EUROPEAN ASSESSMENT DOCUMENT

EAD 330001-00-0602

August 2016

EXPANDING STRUCTURAL BOLTING ASSEMBLIES FOR BLIND FASTENING

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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).

Contents

1 SCOPE OF THE EAD

1.1 Description of the Construction Product

The product is a steel bolting assembly that is fastened to steelwork by insertion into a predrilled hole from one face and secured on the far side by the expansion of one part of the assembly after insertion. The expansion is achieved by tightening operations on the near side only; no access is required to the far side.

Two types of assembly are covered by this EAD:

- Blind bolting assembly with expansion sleeve
- Blind bolting assembly without sleeve

Blind bolting assemblies with expansion sleeves are either 3 Part assemblies or 5 Part assemblies. The common components of these two variants are a headed fully threaded bolt and a conical nut. In the 3 part assembly, a cylindrical sleeve is provided around the shank of the bolt, over most of its length; the sleeve has an integral washer-like collar at the end under the head; the end of the sleeve remote from the head is slit longitudinally to allow it to expand radially outwards. The conical nut is screwed onto the bolt after the sleeve is fitted. In the 5-part assembly, the sleeve and the collar are separate and a compressible washer, of the same nominal inner and outer diameters as the sleeve, sits between the collar and the sleeve.

With blind bolting assemblies without sleeves, the primary component is a threaded screwed hollow rod. At the far end, the rod is not threaded and that cylindrical portion of the rod is slit longitudinally to allow it to expand radially outwards. A central threaded bolt is provided inside the hollow rod, with its head bearing on a washer on the near end of the hollow rod; a conical nut is provided at the far end of the central bolt. One or more hexagon nuts are provided on the screwed hollow rod.

In both types of fastener the tightening procedure draws the conical nut into the split end of the sleeve or hollow rod, forcing the sleeve or rod to expand radially and creating a tapered (essentially conical) surface that secures the fastener against the far face of the structural member. The tightening procedure is torque controlled. The fastener assemblies are made of carbon steel, alloy steel or stainless steel, with metric screw threads.

The types of assembly, including both 3 part and 5 part sleeved assemblies, are illustrated, before and after installation, in Figure 1.

The size range covered by this EAD is:

- Assembly with sleeve: bolt size up to M20
- Assembly without sleeve: hollow rod size up to M24

Bolts and screwed rods are carbon steel or alloy steel, Property Class 8.8 or 10.9 in accordance with EN ISO 898-1 or austenitic stainless steel, Property Classes 70 or 80 in accordance with EN ISO 3506-1.

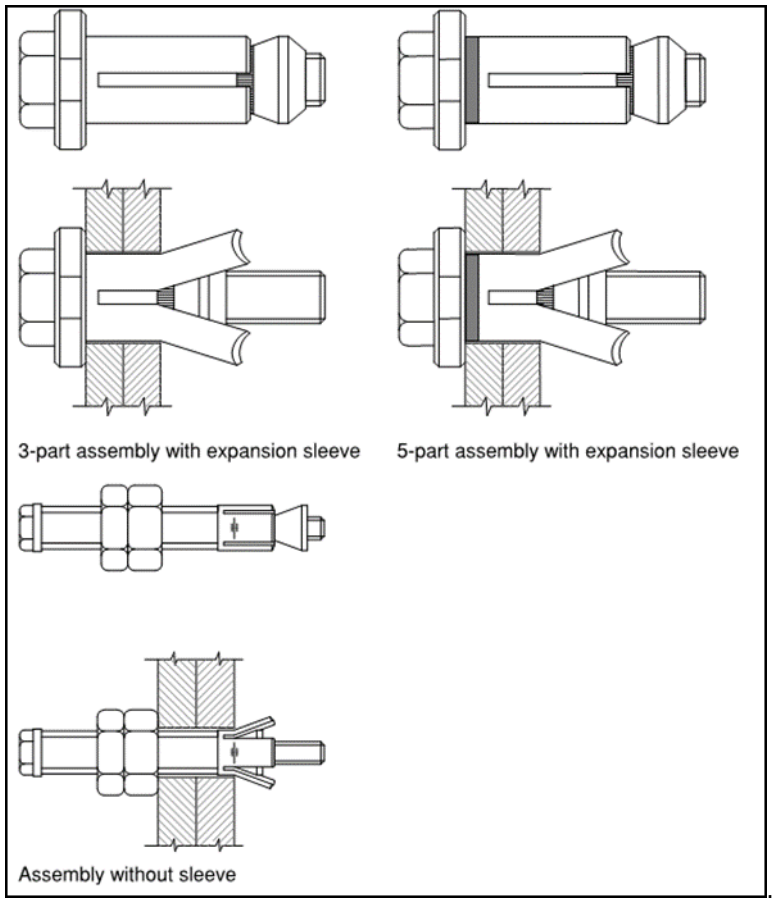
Carbon steel sleeves are formed from free cutting carbon steel in accordance with:

