

EUROPEAN ASSESSMENT DOCUMENT

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Cartridge fired pin
for connections of thin gauge steel
members and sheeting

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This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

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1 SCOPE OF THE EAD

1.1 Description of the construction product

The product is a mechanical fastener (cartridge fired pin / powder actuated fastener)¹ made of steel. The fastener comprises of a pin with a minimum diameter of 3.7 mm which is normally assembled with one or two washers. The washers serve to guide the fastener while it is being driven into the base material. The washers also serve to improve the bearing area. A special fastening tool is used in order to install the fastener. The driving force of the fastening tool is provided by the power load of the cartridge. The application limit depends on the strength and thickness of the base material.

Fastener, fastening tool and cartridge are shown in Annex 1.

The fastener and the corresponding connections are subject to tension and/or shear forces (see Annex 2). Typical failure modes of connections made with cartridge fired pins are shown in Annex 3.

The assessment of the load-bearing capacity of the fastener and the corresponding connections are part of this EAD. The fastening tool (incl. cartridge) is an integral part of this assessment with regards to its effect on the capacity of the connection.

The product is not covered by a harmonised European standard (hEN).

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 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

1.2 Information on the intended use(s) of the construction product

1.2.1 Intended use

The fastener is intended to be used for fastening steel sheeting with a tensile strength $\geq 330 \text{ N/mm}^2$ and a thickness $t_1 \geq 0.63 \text{ mm}$ to steel members (base material) with a tensile strength $\geq 360 \text{ N/mm}^2$ and a thickness $t_{II} \geq 3.0 \text{ mm}$, provided the relevant application limits are taken into account. The sheeting can either be used as cladding or as load bearing wall and roof element. The fastener can also be used for the fastening of other thin gauge steel members. The intended use only comprises fasteners and connections which are not directly exposed to external weather conditions. Furthermore, the intended use comprises connections with predominantly static loads (e.g. wind loads, dead loads).

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 cartridge fired pin for the intended use of 25 years when installed in the works (provided that the cartridge fired pin is subject to appropriate installation). These provisions are based upon the current state of the art and the available knowledge and experience.

¹ Both terms (cartridge fired pin and powder actuated fastener) are commonly used

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 works².

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.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 shows how the performance of the cartridge fired pin is assessed in relation to the essential characteristics.

Table 1 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics

No	Essential characteristic	Assessment method	Type of expression of product performance <i>(level, class, description.)</i>
Basic Works Requirement 1: Mechanical resistance and stability			
1	Tension resistance of connection	2.2.1	Level($N_{R,k}$ [kN]) Level($N_{R,d}$ [kN])
2	Shear resistance of connection	2.2.2	Level($V_{R,k}$ [kN]) Level($V_{R,d}$ [kN])
3	Design resistance in case of combined tension and shear forces (interaction)	2.2.3	Level(Pass/Fail)
4	Check of deformation capacity in case of constraining forces due to temperature	2.2.4	Level(Pass/Fail depending on the type of connection)
5	Determination and check of application limits	2.2.5	Level(Application limit depending on base material thickness and strength)

² 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 the working life referred to above.

No	Essential characteristic	Assessment method	Type of expression of product performance (level, class, description.)
Basic Works Requirement 2: Safety in case of fire			
6	Reaction to fire	2.2.6	Class (A1 if product meets requirements)
7	Resistance to fire	2.2.7	Level (Performance Class)
Basic Works Requirement 3: Hygiene, health and the environment			
8	Content, emission and/or release of dangerous substances	2.2.8	Description (Compliance with legislation and declaration of manufacturer)
Basic Works Requirement 4: Safety and accessibility in use			
9	Tension resistance of connection	2.2.1	Level ($N_{R,k}$ [kN]) Level ($N_{R,d}$ [kN])
10	Shear resistance of connection	2.2.2	Level ($V_{R,k}$ [kN]) Level ($V_{R,d}$ [kN])
11	Design resistance in case of combined tension and shear forces (interaction)	2.2.3	Level (Pass/Fail)
12	Check of deformation capacity in case of constraining forces due to temperature	2.2.4	Level (Pass/Fail depending on the type of connection)
13	Determination and check of application limits	2.2.5	Level (Application limit depending on base material thickness and strength)
Basic Works Requirement 7: Sustainable use of natural resources			
14	Durability	2.2.9	Level (Acc. to EN ISO 12944, EN 1993-1-3, EN 1090-2)

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

2.2.1 Tension resistance of connection

The possible failure modes of a connection of steel components (component t_1 and component t_{II}) with a cartridge fired pin under tensile load are:

- Pull-through failure of component t_1 (sheeting)
- Pull-out failure (pin pull-out of base material component t_{II})

- Failure of fastener (tensile fracture of pin, normally not to be expected)

The different failure modes have to be checked. Failure of fastener occurs, as far as relevant during pull-through or pull-out tests. The lowest test result is relevant for determination of tension resistant of the connection.

2.2.1.1 Static pull-through tests

At least 10 pull-through-tests shall be carried out for each relevant sheeting thickness t_1 . The test load shall be increased until pull-through of the fastener. The respective failure modes as well as the material properties of the sheeting, the base material/steel member and the fastener used for the tests shall be documented in the test report. Furthermore the failure loads shall be given in the test report. The material properties should be documented by means of inspection documents 3.1 according to EN 10204. The material properties have to correspond to the material specifications supplied by the manufacturer. An example for the test setup is shown in Annex 4. The connection to be tested is the connection "Type a" according to Annex 2.

The tensile strength of the material of the component with the thickness t_1 (sheeting) should be at the lower limit according to the relevant product standard (e.g. EN 10346). The tensile strength as well as the thickness of the material of the component with the thickness t_{II} (base material, steel member) is optional as long as failure of the base material is excluded.

