rails. Details on the different roof hooks are presented in the installation sections.

A high degree of adjustability in the roof battens and in the rail zone also makes the installation of level PV arrays on to uneven roofs possible and therefore they can be easily installed on old and new buildings. To do this, the advantages of the extrusion process are effectively used. The interlocking corrugated and optimally compatible surfaces of the roof hooks and mounting rails guarantee the force-fit and form-fit connection as well as great variability.

## Mounting rails

The S:FLEX PV mounting system offers mounting rails of different strengths in order to achieve optimised systems in accordance with the structural requirements of the location and the installation situation:

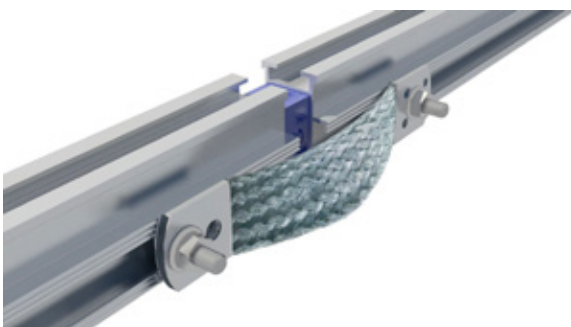


## Splice technology

Further to simple installation, splice technology allows for system alignment without reducing the load bearing capacity in the splice zone as the splices have the same static load values as the corresponding mounting rails. When linking the mounting rails together by using the splices, a connection to earth is possible if the mounting rails are pushed flush into the splice with force. It must be ensured that the connection to earth is examined by a professional on site after installation.



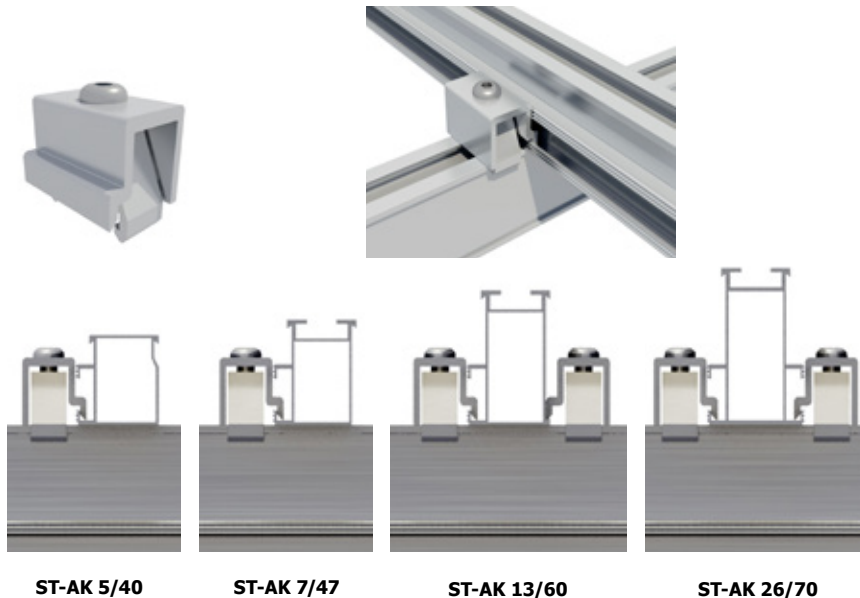
Furthermore, splice technology offers the simple and quick creation of expansion joints in accordance with the structural conditions of the roof. In this case, there is no connection to earth. This must be established by an expert on site without limiting the expansion joint's mode of operation. An example of the creation of a connection to earth in the area of the expansion joint can be seen in the following figure:





## Cross adapter clamps

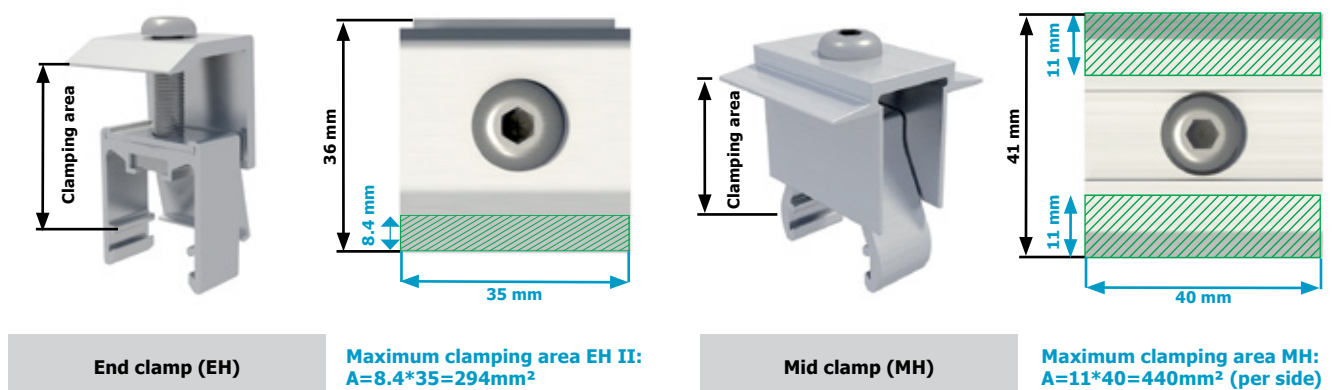
Crossing points (in double layer systems) can be quickly and viably achieved by using cross adapter clamps with patented and proven click technology. Depending on the structural requirements of the location and the installation situation, one or two cross adapter clamps must be used per crossing point.



## Mid clamps and end clamps

Height-adjustable mid clamps and end clamps, both with click technology, allow for maximum flexibility during the installation of nearly all framed module types with a frame height of 30 to 50 mm. When fastening the PV module on to the mounting rails, the module manufacturer's installation instructions must always be observed.

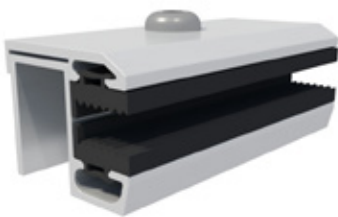
When fitting using mid clamps and end clamps, it must be ensured that they clamp the module frame at the clamping area defined by the module manufacturer. Every person that mounts the S:FLEX PV mounting system must ensure that existing clamping areas correspond to the module manufacturer's installation instructions. If the maximum clamping areas of the mid clamps and end clamps are not sufficient, it is possible to obtain the components in other lengths.



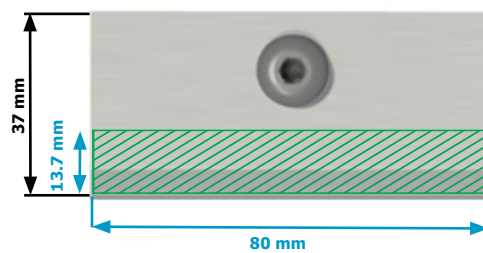
## Laminate clamps

The installation of frameless PV modules (laminates) is made possible by using perfectly fitting, certified laminate end clamps and laminate mid clamps. They are available either with the patented and proven click technology or with hammer-head bolts. Depending on the specifications of the laminate, different clamping areas and lengths are available.

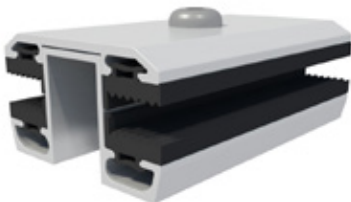
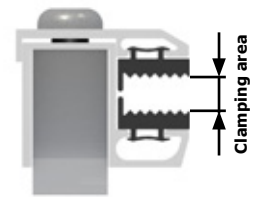
The module manufacturer must approve the use of the laminate end clamps and the laminate mid clamps (certification). You can receive an overview of the approvals from S:FLEX.



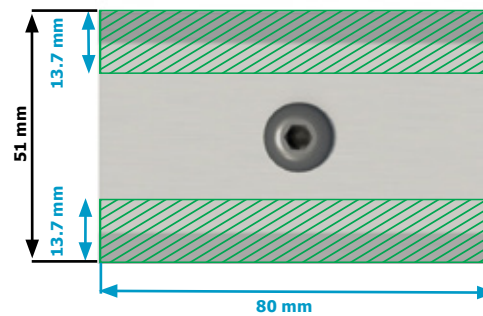
Laminate end clamp (LEK)



Maximum clamping area LEK:  
 $A = 13.7 \times 80 = 1096 \text{ mm}^2$  (above and below)



Laminate mid clamp (LMK)



Maximum clamping area LMK:  
 $A = 13.7 \times 80 = 1096 \text{ mm}^2$  (per side, above and below)



### Earthing

Equipotential bonding between the individual system components is to be ensured according to the respective country-specific guidelines and standards. For that purpose, system-specific properties (see splice technology) can also be used.

An earthing design is not included in these installation guidelines and must be calculated and implemented by the responsible installer according to the valid standards and guidelines.



**The module manufacturer's installation instructions must always be observed.**

## 2.1 System components

### ① Roof hooks

RH Alu 93-7-45 complete



RH Alu 150-7-45 complete



RH Alu 93-7-40 complete



RH Alu 111-9-40 complete



RH Alu 180-9-40 complete



RH Vario2 111-9-40 complete



RH Plain tile complete



RH Slate complete



### ② Mounting rails

ST-AK 5/40



ST-AK 7/47



ST-AK 13/60



ST-AK 26/70



### ③ Splice

Splice 5



Splice 7



Splice 13



Splice 26



### ④ End clamps

EH AK II Klick 30-50



EH AK II Klick 30-50 black



### ⑤ Mid clamps

MH AK II Klick 30-50 A



MH AK II Klick 30-50 black



### ⑥ Slipping protection

Slipping protection



### ⑦ Slider locks

Slider lock AK



### ⑧ Wood screws



### ⑨ Cross adapter clamps

Cross adapter clamps



### ⑩ Covering caps

Covering cap 5



Covering cap 7



Covering cap 13



Covering cap 26



### ⑪ Cable clips (optional)

Cable straps edge clip KC 15

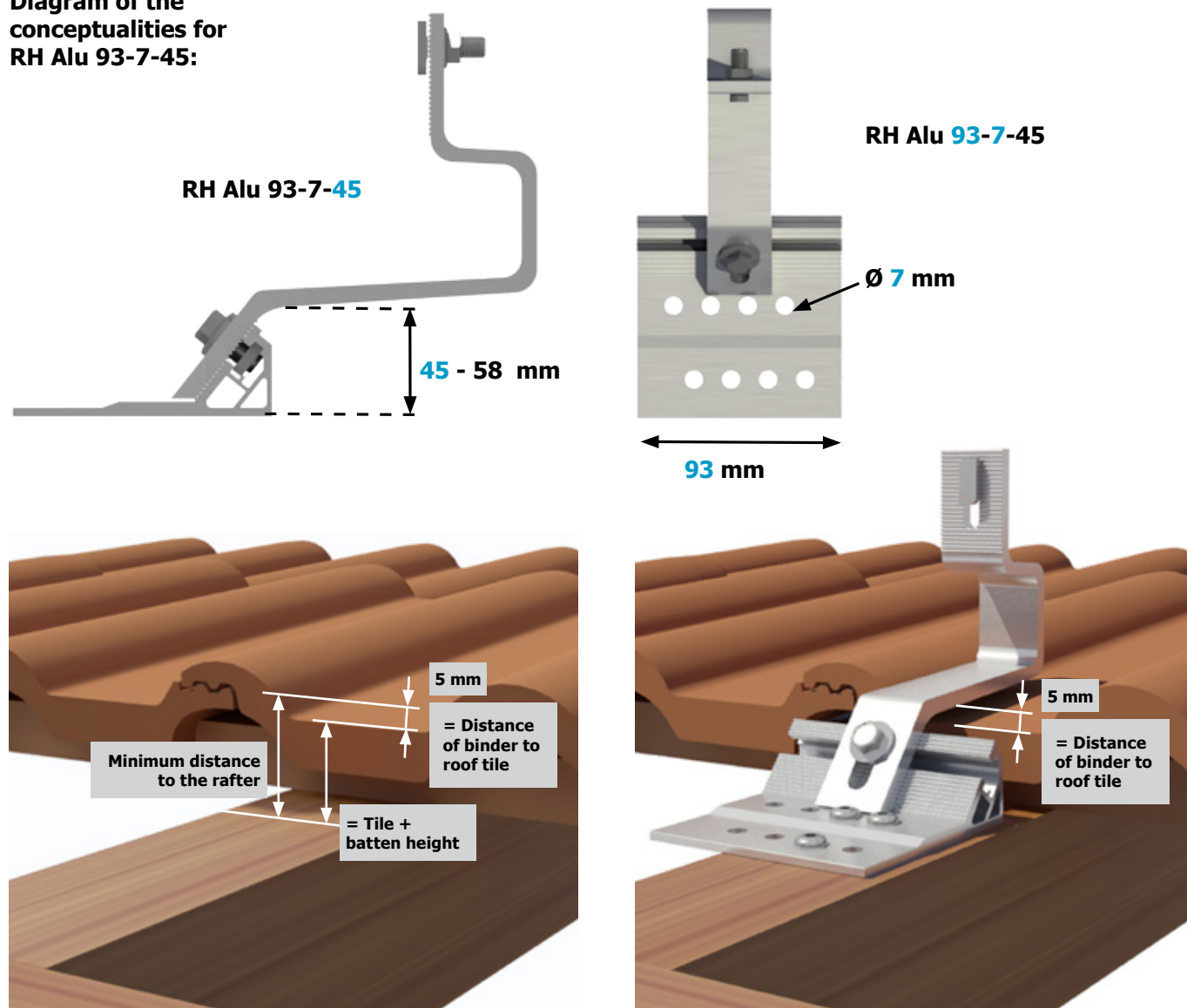


The majority of roofing is covered using pantiles or roof tiles. In this case, the S:FLEX PV mounting system offers suitable roof hooks (RH Alu and RH Vario) for easy fastening to the existing roofing (roof tiles dimensions) or roof construction (thickness of tiles and height of roof battens).

The roof hooks RH Alu are suitable for mounting horizontal mounting rails. The roof hooks DH Vario allow the option of fastening mounting rails horizontally and vertically. For different roof tile dimensions, roof hooks with suitably long adapter plates are available in order to achieve the corresponding lateral adjustability. Furthermore, it is possible to choose between base plates for fastening with 6 mm wood screws (7 mm hole pattern) and 8 mm wood screws (9 mm hole pattern). Depending on tile thickness and height of the roof battens at hand, roof hooks with a suitable punched shank are available. You can find adjustment options between 40 mm and 51.5 mm and from 45 mm to 58 mm. (If the adjustment options of the roof hooks are no longer sufficient, then the roof hook must be completely underlaid with a compression-resistant undercourse.)

The described adjustment options can be found in the description of the RH:  
RH Alu/Vario base plate width – hole pattern – minimum distance to the rafter.  
Examples: RH Alu 100-7-45, RH Vario 111-9-40

**Diagram of the conceptualities for RH Alu 93-7-45:**



The positioning of the roof hooks must be determined according to the structural requirements of the location and the installation situation. In doing so, it must again be checked whether the measurements taken as a basis in planning match the actual measurements found on the roof (if necessary, adjustments must be made). The position of the mounting rails must be checked against the module's prescribed clamping distances. Please remove the roof tiles from the marked positions (where applicable, just push up).



**Check the basis of the plans**



**Positioning according to the structural requirements and the installation situation**



**Alignment of the roof hooks using plumb line**

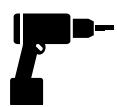
Loosen the screw on the roof hook binder until the binder can be moved. Position the roof hook (using the plumb line) and fasten to the rafter according to the guidelines of Eurocode 5 (e.g. distances to edge and screw lengths), either with at least 2 screws with 8 mm diameter or at least 3 screws with 6 mm diameter.

When fastening with at least 2 screws with 8 mm diameter, the screws are to be positioned so that 1 screw is positioned in the lower row of holes and 1 screw is positioned in the upper row of holes.

When fastening with at least 3 screws with 6 mm diameter, the screws are to be positioned so that 2 screws are positioned in the lower row of holes and 1 screw is positioned in the upper row of holes.

