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European Assessment Document for

Fixing clips and sliding clips for double standing seam roof

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1 SCOPE OF THE EAD

1.1 Description of the construction product

This EAD covers fixing clips and sliding clips for double standing seam roof, in the text designated as “fixing clips” and “sliding clips“, that are made of stainless steel and used to fasten a double standing seam roof to a substructure. Figure 1.1.1 shows an example for a fixing clip and Figure 1.1.2 for a sliding clip.

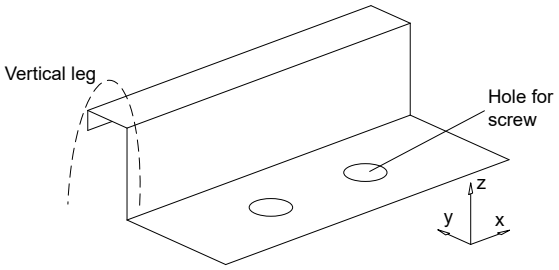


Figure 1.1.1 Fixing clip – Example

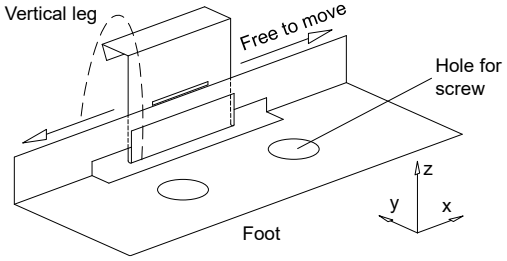


Figure 1.1.2 Sliding clip – Example

Fastening to the substructure is carried out with screws. The EAD is for fixing clips and sliding clips but not for the fasteners.

The product is not covered by a harmonised European standard (hEN) nor by any other European Assessment Document (EAD) than the present one.

Concerning product packaging, transport, storage, maintenance, replacement, and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement, and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer’s instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer’s stipulations, e.g., with regard to the intended end use conditions, having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA as long as the details of the assessment methods as laid down in this EAD are respected.

1.2 Information on the intended use of the construction product

1.2.1 Intended use

Fixing clips and sliding clips are intended to fasten a double standing seam roof to a substructure made of timber or any other material providing resistance, e.g., steel, aluminium, etc..

The fixing clips and sliding clips provide for load transfer of the double standing seam roof including roof-mounted installations to the substructure.

Fixing clips are intended for loading in x- and z-direction only, see Figure 1.1.1. The sliding clips are intended for loading in z-direction only and allow for dilation in x-direction, see Figure 1.1.2.

Fixing clips and sliding clips are placed in x-direction in such a way as to avoid constraints by thermal expansions. Loading is by static or quasi static loads only.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the fixing clips and sliding clips for the intended use of 50 years when installed in the works. These provisions are based upon the current state of the art and the available knowledge and experience.

When assessing the product, the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[1].

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

1.3 Specific terms used in this EAD

1.3.1 Symbols

1.3.1.1 Uplift capacity

α_1	—		Reduction factor to consider repeated loads
α_0	—		Reduction factor to consider actual fixing clip and sliding clip parameters
F_{lo}	N		Lower force in cyclic load test, force for one fixing clip or sliding clip
$F_{proof,\ 5}$	N		5 % fractile of corrected proof forces
$F_{proof,\ c,\ i,\ corr}$	N		Corrected proof force of specimen i, following cyclic load test
$F_{proof,\ c,\ m}$	N		Mean value of corrected proof forces, following cyclic load test
$F_{proof,\ i}$	N		Proof force of specimen i
$F_{proof,\ i,\ corr}$	N		Corrected proof force to consider actual fixing clip and sliding clip parameters, specimen i
$F_{proof,\ m}$	N		Mean value of corrected proof forces
F_{up}	N		Upper force in cyclic load test, force for one fixing clip or sliding clip
i	—		Specimen number, i = 1 to n
n	—		Number of specimens, $n \geq 10$
$N_{R,\ k}$	N		Characteristic uplift capacity
R_m	MPa		Actual tensile strength of the fixing clip and sliding clip material used for testing
$R_{m,\ min}$	MPa		Minimum tensile strength of the fixing clip and sliding clip material in accordance with the material standard
t	mm		Actual thickness of the fixing clip and sliding clip material used for testing

[1] The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

t_{min} ..... mm..... Minimum thickness of the clip material in accordance with the material standard

1.3.1.2 Shear capacity

i..... — ..... Specimen number, i = 1 to n

n..... — ..... Number of specimens, n ≥ 10

α_0 ..... — ..... Reduction factor to consider actual fixing clip parameters

$R_{m, min}$ ..... MPa ..... Minimum tensile strength of fixing clip material in accordance with the material standard

R_m ..... MPa ..... Actual tensile strength of fixing clip material used in testing

t_{min} ..... mm ..... Minimum thickness of fixing clip material in accordance with material standard

t..... mm ..... Actual thickness of fixing clip material used in testing

$G_{proof, i}$ .....N..... Proof force of specimen i

$G_{proof, i, corr}$ .....N..... Corrected proof force to consider actual fixing clip parameters, specimen i

$G_{proof, 5}$ .....N..... 5 % fractile of corrected proof forces

$V_{R, k}$ .....N..... Characteristic shear capacity

1.3.1.3 Combined uplift and shear capacity

$F_{t, E, k}$ .....N..... Characteristic value of the force component in uplift direction

$N_{R, k}$ .....N..... Characteristic uplift capacity in accordance with Clause 2.2.1

$F_{v, E, k}$ .....N..... Characteristic value of the force component in shear direction

$V_{R, k}$ .....N..... Characteristic shear capacity in accordance with Clause 2.2.2

1.3.1.4 Sliding capacity

i..... — ..... Specimen number, i = 1 to n

n..... — ..... Number of specimens, n ≥ 10

s ..... mm ..... Travel in shifting the sliding clip

$F_{sh, pr, i}(s)$.....N..... Force as a function of travel s, specimen i, prior uplift loading