2.2.1.2 Cyclic pull-through tests

Cyclic pull-through tests are additional optional tests. If they are carried out the following applies: At least 5 cyclic pull-through-tests with a constant amplitude loading range from zero to maximum loading shall be carried out at 3 different load levels for each relevant sheeting thickness t_1 . The loading frequency should be 5 Hz. The maximum value of each of the 3 different load levels and the corresponding number of cycles until failure as well as the material properties of the sheeting, the base material/steel member and the fastener used for the tests shall be documented in the test report. The material properties should be documented by means of inspection documents 3.1 according to EN 10204. The material properties have to correspond to the material specifications supplied by the manufacturer. An example for the test setup is shown in Annex 4. The connection to be tested is the connection "Type a" according to Annex 2.

The tensile strength of the material of the component with the thickness t_1 (sheeting) should be at the lower limit according to the relevant product standard (e.g. EN 10346). The tensile strength as well as the thickness of the material of the component with the thickness t_{II} (base material, steel member) is optional as long as failure of the base material is excluded.

(Remark: According to EN 1993-1-3, Table 8.3, the pull-through resistance may be affected by repeated wind loads. In order to take this into account either calculation according to EN 1993-1-3, Table 8.3, is possible or evaluation of results of static and cyclic pull-through tests.)

2.2.1.3 Pull-out tests

These tests are necessary in combination with all types of fastening tools to be approved for setting the cartridge fired pins. The right setting of the cartridge fired pin is essential for a correct load-bearing connection.

At least 10 pull-out-tests shall be carried out for each relevant base material/steel member thickness t_{II} . The test load shall be increased until pull-out or fracture of the fastener. The respective failure modes as well as the material properties of the sheeting, the base material/steel member and the fastener used for the tests shall be documented in the test report. Furthermore the failure loads shall be given in the test report. The material properties should be documented by means of inspection documents 3.1 according to EN 10204. The material properties have to correspond to the material specifications supplied by the manufacturer. An example for the test setup is shown in Annex 5. The connection to be tested is the connection "Type d" or "Type a" with the maximum height of fixture according to Annex 2.

The tensile strength of the material of the component with the thickness t_1 (sheeting) is optional. It should be a typical value according to the relevant product standard (e.g. EN 10346). The maximum possible thickness of the sheeting ($4 \times t_1$) shall be used. This is the maximum thickness for sheeting fastenings where longitudinal and transverse lap joints coincide (side lap and end overlap connection; connection "Type d" according to Annex 2).

The tensile strength of the material of the component with the thickness t_{II} (base material, steel member) should be at the lower limit according to the relevant product standard (e.g. appropriate part of EN 10025).

2.2.1.4 General handling of the results

The test results of the tests according to 2.2.1.1, 2.2.1.2 and 2.2.1.3 (failure loads / relevant maximum loads / number of cycles until failure as far as relevant) shall be multiplied by the following correction factor which depends on the failure mode:

Tests according to Static or Cyclic pull-through tests:

- Failure of sheeting: $\alpha = (R_{m,min}/R_m) \cdot (t_{l,min}/t_l) \leq 1.0$
- Failure of fastener: $\alpha = 1.0$

Tests according to Pull-out tests:

- Pull out failure (structural component t_{II}): $\alpha = 1.0$
- Failure of fastener: $\alpha = 1.0$

With:

$R_{m,min}$ = minimum tensile strength of the relevant structural components t_l or t_{II} according to the relevant product standard

R_m = tensile strength of the relevant components t_l or t_{II} used for the tests

$t_{l,min}$, $t_{II,min}$ = minimum thickness of the relevant structural components t_l or t_{II} according to the relevant product standard *)

t_l , t_{II} = thickness of the relevant components t_l or t_{II} used for the tests *)

*) if the component is coated or galvanised the core thickness shall be taken

The corrected test results shall be evaluated statistically according to EN 1990, Annex D.7.2 (determination of 5% fractile, confidence level 75%). Generally a normal distribution can be assumed. The corrected and statistically evaluated test results are the characteristic values of resistance $N_{R,k}$.

The statistical evaluation of the results of the additional optional cyclic pull-through tests according to 2.2.1.2 refers to the number of cycles until failure. On the basis of the 5% fractile curve of the number of cycles until failure at a certain load level, which shall be determined from the results of tests on 3 different load levels, the pull-through resistance corresponding to 5000 cycles shall be determined. The result is the characteristic value of the pull-through resistance for repeated wind loads. (Remark: Background information is given in the European Convention for Constructional Steelwork ECCS TC7 TWG 7.10 "Connections in Cold-formed Steel Structures"; 2nd Edition, 2009)

Interpolation and extrapolation of characteristic values determined from test results according to 2.2.1.1 and 2.2.1.2 is possible if:

- the difference in thickness of t_l corresponding to the interpolated characteristic values is ≤ 0.25 mm and
- failure of the fastener itself does not occur.

2.2.1.5 Characteristic pull-through resistance

The static characteristic pull-through resistance as well as the characteristic pull-through resistance for repeated wind loads shall be determined according to 2.2.1.1.

2.2.1.6 Characteristic pull-out resistance

In the ETA the pull-out resistance will be stated only depending on the thickness t_l (see Annex 8). The only condition for the base material/steel member thickness is: $t_{II} \geq 3$ mm. Thus the minimum value of all characteristic values of the pull-out resistance determined according to 2.2.1.3 is the relevant characteristic pull-out resistance.

2.2.1.7 Characteristic tension resistance $N_{R,k}$

The characteristic tension resistance is the minimum value of the characteristic values of either pull-through resistance or relevant pull-out resistance for the corresponding connection.