**Distance to the edge: Centre of screw – edge of rafter at least  $3 \times d$**

Min. 3 screws with  $d=6$  mm



Min. 2 screws with  $d=8$  mm



**Distance to tile 5 mm**



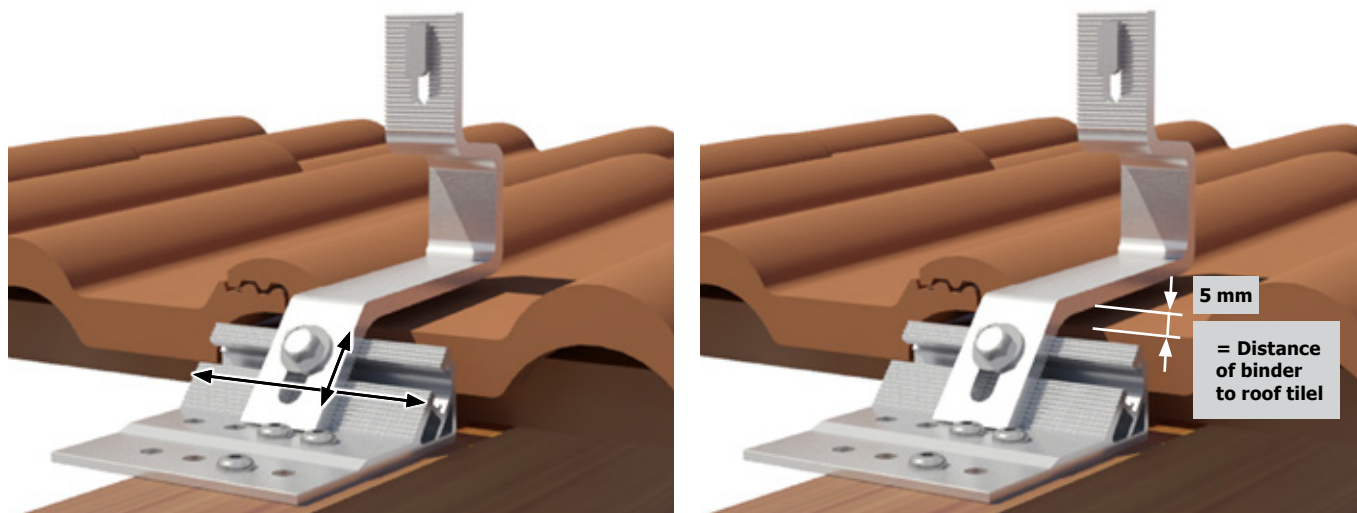
**Observe Eurocode 5 guidelines**



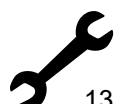
**Observe position of screws and distances to edge**



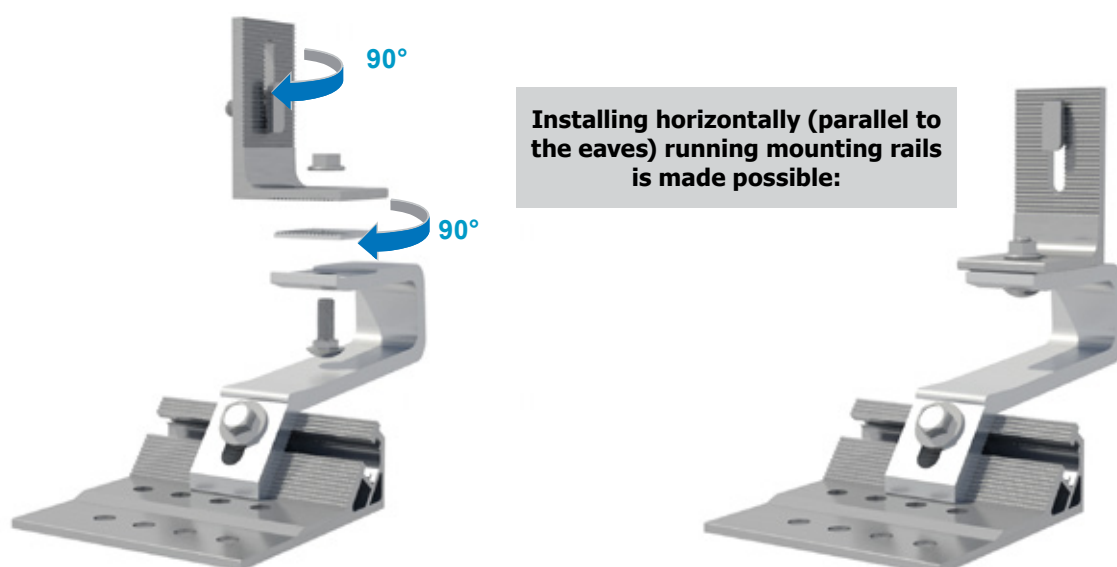
Now adjust the height and breadth of the roof hook binder so that it is positioned in the tile trough. There must be 5 mm clearance between the roof tile and the binder. Screw down the binder with the screw (torque 20-25 Nm)



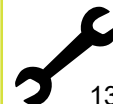
**Observe the distance of binder to the roof tile**



When using RH Vario, turn the bracket and the rippled plate by 90° and retighten (torque 12-15 Nm). Then please proceed as is described and illustrated for RH Alu.

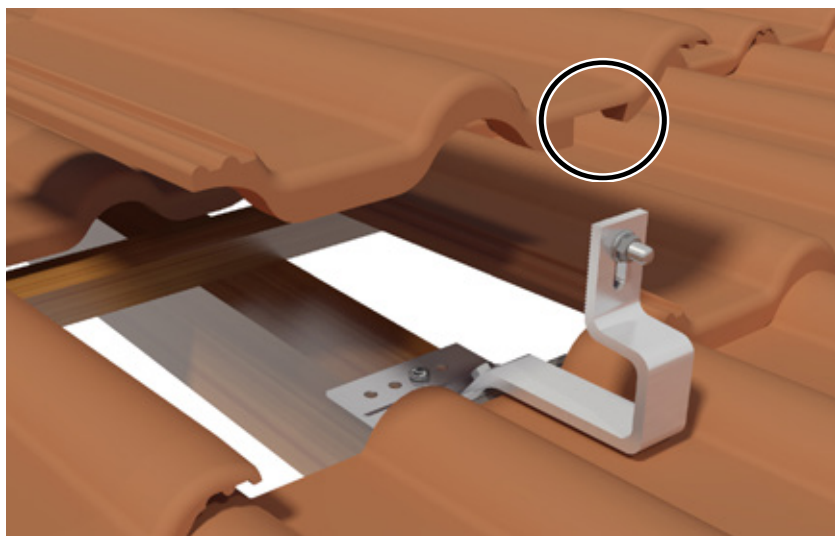


**When using RH Vario, turn the bracket and the rippled plate by 90° and retighten (torque 12-15 Nm). Then please proceed as is described and illustrated for RH Alu.**



Reposition the removed roofing tiles correctly. If necessary, use an angle grinder to notch the roofing tile over the roof hook in the position where the roof hook feeds through. The roof hook should not raise the roofing tile lying above it. In the case of seamed tile roofing, the bottom tile is also to be notched.

Ensure the impermeability of the roofing. In specific cases, it is recommended to install a sheet metal tile instead of processing a tile. Sheet metal tiles compatible with all common tiles can be purchased from S:FLEX.



**Notching the roofing tiles**



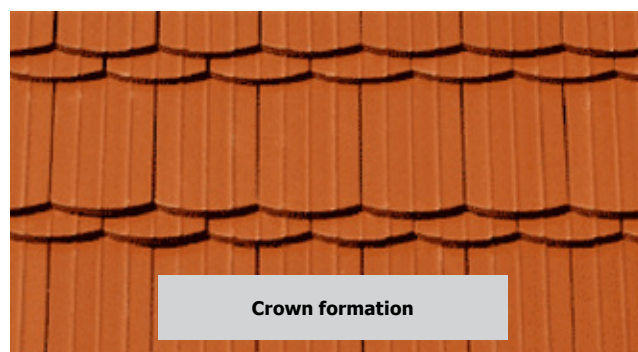
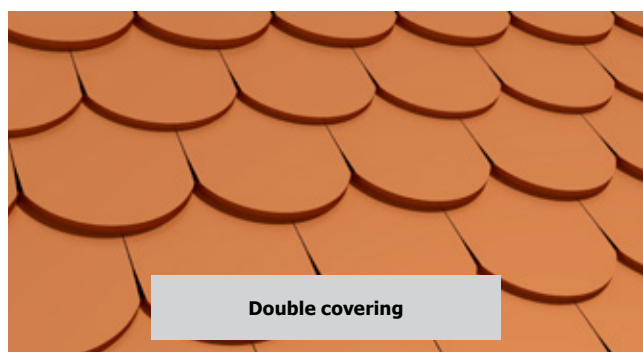
The S:FLEX PV mounting system offers the roof hooks RH Alu, RH Plain tile and RH Vario as a solution for plain tile roofing. For installation, plain tiles must be removed and if necessary processed (notched).

Normally, the plain tile that is situated under the roof hook is exchanged for a metal roof tile, so that the roof hook does not press against the roofing. The metal roof tiles are included in the S:FLEX delivery programme.

**Please contact a specialist roofing company to design the fastening of the S:FLEX PV mounting system to roofs covered in plain tiles.**

The roof hooks RH Alu are suitable for mounting horizontal mounting rails. The roof hooks DH Plain tile and DH Vario allow the option of fastening mounting rails horizontally and vertically.

Depending on the region, there are different plain tile formats and types of roofing, e.g. double covering and crown formation. Installation with RH Plain tile lends itself to double covering. For crown formation, installation with RH Alu (for horizontally running lower mounting rails) or the RH Vario (for vertically running lower mounting rails) is suitable.



Depending on the type of roofing, thickness of the plain tiles, roof batten height and sheet thickness on hand, it may be necessary that the roof hook is completely underlaid with compression-resistant undercourse.

The installation steps for the roof fastening are described in the following using the example of double covering (the most common type) with RH Plain tile.



**The following installation guidelines for the fastening of the S:FLEX PV mounting system to roofs covered in plain tiles with double covering serve as exemplary guidelines. A specialist roofing company is to be contacted to carry out the fastening on to the roof in a technically correct manner.**

The positioning of the roof hooks must be determined according to the structural requirements of the location and the installation situation. In doing so, it must again be checked whether the measurements taken as a basis in the planning match the actual measurements found on the roof (if necessary, adjustments must be made). The position of the mounting rails must be checked against the module's prescribed clamping distances.



**Check the basis of the plans and remove tiles; where applicable, just push up.**



**Positioning according to the structural requirements and the installation situation**



**Use titanium zinc sheet and observe the overlapping length of the sheet**



**Align the roof hooks using plumb line**

In the marked positions, remove three plain tiles and replace the plain tiles under the roof hooks with a metal roof tile. Insert foam wedges into the metal roof tiles.

Position the plain tile roof hook and affix according to the guidelines of Eurocode 5 (e.g. length of screw, distance to edge 3xd) with 2 plate head screws (8x80 / 8x100 / 8x120).

Check whether the connection screw in the bracket is correctly tightened (torque 12 – 15 Nm).

**Min. 2 screws (plate head) with d=8 mm**



**Observe Eurocode 5 guidelines**



**Observe position of screws and distances to edge**

The S:FLEX PV mounting system offers the roof hook RH Slate as a solution for slate roofing. The installation of the RH Slate should be carried out during the roofing (new build). For already existing roofing, slates must be removed and if necessary processed (notched) before installation.

Normally a titanium zinc sheet is fixed above the sarking membrane to the roof boarding. The sheet should overlap with the slate roofing around the exposed area so that the impermeability of the roofing is ensured. Above this sheet, the RH Slate is mounted on to the rafter. Above the RH Slate, a further titanium zinc sheet is fixed to the roof boarding so that the impermeability of the roofing is ensured.

**Please contact a specialist roofing company to design the fastening of the S:FLEX PV mounting system to slate roofs.**

The roof hooks RH Slate are suitable for mounting horizontal and vertical mounting rails. Depending on the region, there are different slate tile formats and types of roofing.



The installation steps for the roof fastening are described in the following using universal roofing with full roof boarding with RH Slate as an example.



**The following installation guidelines for fastening the S:FLEX PV mounting system to slate roofs serve as exemplary guidelines. A specialist roofing company is to be contacted to carry out the fastening on to the roof in a technically correct manner.**

The positioning of the roof hooks must be determined according to the structural requirements of the location and the installation situation. In doing so, it must again be checked whether the measurements taken as a basis in the planning match the actual measurements found on the roof (if necessary, adjustments must be made). The position of the mounting rails must be checked against the module's prescribed clamping distances. In the marked positions, remove the slates or, where applicable, just push up.



**Check the basis of the plans and, where applicable, remove slates**



**Positioning according to the structural requirements and the installation situation**



**Align the roof hooks using plumb line**

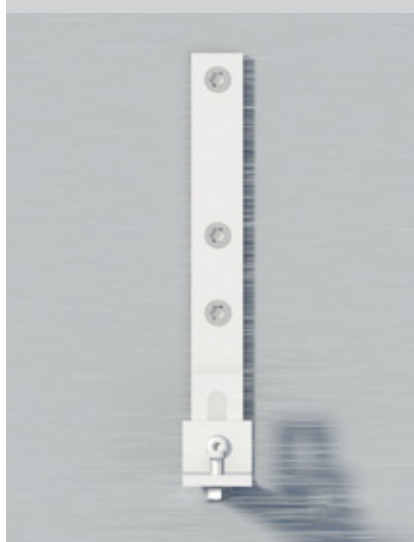


**Use titanium zinc sheet and observe the overlapping length of the sheet**

Depending on the slate size, 1 or 2 slates must be replaced by a titanium zinc sheet to be provided by the customer. This is fixed to the roof boarding according to the guidelines and rules of the German national association of roofers. It must be ensured that the sheet reaches as far under the sideways abutting slate and as far over the lower abutting slate so that the impermeability of the roofing is ensured. Check whether the screw in the bracket is correctly tightened (torque 12 – 15 Nm).

Position the roof hook RH Slate (using the plumb line) and attach to the rafter according to the guidelines of Eurocode 5 (e.g. distances to edge and screw lengths) with at least 3 screws (countersunk head with 6 mm diameter).

**Min. 3 screws (countersunk head)  
with d=6 mm**



**Observe Eurocode 5 guidelines**



**Observe position of screws and distances to edge**

A further titanium zinc sheet is to be mounted above the roof hook. Any arising space between the titanium zinc sheet and the adjacent slate must be sealed using sealing tape provided by the customer. Please affix the adjacent slates according to the guidelines and rules of the German national association of roofers.