$F_{sh, po, i}(s)$.....N..... Force as a function of travel s, specimen i, post uplift loading

$F_{sh, pr, max, i}$ .....N..... Maximum force during shifting one full cycle, specimen i, prior to uplift loading

$F_{sh, po, max, i}$ .....N..... Maximum force during shifting one full cycle, specimen i, post uplift loading

$F_{sh, max}$ .....N..... Maximum of maximum forces of all specimens, i.e., prior and post uplift loading

$R_{sh, i}$ ..... — ..... Ration of maximum force prior uplift loading to maximum force post uplift loading, specimen i

$R_{sh, m}$ ..... — ..... Mean value of the ratios of all specimens

1.3.1.5 Calculation of 5 % fractile

i		i^{th} observation, i = 1, 2, ..., n
n		Number of observations as random values in the sample
x_i		i^{th} observed value
$\bar{x}$		Sample mean
s		Sample standard deviation
V_x		Coefficient of variation
k		Factor in dependence of n
$x_{5\,\%}$		5 % fractile

1.3.1.6 Resistance to corrosion

CRC	—	Corrosion resistance code in accordance with EN 1993-1-4, Table A.3

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

All undated references to standards in this EAD are to be understood as references to the dated versions listed in chapter 4.

2.1 Essential characteristics of the product

Table 2.1.1 shows how the performance of fixing clips and sliding clips is assessed in relation to the essential characteristics.

Table 2.1.1 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics

№	Essential characteristic	Assessment method	Type of expression of product performance
Basic requirement for construction works 4: Safety and accessibility in use			
1	Uplift capacity [1), 2)]	2.2.1	Level
2	Shear capacity [1)]	2.2.2	Level
3	Combined uplift and shear capacity [1)]	2.2.3	Description
4	Sliding capacity [2)]	2.2.4	Level
Aspects of durability			
5	Resistance to corrosion [1), 2)]	2.2.5	Description
[1)] Essential characteristic for fixing clips [2)] Essential characteristic for sliding clips			

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

This chapter is intended to provide instructions for TABs. Therefore, the use of wordings such as “shall be stated in the ETA” or “it has to be given in the ETA” shall be understood only as such instructions for TABs on how results of assessments shall be presented in the ETA. Such wordings do not impose any obligations for the manufacturer and the TAB shall not carry out the assessment of the performance in relation to a given essential characteristic when the manufacturer does not wish to declare this performance in the Declaration of Performance.

2.2.1 Uplift capacity

Purpose of the assessment

Subjects of assessments is uplift capacity by static loading and repeated loading that are representative of this essential characteristic for the fixing clip and sliding clip.

Assessment method

2.2.1.1 Uplift test

The specimen comprises a substrate of plywood with length ≥ 300 mm, width ≥ 120 mm, and thickness ≥ 24 mm. Fixing clips and sliding clips shall be screwed centrically on the plywood substrate as shown in Figure 2.2.1.1.1 and Figure 2.2.1.1.2.

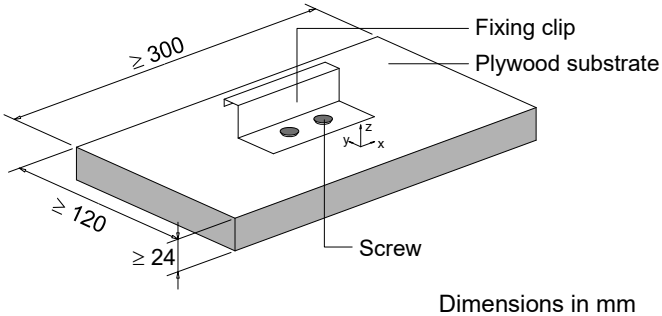


Figure 2.2.1.1.1 Specimen – Example with fixing clip

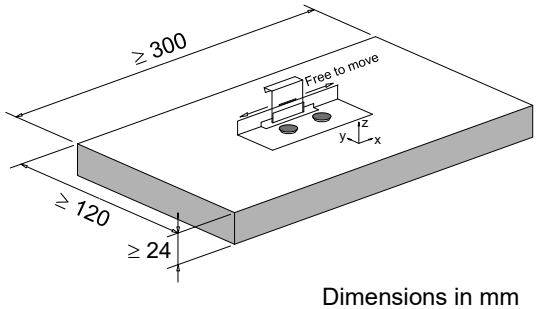


Figure 2.2.1.1.2 Specimen – Example with sliding clip

If the length of the fixing clip or sliding clip exceeds 100 mm, the plywood shall have at least 100 mm clearance to the edges for clamping.

The fixing clips and sliding clips shall be firmly screwed onto the plywood substrate. Failure of the screws or failure of the substrate in testing invalidates the test. The test shall be repeated with fasteners and substrate of higher mechanical capacity.

The minimum number of specimens shall be n = 10 for each type of clip.

Testing shall be performed at (23 ± 2) °C and (65 ± 5) % relative humidity. Prior to testing the specimens shall be conditioned at a temperature of (23 ± 2) °C and (65 ± 5) % relative humidity for at least 24 h.

Load transmission into the fixing clips and sliding clips shall be carried out with a clamp, see Figure 2.2.1.1.4. The upper part of the vertical leg of the fixing clips and sliding clips shall be folded and reinforced with a wire, diameter ≥ 3 mm, to prevent early slipping of the clamp, see Figure 2.2.1.1.3 and Figure 2.2.1.1.4.

