

## National technical approval / General construction technique permit

### Zulassungsstelle für Bauprodukte und Bauarten Bautechnisches Prüfamt

Eine vom Bund und den Ländern  
gemeinsam getragene Anstalt des öffentlichen Rechts

Mitglied der EOTA, der UEAtc und der WFTAO

Date:

22 July 2020

Reference:

I 85-1.14.4-42/20

#### Number:

**Z-14.4-858**

#### Applicant:

**S:FLEX GmbH**

Reinbeker Weg 9  
21029 Hamburg, Germany

#### Validity

from: **21 July 2020**

to: **21 July 2025**

#### Subject of decision:

**Module clamps, laminate clamps, cross connectors and their components for fastening of photovoltaic modules on profile rails**

The subject named above is herewith granted a national technical approval (*allgemeine bauaufsichtliche Zulassung*) / general construction technique permit (*allgemeine Bauartgenehmigung*). This decision contains eleven pages and five annexes with a total of 16 pages.

Translation authorised by DIBt

DIBt

## I GENERAL PROVISIONS

- 1 This decision confirms the fitness for use and application of the subject concerned within the meaning of the Building Codes of the federal states (*Landesbauordnungen*).
- 2 This decision does not replace the permits, approvals and certificates required by law for carrying out construction projects.
- 3 This decision is granted without prejudice to the rights of third parties, in particular private property rights.
- 4 Notwithstanding further provisions in the 'Special Provisions', copies of this decision shall be made available to the user and installer of the subject concerned. The user and installer of the subject concerned shall also be made aware that this decision must be made available at the place of use or place of application. Upon request, copies of the decision shall be provided to the authorities involved.
- 5 This decision shall be reproduced in full only. Publication in whole or in part requires the consent of Deutsches Institut für Bautechnik (DIBt). Texts and drawings in promotional material shall not contradict this decision. In the event of a discrepancy between the German original and this authorised translation, the German version shall prevail.
- 6 This decision may be revoked. The provisions contained herein may subsequently be supplemented and amended, in particular if this is required by new technical findings.
- 7 This decision is based on the information and documents provided by the applicant. Alterations to this basis are not covered by this decision and shall be notified to DIBt without delay.
- 8 The general construction technique permit included in this decision also serves as a national technical approval for the construction technique.

## II SPECIAL PROVISIONS

### 1 Subject concerned and field of use and application

#### 1.1 Subject of approval and field of use

The subject of approval is module clamps and laminate clamps as well as cross connectors for the fastening of framed and frameless photovoltaic modules to profile rails with rail channels (sheet metal rail profiles, trapezoidal sheet metal rails, mounting rails) and for the connection of the mounting rails, see Annexes 1.1 to 5.3.

#### 1.2 Subject of permit and field of application

The subject of the permit is the planning, design and execution of the mounting system, consisting of:

- Module clamps as mid and end clamps in accordance with this decision (Annexes 1.1 to 1.3)  
MH AK 36-51 and MH AK II Klick 30-50
- Laminate clamps with hammer-head bolts as mid and end clamps in accordance with this decision (Annexes 2.1 to 2.3)  
LMK AK and LEK AK
- Laminate clamps with click-fastening as mid and end clamps in accordance with this decision (Annexes 3.1 to 3.3)  
LMK AK Klick and LEK AK Klick
- Cross connectors with click-fastening in accordance with this decision (Annexes 4.1 to 4.4)
- Sheet metal rail profiles AK with rail channels in accordance with this decision (Annex 5.1)
- Trapezoidal sheet metal rails AK with rail channels in accordance with this decision (Annex 5.1)
- Mounting rails with rail channels in accordance with this decision (Annexes 5.1 to 5.3)  
ST-AK 1/12, ST-AK 2/25 FMP, ST-AK 3/27, ST-AK 5/40, ST-AK 7/47, ST-AK 8/50, ST-AK 13/60, ST-AK 15/66, ST-AK 19/66, ST-AK 26/70, ST-AK 41/80, ST-AK 182/120, ST-AK 215/120, ST-AK 280/125, ST-AK 220/272

The module clamps serve to fasten framed photovoltaic modules to the profile rails (sheet metal rail profiles, trapezoidal sheet metal rails, mounting rails). The four-part module mid clamp consists of a module clamp head profile and a module clamp click profile, which are connected using a flat-head screw and a square nut. The frame of the photovoltaic module is fixed by tightening the flat-head screw. Module mid clamps are manufactured in two different variants, where the cuts for the module clamp head profiles can also be longer (refer to the manufacturer's catalogue). In addition to the components of the module mid clamp named above, the five-part module end clamp additionally includes a C-profile mounted on the side, which serves to prevent the module clamp head profile from twisting.

The laminate clamps serve to fasten frameless photovoltaic modules to the ST-AK 5/40 or ST-AK 7/47 mounting rails. Both laminate clamp variants consist essentially of a clamp profile top part and a clamp profile bottom part with full rubber profiles sandwiched between them. They both come as end or mid clamps. The laminate clamp variant with hammer-head screw is fastened to the mounting rails using a hammer-head screw and a locking nut. The laminate clamp variant with click fastening is fastened to the mounting rails using a click profile and a flat-head screw with a square nut.

The cross connectors serve to connect two or multiple layers of mounting rails to form a mounting system for photovoltaic modules. A connection point can be realised using one, two or four cross connectors. The cross connector consists essentially of an upper cross connector profile and a lower click profile which is connected using a flat-head screw with a square nut. The cross connector is inserted in a grooved channel or bead-like pin for connection of the upper profile.

## 2 Provisions for the construction products

### 2.1 Properties and composition

#### 2.1.1 General

Verification of the required material properties shall be provided through an inspection certificate "type 3.1" in accordance with DIN EN 10204<sup>1</sup>.

#### 2.1.2 Module clamps, laminate clamps, cross connectors

The module clamp head profiles and module clamp click profiles, the C-profiles of the module end clamps, the top and the bottom parts of the clamp profiles of the laminate clamps, the cross connector profile and the click profile of the cross connector shall be made of the aluminium alloy EN AW-6063 T6 in accordance with DIN EN 755-2<sup>2</sup> or an aluminium alloy with at least the same material properties in accordance with DIN EN 755-2<sup>2</sup>. DIN EN 755-9<sup>3</sup> shall apply to the dimensional tolerances.

The flat-head screws M8x35 for the module clamps, the hammer-head screws M8x40 for the laminate clamps as well as the flat-head screws M8x20 for the laminate clamps and the cross connectors shall be made from stainless steel of strength class 70. The square nuts M8 for the flat-head screws and the locking nuts M8 for the hammer-head screws shall be made from stainless steel A2.

The main dimensions shall be taken from Annexes 1.1 to 4.4.

Further specifications are deposited with DIBt.

#### 2.1.3 Sheet metal rail profiles, trapezoidal sheet metal rails and mounting rails

The sheet metal rail profiles, trapezoidal sheet metal rails and mounting rails connected with the module clamps, laminate clamps and cross connectors shall be made of the aluminium alloy EN AW-6063 T6 in accordance with DIN EN 755-2<sup>2</sup> or an aluminium alloy with at least the same material properties in accordance with DIN EN 755-2<sup>2</sup>. DIN EN 755-9<sup>3</sup> shall apply to the dimensional tolerances.

The main dimensions shall be taken from Annexes 5.1 to 5.3.

Further specifications are deposited with DIBt.

### 2.2 Marking

The packaging or the documents accompanying the delivery note for the construction products named in Section 2.1 shall be marked by the manufacturer with the national conformity mark (*Ü-Zeichen*) in accordance with the Conformity Marking Ordinances (*Übereinstimmungszeichen-Verordnungen*) of the federal states. The mark shall only be applied if the requirements given in Section 2.3 are met.

1	DIN EN 10204:2005-01	Metallic products – Types of inspection documents
2	DIN EN 755-2:2016-10	Aluminium and aluminium alloys – Extruded rod/bar, tube and profiles – Part 2: Mechanical properties
3	DIN EN 755-9:2016-10	Aluminium and aluminium alloys – Extruded rod/bar, tube and profiles – Part 9: Profiles, tolerances on dimensions and form

## 2.3 Confirmation of conformity

### 2.3.1 General

The manufacturer shall confirm for each manufacturing plant that the construction products named in Section 2.1 comply with the provisions of the national technical approval included in this decision by way of a declaration of conformity based on factory production control and a certificate of conformity issued by a certification body recognised for these purposes as well as on regular external surveillance carried out by a recognised inspection body in accordance with the following provisions.

To issue the certificate of conformity and for external surveillance including the associated product testing, the manufacturer of the construction products named in Section 2.1 shall use a certification body and an inspection body recognised for these purposes.

The declaration of conformity shall be submitted by the manufacturer through marking of the construction products named in Section 2.1 with the national conformity mark (*Ü-Zeichen*) including statement of the intended use.

The certification body shall send a copy of the certificate of conformity issued by it to DIBt.

### 2.3.2 Factory production control

A factory production control system shall be set up and implemented in each manufacturing plant. Factory production control shall be understood to be continuous surveillance of production by the manufacturer to ensure that the manufactured construction products meet the provisions of the national technical approval included in this decision.

The factory production control shall at least include the following measures:

- The required dimensions and tolerances as specified in Section 2.1 including those of the threads of all screw channels shall be checked for each batch.
- The conformity of the information in the inspection certificate with the information given in Section 2.1 shall be checked.
- For the connectors and small parts made of stainless steel, the provisions of decision no. Z-30.3-6<sup>4</sup> shall apply accordingly.
- The Principles for confirmation of conformity for fasteners for light-weight metal construction (*Grundsätze für den Übereinstimmungsnachweis für Verbindungselemente im Metallleichtbau*<sup>5</sup>) shall apply accordingly.