**Seal spaces with  
sealing tape**

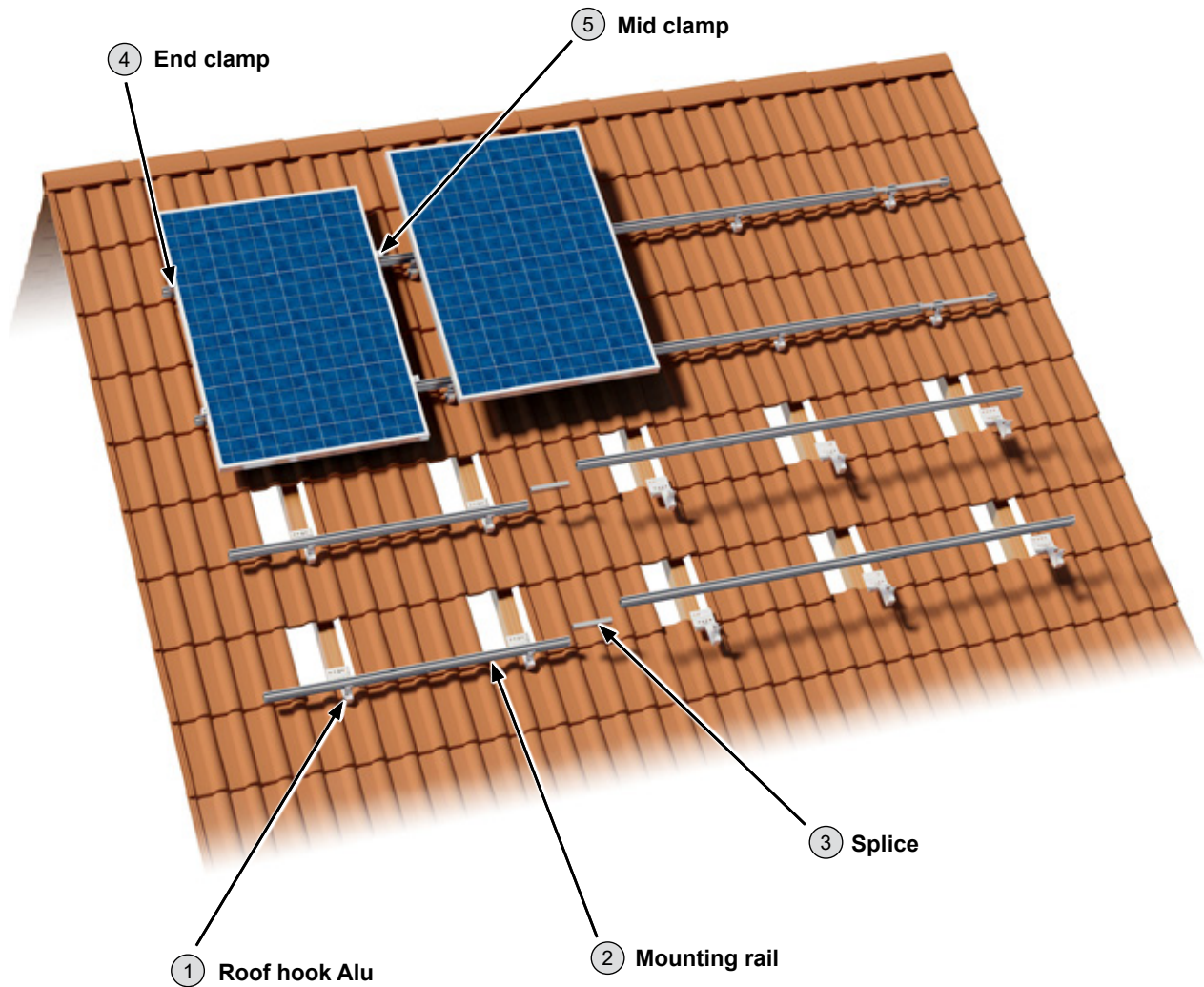


**If necessary, notch the  
roofing tiles**



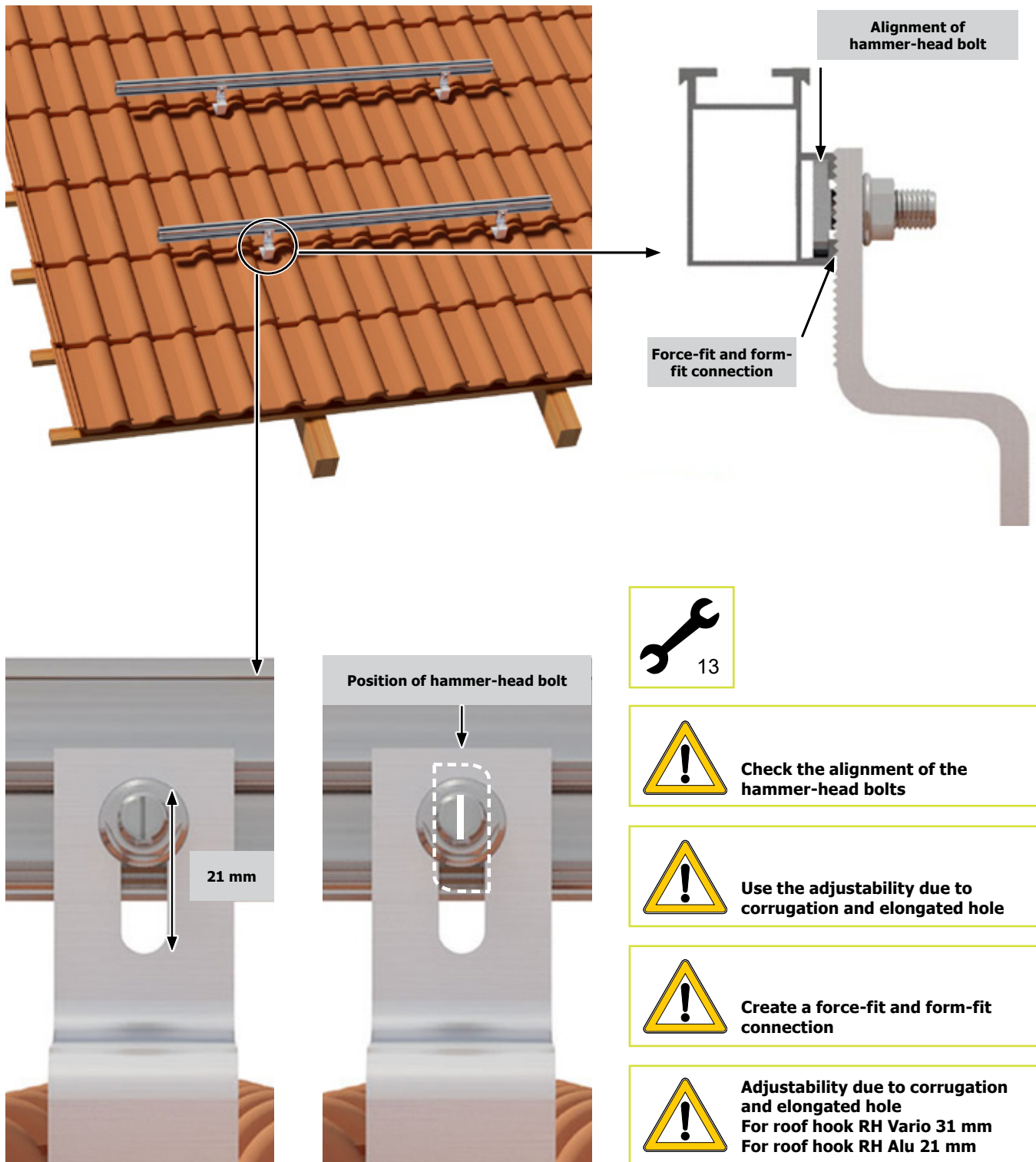
**Single layer installation with framed PV modules, vertically mounted**

The installation guidelines "Single layer installation with framed PV modules, vertically mounted" are only valid in conjunction with the guidelines in Section 1. The installer has to ensure that only the current and complete installation guidelines are used for the installation.



### Single layer installation with framed PV modules, vertically mounted

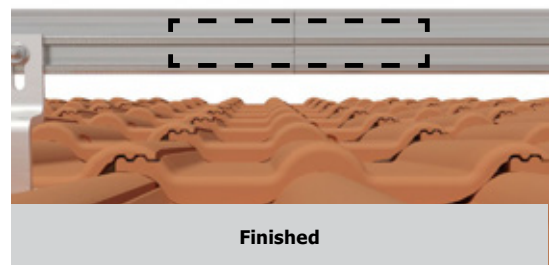
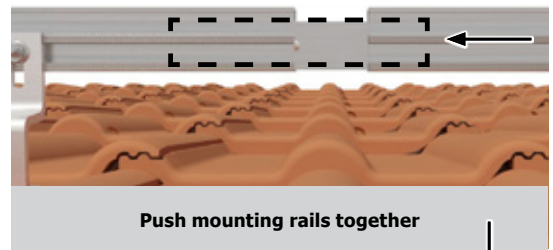
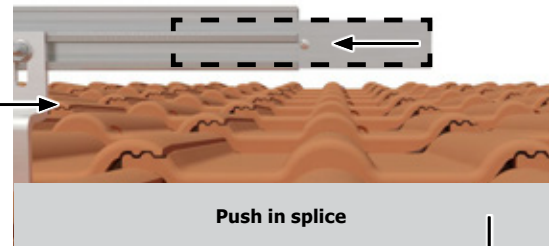
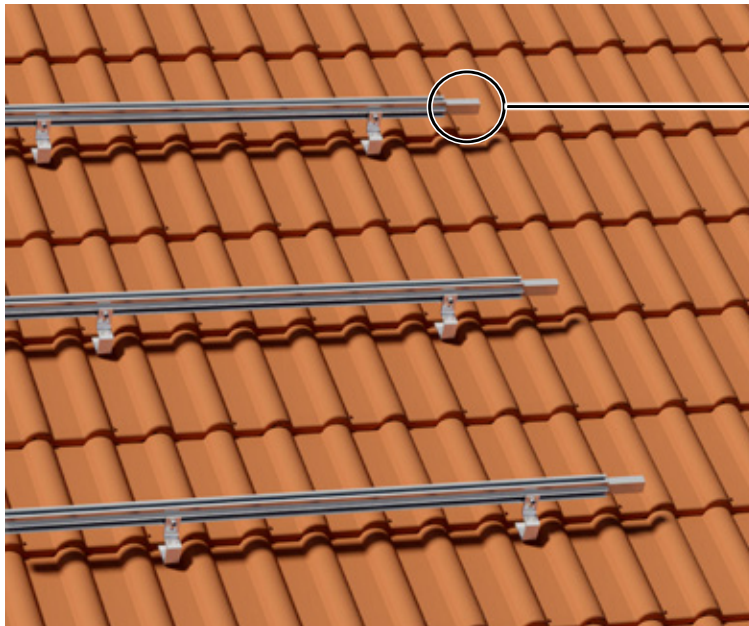
Mount the horizontally (parallel to the eaves) running mounting rails to the roof hook using the hammer-head bolt M8x25 and the self-locking nut. Ensure the correct alignment of the hammer-head bolts in the mounting rail channel (torque 12-15 Nm) and that the mounting rails are mounted stress-free. To do this, use the adjustability that is created by the corrugation of the components and the elongated hole. Ensure that a force-fit and form-fit connection is created by interlocking the corrugations.



## Single layer installation with framed PV modules, vertically mounted

In order to link several mounting rails, half of the splice, which has the same structural values as the mounting rails, is pushed into the already installed mounting rail. Then push the other mounting rail on to the splice. Use pressure to push the mounting rails flush together and check if a connection to earth has been created. The connection is finished.

Fix the joined mounting rail on to the roof hook as is described.



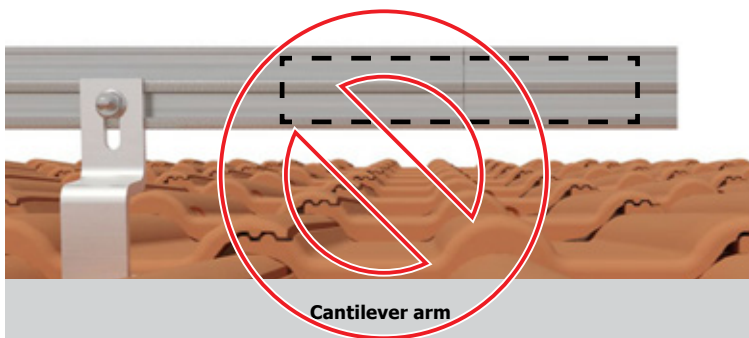
**Push in splice**



**Check connection to earth, observe notes contained under point 1.7.**



**No cantilever arms with splices.  
Position the splices so that they lie between 2 roof hooks.**





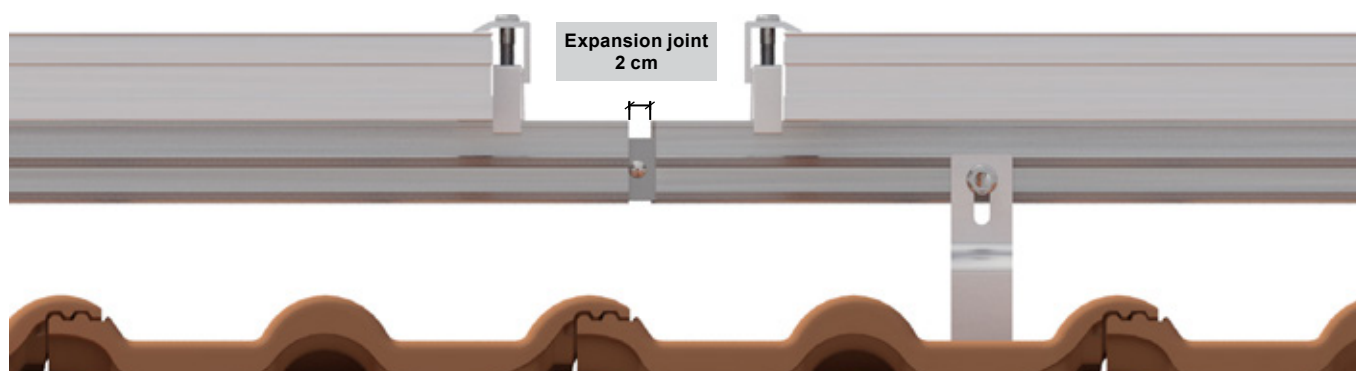
## Single layer installation with framed PV modules, vertically mounted



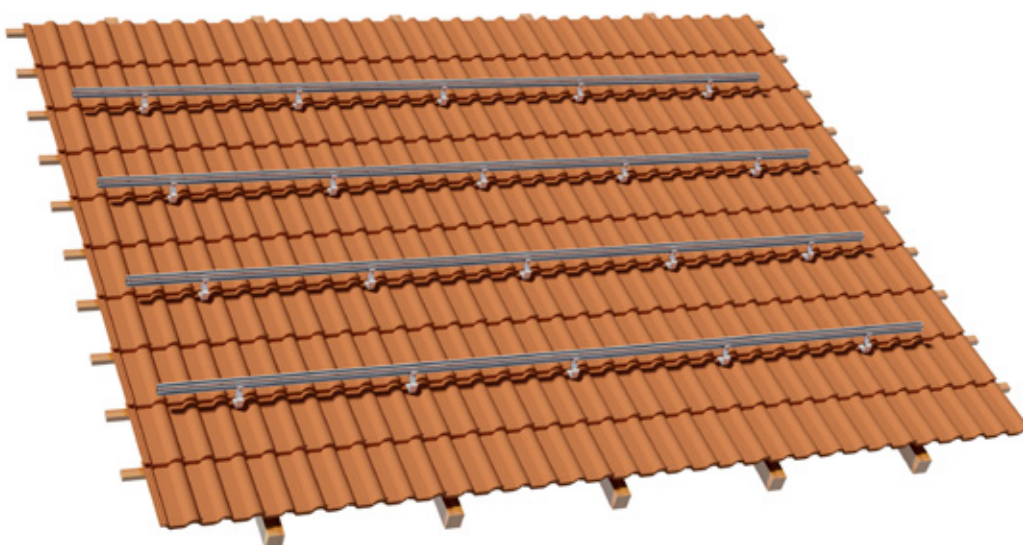
If the mounting rail is longer than 12.00 m, the module array is to be separated by placing two end clamps. In the zone between the end clamps, the mounting rail is to be separated and connected using a splice to allow the rail to move by 2 cm (expansion joint). The alignment of the expansion joints is to be adjusted according to the structural conditions of the roof and the different expansion properties of the materials. Observe Section "Installation – PV modules" in these installation guidelines when placing the end clamps.