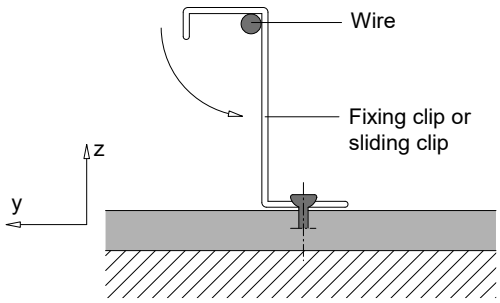


Figure 2.2.1.1.3 Wire reinforcement

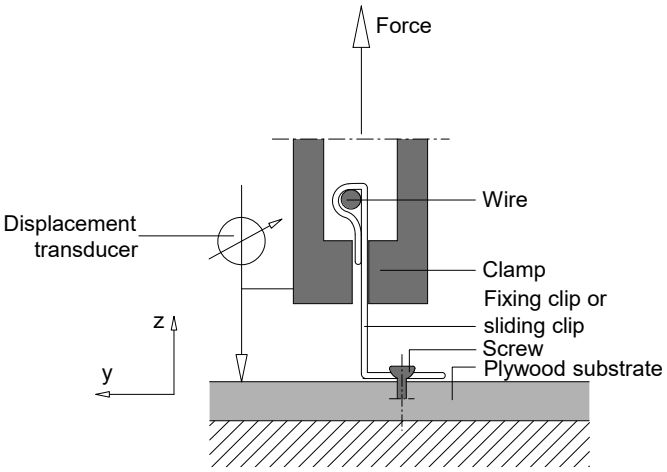


Figure 2.2.1.1.4 Load transmission

Test procedure – Measurements and observations:

- All materials and dimensions of products used for testing shall be recorded, take photos:
  - Actual thickness shall be measured in the middle of the vertical leg of fixing clip and sliding clip and in the middle of the foot of sliding clip. The measuring instrument shall have a resolution of ≤ 0,01 mm.
  - Actual tensile strength of material of the fixing clips and sliding clips shall be determined on strips in accordance with EN ISO 6892-1.
  - Actual dimensions of the fixing clips and sliding clips, including holes for screws shall be measured
  - For the screw, nominal diameter, head diameter shall be recorded.
- Displacement and associated force shall be measured throughout the test
- Any particular observations during the test shall be recorded:
  - Failure mode
  - Other observations.
- Measurements and observations shall be presented in a test report with contents in accordance with Annex B.

Loading shall be in accordance with EN 26891. The following parameters apply with regard to EN 26891:

- Sliding clip shall be tested in shifted position, approximately 1 mm before final stop, see Clause 2.2.4.
- The test shall be performed crosshead controlled.
- A testing machine with a feed rate of (10 ± 2) mm/min shall be used.
- The expected proof force shall be estimated. Possibly in pre-tests.
- The fixing clips and sliding clips shall be loaded in increasing the force up to 40 % of expected proof force.
- Force shall be maintained constant for 30 s.
- Subsequently, the force shall be decreased to 10 % of expected proof force
- Again, the force shall be maintained constant for 30 s.

– Then the force shall be increased until failure of the specimen.

Displacement and associated force shall be recorded throughout the test, see example of Figure 2.2.1.1.5.

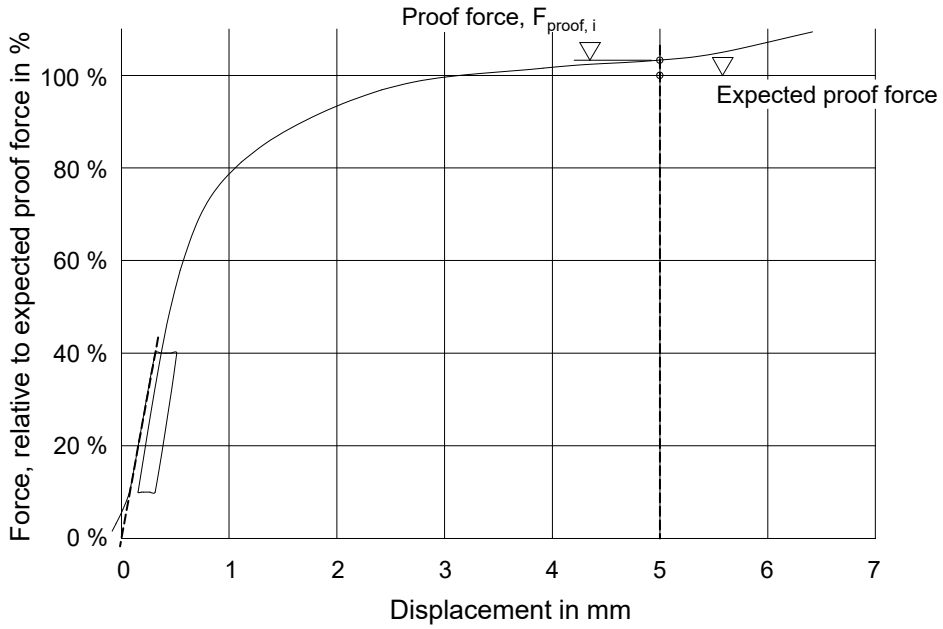


Figure 2.2.1.1.5 Exemplary force-displacement curve

Proof force shall be the higher force of either the maximum force before attaining a displacement of 5 mm or the force at a displacement of 5 mm, see Equation (2.2.1.1.1).

$$F_{proof, i} = \max \begin{cases} \text{Maximum force prior to attaining 5 mm displacement} \\ \text{Force at 5 mm displacement} \end{cases} \quad (2.2.1.1.1)$$

The individual proof forces, $F_{proof, i}$, shall be multiplied by the following correction factor α_0, see Equation (2.2.1.1.2) and Equation (2.2.1.1.3).

$$\alpha_0 = \begin{cases} \frac{R_{m, min}}{R_m} \cdot \frac{t_{min}}{t}^{1)} \\ \text{or} \\ \frac{t_{min}}{t}^{2)} \end{cases} \leq 1 \quad (2.2.1.1.2)$$

Key

1) $F_{proof, i}$ is induced by fracture of the fixing clips and sliding clips

2) $F_{proof, i}$ is induced by deformation of the fixing clips and sliding clips, without fracture

$$F_{proof, i, corr} = \alpha_0 \cdot F_{proof, i} \quad (2.2.1.1.3)$$

The mean value shall be calculated from the individual corrected proof forces in accordance with Equation (2.2.1.1.4).

$$F_{proof,\,m} = \frac{1}{n} \cdot \sum_{i=1}^{n} F_{proof,\,i,\,corr} \qquad (2.2.1.1.4)$$

The 5 % fractile, $F_{proof,\,5}$, shall be calculated from the individual corrected proof forces, $F_{proof\,i,\,corr}$, in accordance with Annex A.