2.2.1.8 Determination of design values of tension resistance $N_{R,d}$

The values for the partial safety factor γ_M given in the following are recommended values. They should be used in cases in which no values are given in national regulations of the member state in which the fastener is used or in the respective National Annex to Eurocode 3.

Design pull-through resistance

The design value of the static pull-through resistance is the characteristic value of the static pull-through resistance according to 2.2.1.5 divided by the recommended partial safety factor $\gamma_M = 1.25$.

The design value of the pull-through resistance for repeated wind loads should be determined as follows:

- If no cyclic pull-through tests were carried out according to 2.2.1.2, the design rules according to EN 1993-1-3, Table 8.3 should be taken into account. Thus the design value is the design value of the static pull-through resistance multiplied by the reduction factor $\alpha_{cycl} = 0.5$.
- If cyclic pull-through tests were carried out according to 2.2.1.2, the design value is the design value of the static pull-through resistance multiplied by the following reduction factor α_{cycl} :

$$\alpha_{cycl} = 1.5 \times (\text{char. cyclic pull-through resistance} / \text{char. static pull-through resistance}) \leq 1.0$$

(Remark: The factor 1.5 takes into account the different safety levels for fatigue design and design for predominantly static loads. α_{cycl} is limited to 1.0.)

The possibly required reduction of the pull-through resistance due to the position of the fastener shall be taken into account according to EN 1993-1-3, section 8.3 (7) and Fig. 8.2.

Design pull-out resistance

The design value of the pull-out resistance is the characteristic value according to 2.2.1.6 divided by the recommended partial safety factor $\gamma_M = 1.25$.

2.2.2 Shear resistance of connection

2.2.2.1 Single layer shear tests

At least 10 shear tests with single sheet layers shall be carried out for each relevant sheeting thickness t_l . The test load shall be increased until shear failure of the fastener or local bearing deformation (hole elongation) of the sheeting. The deformation capacity up to maximum load shall be at least 0.5 mm. The maximum load which shall be taken into account in order to determine the relevant characteristic resistance is the maximum load which corresponds to a deformation capacity within a range from 0.5 mm – 3.0 mm. The load-deformation curves and the respective failure modes as well as the material properties of the sheeting, the base material/steel member and the fastener used for the tests shall be documented in the test report. Furthermore the failure loads shall be given in the test report. The material properties should be documented by means of inspection documents 3.1 according to EN 10204. The material properties have to correspond to the material specifications supplied by the manufacturer. An example for the test setup is shown in Annex 6. The connection to be tested is the connection "Type a" according to Annex 2.

The tensile strength of the material of the component with the thickness t_l (sheeting) should be at the lower limit according to the relevant product standard (e.g. EN 10346). The tensile strength as well as the thickness of the material of the component with the thickness t_{II} (base material, steel member) is optional as long as failure of the base material is excluded.

2.2.2.2 Four layer shear tests

At least 10 shear tests with 4 sheet layers shall be carried out for each relevant base material/steel member thickness t_{II} . The test load shall be increased until shear failure of the fastener or local bearing deformation (hole elongation) of the sheeting or steel member. The deformation capacity up to maximum load shall be

at least 0.5 mm. The maximum load which shall be taken into account in order to determine the relevant characteristic resistance is the maximum load which corresponds to a deformation capacity within a range from 0.5 mm – 3.0 mm. The load-deformation curves and the respective failure modes as well as the material properties of the sheeting, the base material/steel member and the fastener used for the tests shall be documented in the test report. Furthermore the failure loads shall be given in the test report. The material properties should be documented by means of inspection documents 3.1 according to EN 10204. The material properties have to correspond to the material specifications supplied by the manufacturer. An example for the test setup is shown in Annex 6. The connection to be tested is the connection "Type d" according to Annex 2.

The tensile strength of the material of the component with the thickness t_I (sheeting) should be at the upper limit range according to the relevant product standard (e.g. EN 10346). The maximum possible thickness of the sheeting ($4 \times t_I$) shall be used. This is the maximum thickness for sheeting fastenings where longitudinal and transverse lap joints coincide (side lap and end overlap connection; connection "Type d" according to Annex 2).

The tensile strength of the material of the component with the minimum thickness t_{II} (base material, steel member) should be at the lower limit according to the relevant product standard (e.g. appropriate part of EN 10025). The tensile strength of the material of the component with the maximum thickness t_{II} (base material, steel member) should be at the upper range of the application limit according to 2.2.5.

2.2.2.3 Single layer shear test (base material and fastener failure)

In case the intended use of the cartridge fired pin is limited to single layer fastenings these tests have to be executed instead of four layer shear tests. Test execution according to 2.2.2.1

The tensile strength of the material of the component with the thickness t_I (sheeting) should be at the upper limit range of the relevant product standard (e.g. EN 10346). The maximum possible single layer thickness (max t_I) shall be used. The tensile strength of the component with the thickness t_{II} (base material, steel member) should be at the lower limit according to the relevant product standard (e.g. appropriate part of EN 10025). The minimum possible base material thickness (min t_{II}) shall be used.