Modules may not be built over expansion joints. There is no connection to earth. This must be established without limiting the expansion joint's mode of operation. Observe the notes contained under point 1.7



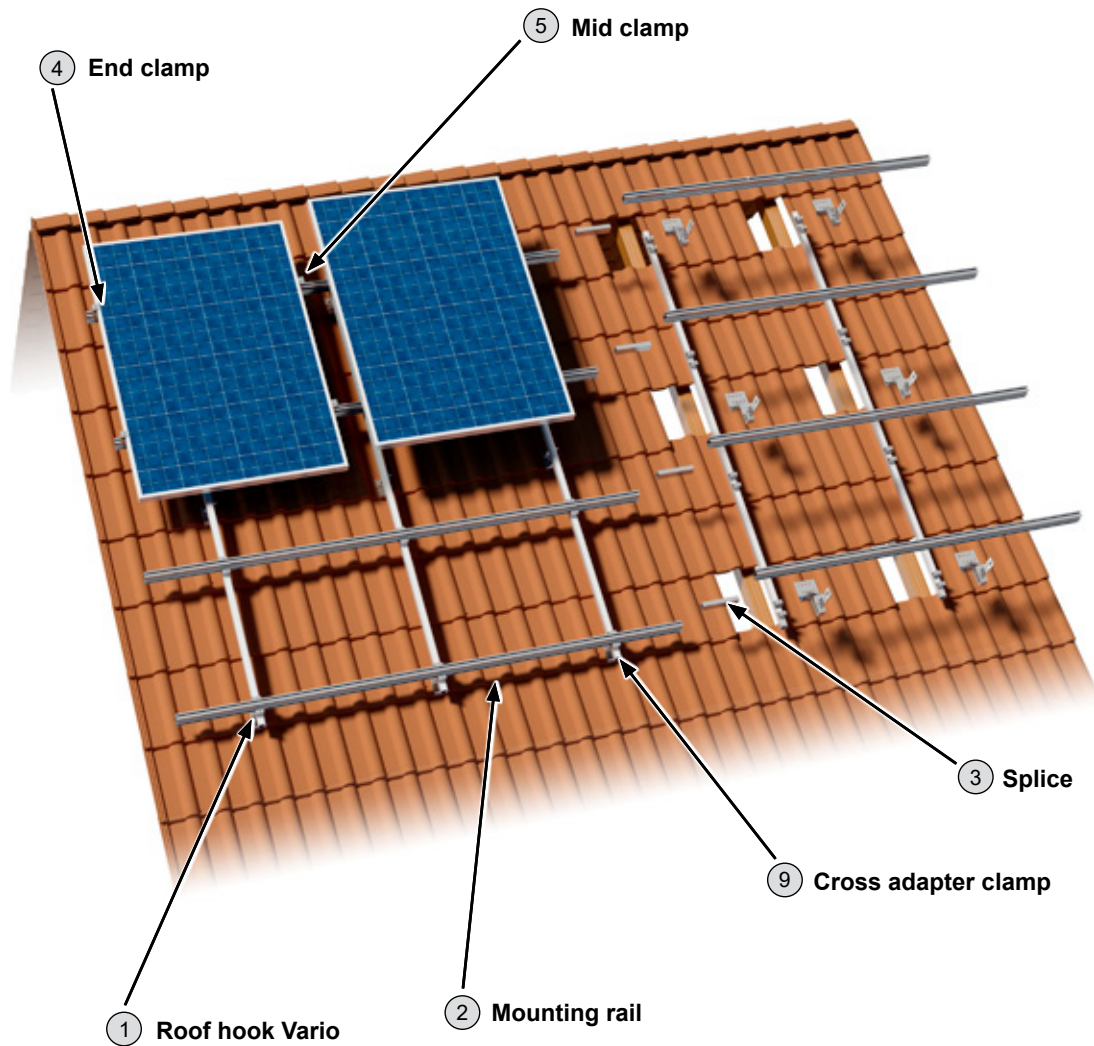
Completion of the mounting rail layer installation.



### Double layer installation with framed PV modules, vertically mounted

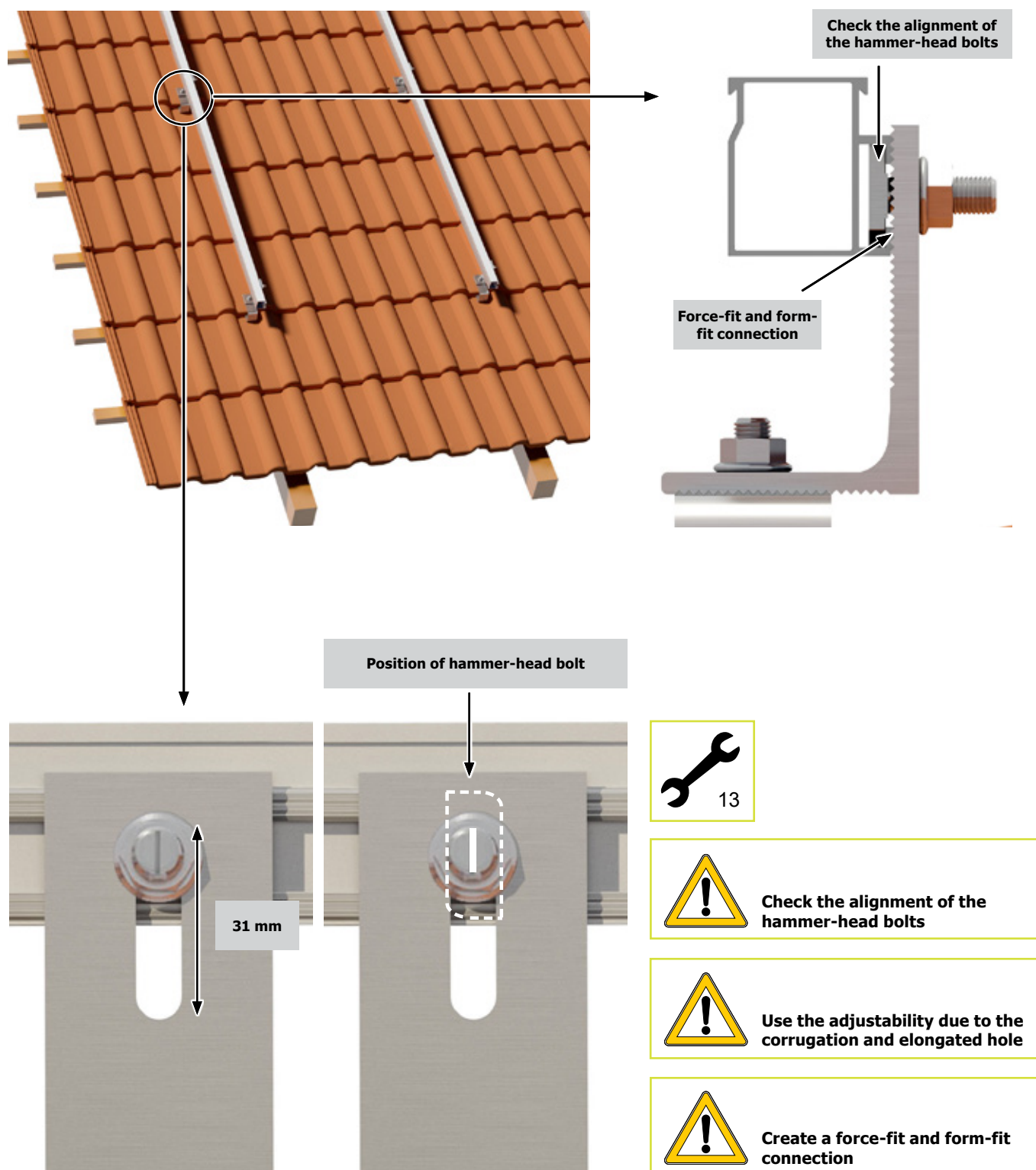
The installation guidelines “Double layer installation with framed PV modules, vertically mounted” are only valid in conjunction with the guidelines in Section 1. The installer has to ensure that only the current and complete installation guidelines are used for the installation.

The roof hooks Vario are to be used for the double layer installation with framed PV modules, vertically mounted.



## Double layer installation with framed PV modules, vertically mounted

Mount the vertical (vertical to the eaves) running mounting rails to the roof hook Vario using the hammer-head bolt M8x25 and the self-locking nut. Ensure the correct alignment of the hammer-head bolts in the mounting rail channel (torque 12-15 Nm) and that the mounting rails are mounted stress-free. To do this, use the adjustability that is created by the corrugation of the components and the elongated hole. Ensure that a force-fit and form-fit connection is created by interlocking the corrugations.



## Double layer installation with framed PV modules, vertically mounted

In order to link several mounting rails, half of the splice, which has the same structural values as the mounting rails, is pushed into the already installed mounting rail. Then push the other mounting rail on to the splice. Use pressure to push the mounting rails flush together and check if a connection to earth has been created. The connection is finished.

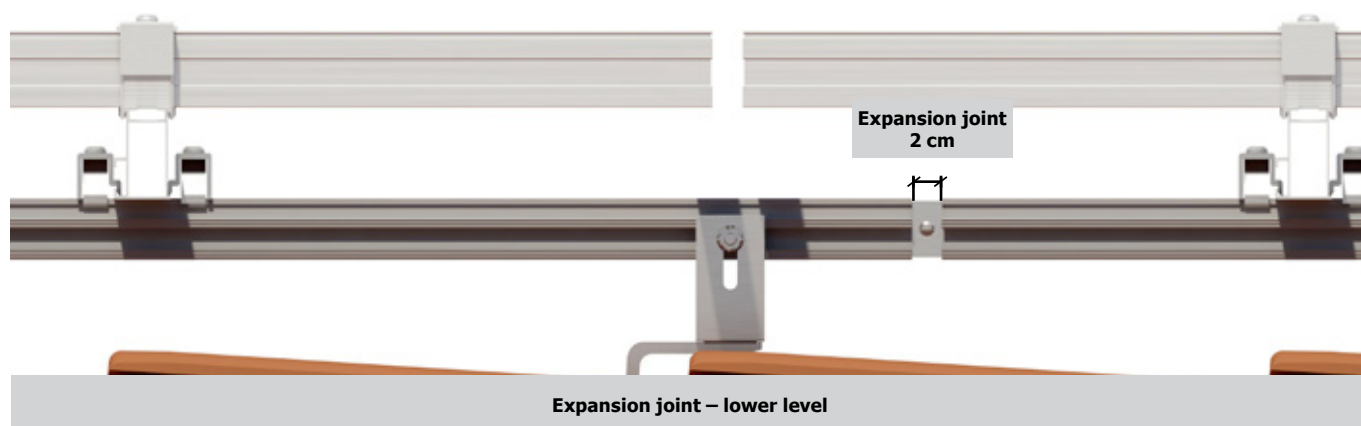
Fix the joined mounting rail on to the roof hook.



The vertical mounting rails are linked as is shown for horizontal mounting rails. Position the splices so that they lie between 2 roof hooks (no cantilever arm with splices). Check the connection to earth and observe the notes contained under point 1.7.

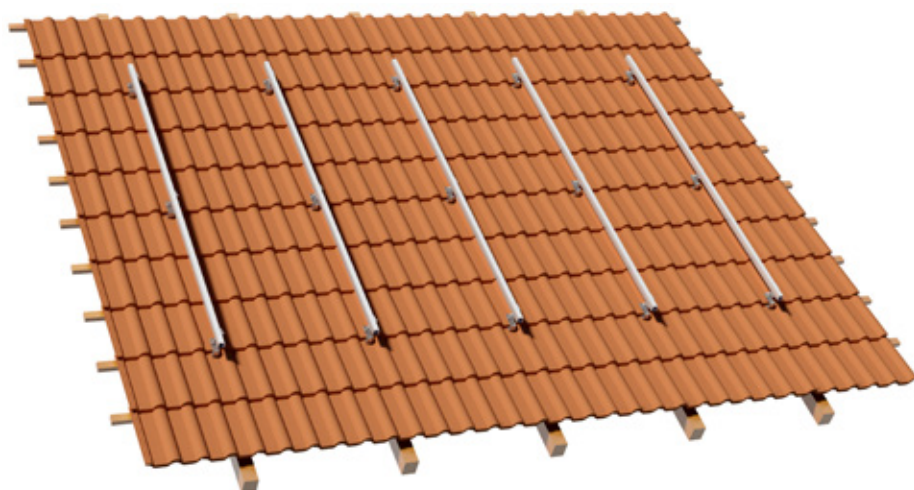


For double layer substructures, expansion joints are arranged in both layers. If the lower mounting rail is longer than 12.00 m, it must be separated and connected using a splice to allow the rail to move by 2 cm (expansion joint). The alignment of the expansion joints is to be adjusted according to the structural conditions of the roof and the different expansion properties of the materials.



Modules may not be built over expansion joints. There is no connection to earth. This must be established without limiting the expansion joint's mode of operation. Observe the notes contained under point 1.7.

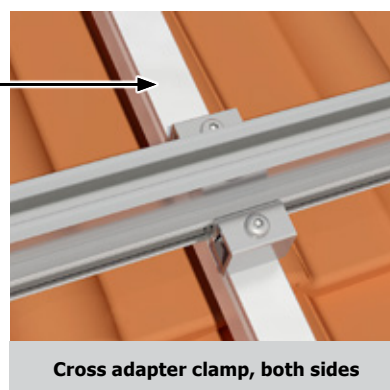
Completion of the lower mounting rail layer installation.



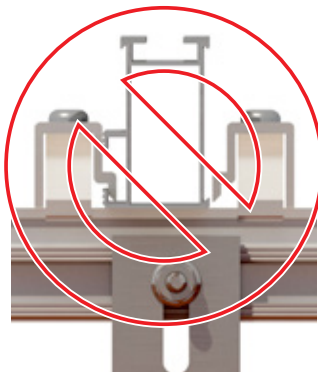


## Double layer installation with framed PV modules, vertically mounted

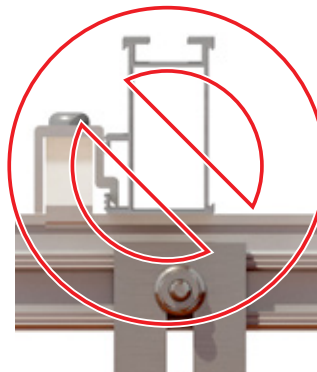
Install the horizontal mounting rails on the vertical mounting rails for each row of modules using the cross adapter clamps. To do this, click the cross adapter clamp on to the vertical mounting rail and fix the horizontal mounting rail with it. Check the distance of the horizontal mounting rails against the module's prescribed clamping distances. Ensure that the cross adapter clamp is clicked in on both sides of the mounting rail and tighten the screw (torque 8-10 Nm).



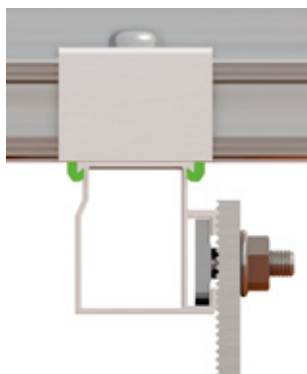
Cross adapter clamp, both sides

CAC in side HHB channel  
and opposite

INCORRECT



INCORRECT



Both sides clicked



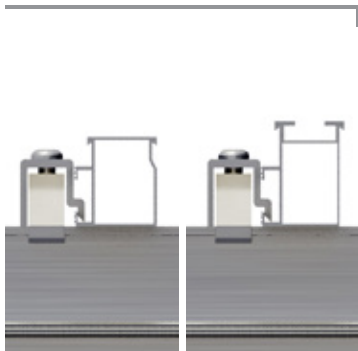
INCORRECT

**Double layer installation with framed PV modules, vertically mounted**

Depending on the structural requirements of the location and the installation situation, several cross adapter clamps may be required per crossing point. If a second cross adapter clamp is required, it is fixed to the opposite side, as described above (torque 8-10 Nm).