The results of factory production control shall be recorded and evaluated. The records shall include at least the following information:

- designation of the construction product or the starting material or the components,
- type of check or test,
- date of manufacture and testing of the construction product or the starting material or the components,
- results of the checks and tests as well as, if applicable, comparison with requirements,
- signature of the person responsible for factory production control.

The records shall be kept for at least five years and submitted to the inspection body used for external surveillance. They shall be submitted to DIBt and the competent supreme building authority upon request.

If the test result is unsatisfactory, the manufacturer shall immediately take the necessary measures to resolve the defect. Construction products which do not meet the requirements shall be handled in such a way that they cannot be confused with compliant products. After

<sup>4</sup> Z-30.3-6: 5 March 2018 DIBt decision: Products, structural components and fasteners made of stainless steels

<sup>5</sup> Principles for the confirmation of conformity for fasteners for light-weight metal construction, August 1999, *DIBt Mitteilungen*, vol. 6/1999

the defect has been remedied, the relevant test shall be repeated immediately – where technically feasible and necessary to show that the defect has been eliminated.

### 2.3.3 External surveillance

The plant and the factory production control system shall be inspected regularly, i.e. at least once a year, by means of external surveillance at each manufacturing plant.

Initial type-testing of the construction products named in Section 2.1 shall be carried out within the scope of external surveillance. Samples for random testing may also be taken. Sampling and testing shall be the responsibility of the recognised inspection body.

The results of certification and external surveillance shall be kept for at least five years. They shall be presented by the certification or inspection body to DIBt and the competent supreme building authority upon request.

## 3 Provisions for planning, design and execution

### 3.1 Planning

Unless otherwise specified below, the Technical Building Rules (*Technische Baubestimmungen*) as well as the provisions set out in the national technical approvals/general construction technique permits cited below shall apply.

The construction technique comprises the following construction products:

- module clamps as mid and end clamps in accordance with this decision,
- laminate clamps with hammer-head screw as mid and end clamps in accordance with this decision,
- laminate clamps with click-fastening as mid and end clamps in accordance with this decision,
- cross connectors with click-fastening in accordance with this decision,
- sheet metal rail profiles with rail channels in accordance with this decision,
- trapezoidal sheet metal rails with rail channels in accordance with this decision,
- mounting rails with rail channels in accordance with this decision.

With respect to corrosion protection, the provisions set out in the Technical Building Rules as well as the provisions of decision no. Z-30.3-6<sup>4</sup> shall apply.

Fire safety and other building physics verifications shall be provided separately where necessary.

### 3.2 Design

#### 3.2.1 General

The verification concept set out in DIN EN 1990<sup>6</sup> shall apply.

The serviceability and the structural safety of the mounting system shall be verified on a case-by-case basis by structural analysis in accordance with the Technical Building Rules.

This decision only covers the application of the mounting system as well as the ultimate limit state verification (ULS) of the connections of the mounting system under tensile loading (e.g. as a result of wind suction) as well as under longitudinal or transverse shear forces acting in the plane of the photovoltaic module (e.g. as a result of the self-weight of the system).

The ULS verification of the mounting system shall be carried out in accordance with the specifications given in Sections 3.2.2, 3.2.3 and 3.2.4. The characteristic resistance values given in Sections 3.2.2, 3.2.3 and 3.2.4 shall be used for this. For combined actions, a linear interaction verification in accordance with Sections 3.2.2.4 and 3.2.4.4 shall also be provided.

<sup>6</sup> DIN EN 1990:2010-12

Eurocode: Basis of structural design in conjunction with DIN EN 1990/NA:2010-12

It shall be verified that the design value of an action  $E_d$  does not exceed the design value of the associated resistance  $R_d$ .

The following verifications shall be provided separately:

- serviceability
- structural safety of the profile rails with rail channels (sheet metal rail profiles, trapezoidal sheet metal rails, mounting rails)
- structural safety of the connection of the profile rails with rail channels to the subframe
- structural safety of the subframe
- positional stability
- introduction and transfer of the forces verified in Sections 3.2.2, 3.2.3 and 3.2.4 into the main structural system

### 3.2.2 Verification for module clamps

#### 3.2.2.1 Tensile strength

$$\frac{F_{z,Ed} \cdot \gamma_M}{F_{z,Rk}} \leq 1,0$$

where:

$F_{z,Ed}$ [kN]	design value of tensile force acting on each module clamp
$F_{z,Rk}$ [kN]	characteristic value of tensile strength per module clamp
$F_{z,Rk}$	= 6.50 kN (for mid clamp MH AK 36-51)
$F_{z,Rk}$	= 6.45 kN (for mid clamp MH AK II Klick 30-50)
$F_{z,Rk}$	= 2.52 kN (for end clamp)
$\gamma_M$	= 1.33 (partial safety factor)

### 3.2.2.2 Shear resistance perpendicular to the profile rails

$$\frac{V_{q,Ed} \cdot \gamma_M}{V_{q,Rk}} \leq 1,0$$

where:

- $V_{q,Ed}$  [kN] design value of shear force acting in transverse direction per module clamp  
 $V_{q,Rk}$  [kN] characteristic value of shear resistance in transverse direction per module clamp  
 $V_{q,Rk}$  = -0.13 x  $F_{z,Ed}$  + 1.35 (for mid clamp MH AK 36-51 with  $F_{z,Ed} \leq 4.50$  kN)  
 $V_{q,Rk}$  = -0.13 x  $F_{z,Ed}$  + 1.35 (for mid clamp MH AK II Klick 30-50 with  $F_{z,Ed} \leq 4.50$  kN)  
 $V_{q,Rk}$  = -0.32 x  $F_{z,Ed}$  + 1.17 (for end clamp with  $F_{z,Ed} \leq 2.50$  kN)  
 $F_{z,Ed}$  [kN] design value of tensile force acting on each module clamp  
 $\gamma_M$  = 1.33 (partial safety factor)

### 3.2.2.3 Shear resistance in longitudinal direction of profile rails

$$\frac{V_{l,Ed} \cdot \gamma_M}{V_{l,Rk}} \leq 1,0$$

where:

- $V_{l,Ed}$  [kN] design value of shear force acting in longitudinal direction per module clamp  
 $V_{l,Rk}$  [kN] characteristic value of shear resistance in longitudinal direction per module clamp  
 $V_{l,Rk}$  = -0.13 x  $F_{z,Ed}$  + 1.97 for mid clamp MH AK 36-51 with  $F_{z,Ed} \leq 4.50$  kN)  
 $V_{l,Rk}$  = -0.13 x  $F_{z,Ed}$  + 1.97 (for mid clamp MH AK II Klick 30-50 with  $F_{z,Ed} \leq 4.50$  kN)  
 $V_{l,Rk}$  = -0.32 x  $F_{z,Ed}$  + 1.53 (for end clamp with  $F_{z,Ed} \leq 2.50$  kN)  
 $F_{z,Ed}$  [kN] design value of tensile force acting on each module clamp  
 $\gamma_M$  = 1.33 (partial safety factor)

### 3.2.2.4 Interaction

For combined tensile and shear loading, a linear interaction verification shall also be provided. To determine the characteristic shear resistance, the maximum design value of the acting tension load per module clamp shall always be used for  $F_{z,Ed}$ .

$$\frac{F_{z,Ed} \cdot \gamma_M}{F_{z,Rk}} + \frac{V_{q,Ed} \cdot \gamma_M}{V_{q,Rk}} \leq 1,0 \quad \text{or} \quad \frac{F_{z,Ed} \cdot \gamma_M}{F_{z,Rk}} + \frac{V_{l,Ed} \cdot \gamma_M}{V_{l,Rk}} \leq 1,0$$

## 3.2.3 Verifications for laminate clamps

### 3.2.3.1 Tensile strength

$$\frac{F_{z,Ed} \cdot \gamma_M}{F_{z,Rk}} \leq 1,0$$

where:

- $F_{z,Ed}$  [kN] design value of tensile force acting on each laminate clamp  
 $F_{z,Rk}$  [kN] characteristic value of tensile strength per laminate clamp  
 $F_{z,Rk}$  = 1.47 kN (for mid clamp LMK AK)  
 $F_{z,Rk}$  = 0.74 kN (for end clamp LEK AK)  
 $F_{z,Rk}$  = 1.68 kN (for mid clamp LMK AK Klick)  
 $F_{z,Rk}$  = 0.75 kN (for end clamp LEK AK Klick)  
 $\gamma_M$  = 1.33 (partial safety factor)

### 3.2.3.2 Shear resistance of laminate clamps perpendicular to the mounting rails and cyclical actions



The design does not provide for the transfer of shear forces acting perpendicular to the mounting rails. If the LEK AK and LMK AK laminate clamps are installed parallel to the mounting rails, no forces can be transferred along the longitudinal axis of the mounting rails as part of the regular design. When the laminate clamps are installed parallel to the mounting rails, the design specifications given in Section 3.2.3.3 shall apply.

The design does not provide for the transfer of cyclical stresses acting on the LMK AK Klick and LEK AK Klick laminate clamps along the longitudinal axis of the mounting rails.