2.2.2.4 General handling of the results

The results of the tests according to 2.2.2.1, 2.2.2.2 and 2.2.2.3 (failure loads or maximum loads) shall be multiplied by the following correction factor which depends on the failure mode:

- Local bearing of sheeting: $\alpha = (R_{m,min}/R_m) \cdot (t_{I,min}/t_I) \leq 1.0$
- Local bearing of metal supporting structure: $\alpha = (R_{m,min}/R_m) \cdot (t_{II,min}/t_{II}) \leq 1.0$
- Failure of fastener: $\alpha = 1.0$

With:

$R_{m,min}$ = minimum tensile strength of the relevant structural components t_I or t_{II} according to the relevant product standard

R_m = tensile strength of the relevant components t_I or t_{II} used for the tests

$t_{I,min}$, $t_{II,min}$ = minimum thickness of the relevant structural components t_I or t_{II} according to the relevant product standard ^{*)}

t_I , t_{II} = thickness of the relevant components t_I or t_{II} used for the tests ^{*)}

^{*)} if the component is coated or galvanised the core thickness shall be taken

The corrected test results shall be evaluated statistically according to EN 1990, Annex D.7.2 (determination of 5% fractile, confidence level 75%). Generally a normal distribution can be assumed. The corrected and statistically evaluated test results are the characteristic values of resistance.

2.2.2.5 Characteristic shear resistance $V_{R,k}$

The characteristic shear resistance is the minimum value of the characteristic values determined according to 2.2.2.4 for the corresponding connection.

2.2.2.6 Determination of design values of shear resistance $V_{R,d}$

The value for the partial safety factor γ_M given in the following is a recommended value. It should be used in cases in which no value is given in national regulations of the member state in which the fastener is used or in the respective National Annex to Eurocode 3.

The design value of the shear resistance is the characteristic value according to 2.2.2.5 divided by the recommended partial safety factor $\gamma_M = 1.25$.

2.2.3 Design resistance in case of combined tension and shear forces (interaction)

In case of combined tension and shear forces the following linear interaction formula should be taken into account (see also EN 1993-1-3, formula (8.2)).

$$\frac{V}{V_{R,d}} + \frac{N}{N_{R,d}} \leq 1.0$$

With:

V = design value of acting shear load

N = design value of acting tensile load

2.2.4 Check of deformation capacity in case of constraining forces due to temperature

In order to check the sufficient deformation capacity in case of constraining forces due to temperature at least 10 shear / pull-out tests with 2 sheet layers shall be carried out for the minimum base material/steel member thickness t_{II} (≥ 3 mm) and the maximum base material/steel member thickness t_{II} (but not more than 20 mm). The test load shall be increased up to a lateral deformation of 2 mm. After the lateral deformation the remaining pull-out resistance of the fastener shall be determined. The material properties of the sheeting, the base material/steel member and the fastener used for the tests shall be documented in the test report. Furthermore the failure loads shall be given in the test report. The material properties should be documented by means of inspection documents 3.1 according to EN 10204. The material properties have to correspond to the material specifications supplied by the manufacturer.

The connection "Type b" is the most unfavourable connection concerning constraining forces (lateral forces) due to temperature. Thus the connection to be tested is the connection "Type b" (see Annex 2). An example for the test setup is shown in Annex 7.

The tensile strength of the material of the component with the thickness t_I (sheeting) should be at the upper limit range according to the relevant product standard (e.g. EN 10346). The thickness of the sheeting ($2 \times t_I$) is the maximum thickness for sheeting fastenings for longitudinal joints (side lap connections). The tensile strength of the material of the component with the minimum thickness t_{II} (base material, steel member) should be at the lower limit according to the relevant product standard (e.g. appropriate part of EN 10025). The tensile strength of the material of the component with the maximum thickness t_{II} (base material, steel member) should be at the upper range of the application limit according to 2.2.5.

No shear failure may occur up to the deformation of 2 mm. The remaining pull-out resistance of each fastener shall be at least 50% of the minimum pull-out resistance according to 2.2.1.6 (Remark: Due to the intended use constraining forces due to temperature may only occur during the construction stage.)

In case the intended use of the cartridge fired pins is limited to single layer fastenings, the check of the deformation capacity has to be executed with the maximum single layer thickness ($\max t_I$) instead with the maximum double layer thickness ($2 \times t_I$).

2.2.5 Determination and check of application limits

These tests are necessary in combination with all types of fastening tools to be approved for setting the cartridge fired pins.

The application limits, such as minimum and maximum penetration depth, maximum strength of base material depending on the corresponding thickness t_{II} , type of fastening tool and cartridge as well as maximum nail head standoff (see Annex 8) shall be determined by the manufacturer. The application limits concerning the maximum strength of the base material depending on the corresponding thickness t_{II} (see Annex 8) shall be checked by pull-out tests according to 2.2.1.3. The tensile strength of the material of the component with the thickness t_I (sheeting) is optional. It should be a typical value according to the relevant product standard (e.g. EN 10346). The minimum possible thickness ($1 \times t_I$) as well as the maximum possible thickness ($4 \times t_I$) of the sheeting shall be used. The tensile strength of the material of the component with the thickness t_{II} (base material, steel member) shall be at the upper application limit according to the application diagram (see Annex 8) determined by the manufacturer. The pull-out resistance shall be at least the minimum resistance determined according to 2.2.1.6.

2.2.6 Reaction to fire

The cartridge fired pin is considered to satisfy the requirements to performance class A1 of the characteristic reaction to fire, in accordance with the provisions of EC decision 96/603/EC (as amended) without the need for testing on the basis of conformity with the specification of the product detailed in that Decision and its intended end use application being covered by that Decision. The product shall be classified according to EN 13501-1.

2.2.7 Resistance to fire

The part of the works or assembled system in which the cartridge fired pins are intended to be incorporated, installed or applied shall be tested, using the test method relevant for the corresponding fire resistance class, in order to be classified according to the appropriate part of EN 13501.