- EN 10087, having a minimum tensile strength of 430 MPa for assembly sizes up to M16 and a minimum tensile strength of 390 MPa for assembly size M20, or cold forming carbon steel having the same minimum tensile strength.
- Carbon Steel Grades GB699-20, EN10083, Grade 1.1151

Stainless steel sleeves are formed from stainless steel in accordance with EN 10088-1, or ASTM 276-08a, having a minimum tensile strength of 500 MPa. Conical nuts are formed from the same material as the sleeves.

For carbon steel assemblies, hexagon nuts are carbon steel, Strength Grade 8 in accordance with BS 3692. For stainless steel assemblies, hexagon nuts are Austenitic Stainless Steel, Property Classes 70 or 80 in accordance with EN ISO 3506-2. Nuts used as securing nuts may be Austenitic Stainless Steel, Property Classes 035 or 040.

Figure 1: Types of Bolting Assemblies:



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 product is intended to fasten together two steel structural components, or a structural steel component and a non-structural component, when the far face of the steelwork is inaccessible; such a situation commonly occurs when a bolted connection is required to a structural hollow section. The connection may be required to resist shear force, tensile force or a combination of shear and tensile forces.

1.2.2 Working Life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturers request to take into account a working life of the Expanding Structural Bolting Assemblies 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.

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 Blind Fastening

The fastening of two components together, using a bolt-like assembly, when access for installation, tightening and subsequent inspection of the fastener is only carried out from one side of the connection.

1.3.2 Conical Nut

A nut that has an edge profile that is rotated about its thread axis, such that a frustum (cone-shaped) surface is achieved at either end of the nut. A short cylindrical portion may be provided between the two frustums. The surface that engages with the expansion sleeve or split hollow rod may be wholly or partially grooved, to facilitate engagement.

1.3.3 Expansion Sleeve

A cylindrical component that has longitudinal slits along most of its length and which fits around the shank of the threaded bolt that is the primary component of the product. The slits allow the portions of the sleeve to be deformed outwards (radially, outwards from the cylindrical axis) during the tightening process.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential Characteristics of the Product

Table 1 shows how the performance of the Expanding Structural Bolting Assemblies for Blind Fastening 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 *(Level, Class, Description)*
Basic Works Requirement 1: Mechanical Resistance and Stability			
1	Mechanical Resistance	2.2.1	Pass/ Fail, Level
2	Dimensional Stability	2.2.2	Pass/ Fail, Level
3	Anchorage and Deformation of the Fastener	2.2.3	Pass/ Fail, Level
Basic Works Requirement 2: Safety in Case of Fire			
4	Reaction to Fire	2.2.4	Classification
Basic Works Requirement 4: Safety and Accessibility in Use			
5	Assessed as BWR1	2.2.5	
other characteristics			
6	Durability	2.2.6	Classification

2.2 Methods and Criteria for Assessing the Performance of the Product in Relation to Essential Characteristics of the Product

2.2.1 Mechanical Resistance

The mechanical resistance of the product shall be sufficient to withstand, after installation, the effects of:

- Tensile forces, along the axis of the fastener
- Shear forces, normal to the axis of the fastener
- Bearing forces, normal to the axis of the fastener

Table 2 summarises the methods to be used for the derivation of characteristic values for the components of the product.

The derived characteristic values shall be stated in the ETA.