### 3.2.3.3 Shear resistance of laminate clamps in longitudinal direction of mounting rails

$$\frac{V_{I,Ed} \cdot \gamma_M}{V_{I,Rk}} \leq 1,0$$

where:

- $V_{I,Ed}$  [kN] design value of shear force acting in longitudinal direction per laminate clamp
- $V_{I,Rk}$  [kN] characteristic value of shear resistance in longitudinal direction per laminate clamp
- $V_{I,Rk}$  = -1.08 kN with  $F_{z,Ed} \leq 1.47$  kN (for mid clamp LMK AK)
- $V_{I,Rk}$  = -0.03 x  $F_{z,Ed}^2$  + 0.70 with  $F_{z,Ed} \leq 0.74$  kN (for end clamp LEK AK)
- $V_{I,Rk}$  = 0.76 x (-0.07 x  $F_{z,Ed}^2$  + 1.60) with  $F_{z,Ed} \leq 1.68$  kN (for mid clamp LMK AK Klick)
- $V_{I,Rk}$  = 0.76 x (-0.33 x  $F_{z,Ed}^2$  + 0.95) with  $F_{z,Ed} \leq 0.75$  kN (for end clamp LEK AK Klick)
- $F_{z,Ed}$  [kN] design value of tensile force acting on each laminate clamp
- $\gamma_M$  = 1.33 (partial safety factor)

### 3.2.4 Verifications for cross connectors (1-way, 2-way or 4-way connector)

#### 3.2.4.1 Tensile strength

$$\frac{F_{z,Ed} \cdot \gamma_M}{F_{z,Rk}} \leq 1,0$$

where:

- $F_{z,Ed}$  [kN] design value of tensile force acting on each cross connector
- $F_{z,Rk}$  [kN] characteristic tensile strength per cross connector
- $F_{z,Rk}$  = 1.72 kN (for 1-way connector)
- $F_{z,Rk}$  = 4.31 kN (for 2-way connector)
- $F_{z,Rk}$  = 8.49 kN (for 4-way connector)
- $\gamma_M$  = 1.33 (partial safety factor)

#### 3.2.4.2 Shear resistance perpendicular to lower mounting rails

$$\frac{V_{q,Ed} \cdot \gamma_M}{V_{q,Rk}} \leq 1,0$$

where:

- $V_{q,Ed}$  [kN] design value of shear force acting in transverse direction per cross connector
- $V_{q,Rk}$  [kN] characteristic value of shear resistance in transverse direction per cross connector
- $V_{q,Rk}$  = 0.14 x  $F_{z,Ed}$  + 0.35 (for 1-way connector with  $F_{z,Ed} \leq 1.06$  kN)
- $V_{q,Rk}$  = -0.18 x  $F_{z,Ed}$  + 1.47 (for 2-way connector with  $F_{z,Ed} \leq 1.87$  kN)
- $V_{q,Rk}$  = 3.21 kN (for 4-way connector with  $F_{z,Ed} \leq 3.60$  kN)
- $F_{z,Ed}$  [kN] design value of tensile force acting on each cross connector
- $\gamma_M$  = 1.33 (partial safety factor)

### 3.2.4.3 Shear resistance in longitudinal direction of lower mounting rails

$$\frac{V_{I,Ed} \cdot \gamma_M}{V_{I,Rk}} \leq 1,0$$

where:

- $V_{I,Ed}$  [kN] design value of shear force acting in longitudinal direction per cross connector  
 $V_{I,Rk}$  [kN] characteristic value of shear resistance in longitudinal direction per cross connector  
 $V_{I,Rk} = 0.27 \times F_{z,Ed} + 0.68$  (for 1-way connector with  $F_{z,Ed} \leq 1.06$  kN)  
 $V_{I,Rk} = -0.45 \times F_{z,Ed} + 3.70$  (for 2-way connector with  $F_{z,Ed} \leq 1.87$  kN)  
 $V_{I,Rk} = 6.90$  kN (for 4-way connector with  $F_{z,Ed} \leq 3.60$  kN)  
 $F_{z,Ed}$  [kN] design value of tensile force acting on each cross connector  
 $\gamma_M = 1.33$  (partial safety factor)

### 3.2.4.4 Interaction

For combined tensile and shear loading, a linear interaction verification shall also be provided. To determine the characteristic shear resistance, the maximum design value of the tensile force acting on each cross connector shall be used for  $F_{z,Ed}$ .

$$\frac{F_{z,Ed} \cdot \gamma_M}{F_{z,Rk}} + \frac{V_{q,Ed} \cdot \gamma_M}{V_{q,Rk}} \leq 1,0 \quad \text{or} \quad \frac{F_{z,Ed} \cdot \gamma_M}{F_{z,Rk}} + \frac{V_{I,Ed} \cdot \gamma_M}{V_{I,Rk}} \leq 1,0$$

## 3.3 Execution

The connections of the mounting system shall be executed in accordance with the annexes.

The clamping height of the module clamps shall correspond to the height of the photovoltaic module frame between  $30 \text{ mm} \leq h \leq 50 \text{ mm}$ . Refer to the manufacturer's catalogue for the clamping heights for frameless photovoltaic modules fastened with laminate clamps. For installation, the frames of the photovoltaic modules shall rest against the module clamps or the laminate clamps.

The screw connections of the laminate clamps shall regularly be tightening with a torque of 13.5 Nm, all other screw connections with a torque of 10 Nm. The components of the mounting system and photovoltaic modules to be fastened shall be stored and installed in clean, dry and grease-free condition.

The module clamps MH AK 36-51 and MH AK II Klick 30-50 shall be mounted on sheet metal rail profiles AK, trapezoidal sheet metal rails AK and mounting rails ST-AK 1/12, ST-AK 2/25 FMP, ST-AK 3/27, ST-AK 5/40, ST-AK 7/47, ST-AK 8/50, ST-AK 13/60, ST-AK 15/66, ST-AK 19/66, ST-AK 26/70, ST-AK 41/80, ST-AK 182/120, ST-AK 215/120, ST-AK 280/125, ST-AK 220/272 or on components with an identical connection geometry from the manufacturer's catalogue.

The laminate clamps LMK AK and LEK AK with hammer-head screws shall be mounted on ST-AK 7/47 mounting rails from the manufacturer's catalogue or on components with an identical connection geometry. The laminate clamps with LMK AK Klick and LEK AK Klick click fastening shall be mounted on ST-AK 5/40 or ST-AK 7/47 mounting rails from the manufacturer's catalogue or on components with an identical connection geometry.

The 1-way cross connectors serve to connect the ST-AK 5/40 mounting rails or components with an identical connection geometry to ST-AK 13/60 mounting rails or components with an identical connection geometry from the manufacturer's catalogue.

The 2-way cross connectors serve to connect the ST-AK 13/40 mounting rails or components with an identical connection geometry to ST-AK 13/60 mounting rails or components with an identical connection geometry from the manufacturer's catalogue.

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The 4-way cross connectors serve to connect the ST-AK 182/120 mounting rails or components with an identical connection geometry to ST-AK 182/120 mounting rails or components with an identical connection geometry from the manufacturer's catalogue.

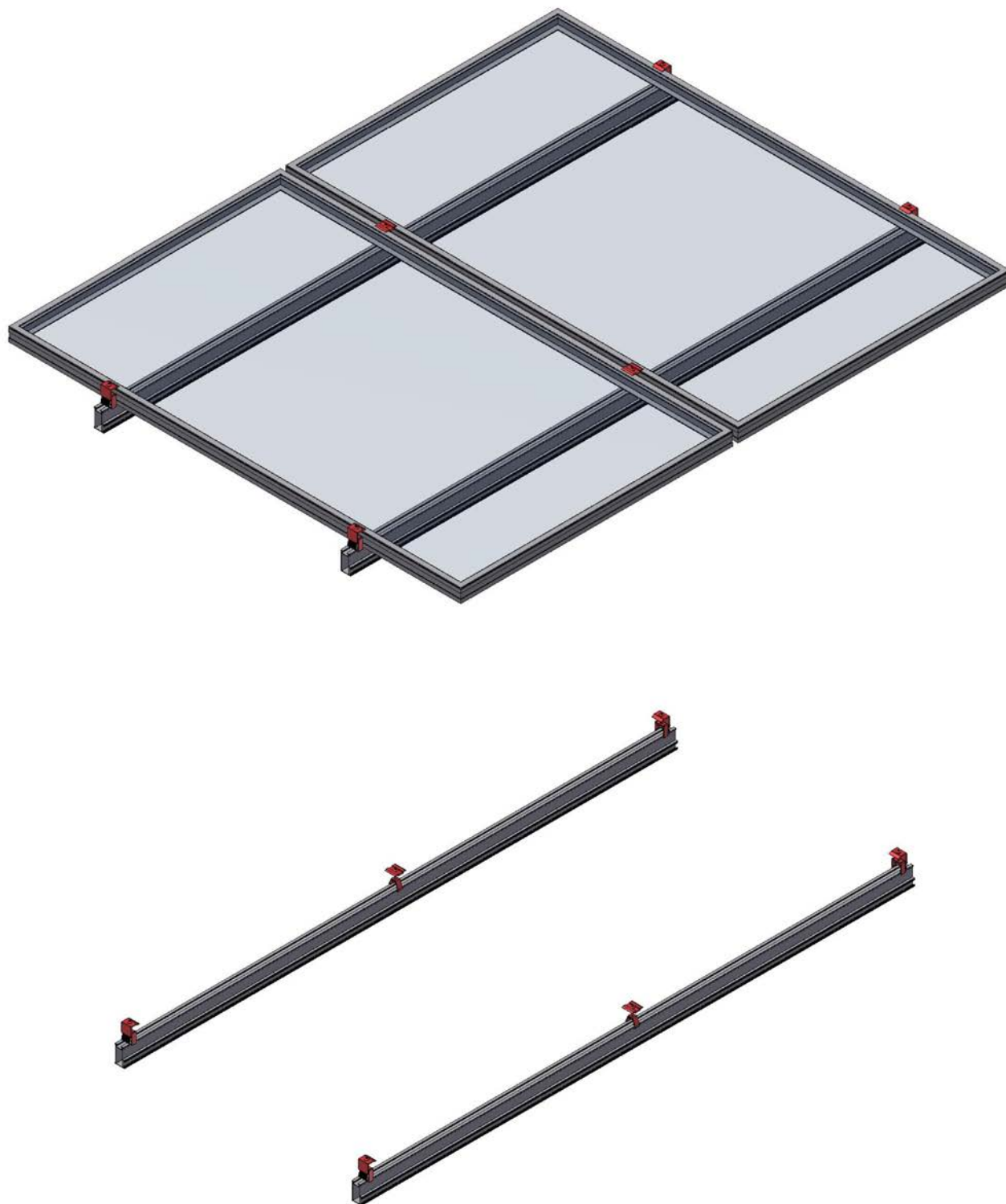
The manufacturer shall draw up instructions for the installation of the mounting system and provide them to the executing company. The installation instructions shall contain information on the screwing tool, adjustment of the screwing tool, minimum clamping depth and torque. Use of impact drivers is not permissible.