2.2.8 Content, emission and/or release of dangerous substances

The performance of the product related to the emissions and/or release and, where appropriate, the content of dangerous substances will be assessed on the basis of the information provided by the manufacturer using the following methods and criteria: EOTA TR 034, in particular for

- “T+” or “T”, Carcinogenic (T, R 45; T, R 49) and mutagenic (T, R 46) substances of categories 1 and 2 respectively 1A and 1B (CLP): EOTA TR 034, Substance list, No 1;
- VOC, SVOC: EOTA TR 034, Substance list, No 7;

based on the distinction made between the following areas of application:

IA2: Product with no direct contact to (e.g. covered products) but possible impact on indoor air,

SW2: Product with no direct contact to but possible impact on soil-, ground- and surface water.

2.2.9 Durability

For the corrosion protection of the cartridge fired pins and therewith executed connections the rules given in EN 1993-1-3 and EN 1090-2 shall be taken into account. Cartridge fired pins which are intended to be used in external environments according to the standard EN ISO 12944-2:1998 shall be protected properly against the influence of corrosive media.

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: Decision 1998/214/EC, amended by 2001/596/EC

The system is: **2+**

3.2 Tasks of the manufacturer

The corner stones of the actions to be undertaken by the manufacturer of the cartridge fired pin in the procedure of assessment and verification of constancy of performance are laid down in Table 2.

Table 2 Control plan for the manufacturer; corner stones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC) [including testing of samples taken at the factory in accordance with a prescribed test plan]*					
1	Dimensions and tolerances	Measuring or visual check	Acc. to Control plan		Every manufacturing batch or 100000 fasteners
2	Mechanical properties e.g. tensile strength, hardness, ductility, hydrogen embrittlement	E.g. tensile test, hardness test acc. to Brinell or Vickers			
3	Coating	Measuring thickness			
4	Check of initial materials	Inspection document 3.1. acc. to EN 10204-2004 (to be furnished by the supplier)	Comparison with manufacturer's specifications	Acc. to Control plan	
5	Geometry and dimensions	Check of dimensions and tolerances	Comparison with manufacturer's specifications		
6	Tensile strength (f_{uk})	Conversion of hardness values according to EN ISO 18265	Comparison with manufacturer's specifications		
7	Core hardness and Surface hardness (at specified functioning relevant points of the product) (where relevant)	Tests according to: EN ISO 6507 or EN ISO 6508	Comparison with manufacturer's specifications		
8	Zinc plating (where relevant)	x-ray measurement	Comparison with manufacturer's specifications		
9	Manufacturer's mark	Check of manufacture's mark	According to the requirements stated in the ETA		

3.3 Tasks of the notified body

The corner stones of the actions to be undertaken by the notified body in the procedure of verification of constancy of performance for the cartridge fired pin are laid down in Table 3.

Table 3 Control plan for the notified body; corner stones

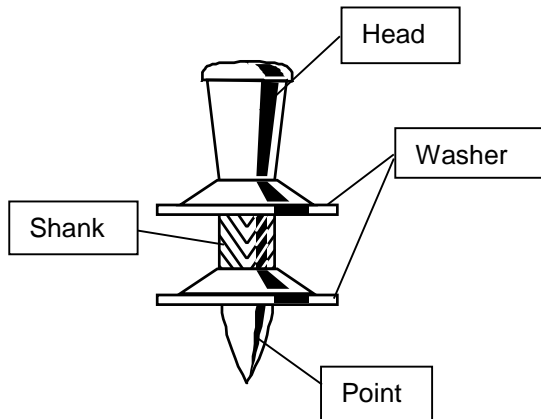
No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control					
1	Ascertain that the factory production control with the staff and equipment are suitable to ensure a continuous and orderly manufacturing of the fastener		Laid down in control plan	-	When starting the production or a new production line
Continuous surveillance, assessment and evaluation of factory production control					
2	Verifying that the system of factory production control and the specified automated manufacturing process are maintained taking account of the control plan.		Laid down in control plan	10	Once per year

4 REFERENCE DOCUMENTS

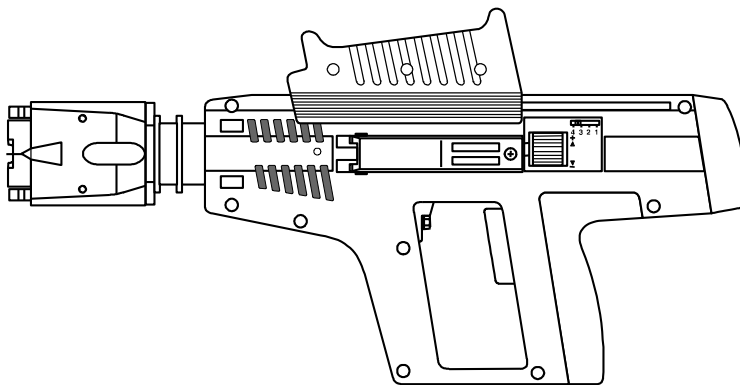
As far as no edition date is given in the list of standards thereafter, the standard in its current version at the time of issuing the European Technical Assessment is of relevance.

EOTA TR 034	General BWR 3 Checklist for EADs/ETAs
EN 1090-2:2008+A1:2011	Execution of steel structures and aluminium structures - Part 2: Technical requirements for steel structures
EN 1990:2002 + A1:2005 + A1:2005/AC:2010	Eurocode: Basis of structural design
EN 1993-1-3:2006 + AC:2009	Eurocode 3: Design of steel structures - Part 1-3: General rules - Supplementary rules for cold-formed members and sheeting
EN 10025-1:2004	Hot rolled products of structural steels – Part 1: General technical delivery conditions
EN 10346:2009	Continuously hot-dip zinc coated strip and sheet of structural steels – Technical delivery conditions
EN 10204:2004	Metallic products – Types of inspection documents
EN 13501-1:2007+A1:2009	Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests
EN ISO 6507-1:2005	Metallic materials – Vickers hardness test – Part 1: Test method
EN ISO 6508-1:2015	Metallic materials – Rockwell hardness test – Part 1: Test method
EN ISO 12944-2:1998	Paints and varnishes-Corrosion protection of steel structures by protective paint systems, Part 2 Classification of environments
EN ISO 18265:2013	Metallic materials – Conversion of hardness values