Table 2: Derivation of Characteristic Values

Characteristic Value	Method	Derivation of Characteristic Values
Tensile Strength of Bolts and Hollow Screwed Rods	Reference to Standard	Mechanical characteristics: Property Class 8.8 or 10.9 in accordance with EN ISO 898-1 for Carbon Steel or Alloy Steel. Property Class 70 or 80 in accordance with EN ISO 3506-1 for Austenitic Stainless Steel.
Tensile Strength of Sleeve	Reference to Standard and Testing	Mechanical characteristics of material for sleeve to be those specified for material product standard specified in the ETA. The Suitability Test (Refer to Annex A) shall confirm that the tensile resistance of the installed component, in the relevant test set-up, is not less than the characteristic tensile strength of the sleeve or hollow screwed rod.
Shear Resistance of Assembly	Calculation	The characteristic resistance of the assembly to shear shall be determined from the tensile strengths of the components and their dimensions. The characteristic resistance of the assembly in shear shall be determined from the characteristic shear strengths of the components (the bolt and sleeve or the screwed rod and inner bolt, as appropriate) and their cross sectional areas in the shear plane. The characteristic shear strength shall be taken as 0.6 times the characteristic tensile strength, for structural steel, for grade 8.8 bolts and for category 70 or 80 stainless steel bolts The characteristic tensile resistance of the installed assembly shall be taken as the tensile resistance of the split portions of the sleeve or screwed rod, based on the specified minimum tensile strength of the sleeve or rod material and the cross section of the slotted section.
Resistance of Installed Assembly to Tensile Load	Calculation Assisted by Testing	The characteristic resistance of the installed assembly to tensile load shear shall be determined from the tensile strength of the sleeve or screwed rod and its dimensions. The Suitability Test (Refer to Annex A) shall confirm that, after following the prescribed installation procedure, this resistance value is achieved.

Note:

Design values for the assembly, for use in the design of connections using the product, will be derived from the characteristic values of the components in accordance with EN 1993, using non-contradictory complimentary information where appropriate.

2.2.2 Dimensional Stability

The manufacturing tolerances on sizes of the product shall be such that the product performance can be maintained.

The dimensions, tolerances on dimensions, form and position of the components of the product shall be checked by standard gauges or measuring equipment.

The tolerances for dimensions, form and position shall be in accordance with the requirements of the relevant test standard/method. The tolerances apply to the components before coating, where a coating is applied.

2.2.3 Anchorage and Deformation of the Fastener

The mechanical resistance, stiffness and ductility of the product and its performance during tightening shall be sufficient to allow the development of the intended deformation after installation as defined by the Manufacturer.

The suitability for use as a blind fastener shall be demonstrated by initial type testing. The test shall demonstrate that the tightening of the assembly will achieve a deformation of the split sleeve or the split screwed body that is sufficient to achieve a failure load in tension (applied as a force on the underside of the collar or on the underside of the hexagon nut on the hollow screwed rod) that is not less than the calculated characteristic tensile resistance, as defined in 2.2.1.1. Annex 1 provides further details of the required procedure and test method.

The failure of the assembly shall be by fracture of one or more segments of the split body or sleeve and the maximum load during the test shall be not less than the characteristic tensile resistance, as defined in 2.2.1.1.

The satisfactory performance of the conical nut shall be demonstrated by the thread of the conical nut being intact after test, usually demonstrated by the ability to unscrew the nut by hand, the exception being stainless steel threads which can gall, preventing removal by hand.

2.2.4 Reaction to Fire

The product shall be classified according to EN 13501-1. The product is considered to satisfy the requirements for Performance Class A1 of the characteristic reaction to fire, in accordance with the Decision 1996/603/EC (as amended) without the need for further testing on the basis of its conformity with the specification of the product detailed in that Decision and its intended end use application being covered by that Decision.

2.2.5 Safety and Accessibility in Use

Assessed as part of BWR 1.

2.2.6 Durability

The product shall have a verified durability expressed as a Corrosivity Classification (C1 to C5) in accordance with EN ISO 9223. The durability of the product in relevant environmental conditions shall be stated in the ETA. Where a protective coating is provided, its product specification and application shall be detailed in the ETA.

If stainless steel is used it shall be designated in accordance with EN 10088-1.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) 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

The system is: **2+**

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.