Where:

i	—	Specimen number, i = 1 to n
n	—	Number of specimens, n ≥ 10
α_0	—	Reduction factor to consider actual fixing clip and sliding clip parameters
$R_{m,\,min}$	MPa	Minimum tensile strength of the fixing clip and sliding clip material in accordance with the material standard
R_m	MPa	Actual tensile strength of the fixing clip and sliding clip material used for testing
t_{min}	mm	Minimum thickness of the fixing clip and sliding clip material in accordance with the material standard
t	mm	Actual thickness of the fixing clip and sliding clip material used for testing
$F_{proof,\,i}$	N	Proof force of specimen i
$F_{proof,\,i,\,corr}$	N	Corrected proof force to consider actual fixing clip and sliding clip parameters, specimen i
$F_{proof,\,m}$	N	Mean value of corrected proof forces
$F_{proof,\,5}$	N	5 % fractile of corrected proof forces

2.2.1.2 Functioning under repeated loads

The specimen comprises a substrate of plywood with length ≥ 400 mm, width ≥ 120 mm, and thickness ≥ 24 mm. Two fixing clips or two sliding clips shall be firmly screwed onto the plywood substrate, free of play. The centre distance between the two fixing clips or sliding clips shall be 300 mm. The fixing clips and sliding clips shall be seamed into a standing seam, each fixing clips and sliding clips at the end of the standing seam, see Figure 2.2.1.2.1. The standing seam shall not be the weak point of the test assembly. Standing seam made of aluminium or galvanised steel thickness of 0,7–1 mm is recommended.

Failure of the screws or the substrate in testing invalidates the test. The test shall be repeated with fasteners and substrate of higher mechanical capacity.

At least five specimens for each type of clip shall be used for testing.

Testing shall be performed at (23 ± 2) °C and (65 ± 5) % relative humidity. Prior to testing the specimens shall be conditioned at a temperature of (23 ± 2) °C and (65 ± 5) % relative humidity for least 24 h.

Load transmission into the fixing clips and sliding clips shall be performed with a clamp, gripping the standing seam in the middle between the fixing clips and sliding clips, see Figure 2.2.1.2.1.

Test procedure – Measurements and observations:

- All materials and dimensions of products used for testing shall be recorded, take photos:
  - Actual thickness shall be measured in the middle of the vertical leg of fixing clip and sliding clip and in the middle of the foot of sliding clip. The measuring instrument shall have a resolution of ≤ 0,01 mm.

- Actual tensile strength of material of fixing clips and sliding clips shall be determined on strips in accordance with EN ISO 6892-1.
- Actual fixing clips and sliding clips dimensions, including holes for screws shall be measured
- Nominal sheet thickness and tensile strength of the standing seam material shall be determined
- For the screw, nominal diameter, head diameter shall be recorded.

- Displacement and associated force shall be measured as specified below
- Any particular observations during the test shall be recorded:
  - Failure mode
  - Other observations.
- Measurements and observations shall be presented in a test report with contents in accordance with Annex B.

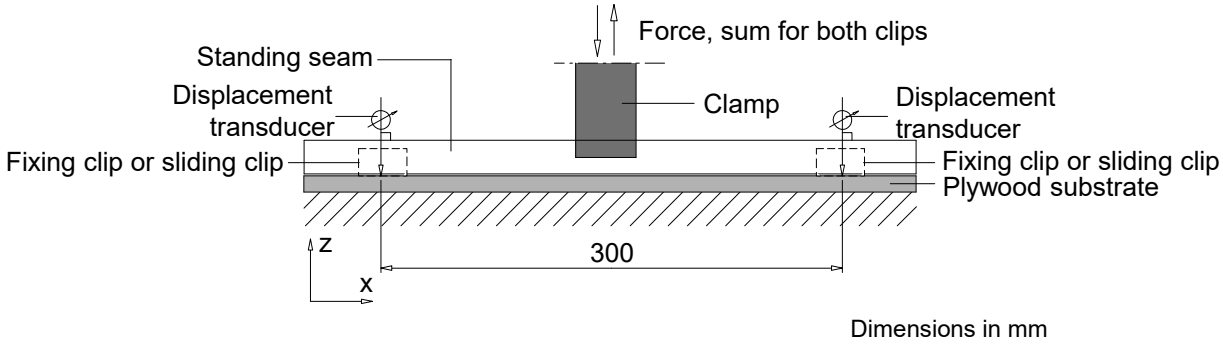


Figure 2.2.1.2.1 Cyclic load test

The specimen shall be subjected to 10 000 pulsating load cycles with a maximum frequency of approximately 1 Hz. During each cycle, the force follows a sinusoidal function between upper, F_{up}, and lower force, F_{lo}. The following measurements and records shall be taken during the cyclic load test:

- Throughout initial loading and the first load cycle, force and deformation shall be continuously recoded.
- Upper and lower force shall be continuously measured and recorded throughout the full cyclic load test.
- Displacement at upper and lower force shall be continuously measured and recoded throughout the full cyclic load test.
- At least at load cycle 10, 100 ± 10, 1 000 ± 100, and 10 000, force and displacement shall be measured and recoded for at least one full load cycle.
- Upper and lower force in cyclic load test, given as force per fixing clip or sliding clip, shall be in accordance with Equation (2.2.1.2.1).

$$F_{up} = 0{,}50 \cdot F_{proof,\,5}$$

$$F_{lo} = 0{,}15 \cdot F_{proof,\,5} \qquad (2.2.1.2.1)$$

After completion of the cyclic load test, the specimen shall be unloaded. The standing seam shall be cut in the middle between the fixing clips and sliding clips. Each fixing clips and sliding clips shall be individually subjected to an uplift test in accordance with Clause 2.2.1.1. However, instead of wire reinforcement, the clamp of the testing machine is gripping the standing seam at the sides to the fixing clips and sliding clips, see Figure 2.2.1.2.2.