The mounting system shall only be executed by companies possessing the necessary experience for this, unless training of assembly personnel by specialists of companies experienced in this field is provided for.

The executing company shall provide a declaration of conformity in accordance with Sections 16a(5) and 21(2) of the Model Building Code to confirm the conformity of the installed mounting system with the general construction technique permit included in this decision.

Dr.-Ing. Ronald Schwuchow  
Head of Section

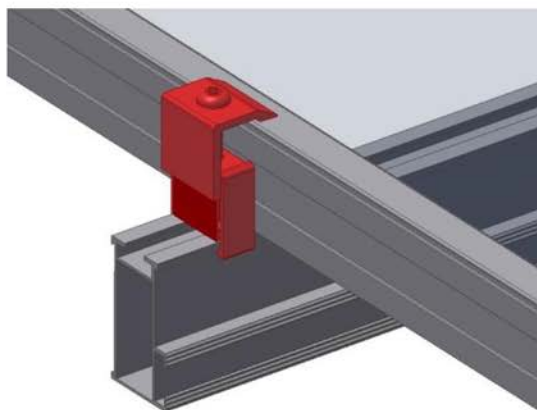
Drawn up by



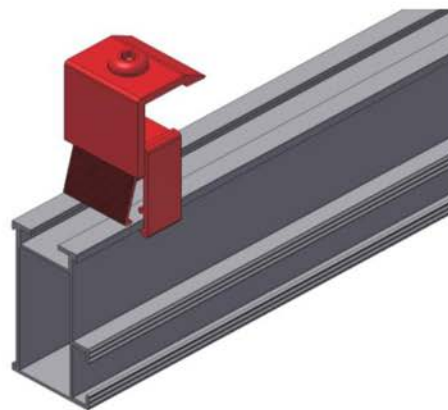
Module clamps, laminate clamps, cross connectors and their components for fastening of photovoltaic modules on profile rails

Installation examples for the fastening of framed photovoltaic modules using module clamps  
Overall design

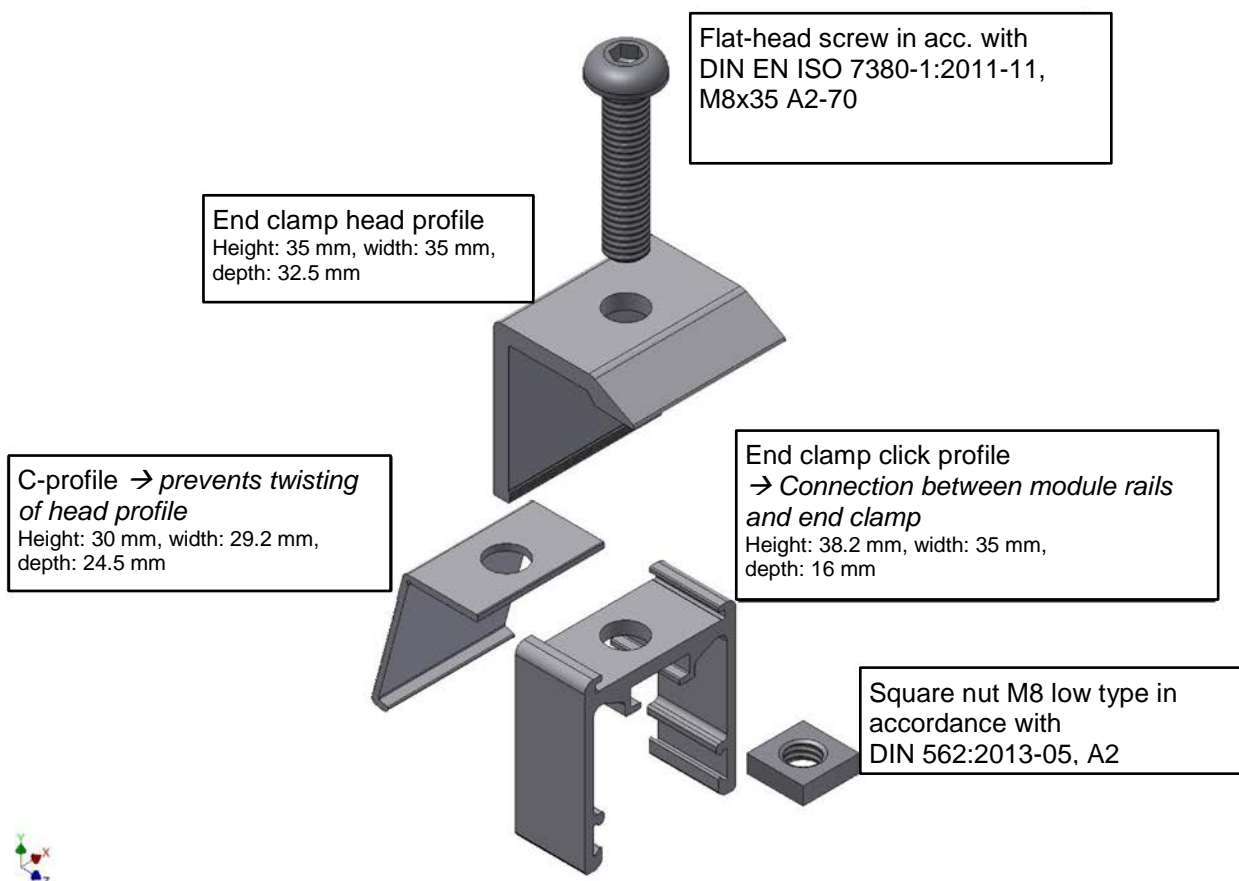
Annex 1.1



End clamp with module



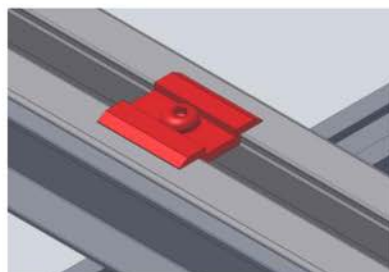
End clamp without module



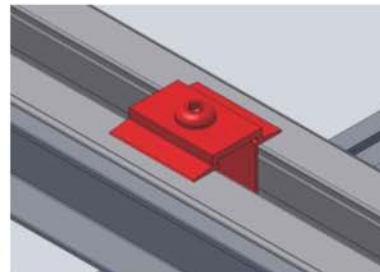
Module clamps, laminate clamps, cross connectors and their components for fastening of photovoltaic modules on profile rails

Installation examples for the fastening of framed photovoltaic modules using module clamps  
 Details of end clamp

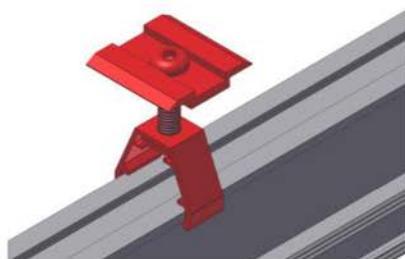
Annex 1.2



Mid clamp MH AK 36-51  
 with module



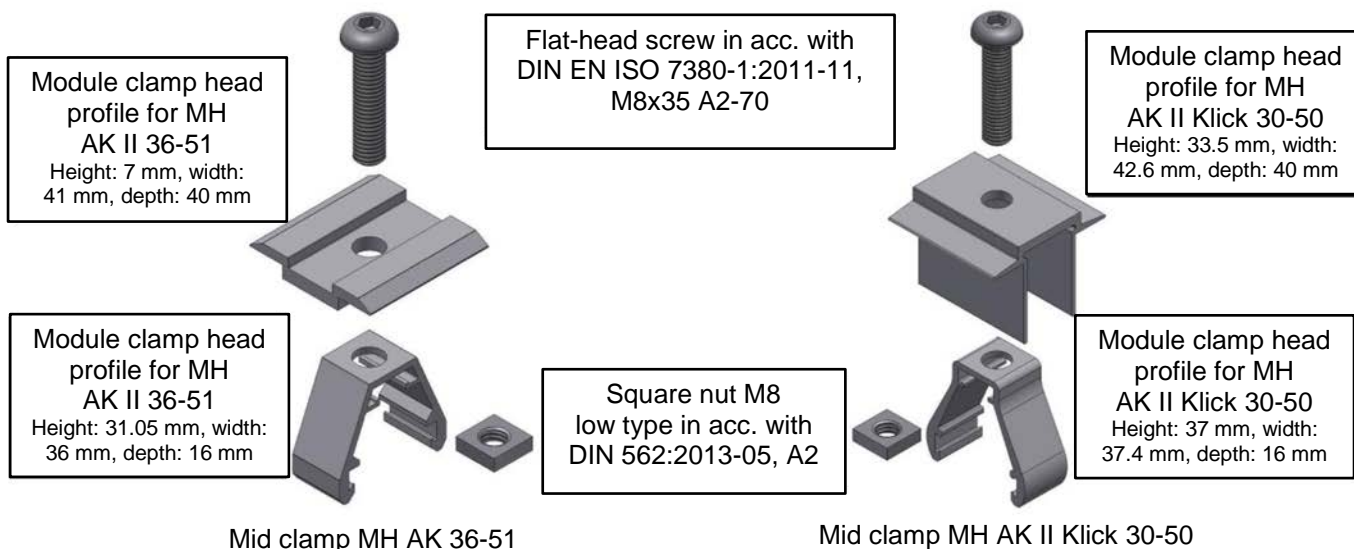
Mid clamp MH AK II Klick 30-50  
 with module