Table 3: Control Plan for the Manufacturer; Cornerstones

No.	Subject/Type of Control *(product, raw/constituent material, component - indicating characteristic concerned)*	Test or Control Method *(refer to 2.2 or 3.4)*	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	Check of Material Properties and Chemical Composition stated in the ETA	Inspection document 3.1. acc. to EN 10204-2004 (to be furnished by the supplier)	Results have to fulfil the performance outlined in the ETA	-	Every production unit
2	Geometry and Dimensions	Check of dimensions and tolerances	Results have to fulfil the performance outlined in the ETA	10	Every production unit
3	Tensile Strength of Bolts and Hollow Screwed Rods	Check according to test plan	Each result has to fulfil the performance outlined in the ETA	10	Every production unit
4	Tensile Strength of Sleeve	Check according to test plan	Each result has to fulfil the performance outlined in the ETA	10	Every production unit
5	Resistance of Installed Assembly to Tensile Load	Check according to test plan	Each result has to fulfil the performance outlined in the ETA	10	Every production unit

3.3 Tasks of the Notified Body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for ... [*product*] are laid down in Table 4.

Table 4: Control Plan for the Notified Body; Cornerstones

No.	Subject/Type of Control *(product, raw/constituent material, component - indicating characteristic concerned)*	Test or Control Method *(refer to 2.2 or 3.4)*	Criteria, if any	Minimum Number of Samples	Minimum Frequency of Control
Initial Inspection of the Manufacturing Plant and of Factory Production Control *(for Systems 1+, 1 and 2+ only)*					
1	Inspection of Factory and Factory Production Control	-	-	-	Before Certification
Continuous Surveillance, Assessment and Evaluation of Factory Production Control *(for systems 1+, 1 and 2+ only)*					
2	Surveillance of Factory and Factory Production Control	-	-	-	2/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.

EN ISO 898-1	Mechanical properties of fasteners made of carbon steel and alloy steel. Bolts, screws and studs
EN ISO 3506-1	Mechanical properties of corrosion-resistant stainless-steel fasteners. Bolts, screws and studs
EN ISO 3506-2	Mechanical properties of corrosion-resistant stainless-steel fasteners. Nuts.
EN 1993	Eurocode 3. Design of steel structures.
BS 3692	ISO metric precision hexagon bolts, screws and nuts. Specification
EN ISO 1460	Metallic coatings. Hot dip galvanized coatings on ferrous materials. Gravimetric determination of the mass per unit area
EN ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
EN ISO 2081	Metallic and other inorganic coatings. Electroplated coatings of zinc with supplementary treatments on iron or steel
EN ISO 2177	Metallic coatings. Measurement of coating thickness. Coulometric method by anodic dissolution
EN ISO 2178	Non-magnetic coatings on magnetic substrates. Measurement of coating thickness. Magnetic method
EN 10087	Free cutting steels. Technical delivery conditions for semi-finished products, hot rolled bars and rods
EN 10083	Steels for Quenching and Tempering
EN 10088-1	Stainless steels. List of stainless steels
EN ISO 10684	Fasteners. Hot dip galvanized coatings
EN 13501-1	Fire classification of construction products and building elements. Classification using data from reaction to fire tests
ISO 9223	Corrosion of metals and alloys -- Corrosivity of atmospheres - Classification
EN 1179	Zinc and zinc alloys. Primary Zinc
ASTM276-08	Stainless Steel Bars and Shapes
GB699	Steels for Quenching and Tempering

ANNEX 1: TEST METHOD – ANCHORAGE AND DEFORMATION OF THE FASTENER

The achievement of an appropriate deformed shape of the split sleeve, or of the split portion of the screwed rod is essential to ensuring adequate anchorage of the fastener.

The intention of the assembly is to provide an anchorage that would resist a tensile load that is at least equal to the characteristic tensile resistance of the sleeve (in the sleeved form of the fastener) or of hollow screwed rod (in the un-sleeved form of the fastener), determined in accordance with 2.2.1.

In many instances where the fastener would be used, the thin component to which the fastener is anchored would deform and fail at a lower load but it is not the intention that the deformed assembly itself would have a lesser anchorage resistance in such cases. The test should therefore be carried out within a set-up that will not fail or deform significantly before the assembly fails in tension.