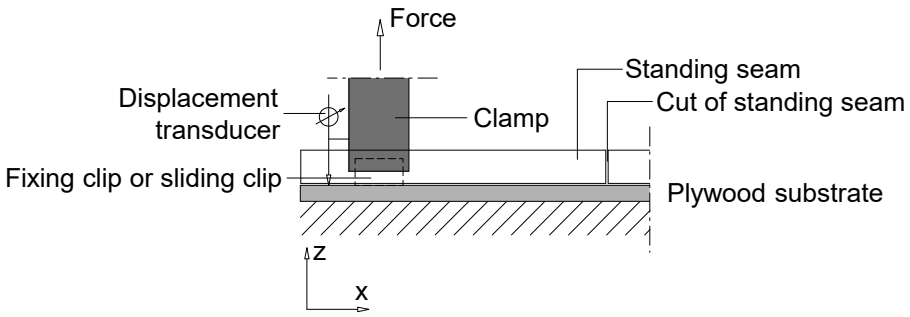


Figure 2.2.1.2.2 Uplift after cyclic loading

The mean value of the corrected proof forces from uplift tests shall be calculated in accordance with Equation (2.2.1.2.2).

$$F_{proof,\,c,\,m} = \frac{1}{n} \cdot \sum_{i=1}^{n} F_{proof,\,c,\,i,\,corr} \qquad (2.2.1.2.2)$$

The correction factor α_1 shall be calculated by Equation (2.2.1.2.3).

$$\alpha_1 = \min \begin{cases} \dfrac{F_{proof,\,c,\,m}}{F_{proof,\,m}} \\ 1{,}0 \end{cases} \qquad (2.2.1.2.3)$$

Where

i ..... — ..... Specimen number, i = 1 to n

n ..... — ..... Number of specimens, $n \geq 10$

$F_{proof,\,c,\,i,\,corr}$ ... N ..... Corrected proof force of specimen i, following cyclic load test, see Clause 2.2.1.1

$F_{proof,\,c,\,m}$ ..... N ..... Mean value of corrected proof forces, following cyclic load test

$F_{proof,\,m}$ ..... N ..... Mean value of corrected proof forces in accordance with Clause 2.2.1.1, i.e., without prior cyclic load test

$F_{proof,\,5}$ ..... N ..... 5 % fractile in accordance with Clause 2.2.1.1, i.e., without prior cyclic load test

F_{up} ..... N ..... Upper force in cyclic load test, force for one fixing clip or sliding clip

F_{lo} ..... N ..... Lower force in cyclic load test, force for one fixing clip or sliding clip

2.2.1.3 Characteristic uplift capacity

The characteristic uplift capacity, as 5 % fractile of the proof forces shall be calculated and multiplied with correction factor α_1 to consider repeated loads, see Equation (2.2.1.3.1).

$$N_{R,\,k} = \alpha_1 \cdot F_{proof,\,5} \qquad (2.2.1.3.1)$$

Where

$N_{R,\,k}$ ..... N ..... Characteristic uplift capacity

α_1 .....—..... Reduction factor to consider repeated loads

$F_{proof,\,5}$ ..... N ..... 5 % fractile of corrected proof forces in accordance with Clause 2.2.1.1

The characteristic uplift capacity, $N_{R,\,k}$, shall be stated in the ETA.

2.2.2 Shear capacity

Purpose of the assessment

Subject of assessments is shear capacity by static loading, representative of this essential characteristic for the fixing clips.

Assessment method

For details of the specimen see Clause 2.2.1.1.

The fixing clips shall be firmly screwed onto the plywood substrate, free of play. Failure of the screws or failure of the substrate in testing invalidates the test. The test shall be repeated with fasteners and substrate of higher mechanical capacity.

The minimum number of specimens shall be n = 10.

Testing shall be performed at (23 ± 2) °C and (65 ± 5) % relative humidity. Prior to testing the specimens shall be conditioned at a temperature of (23 ± 2) °C and (65 ± 5) % relative humidity for at least 24 h.

The load transmission into the fixing clips shall be carried out with a clamp, gripping the upper part of the folded vertical leg of the fixing clips. Loading shall be performed in x-direction, centric to the vertical leg of the fixing clips as shown in Figure 2.2.2.1.

Test procedure – measurements and observations:

- All materials and dimensions of products used for testing shall be recorded, take photos:
  - Actual thickness shall be measured in the middle of the vertical leg of fixing clip. The measuring instrument shall have a resolution of ≤ 0,01 mm.
  - Actual tensile strength of material of fixing clips shall be determined on strips in accordance with EN ISO 6892-1.
  - Actual fixing clips dimensions, including holes for screws shall be measured
  - Screw, nominal diameter, head diameter shall be recorded.
- Displacement and associated force shall be measured throughout the test
- Any particular observations during the test shall be recorded:
  - Failure mode
  - Other observations.
- Measurements and observations shall be presented in a test report with contents in accordance with Annex B.

Testing and evaluation of the measurements shall be done as described in Clause 2.2.1.1.