Cartridge Fired Pin / Powder Actuated Fastener



Powder actuated fastening tool and cartridge



Example of application

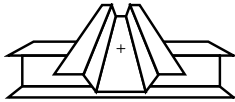
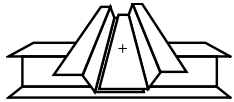
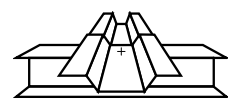
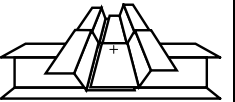
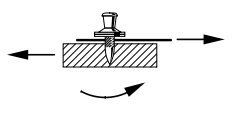
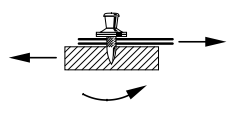
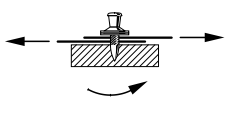
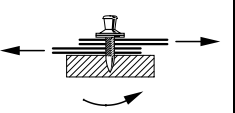
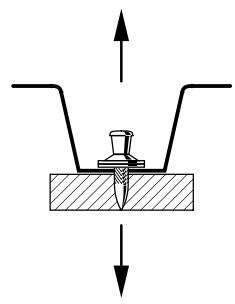
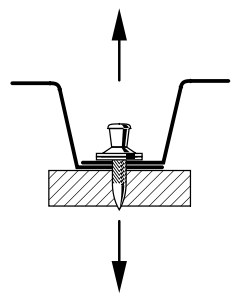
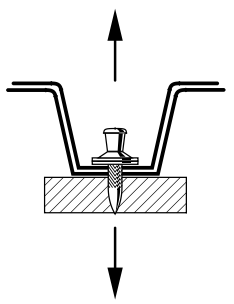
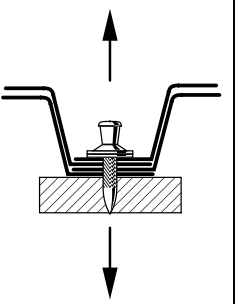


Cartridge Fired Pin

Fastener, Fastening Tool, Cartridge

ANNEX 1

Types of connection and corresponding loading conditions

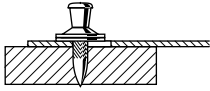


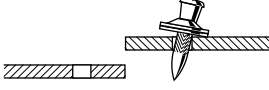
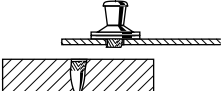
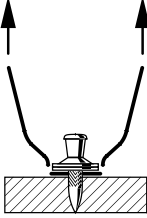
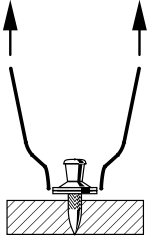
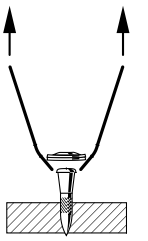
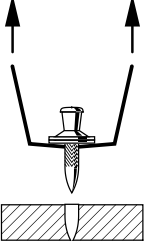
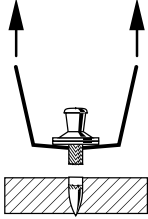
	Types of connection			
	Type a	Type b	Type c	Type d
				
Type of loading	Single connection	Side lap connection	End overlap connection	Side lap + end overlap connection
Lateral loading due to constraining forces due to temperature, in plane components of wind, dead loads, etc.				
Tension loading due to wind suction				

Cartridge Fired Pin

Types of connections and corresponding loading conditions

ANNEX 2

Possible failure modes of connections

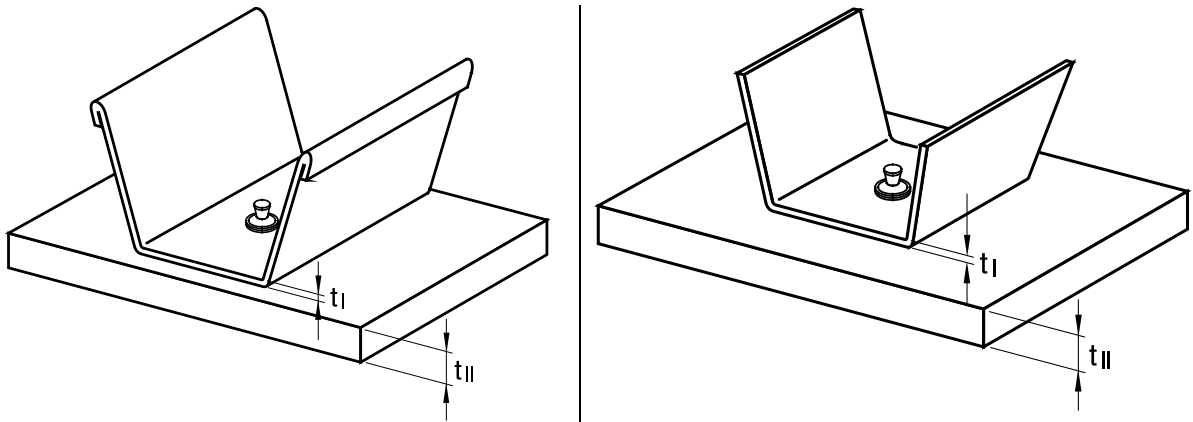
Type of loading	Failing component		
	sheeting	base material	cartridge fired pin
Lateral shear loading	 Slotted hole	 Slotted hole  Rotation of fastener  Pull-out of fastener	 Shear failure
Tensile loading	 Pull-through with punching shear failure  Pull-through  Pull-through with washer pull-over	 Pull-out	 Tension failure of fastener