Mid clamp MH AK 36-51  
 without module



Mid clamp MH AK II Klick 30-50  
 without module

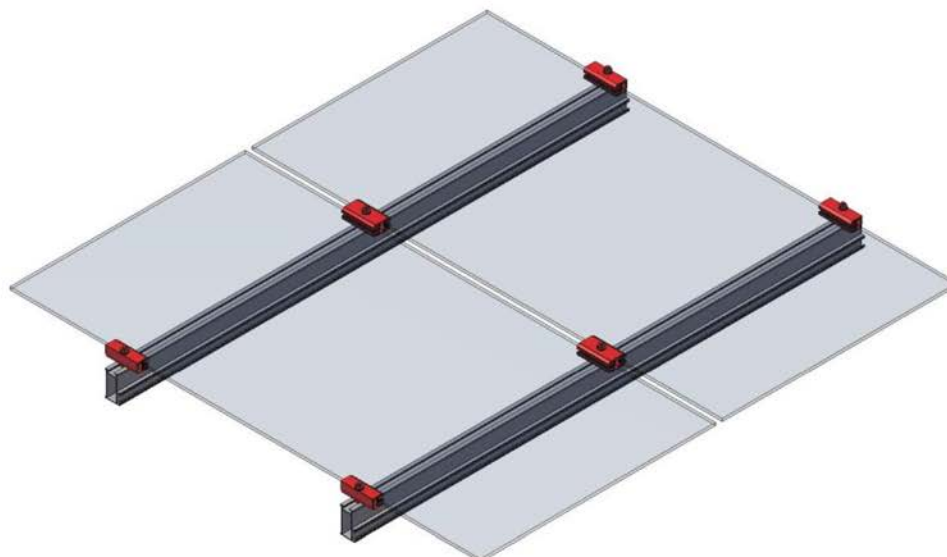


Module clamps, laminate clamps, cross connectors and their components for fastening of photovoltaic modules on profile rails

Installation examples for the fastening of framed photovoltaic modules using module clamps  
 Details of mid clamp

Annex 1.3

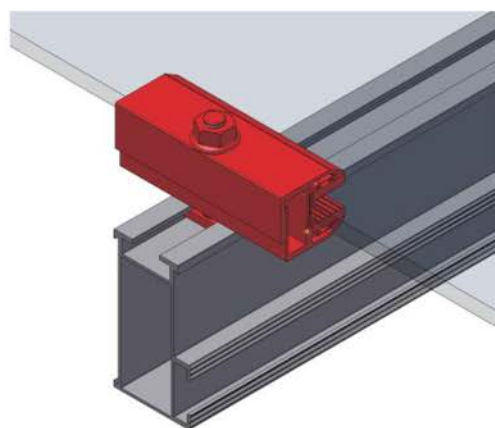




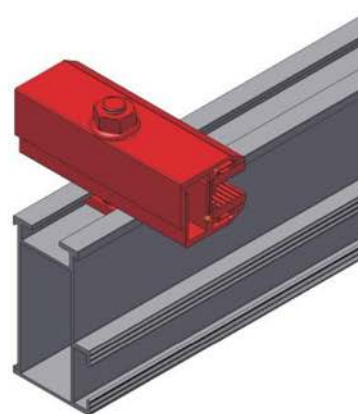
Module clamps, laminate clamps, cross connectors and their components for fastening of photovoltaic modules on profile rails

Installation examples for the fastening of frameless photovoltaic modules using laminate clamps with hammer-head screw  
Overall design

Annex 2.1



Laminate end clamp with module

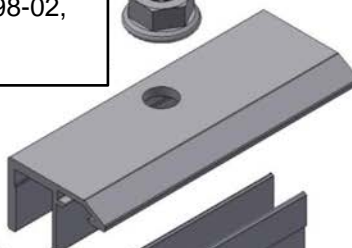


Laminate end clamp without module

Locking nut in acc. with  
 DIN EN 1661:1998-02,  
 M8 A2



Laminate end clamp profile  
 top part  
 Height: 19.5 mm, width: 80 mm,  
 depth: 30.6 mm



Laminate end clamp profile  
 bottom part  
 Height: 22.5 mm, width: 80 mm,  
 depth: 28.1 mm



Full rubber profile (EPDM)  
 Height: 9.6 mm, width: 80 mm,  
 depth: 15.4 mm



Hammer-head screw  
 M8x40, 28/15, A2-70

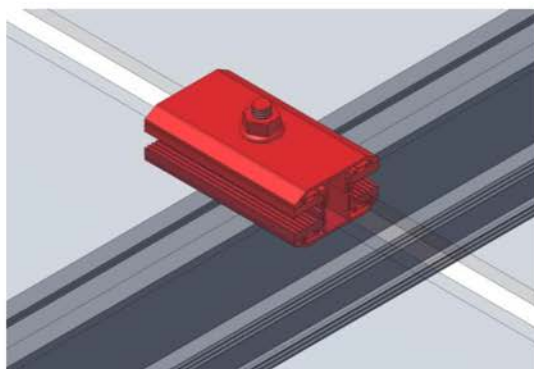


Module clamps, laminate clamps, cross connectors and their components for fastening of photovoltaic modules on profile rails

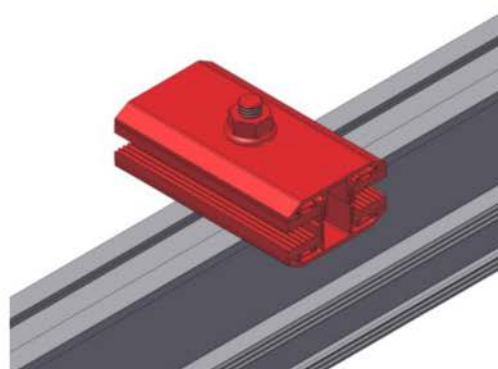
Installation examples for the fastening of frameless photovoltaic modules using laminate clamps with hammer-head screw  
 Details of end clamp

Annex 2.2





Laminate end clamp with module



Laminate end clamp without module

Locking nut in acc. with  
 DIN EN 1661:1998-02,  
 M8 A2

Laminate end clamp profile  
 top part  
 Height: 19.5 mm, width: 80 mm,  
 depth: 45.05 mm

Full rubber profile (EPDM)  
 Height: 9.6 mm, width: 80 mm,  
 depth: 15.4 mm

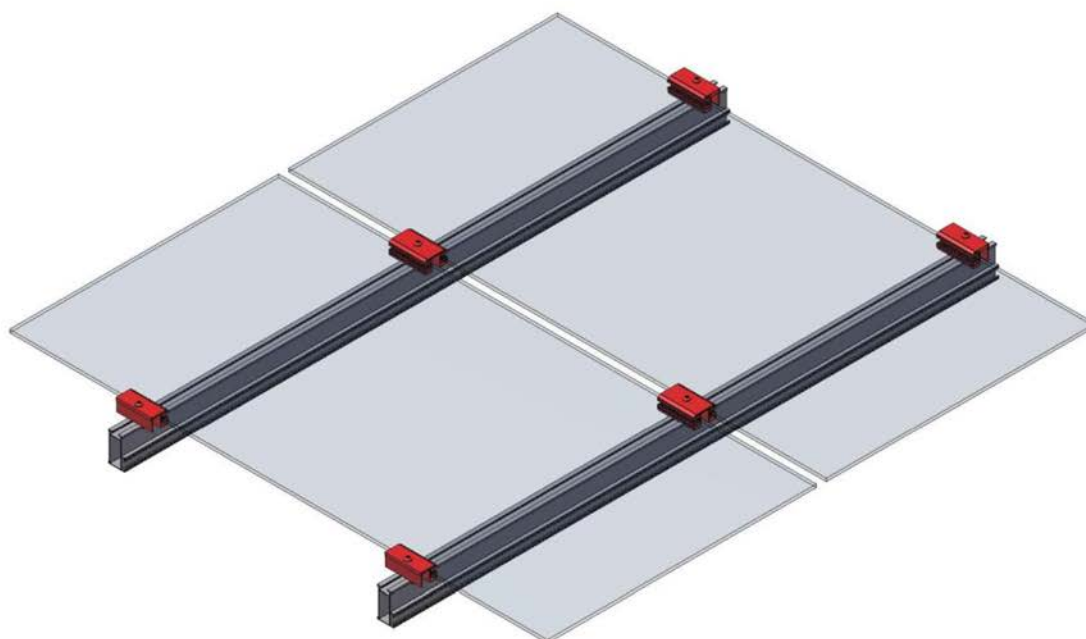
Laminate end clamp profile  
 bottom part  
 Height: 11.5 mm, width: 80 mm,  
 depth: 45.2 mm