**Crossing points:**

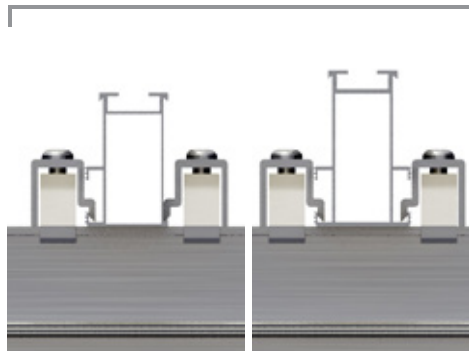
1 CAC in side HHB channel



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1 CAC in side HHB channel and 1 CAC opposite



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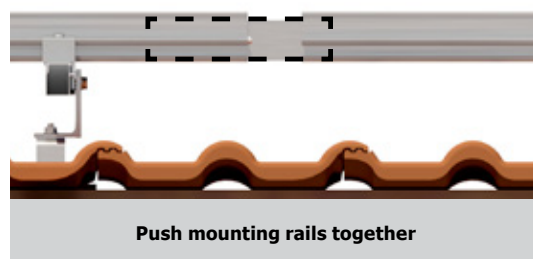
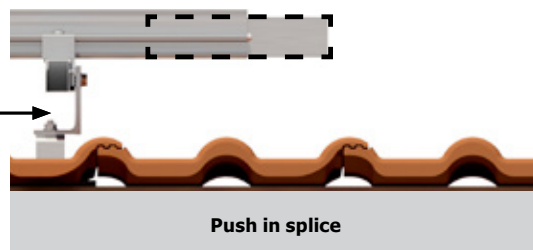
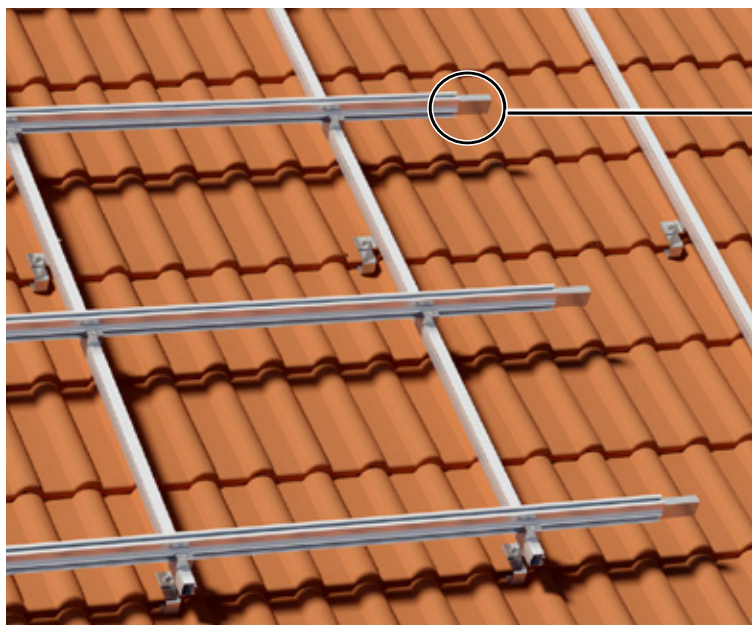
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Observe the module's installation instructions for the distance between the vertical mounting rails.

## Double layer installation with framed PV modules, vertically mounted

In order to link several mounting rails, half of the splice, which has the same structural values as the mounting rails, is pushed into the already installed mounting rail. Then push the other mounting rail on to the splice. Use pressure to push the mounting rails flush together and check if a connection to earth has been created. The connection is finished.

Fix the joined mounting rail on to the vertical mounting rail, as described.



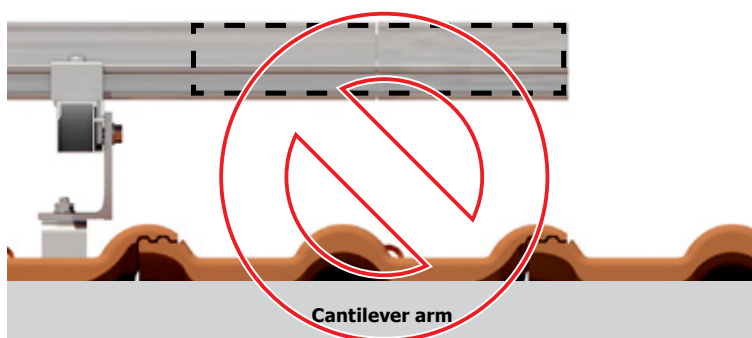
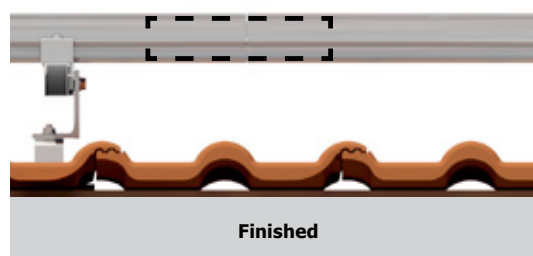
**Push in splice**



**Check connection to earth, observe notes contained under point 1.7.**



**No cantilever arms with splices. Position the splices so that they lie between 2 roof hooks.**



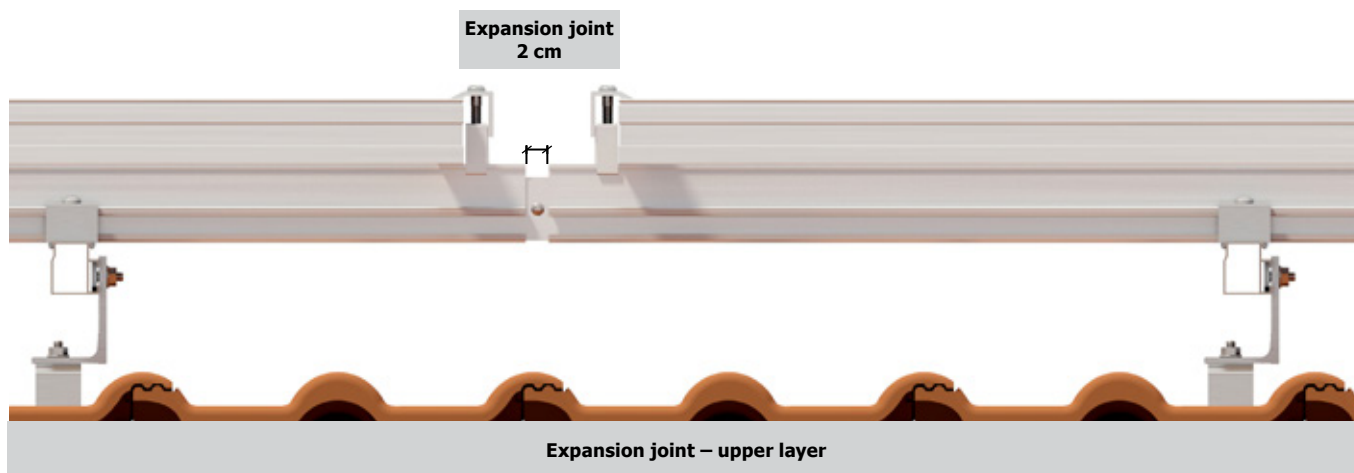
## Double layer installation with framed PV modules, vertically mounted



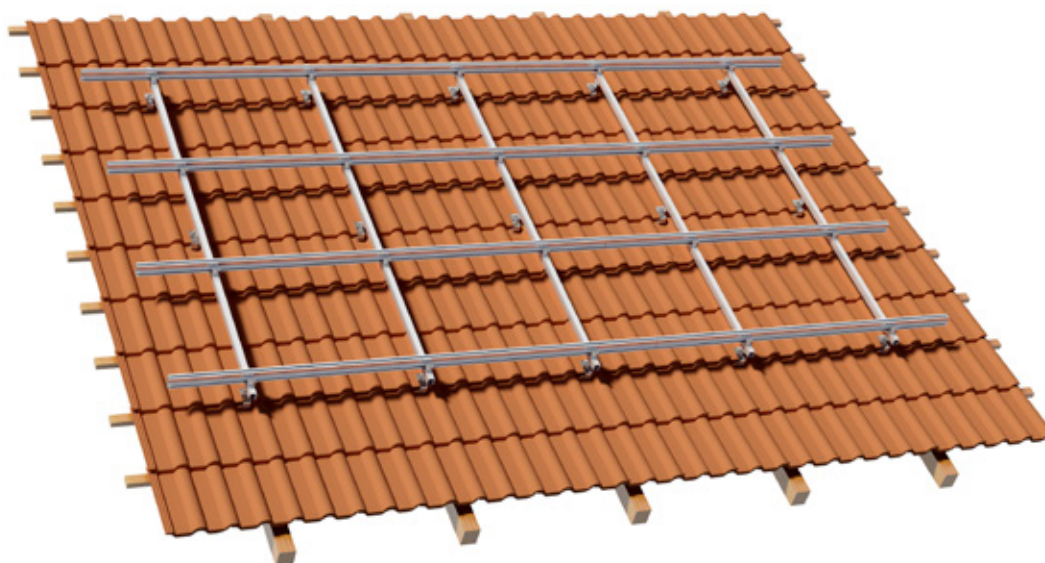
If the mounting rail is longer than 12.00 m, the module array is to be separated by placing two end clamps. In the zone between the end clamps, the mounting rail is to be separated and connected using a splice to allow the rail to move by 2 cm (expansion joint). The alignment of the expansion joints is to be adjusted according to the structural conditions of the roof and the different expansion properties of the materials. Observe Section "Installation – PV modules" in these installation guidelines when placing the end clamps.



Modules may not be built over expansion joints. There is no connection to earth. This must be established without limiting the expansion joint's mode of operation. Observe the notes contained under point 1.7.



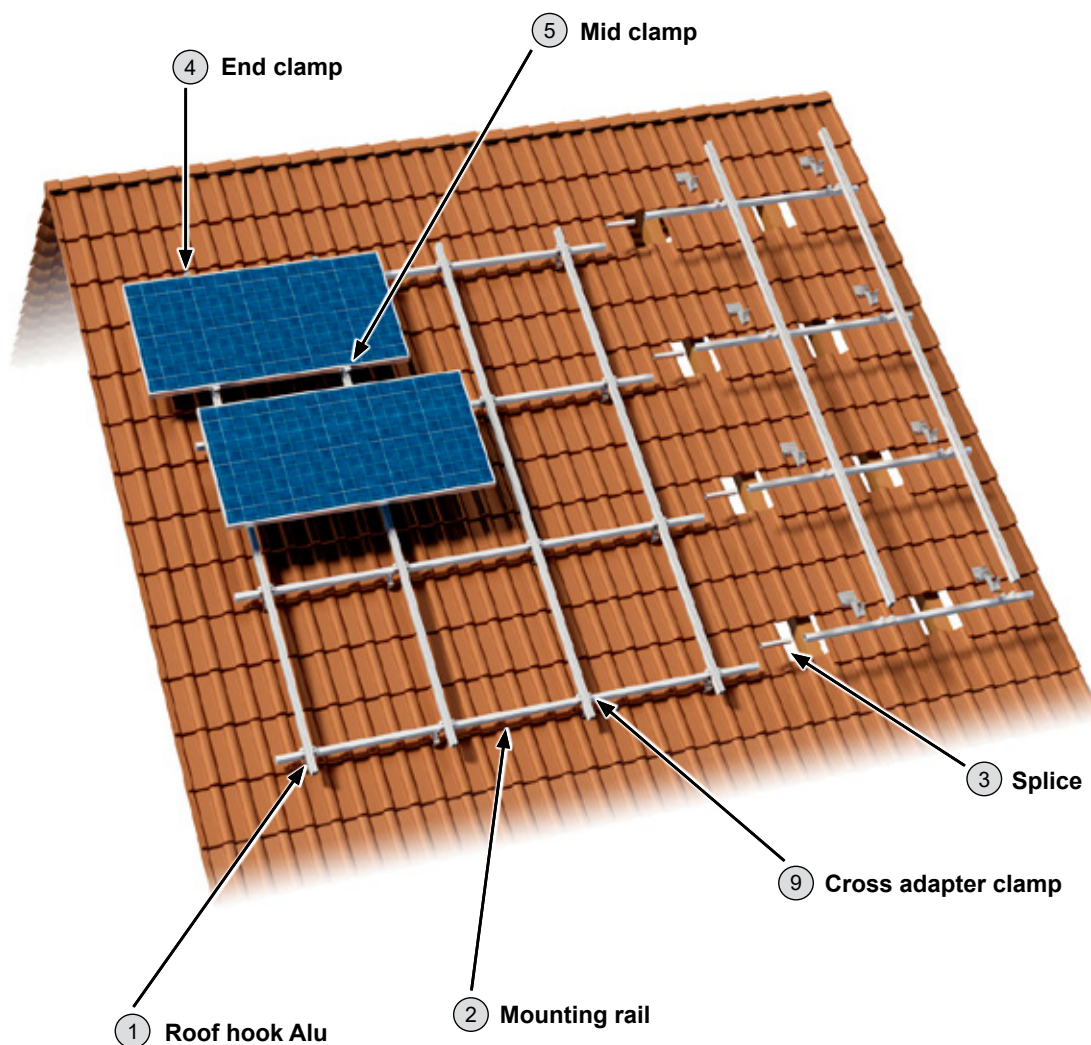
Completion of the upper mounting rail layer installation.





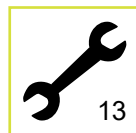
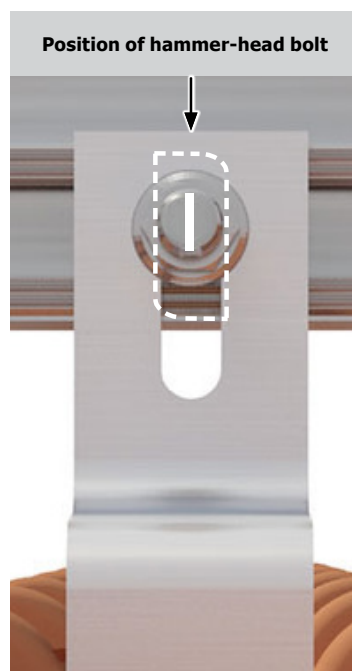
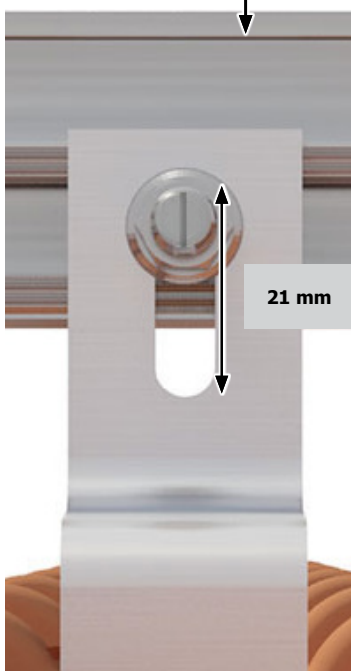
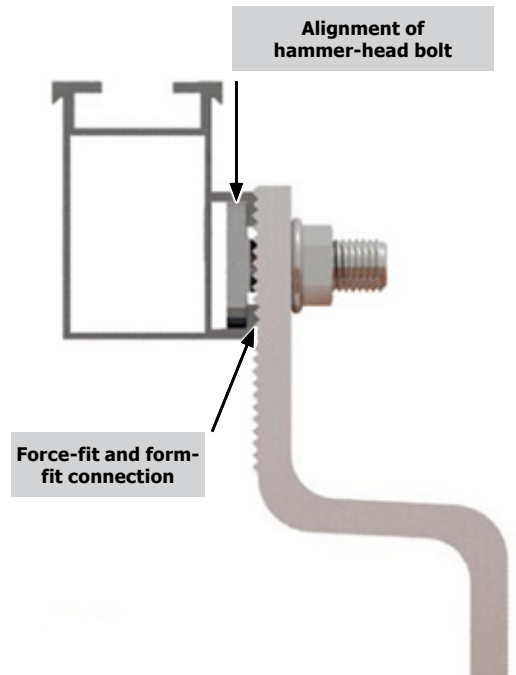
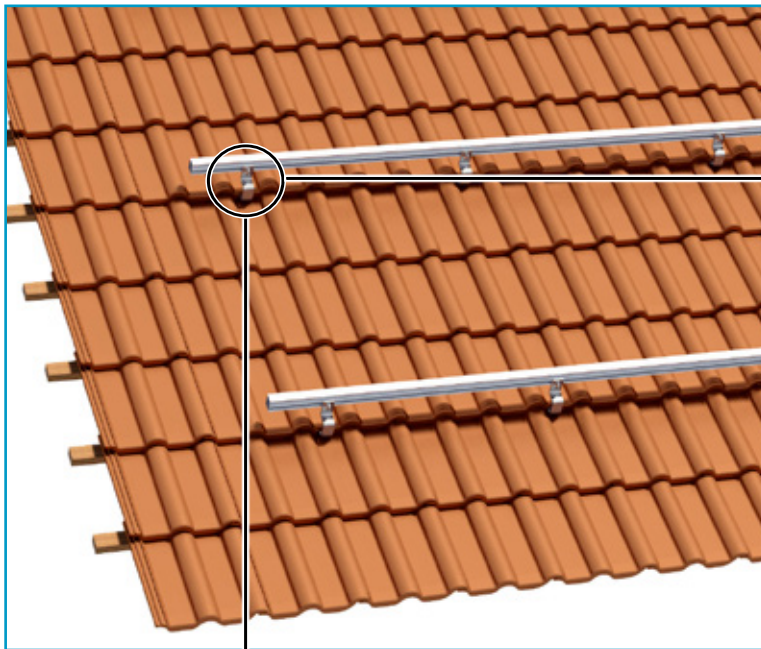
**Double layer installation with framed PV modules, horizontally mounted**

The installation guidelines “Double layer installation with framed PV modules, horizontally mounted” are only valid in conjunction with the guidelines in Section 1. The installer has to ensure that only the current and complete installation guidelines are used for the installation.