Cartridge Fired Pin

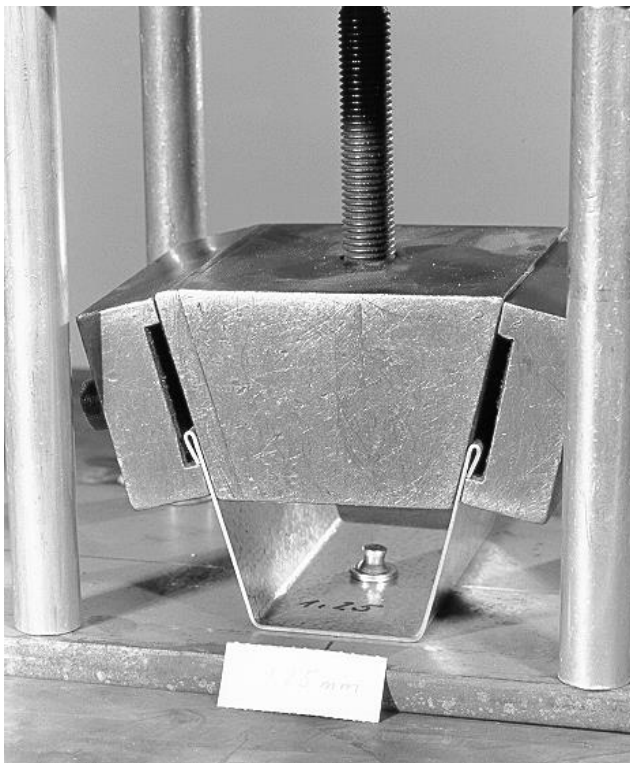
Possible failure modes of connections

ANNEX 3

Pull-through specimen (with or without folded lip)