Hammer-head screw  
 M8x40, 28/15, A2-70

Module clamps, laminate clamps, cross connectors and their components for fastening of photovoltaic modules on profile rails

Installation examples for the fastening of frameless photovoltaic modules using laminate clamps with hammer-head screw  
 Details of mid clamp

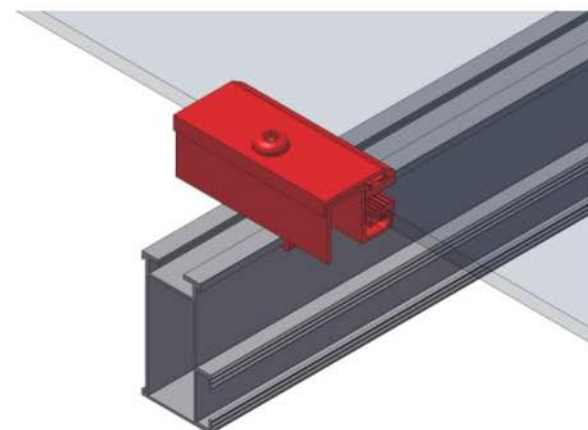
Annex 2.3



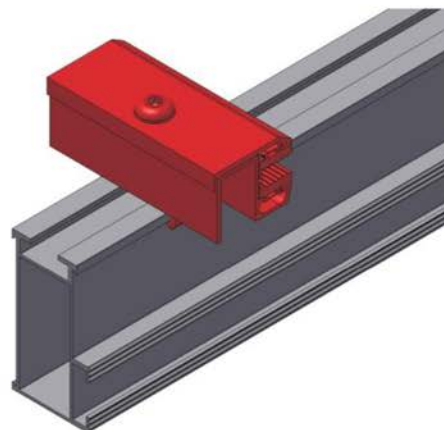
Module clamps, laminate clamps, cross connectors and their components for fastening of photovoltaic modules on profile rails

Installation examples for the fastening of frameless photovoltaic modules using laminate clamps with click fastening  
Overall design

Annex 3.1



Laminate end clamp with module



Laminate end clamp without module

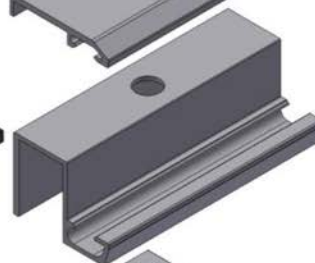
Flat-head screw in acc. with  
 DIN EN ISO 7380-1:2011-11,  
 M8x20 A2-70



Laminate end clamp profile  
 top part  
 Height: 7 mm, width: 80 mm,  
 depth: 36.9 mm



Laminate end clamp profile  
 bottom part  
 Height: 26.6 mm, width: 80 mm,  
 depth: 35.6 mm



Full rubber profile (EPDM)  
 Height: 9.6 mm, width: 80 mm,  
 depth: 15.4 mm



Square nut M8  
 low type in acc. with  
 DIN 562:2013-05, A2



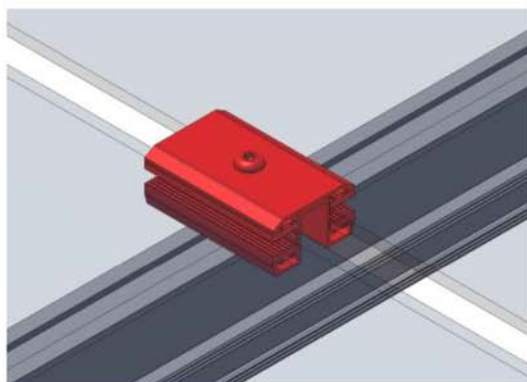
Click profile  
 Height: 31.05 mm,  
 width: 36 mm,  
 depth 16 mm



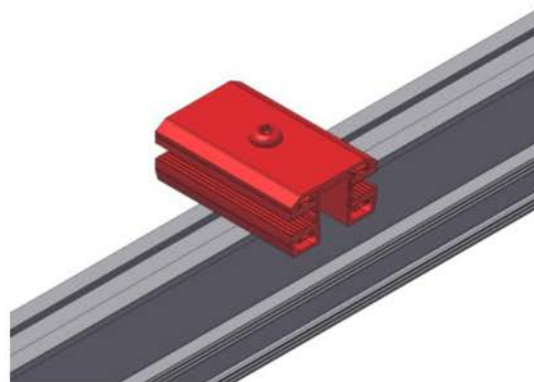
Module clamps, laminate clamps, cross connectors and their components for fastening of photovoltaic modules on profile rails

Installation examples for the fastening of frameless photovoltaic modules using laminate clamps with click fastening  
 Details of end clamp

Annex 3.2



Laminate end clamp with module

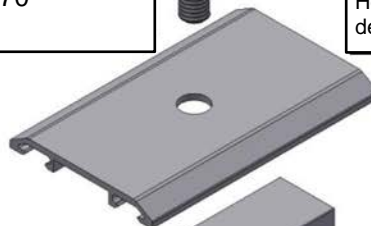


Laminate end clamp without module

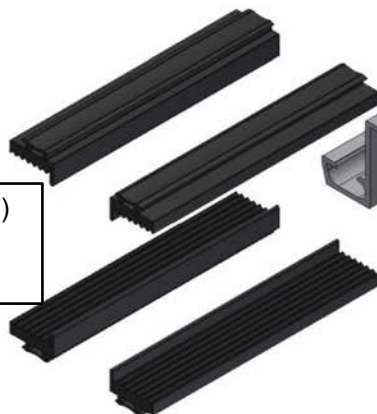
Flat-head screw in acc. with  
 DIN EN ISO 7380-1:2011-11,  
 M8x20 A2-70



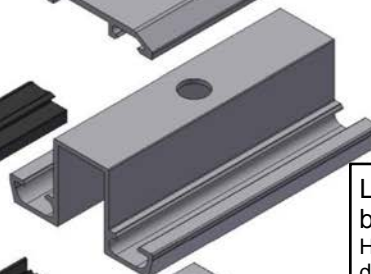
Laminate end clamp profile  
 top part  
 Height: 6 mm, width: 80 mm,  
 depth: 50.7 mm



Full rubber profile (EPDM)  
 Height: 9.6 mm, width: 80 mm,  
 depth: 15.4 mm



Laminate end clamp profile  
 bottom part  
 Height: 26.6 mm, width: 80 mm,  
 depth: 50.7 mm



Square nut M8  
 low type in acc. with  
 DIN 562:2013-05, A2



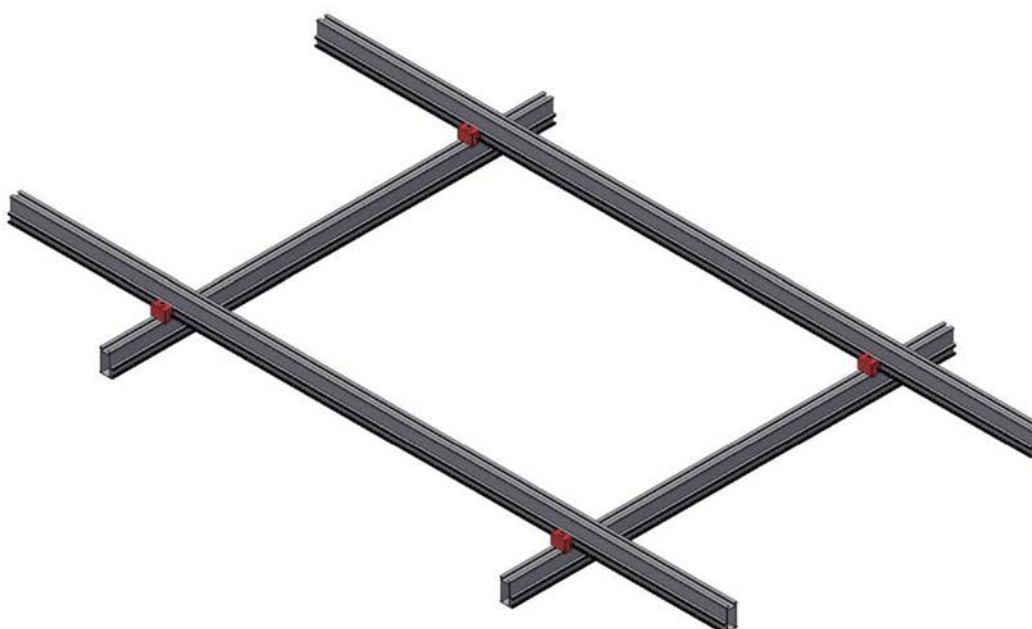
Click profile  
 Height: 31.05 mm,  
 width: 36 mm,  
 depth 16 mm



Module clamps, laminate clamps, cross connectors and their components for fastening of photovoltaic modules on profile rails

Installation examples for the fastening of frameless photovoltaic modules using laminate clamps with click fastening  
 Details of mid clamp

Annex 3.3



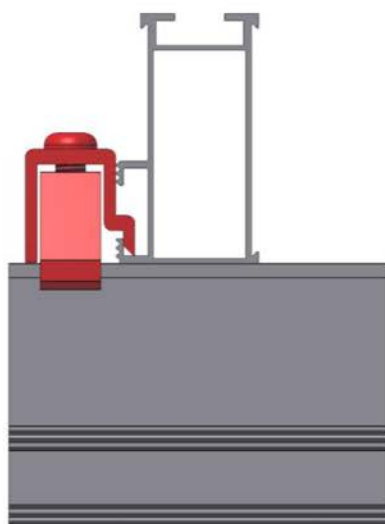
Module clamps, laminate clamps, cross connectors and their components for fastening of photovoltaic modules on profile rails