### Double layer installation with framed PV modules, horizontally mounted

Mount the horizontally (parallel to the eaves) running mounting rails to the roof hook using the hammer-head bolt M8x25 and the self-locking nut. Ensure the correct alignment of the hammer-head bolts in the mounting rail channel (torque 12-15 Nm) and that the mounting rails are mounted stress-free. To do this, use the adjustability that is created by the corrugation of the components and the elongated hole. Ensure that a force-fit and form-fit connection is created by interlocking the corrugations.



**Check the alignment of the hammer-head bolts**



**Use the adjustability due to corrugation and elongated hole**



**Create a force-fit and form-fit connection**

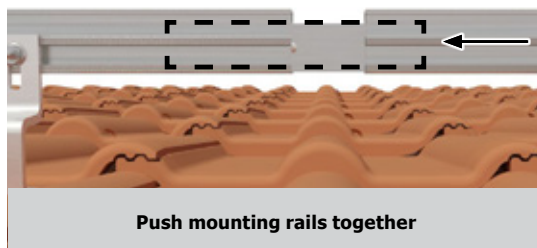
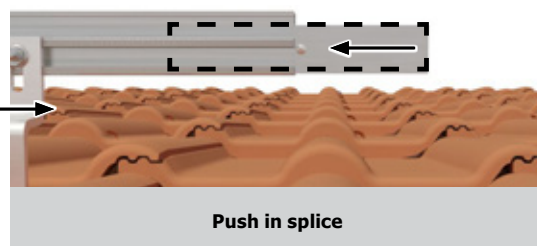
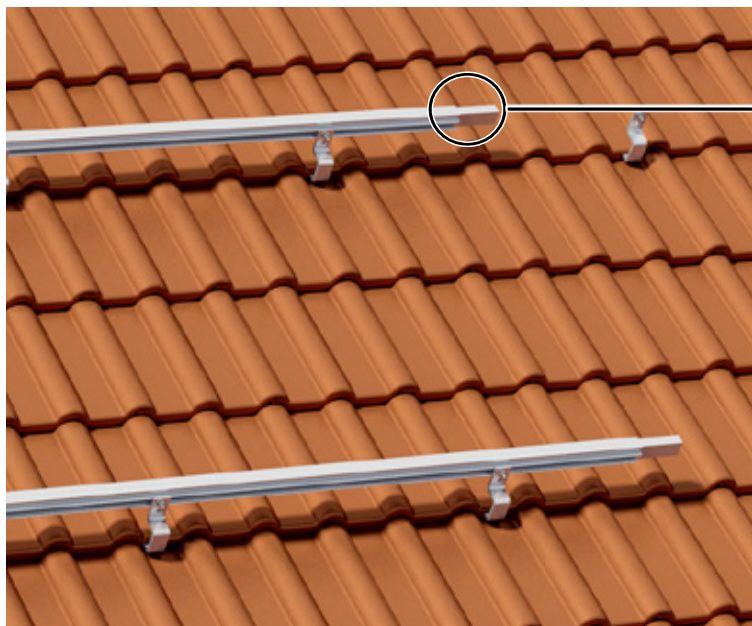


**Adjustability due to corrugation and elongated hole**  
For roof hook RH Vario 31 mm  
For roof hook RH Alu 21 mm

## Double layer installation with framed PV modules, horizontally mounted

In order to link several mounting rails, half of the splice, which has the same structural values as the mounting rails, is pushed into the already installed mounting rail. Then push the other mounting rail on to the splice. Use pressure to push the mounting rails flush together and check if a connection to earth has been created. The connection is finished.

Fix the joined mounting rail on to the roof hook as is described.



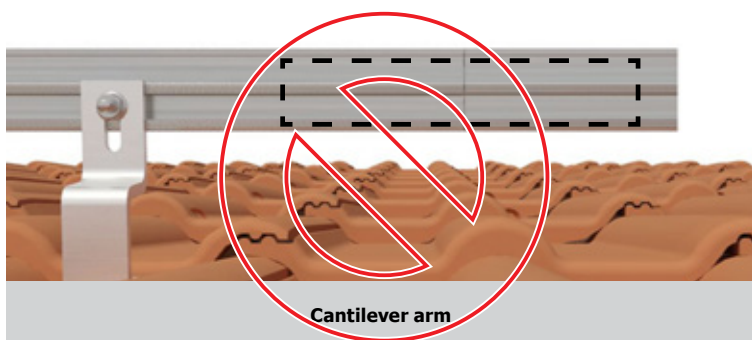
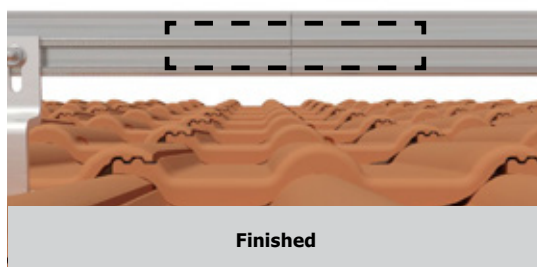
**Push in splice**



**Check connection to earth, observe notes contained under point 1.7.**



**No cantilever arms with splices. Position the splices so that they lie between 2 roof hooks.**





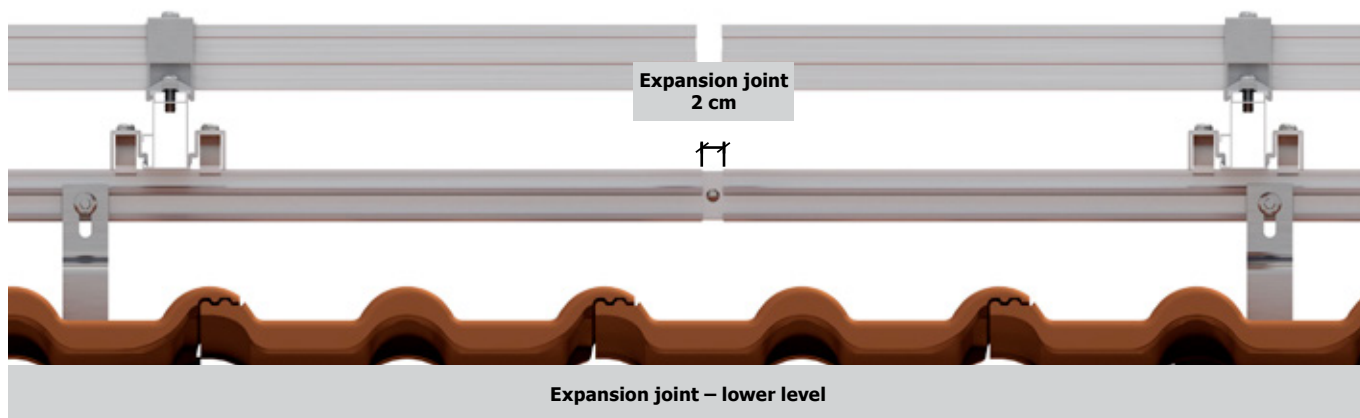
## Double layer installation with framed PV modules, horizontally mounted



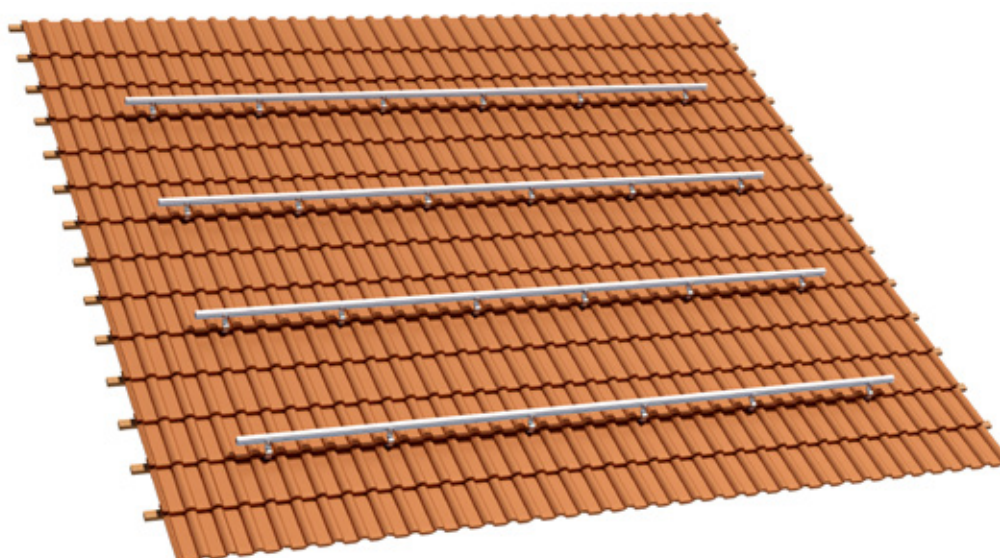
For double layer substructures, expansion joints are arranged in both layers. If the lower mounting rail is longer than 12.00 m, it must be separated and connected using a splice to allow the rail to move by 2 cm (expansion joint).  
The alignment of the expansion joints is to be adjusted according to the structural conditions of the roof and the different expansion properties of the materials.  
Observe Section "Installation – PV modules" in these installation guidelines when placing the end clamps.



Modules may not be built over expansion joints.  
There is no connection to earth. This must be established without limiting the expansion joint's mode of operation. Observe the notes contained under point 1.7.

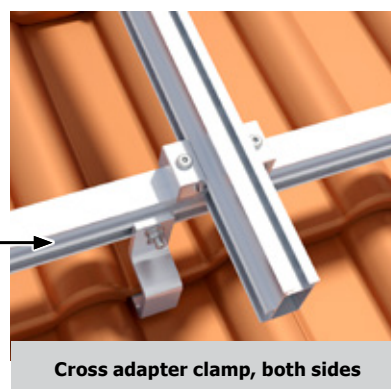


Completion of the lower mounting rail layer installation.

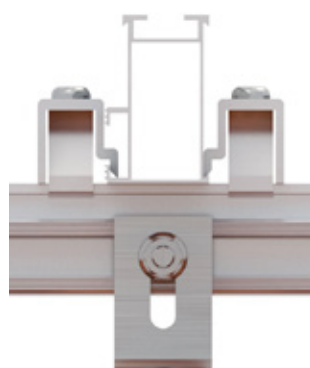
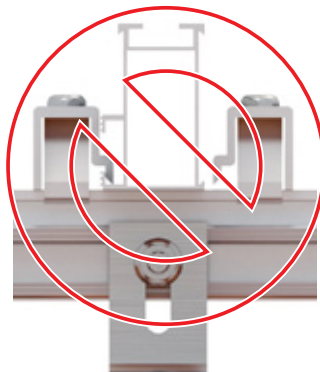


## Double layer installation with framed PV modules, horizontally mounted

Mount the vertical mounting rails on the horizontal mounting rails for each row of modules using the cross adapter clamps. To do this, click the cross adapter clamp on to the horizontal mounting rail and fix the vertical mounting rail with it. Check the distance of the vertical mounting rails against the module's prescribed clamping distances. Ensure that the cross adapter clamp is clicked in on both sides of the mounting rail and tighten the screw (torque 8-10 Nm).



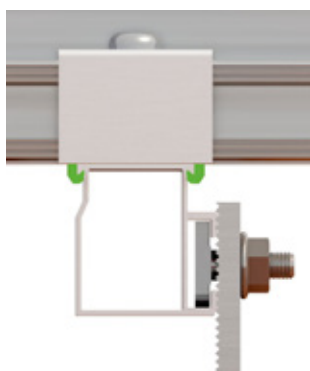
Cross adapter clamp, both sides

CAC in side HHB channel  
and opposite

INCORRECT



INCORRECT



Both sides clicked



INCORRECT

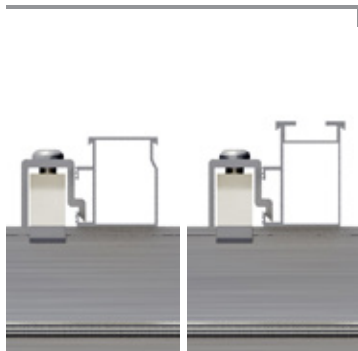


**Double layer installation with framed PV modules, horizontally mounted**

Depending on the structural requirements of the location and the installation situation, several cross adapter clamps may be required per crossing point. If a second cross adapter clamp is required, it is fixed to the opposite side, as described above (torque 8-10 Nm).

**Crossing points:**

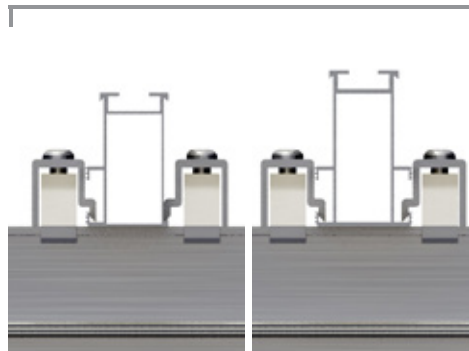
1 CAC in side HHB channel



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1 CAC in side HHB channel and 1 CAC opposite



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Observe the module's installation instructions for the distance between the vertical mounting rails.

In order to link several mounting rails, half of the splice, which has the same structural values as the mounting rails, is pushed into the already installed mounting rail.

Then push the other mounting rail on to the splice. Use pressure to push the mounting rails flush together and check if a connection to earth has been created.

The connection is finished.

Fix the joined mounting rail on to the horizontal mounting rails using the cross adapter clamp, as described.



**The vertical mounting rails are linked as is shown for horizontal mounting rails. Position the splices so that they lie between 2 mounting rail crossing points (no cantilever arm with splices). When extending the vertical mounting rails on the lower eaves, it is to be ensured that the short mounting rail sections, which are connected underneath, run over at least 2 rails of the lower mounting rail layer. Check the connection to earth and observe the notes contained under point 1.7.**

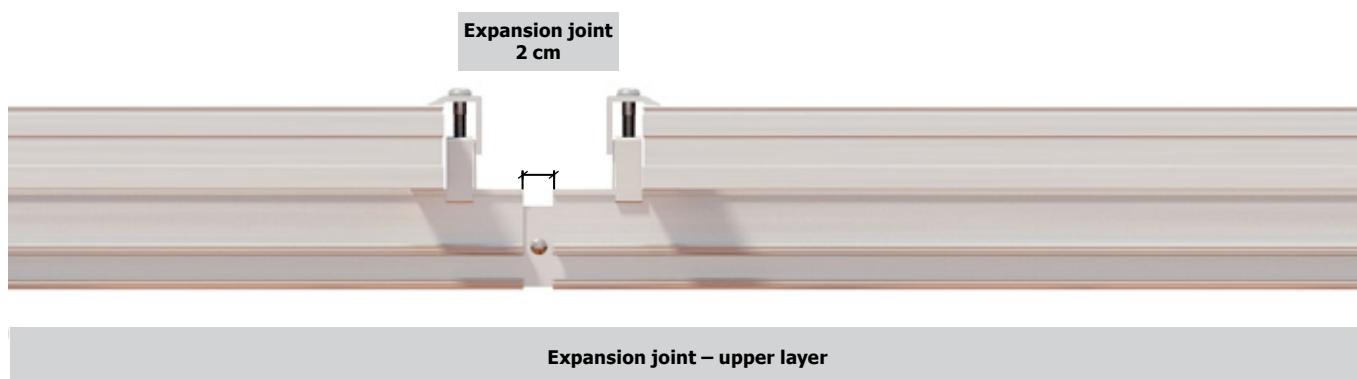
## Double layer installation with framed PV modules, horizontally mounted



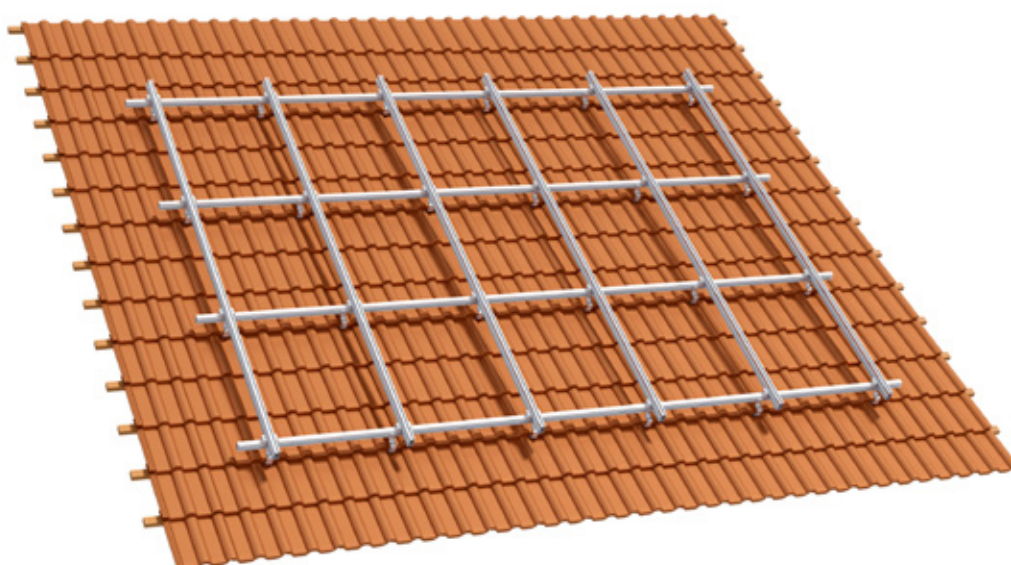
If the mounting rail is longer than 12.00 m, the module array is to be separated by placing two end clamps. In the zone between the end clamps, the mounting rail is to be separated and connected using a splice to allow the rail to move by 2 cm (expansion joint). The alignment of the expansion joints is to be adjusted according to the structural conditions of the roof and the different expansion properties of the materials. Observe Section "Installation – PV modules" in these installation guidelines when placing the end clamps.