Test setup for pull-through tests

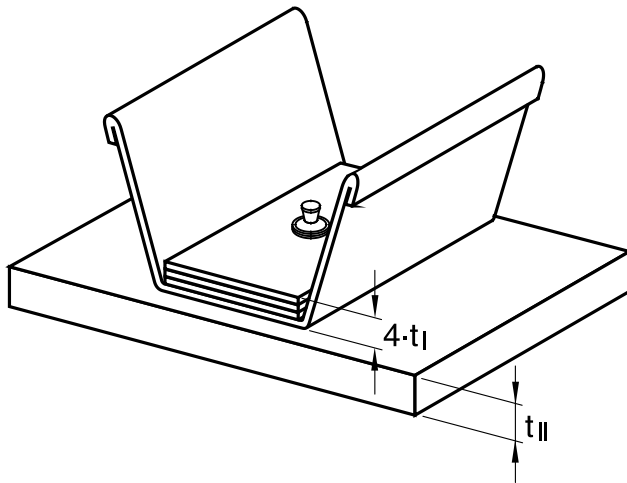


Cartridge Fired Pin

Test setup for pull-through tests

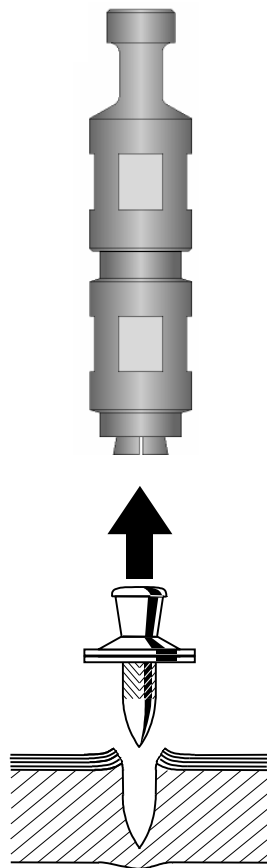
ANNEX 4

Pull-out test with pull-through specimen



Test setup according to Annex 4

Pull-out test with nail head adapter set

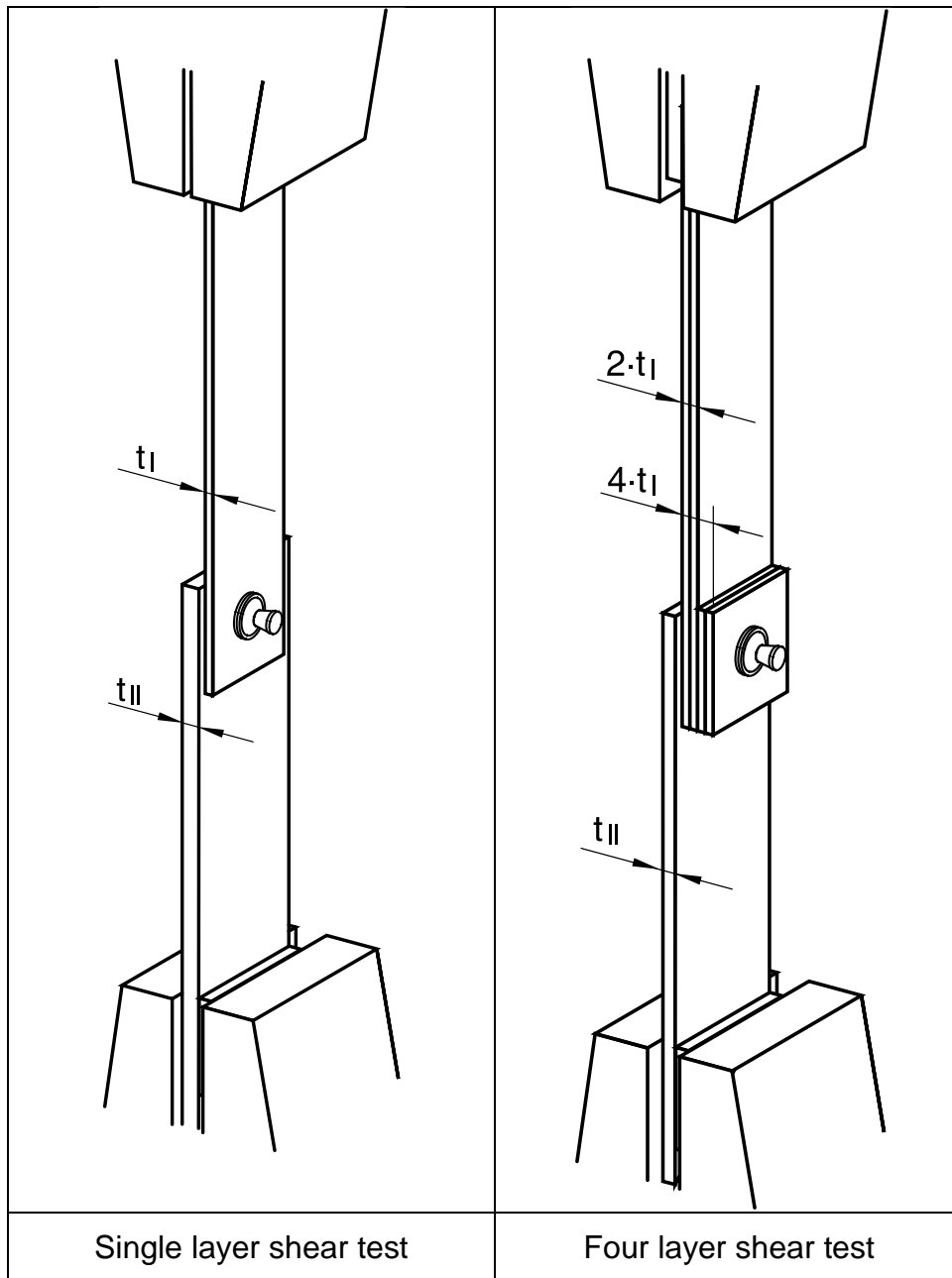


Cartridge Fired Pin

Test setup for pull-out tests

ANNEX 5

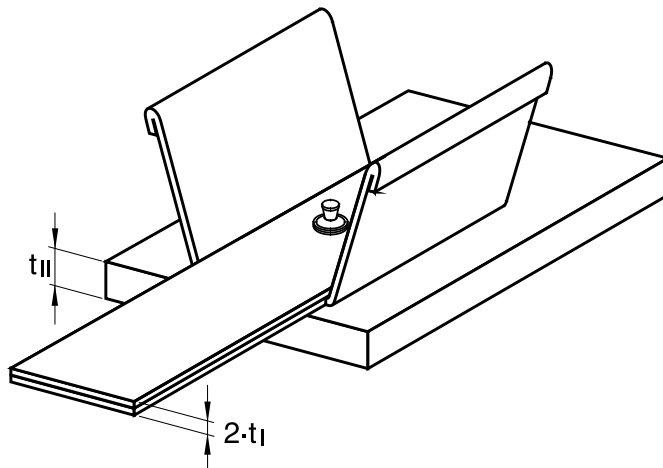
Shear test setup



Remark: Clamping of the specimen in the test equipment has to be done in such a way, that the axis of the load is lying in the interface between the sheeting (t_I) and the base material (t_{II})

Cartridge Fired Pin	ANNEX 6
Test setup for shear tests	

Test set-up and procedure for shear / pull-out test



Procedure:

- Step 1: Increase of shear load up to a lateral deformation of 2 mm
- Step 2: Pull-out of the fastener (either with pull-through specimen or with direct pulling of the fastener head according to Annex 5)

Cartridge Fired Pin

Test setup for shear/pull-through tests

ANNEX 7

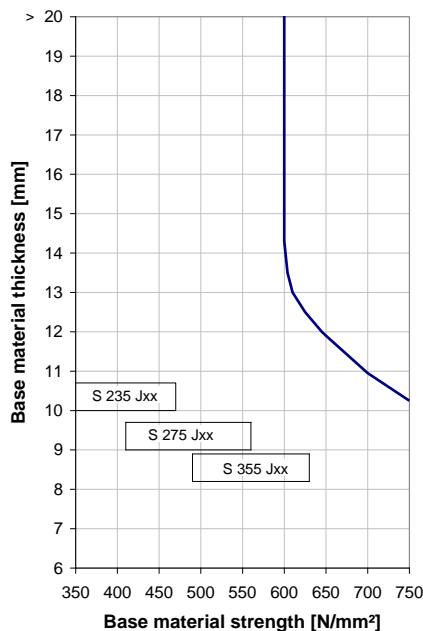
Fastener and Tools

Cartridge fired pin (Powder actuated fastener)	Powder actuated fastening tool, piston and cartridge
<i>Sketch of fastener Designation of fastener</i>	<i>Designation of tool, piston and cartridge</i>

Characteristic tension and shear resistance

Thickness of sheeting	Maximum number of layers	Characteristic tension resistance	Characteristic shear resistance
t_l [mm]	n	N_k [kN]	V_k [kN]
0.63			
0.75			
0.88			
1.00			
1.13			
1.25			
1.50			
1.75			
2.00			
2.50			

Application limit diagram



Cartridge selection and tool energy setting

Quality Control

NHS = Nail Head Stand off

Required range of NHS

Minimum required edge distance

Thickness of base material $t_{II} \geq 3$ mm

Cartridge Fired Pin
Application limits

ANNEX 8