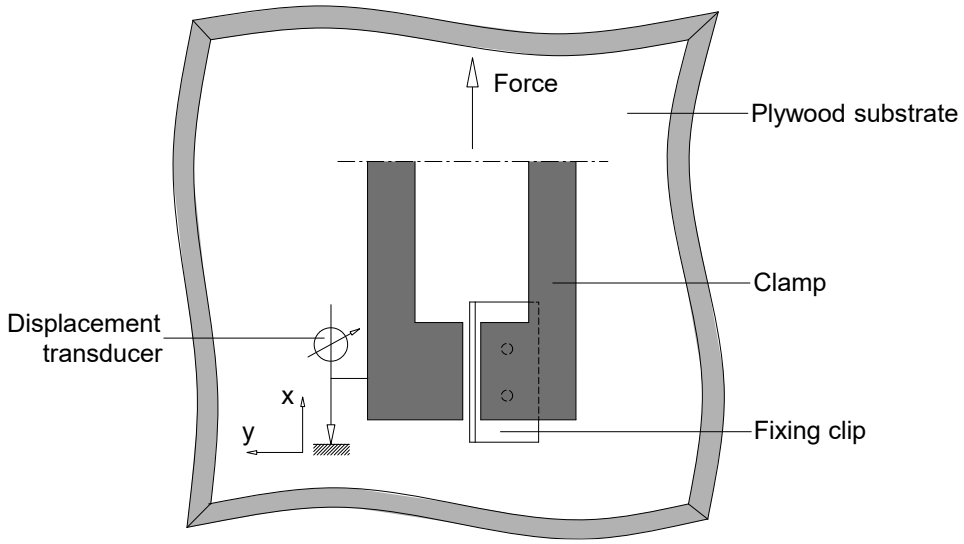


Figure 2.2.2.1 Shear testing of fixing clips

The individual proof forces, $G_{proof,\,i}$, shall be multiplied by the following correction factor α_0, see Equation (2.2.2.1) and Equation (2.2.2.2).

$$\alpha_0 = \begin{cases} \frac{R_{m,\,min}}{R_m} \cdot \frac{t_{min}}{t}\ ^{1)} \\ \text{or} \\ \frac{t_{min}}{t}\ ^{2)} \end{cases} \leq 1 \qquad (2.2.2.1)$$

Key

1) $G_{proof,\,i}$ is induced by fracture of the fixing clips

2) $G_{proof,\,i}$ is induced by deformation of the fixing clips, without fracture

$$G_{proof,\,i,\,corr} = \alpha_0 \cdot G_{proof,\,i} \qquad (2.2.2.2)$$

The characteristic shear capacity, the 5 % fractile $G_{proof,\,5}$, shall be calculated from the individual corrected proof forces, $G_{proof\,i,\,corr}$, see Equation (2.2.2.2), in accordance with Annex A, see Equation (2.2.2.3).

$$V_{R,\,k} = G_{proof,\,5} \qquad (2.2.2.3)$$

Where

i	—	Specimen number, i = 1 to n
n	—	Number of specimens, n ≥ 10
α_0	—	Reduction factor to consider actual fixing clip parameters
$R_{m,\,min}$	MPa	Minimum tensile strength of fixing clip material in accordance with the material standard
R_m	MPa	Actual tensile strength of fixing clip material used in testing
t_{min}	mm	Minimum thickness of fixing clip material in accordance with material standard
t	mm	Actual thickness of fixing clip material used in testing

$G_{proof, i}$ .....N..... Proof force of specimen i

$G_{proof, i, corr}$ .....N..... Corrected proof force to consider actual fixing clip parameters, specimen i

$G_{proof, 5}$ .....N..... 5 % fractile of corrected proof forces

$V_{R, k}$ .....N..... Characteristic shear capacity

Expression of results

The characteristic shear capacity, $V_{R, k}$, shall be stated in the ETA.

2.2.3 Combined uplift and shear capacity

Purpose of the assessment

Subject of assessments is combined uplift and shear capacity for the fixing clips.

Assessment method

For combined uplift and shear forces the following Equation (2.2.3.1) shall be used.

$$\frac{F_{t, E, k}}{N_{R, k}} + \frac{F_{v, E, k}}{V_{R, k}} \leq 1 \qquad (2.2.3.1)$$

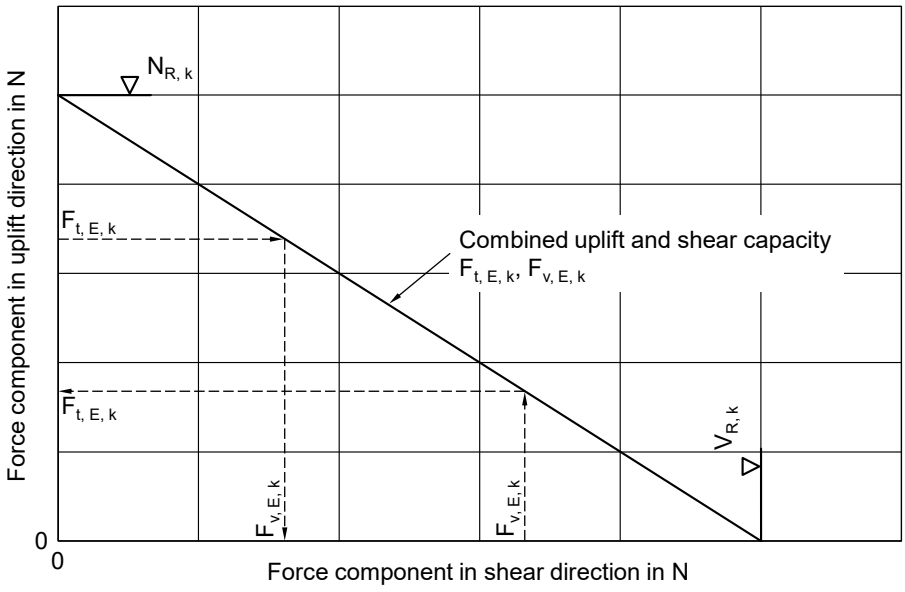


Figure 2.2.3.1 Combined uplift and shear capacity

Where

$F_{t, E, k}$ .....N..... Characteristic value of the force component in uplift direction

$N_{R, k}$ .....N..... Characteristic uplift capacity in accordance with Clause 2.2.1

$F_{v, E, k}$ .....N..... Characteristic value of the force component in shear direction

$V_{R, k}$ .....N..... Characteristic shear capacity in accordance with Clause 2.2.2

Expression of results

Figure 2.2.3.1 shall be stated in the ETA.