Modules may not be built over expansion joints. There is no connection to earth. This must be established without limiting the expansion joint's mode of operation. Observe the notes contained under point 1.7.



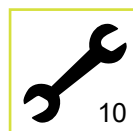
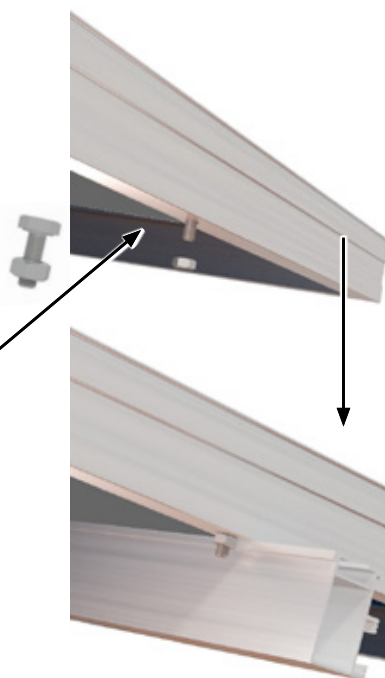
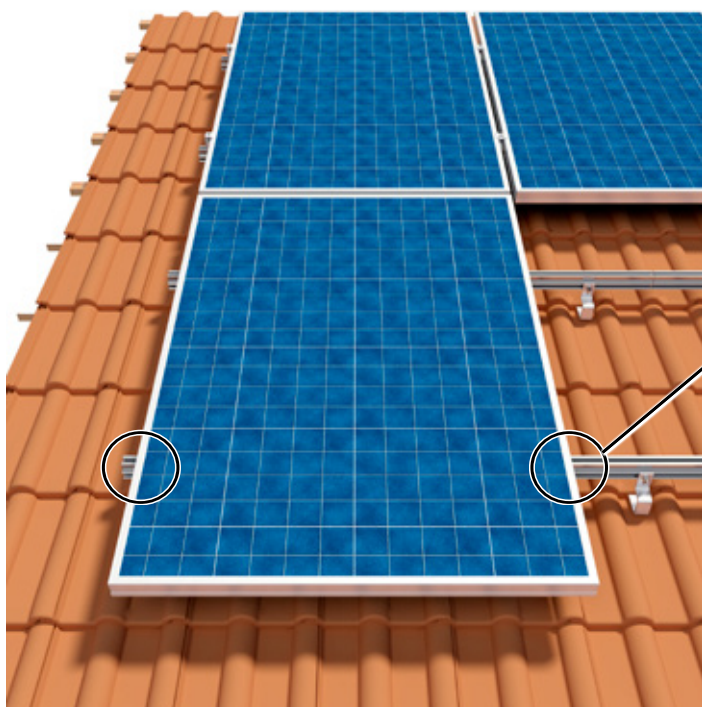
Completion of the upper mounting rail layer installation.



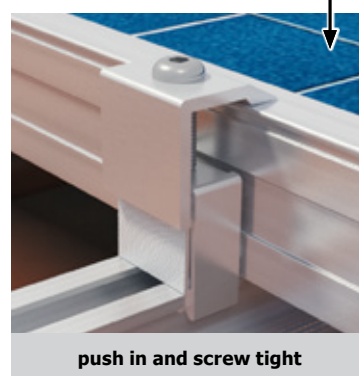
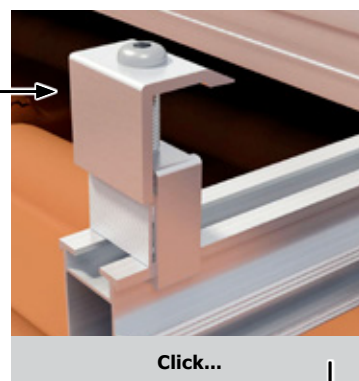
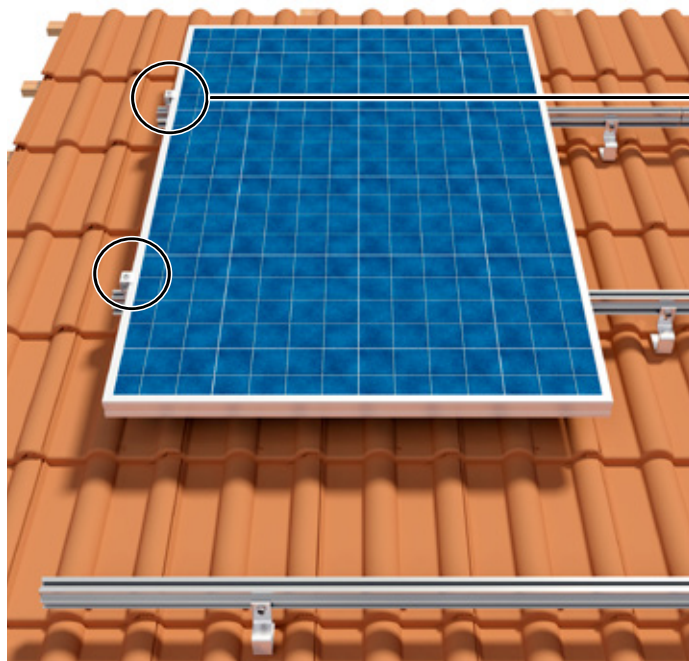


**Before the installation of the modules in the lowest row of modules, the modules are generally to be furnished with the slipping protection. The same applies for modules under which no further module directly adjoins (modules above obstructions, e.g. windows, chimneys etc.).**

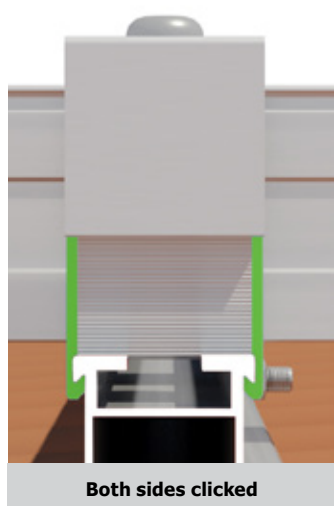
**Fix 2 screws M6 x 20 (with the shank downward) with nuts M6 in 2 of the module's frame holes (8 mm) so that the screws are at the same level and that when installed they are above at least one horizontal mounting rail layer, if necessary so that the screws on the underside of the module frame touch the horizontal mounting rails from above. If the lower fastening borehole is larger than 8 mm, please use a screw appropriate for this.**



Place the module on the mounting rails. Mount the end clamps. To do this, click the end clamp on to the mounting rail and push it on to the module. It must be ensured that the end clamp is clicked into both sides of the mounting rail. Now adjust the end clamp to the height of the module and tighten the screw (torque 8-10 Nm). Ensure that the end clamp clamps the module frame at the clamping area defined by the module manufacturer.



**Mount end clamp**



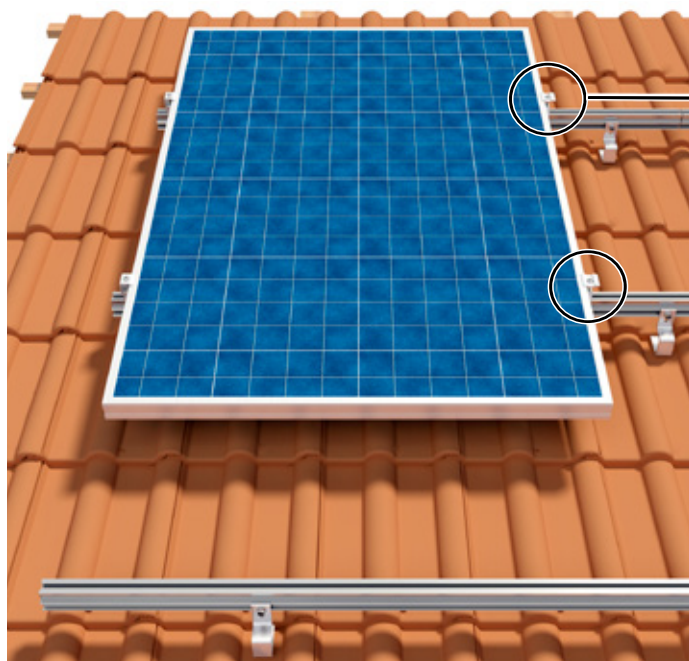
**Check the end clamp has been clicked in**



**Check the clamping area defined by the module manufacturer, observe the notes contained under point 1.7. (observe the module manufacturer's specifications).**



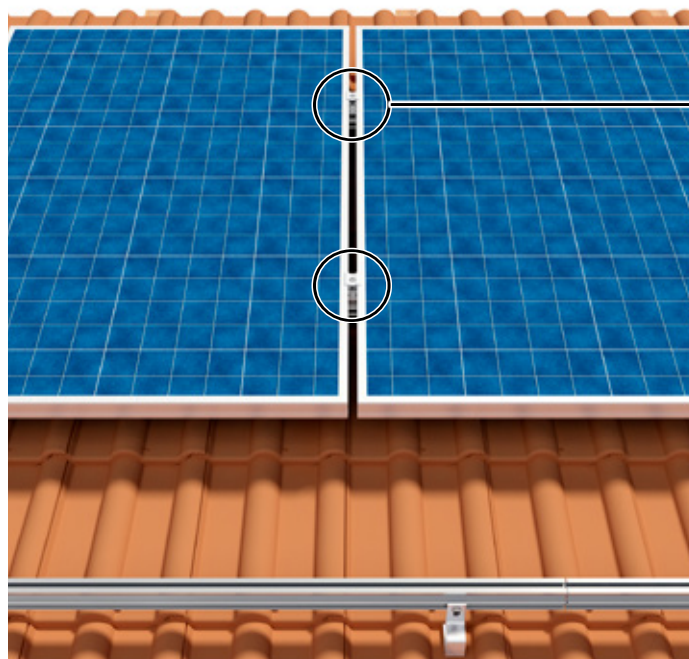
Now mount the mid clamps. To do this, click the mid clamp on to the mounting rail and push it on to the module. It must be ensured that the mid clamp is clicked into both sides of the mounting rail. Ensure that the mid clamp clamps both module frames at the clamping area defined by the module manufacturer.



Click module clamps  
and push in

Align the upper row of modules using a plumb line or a level.

Now push the next module under the mid clamp, adjust the mid clamp to the height of the module frame and tighten the screw (torque 8-10 Nm).



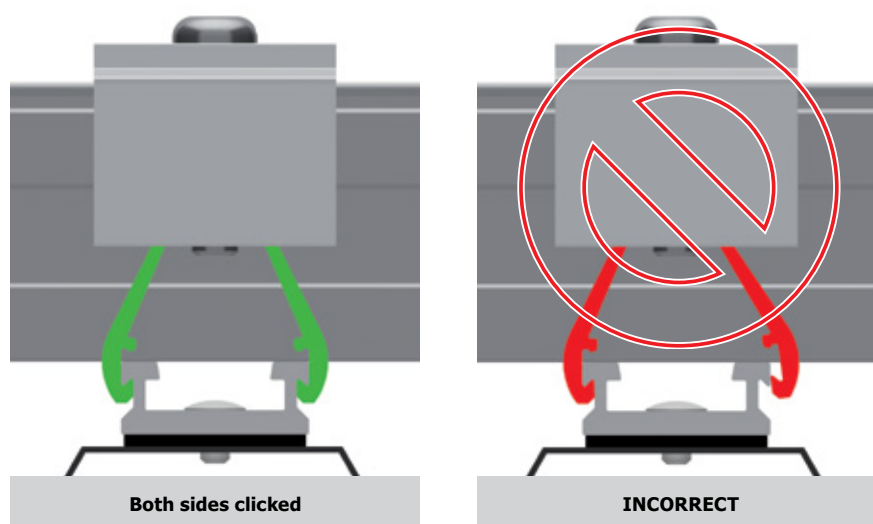
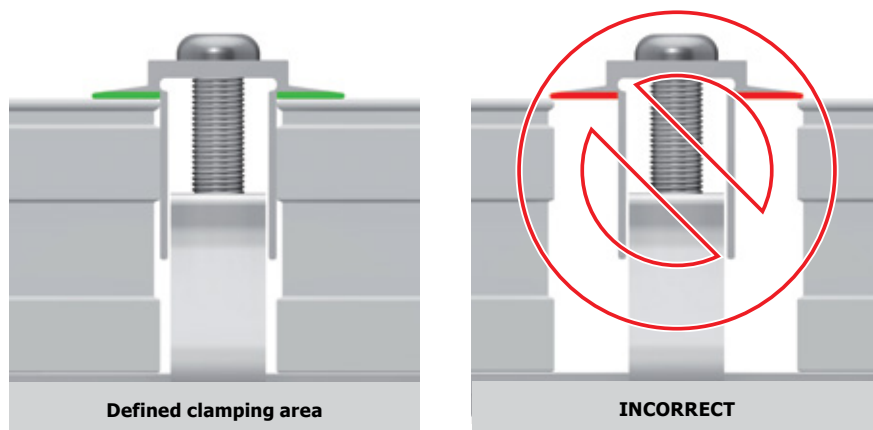
Push module under and screw  
mid clamp tight



Mount mid clamp



Ensure that the mid clamp clamps both module frames at the clamping area defined by the module manufacturer.