Installation example for two- or multi-layered mounting systems using cross connectors with click-fastening  
Overall design

Annex 4.1

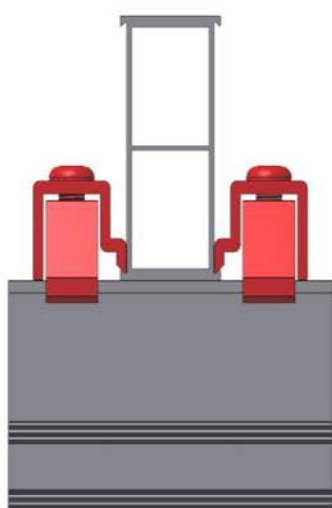


*One fastener per crossing point*

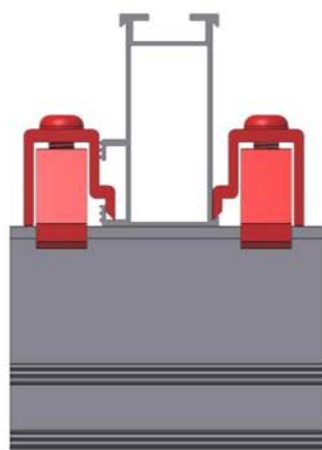


1x cross connector at grooved channel

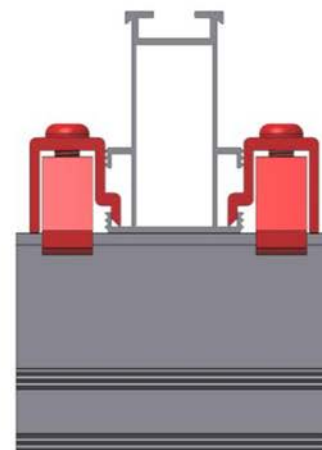
*Two fasteners per crossing point*



2x cross connector at pin



1x cross connector at grooved channel  
 1x cross connector at pin

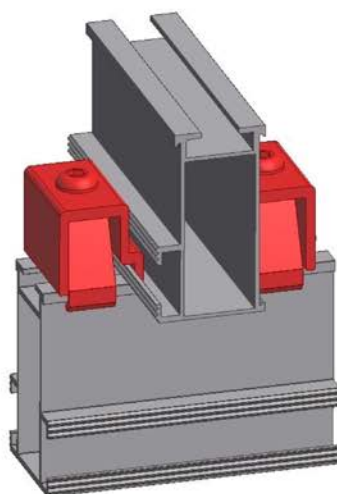


2x cross adapter at grooved channel

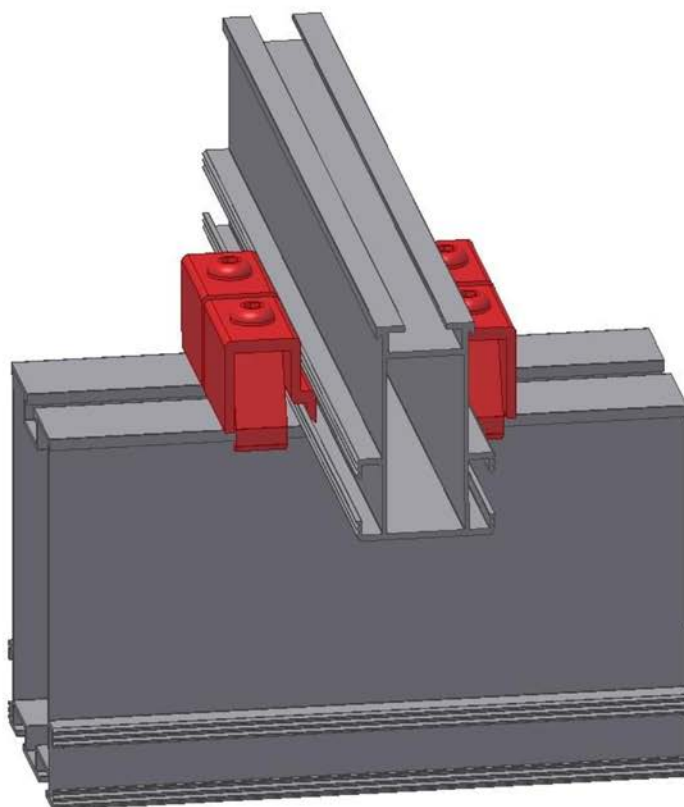
Module clamps, laminate clamps, cross connectors and their components for fastening of photovoltaic modules on profile rails

Installation example for two- or multi-layered mounting systems using cross connectors with click-fastening  
 Illustration of the possible fastening types on the mounting rails

Annex 4.2



max. 2 cross connectors possible

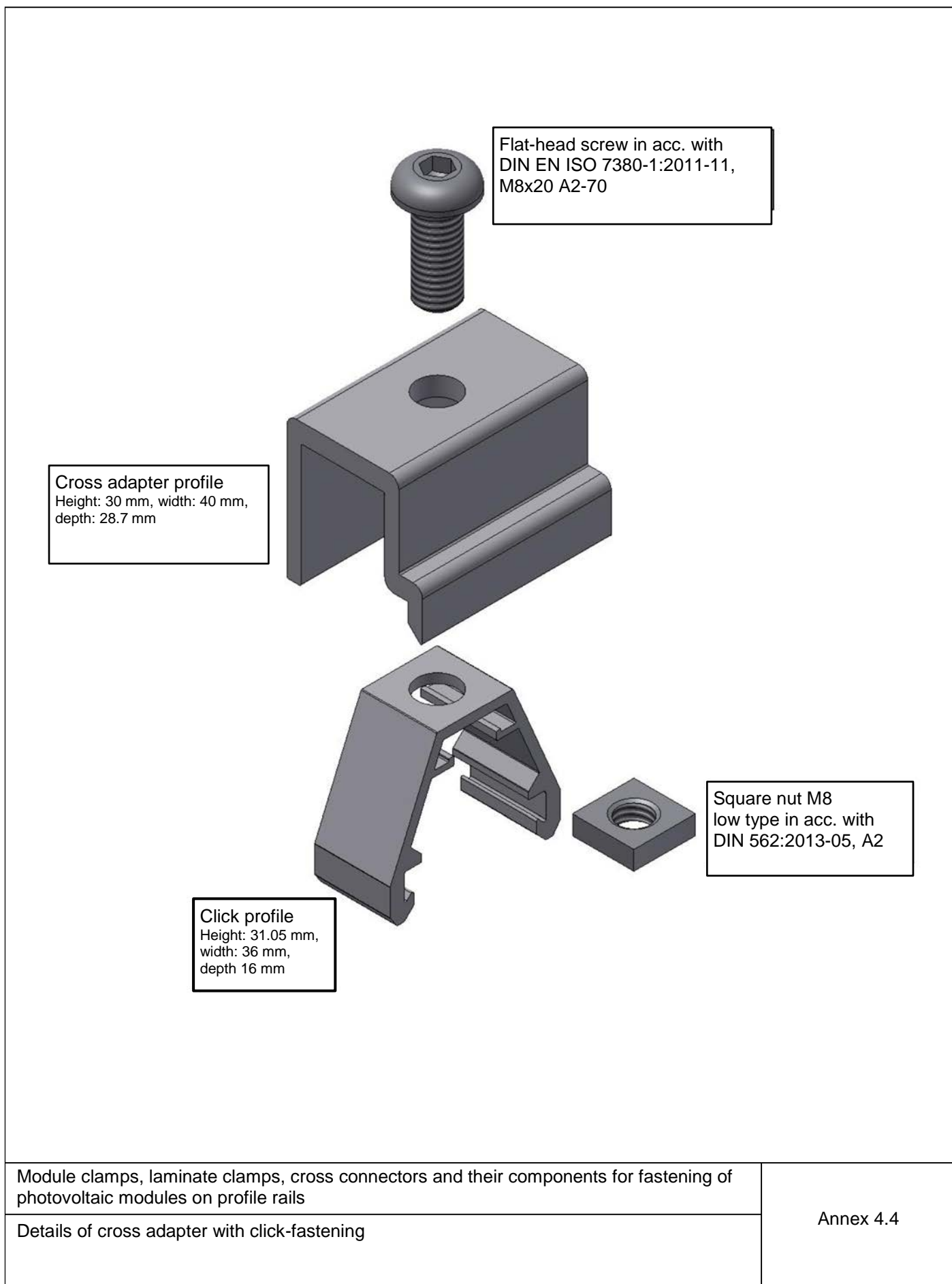


max. 4 cross connectors possible

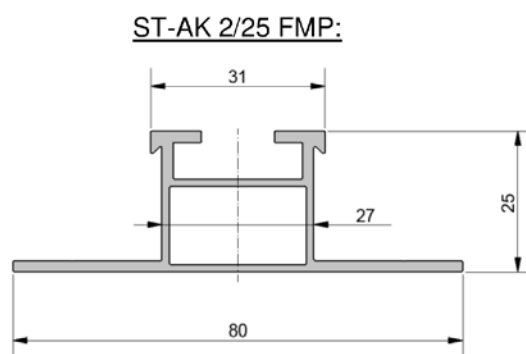
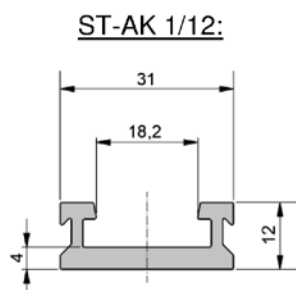
Module clamps, laminate clamps, cross connectors and their components for fastening of photovoltaic modules on profile rails