2.2.4 Sliding capacity

Purpose of the assessment

Subject of assessments is sliding capacity, representative of this essential characteristic for the sliding clips.

Assessment method

For details of the specimen see Clause 2.2.1.1.

The sliding clips shall be firmly screwed onto the plywood substrate, free of play. Failure of the screws or failure of the substrate in testing invalidates the test. The test shall be repeated with fasteners and substrate of higher mechanical capacity.

The sliding clips shall be seamed into a standing seam made of aluminium, sheet thickness 0,7 mm.

The minimum number of specimens shall be n = 10. Shifting, loading in uplift direction, and shifting again are all performed with the same specimens.

Testing shall be performed at (23 ± 2) °C and (65 ± 5) % relative humidity. Prior to testing the specimens shall be conditioned at a temperature of (23 ± 2) °C and (65 ± 5) % relative humidity for at least 24 h.

Load transmission into the sliding clips shall be carried out with clamps, gripping the standing seam as shown in Figure 2.2.4.1 and Figure 2.2.4.2 by the testing machine.

Test procedure – Measurements and observations:

- Record all materials and dimensions of products used for testing, take photos:
  - Actual thickness shall be measured in the middle of the vertical leg of sliding clip and in the middle of the foot of sliding clip. The measuring instrument shall have a resolution of ≤ 0,01 mm.
  - Sliding clips dimensions, including holes for screws shall be measured
  - Nominal sheet thickness and tensile strength of the standing seam material shall be determined
  - Screw, nominal diameter, head diameter shall be recorded.
- Maximum travel from middle position to final stops, left and right, of the sliding clips shall be measured
- Travel and associated force shall be measured as specified below
- Any particular observations during the test shall be recorded
- Measurements and observations shall be presented in a test report with contents in accordance with Annex B.

Firstly, shifting forces, see Figure 2.2.4.1, with sliding clips as delivered shall be determined:

- Shifting shall be performed crosshead controlled. When shifting:
  - The travel of the vertical leg of the sliding clip is measured by a transducer, see Figure 2.2.4.1.
  - The force is measured by the testing machine.
- The sliding clip shall be shifted a full cycle from middle position. I.e., shifting shall be once in both directions with a feed rate of 5 mm/min without touching the final stops, i.e., reverse about 1 mm before final stop
- Load transmission for shifting the sliding clip as given above shall be parallel to the standing seam and centric at the head of the standing seam.

Travel and associated force shall be recorded throughout the test to establish the force-travel curve.

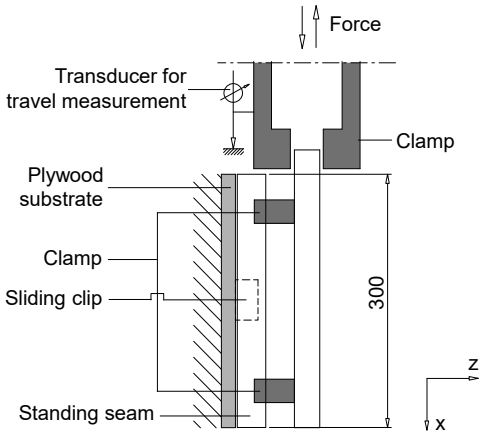
Secondly, the sliding clips shall be loaded in uplift direction, see Figure 2.2.4.2:

- Loading shall be performed force controlled by a testing machine.

- Loading shall be with the characteristic uplift capacity, $N_{R,k}$, determined in accordance with Clause 2.2.1.
- Force shall be induced centric at the standing seam
- Loading rate shall be such as to attain the designated force within 30 to 60 s.
- Characteristic uplift capacity, $N_{R,k}$, shall be maintained for five minutes
- Complete unloading shall be with within 30 to 60 s.

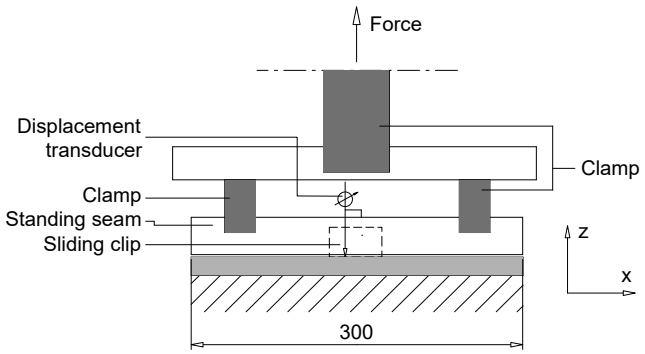
Displacement and associated force shall be recorded throughout the test.

Thirdly, again the shifting forces in accordance with the first step shall be determined and the force-travel curve shall be recorded.



Dimensions in mm

Figure 2.2.4.1 Shifting



Dimensions in mm

Figure 2.2.4.2 Loading with tensile force

From the force-travel curve the maximum force, i.e., the absolute values of the forces from the full shifting cycle, see Equation (2.2.4.1), shall be taken.

$$F_{sh,\,pr,\,max,\,i} = \max \left| F_{sh,\,pr,\,i}(s) \right|$$
$$F_{sh,\,po,\,max,\,i} = \max \left| F_{sh,\,po,\,i}(s) \right| \qquad (2.2.4.1)$$

The maximum of all maximum forces shall be determined in accordance with Equation (2.2.4.2).

$$F_{sh,\,max} = \max \left|_{i=1}^{n} \begin{matrix} F_{sh,\,pr,\,max,\,i} \\ F_{sh,\,po,\,max,\,i} \end{matrix} \right. \qquad (2.2.4.2)$$