**Check that the mid clamp has been clicked in.**

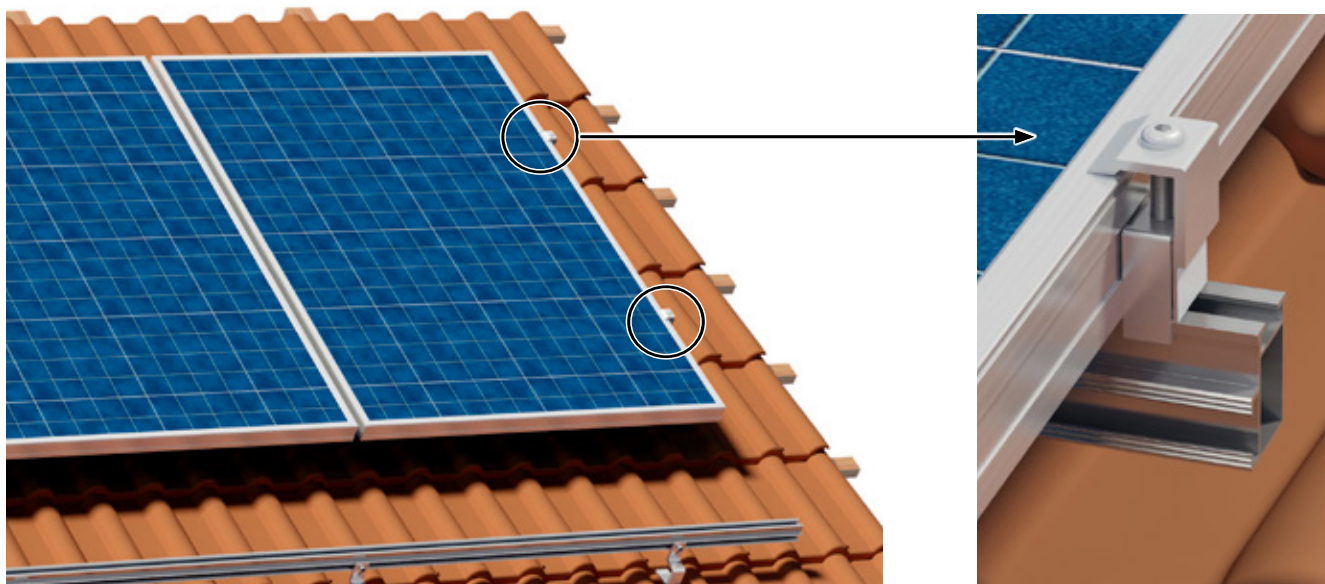


**Check the clamping area defined by the module manufacturer, observe the notes contained under point 1.7 (observe the module manufacturer's specifications).**

On the last module in the row (if applicable, on expansion joints), end clamps are again to be mounted. To do this, click the end clamp on to the mounting rail and push it on to the module. It must be ensured that the end clamp is clicked into both sides of the mounting rail. Now adjust the end clamp to the height of the module and tighten the screw (torque 8-10 Nm).

Ensure that the end clamp clamps the module frame at the clamping area defined by the module manufacturer (see Installation – 8).

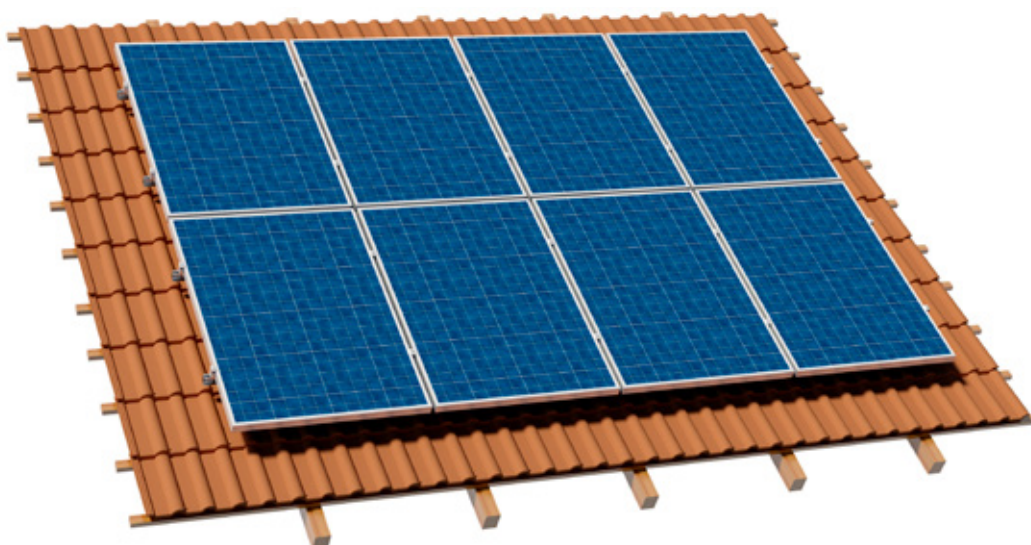
Shorten projecting rails parallel to the module frame. The distance between the module frame and the rail end must be at least 40 mm.



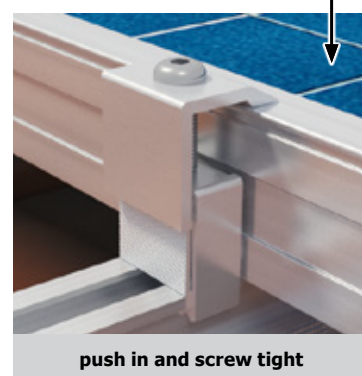
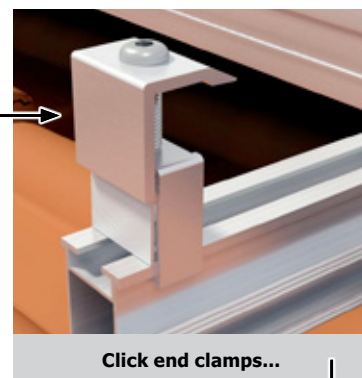
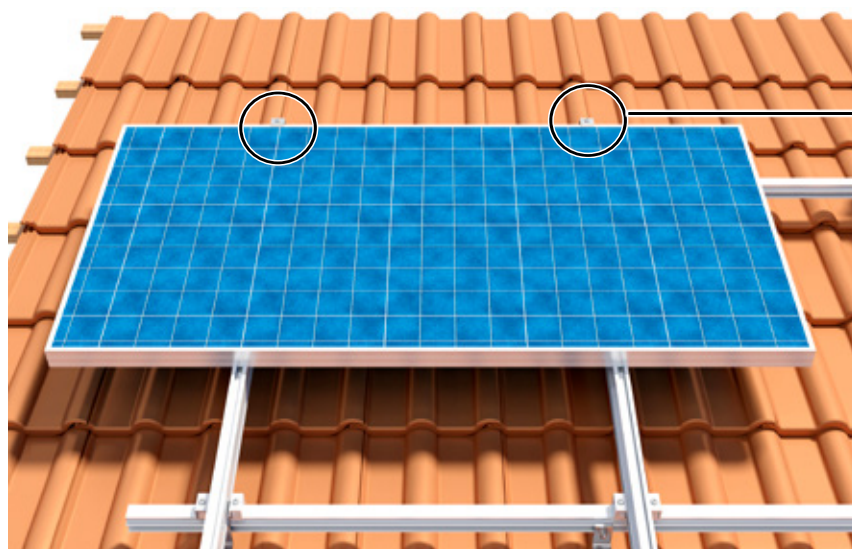
**Mount end clamp on the last module**



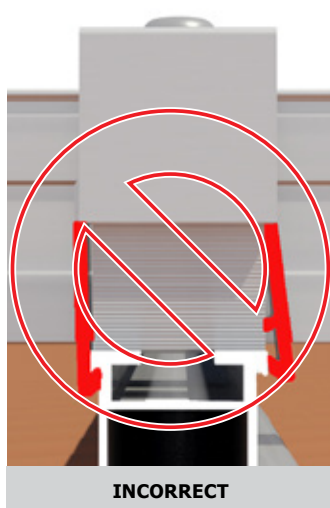
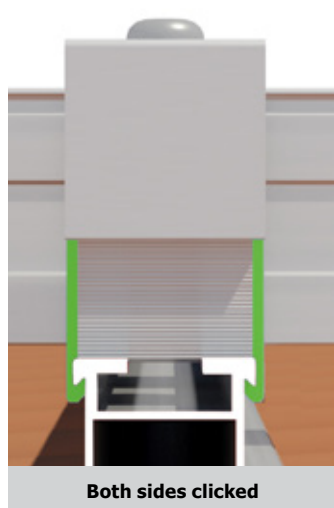
Proceed as described for the following rows.



Place the module on the mounting rails. Mount the end clamps. To do this, click the end clamp on to the mounting rail and push it on to the module. It must be ensured that the end clamp is clicked into both sides of the mounting rail. Now adjust the end clamp to the height of the module and tighten the screw (torque 8-10 Nm). Ensure that the end clamp clamps the module frame at the clamping area defined by the module manufacturer.



**Mount end clamp**



**Check the end clamp has been clicked in.**



**Check the clamping area defined by the module manufacturer, observe the notes contained under point 1.7 (observe the module manufacturer's specifications).**

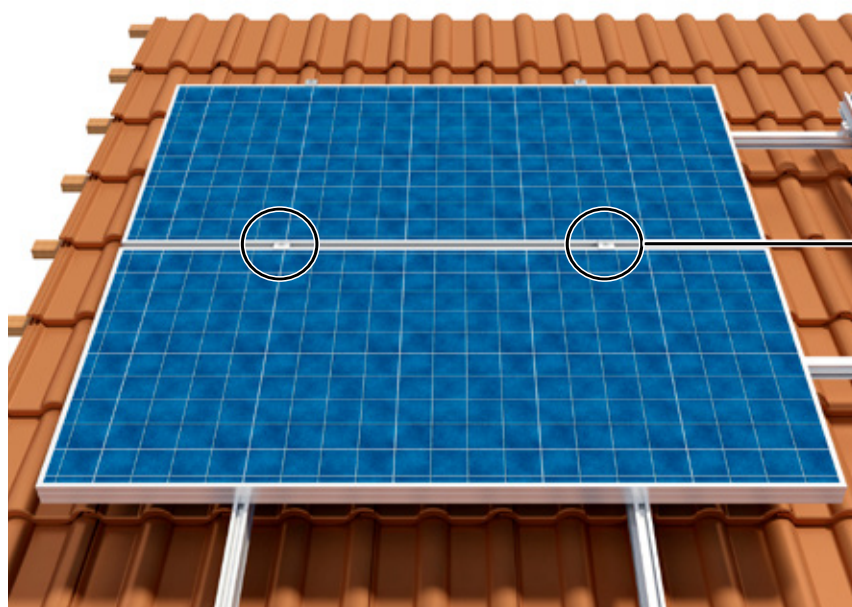


Now mount the mid clamps. To do this, click the mid clamp on to the mounting rail and push it on to the module. It must be ensured that the mid clamp is clicked into both sides of the mounting rail. Ensure that the mid clamp clamps both module frames at the clamping area defined by the module manufacturer.



**Click mid-clamp  
and push in**

Now push the next module under the mid clamp, adjust the mid clamp to the height of the module frame and tighten the screw (torque 8-10 Nm).



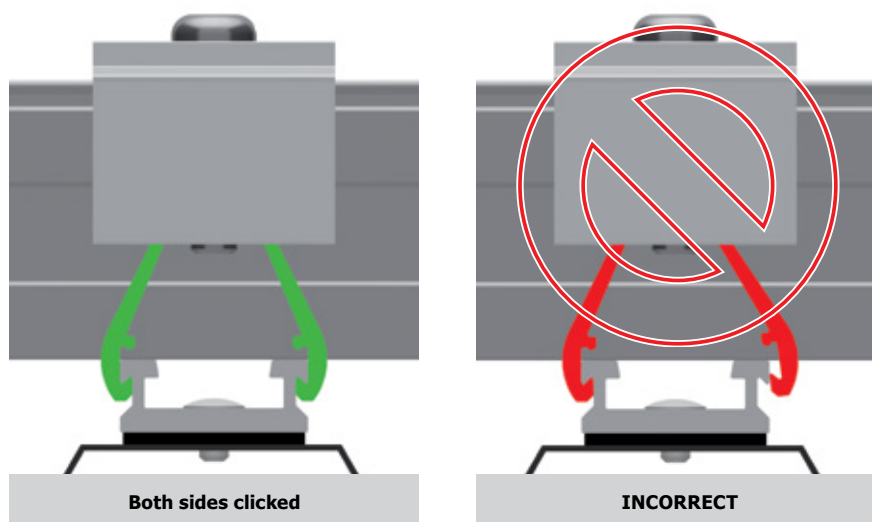
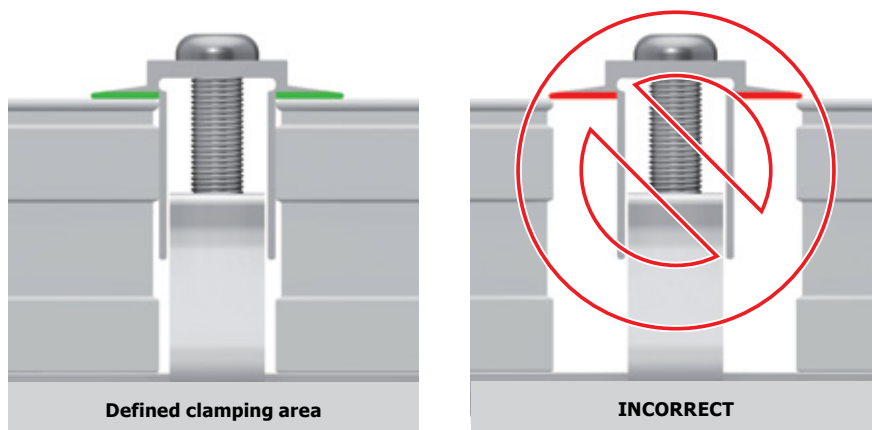
**Push module under and screw  
mid clamp tight**



**Mount mid clamp**



Ensure that the mid clamp clamps both module frames at the clamping area defined by the module manufacturer.



Check that the mid clamp has been clicked in.

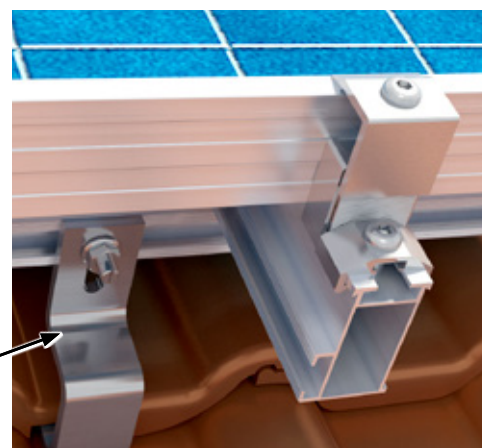
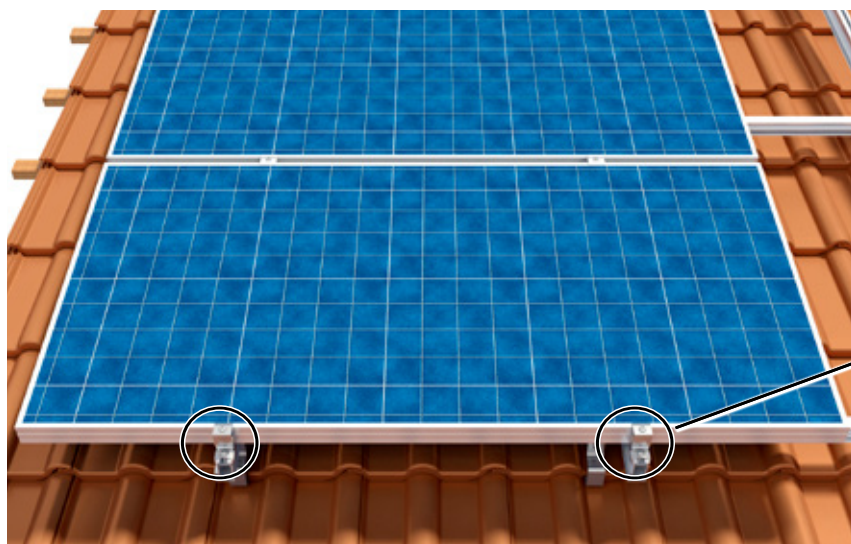


Check the clamping area defined by the module manufacturer, observe the notes contained under point 1.7 (observe the module manufacturer's specifications).



On the last module in the row (if applicable, on expansion joints), end clamps and slider locks (as slipping protection) are again to be mounted. To do this, click the end clamp on to the mounting rail and push it on to the module. It must be ensured that the end clamp is clicked into both sides of the mounting rail. Now adjust the end clamp to the height of the module and tighten the screw (torque 8-10 Nm).

Ensure that the end clamp clamps the module frame at clamping area defined by the module manufacturer. Push the slider lock from below on to the mounting rail up to the end clamp and fasten it (torque 8-10 Nm).



Mount end clamp and slider lock



**Mount end clamp and slider lock on the last module.**



Proceed as described for the following rows.  
Ensure that all end clamps are fixed in a horizontal line.  
Align the upper row of modules using a plumb line or a level.