Installation example for two- or multi-layered mounting systems using cross connectors with click-fastening  
Illustration of the possible fastening types on the mounting rails

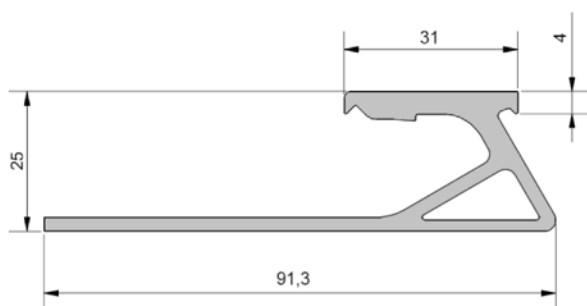
Annex 4.3



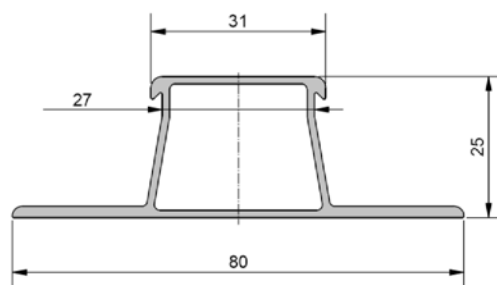




Sheet metal rail profile AK



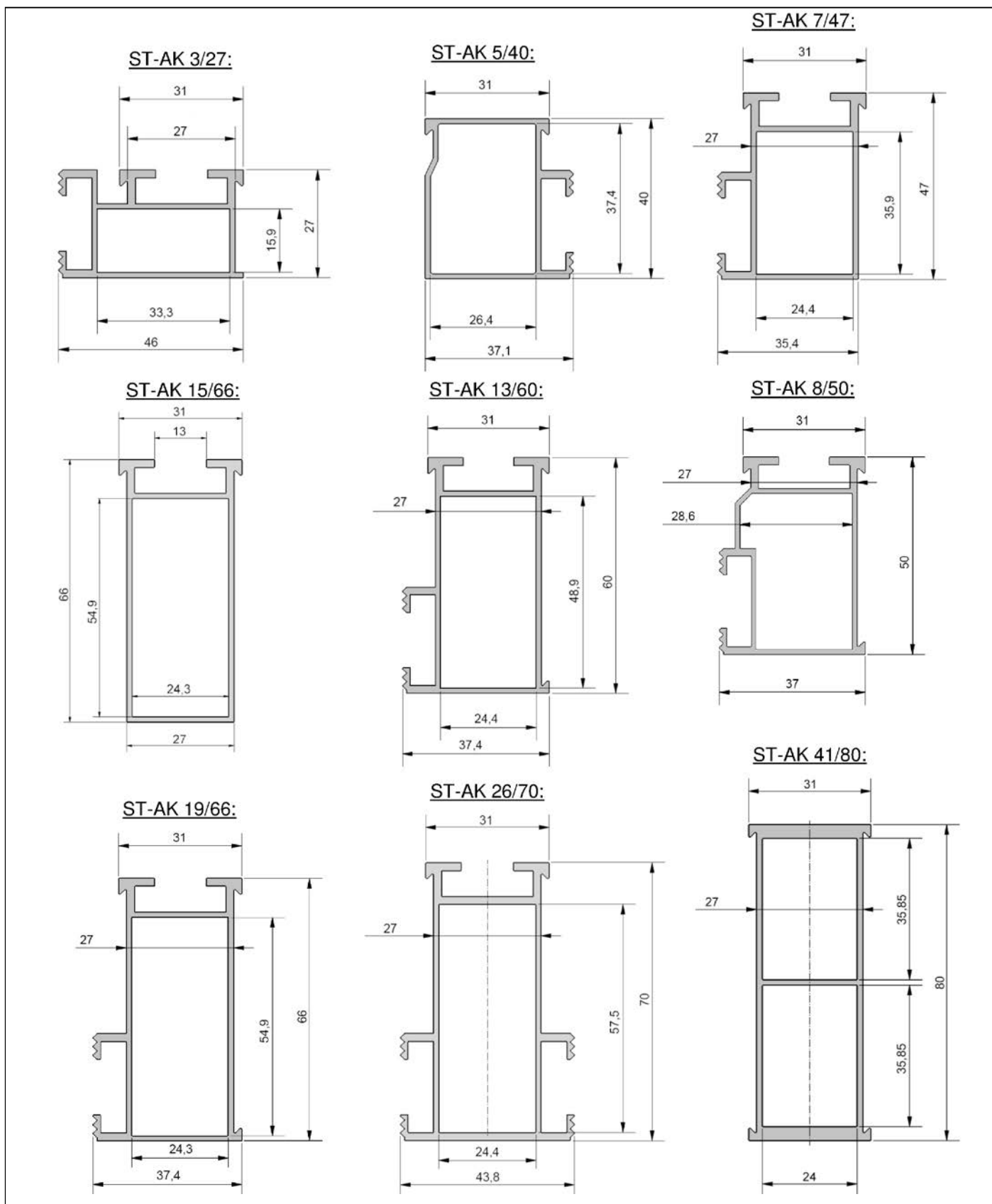
Trapezoidal sheet metal rail AK



Module clamps, laminate clamps, cross connectors and their components for fastening of photovoltaic modules on profile rails

Overview of profile rails with rail channel  
 (Illustration approx. scale 1:1)

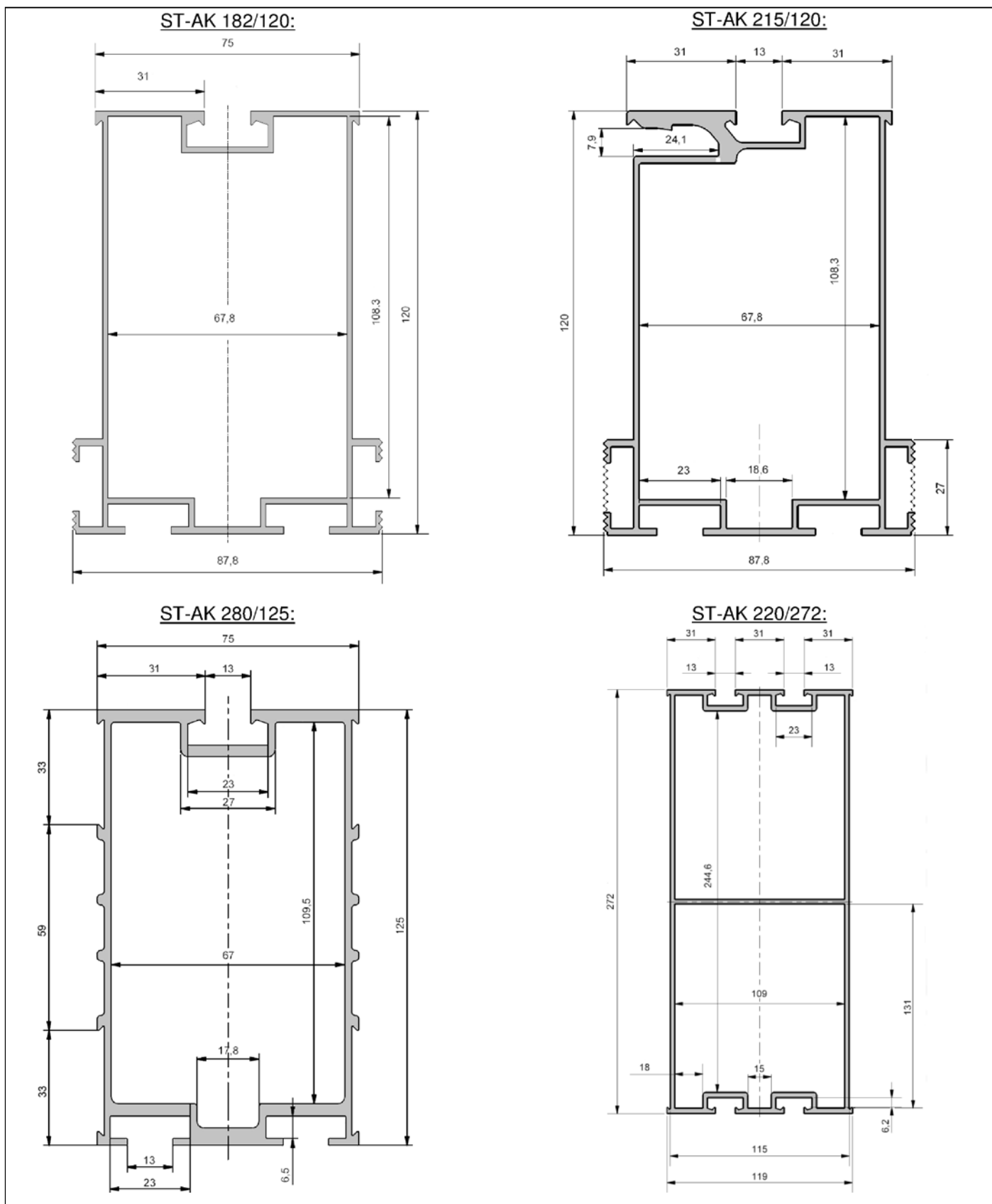
Annex 5.1



Module clamps, laminate clamps, cross connectors and their components for fastening of photovoltaic modules on profile rails

Overview of mounting rails with rail channels  
 (Illustration approx. scale 1:1)

Annex 5.2



Module clamps, laminate clamps, cross connectors and their components for fastening of photovoltaic modules on profile rails

Overview of mounting rails with rail channels  
 (Illustration approx. scale 1:1)

Annex 5.3