During assessment of the performance of the product, the test shall be carried out for each assembly, in accordance with the Manufacturer's instructions. 5 tests shall be carried out for each nominal size, for each Property Class and for each type and source of material. The assemblies shall be tested in holes of the maximum diameter.

Installation Procedure:

The installation procedure detailed in the ETA shall specify, for each manufactured size of the assembly:

- The minimum and maximum grip lengths of the connection in which the particular size of the assembly may be used
- The hole size (including tolerance thereon) into which the assembly may be installed
- The minimum value of torque that should be applied during the tightening process (to the bolt in the sleeved form and to the inner rod in the un-sleeved form)

Test Objective:

- To demonstrate that the application of the specified installation torque will achieve sufficient deformation of the sleeve or the split rod (as appropriate) that the tensile failure load of the assembly, installed in a test piece that does not deform under load, will be at least the value detailed in the ETA.
- To confirm that the specified minimum tensile failure load can be achieved over the range of material strength of the sleeve or split rod that is detailed in the ETA.
- For the 5-part sleeved form of the product, to confirm that the specified minimum tensile failure load can be achieved over the range of stiffness of the compressible washer as detailed in the ETA.

Test Apparatus:

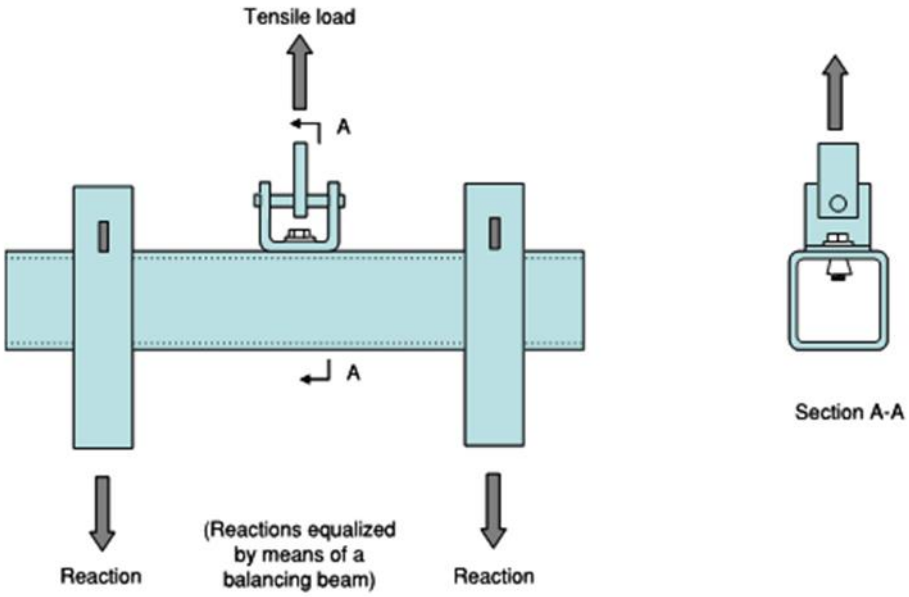
The test apparatus shall be a tensile testing machine of appropriate capacity, a test assembly and the necessary components to apply tensile load to the fastener within the test assembly.

The test assembly shall comprise a length of thick wall RHS section, into which is installed a single test specimen fastener. Tensile load shall be applied to the fastener by means of a suitable cleat that bears on the underside of the collar, or on the underside of the nut on the screwed rod.

The tensile load shall be resisted by restraining the length of RHS in such a way that the load applied to the fastener is tensile, without any bending. A Schematic arrangement of the Test Set-up is shown in Figure A.1.

Note:

The Schematic gives an indication of one type of test set-up/rig. Alternatives are acceptable provided they achieve the identical test conditions. This shall be assessed in the ETA.



Evaluation of the Test Results:

The results of the assessment of the performance of the construction product shall be evaluated to demonstrate that the minimum tensile failure load of the installed assembly (the maximum load sustained during a test to failure) is at least the value specified in the ETA.

The demonstration of the adequacy of the conical nut shall be that, after the test has concluded, with failure of the assembly in tension, the thread of the conical nut shall be intact after test, usually demonstrated by the ability to unscrew the nut by hand, the exception being stainless steel threads which can gall, preventing removal by hand.

[The ETA shall specify the minimum information to be included in the test documentation]