The ratio of the maximum force under condition as delivered and the maximum force after uplift loading with the characteristic uplift capacity shall be calculated for each specimen in accordance with Equation (2.2.4.3).

$$R_{sh,\,i} = \frac{F_{sh,\,po,\,max,\,i}}{F_{sh,\,pr,\,max,\,i}} \qquad (2.2.4.3)$$

The mean value of the ratios, $R_{sh,\,i}$, shall be calculated in accordance with Equation (2.2.4.4).

$$R_{sh,\,m} = \frac{1}{n} \cdot \sum_{i=1}^{n} R_{sh,\,i} \qquad (2.2.4.4)$$

Where

i	—	Specimen number, i = 1 to n
n	—	Number of specimens, n ≥ 10
s	mm	Travel in shifting the sliding clip
$F_{sh,\,pr,\,i}(s)$	N	Force as a function of travel s, specimen i, prior uplift loading
$F_{sh,\,po,\,i}(s)$	N	Force as a function of travel s, specimen i, post uplift loading
$F_{sh,\,pr,\,max,\,i}$	N	Maximum force during shifting one full cycle, specimen i, prior to uplift loading
$F_{sh,\,po,\,max,\,i}$	N	Maximum force during shifting one full cycle, specimen i, post uplift loading
$F_{sh,\,max}$	N	Maximum of maximum forces of all specimens, i.e., prior and post uplift loading
$R_{sh,\,i}$	—	Ration of maximum force prior uplift loading to maximum force post uplift loading, specimen i
$R_{sh,\,m}$	—	Mean value of the ratios of all specimens

Expression of results

- Maximum travel of sliding clips from middle position to final stops in both directions, in mm
- Maximum force during shifting, $F_{sh,\,max}$
- Mean value of the ratios, $R_{sh,\,m}$

shall be stated in the ETA.

2.2.5 Resistance to corrosion

Purpose of the assessment

Subject of assessments is resistance to corrosion for the fixing clip and sliding clip.

Assessment method

The stainless steel is designated in accordance with EN 10088-1. Resistance to corrosion shall be assessed as CRC in accordance with the tabulated values from EN 1993-1-4, Table A.3.

Where

CRC	—	Corrosion resistance code in accordance with EN 1993-1-4, Table A.3

Expression of results

The allocated CRC for the fixing clips and sliding clips shall be stated in the ETA.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is Commission Decision 98/436/EC as amended by Decision 2001/596/EC.

The system is 4.

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the product in the procedure of assessment and verification of constancy of performance are laid down in Table 3.2.1.

Table 3.2.1 Control plan for the manufacturer – Cornerstones

№	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC)					
1	Checks on incoming material	3.1 certificate [1)]	Control plan	100 %	Each delivery
2	Detailed dimensions	Control plan	Control plan	0,1 % ≥ 2	Every production unit
3	Visual inspection [2)]	Visual	Control plan	100 %	Continuously

[1)] Checking of inspection report 3.1 in accordance with EN 10204.
[2)] Successful visual inspection does not need to be documented.

4 REFERENCE DOCUMENTS

EN 1990:2023	Eurocode – Basis of structural and geotechnical design
EN 1993-1-4:2025	Eurocode 3 – Design of steel structures – Part 1-4: Stainless steel structures
EN 10088-1:2023	Stainless steels – Part 1: List of stainless steels
EN 10204:2004	Metallic products – Types of inspection documents
EN 26891:1991	Timber structures – Joints made with mechanical fasteners – General principles for the determination of strength and deformation characteristics
EN ISO 6892-1:2019	Metallic materials – Tensile testing – Part 1: Method of test at room temperature

ANNEX A CALCULATION OF 5 % FRACTILE

Mean shall be calculated in accordance with Equation (A.1).

$$\bar{x} = \frac{1}{n} \cdot \sum_{i=1}^{n} x_i \qquad (A.1)$$

Standard deviation shall be calculated in accordance with Equation (A.2).

$$s = \sqrt{\frac{1}{n-1} \cdot \sum_{i=1}^{n} (x_i - \bar{x})^2} \qquad (A.2)$$

Coefficient of variation shall be calculated in accordance with Equation (A.3).

$$V_x = \frac{s}{\bar{x}} \qquad (A.3)$$

5 % fractile shall be calculated in accordance with Equation (A.4). k_n shall be taken from EN 1990, Table D.1 for unknown V_x.

$$x_{5\,\%} = \bar{x} \cdot (1 - k_n \cdot V_x) \qquad (A.4)$$

Where

i ..... i^{th} observation, i = 1, 2, ..., n

n ..... Number of observations as random values in the sample

x_i ..... i^{th} observed value

$\bar{x}$ ..... Sample mean

s ..... Sample standard deviation

V_x ..... Coefficient of variation

k_n ..... Factor in dependence of n

$x_{5\,\%}$ ..... 5 % fractile

ANNEX B TEST REPORT CONTENTS

Testing of fixing clips and sliding clips shall be documented with test reports that include at least the following information:

- Name and address of the test laboratory
- Test report number or unique identification
- Name and address of the client who has contracted the laboratory
- A signed statement by the laboratory or body that has carried out or witnessed the tests that these tests have been carried out in accordance with this EAD.
- Documentation of the fixing clips and sliding clips, workshop drawings
- Certificates of all relevant materials to confirm compliance with relevant specifications. Actual characteristics of products (mechanical, chemical, metallurgical, geometrical, etc. as relevant) at time of testing
- Certificates of equipment and test machine calibration
- Description and drawing of test specimen with actual dimensions
- Description and drawing of test set-up and measuring equipment including calibration certificate
- Description of detailed test procedure
- Actual ambient temperature, where relevant
- Record of all measurements and observations
- Photographs of test specimen prior, during, and after testing
- Statement of any unexpected or unusual behaviour and observation during testing
- Date and place of testing
- Name and signature of person responsible for testing.

All tests out of a series performed shall be recorded in the test report, irrespectively whether successful or not.