



BSI Standards Publication

Non-preloaded structural bolting assemblies

Part 2: Fitness for purpose

National foreword

This British Standard is the UK implementation of EN 15048-2:2016. It supersedes BS EN 15048-2:2007 which is withdrawn.

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A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

Non-preloaded structural bolting assemblies - Part 2: Fitness for purpose

Boulonnerie de construction métallique non
précontrainte - Partie 2: Aptitude à l'emploi

Garnituren für nicht vorgespannte
Schraubverbindungen im Metallbau - Teil 2:
Gebrauchstauglichkeit

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European foreword

This document (EN 15048-2:2016) has been prepared by Technical Committee CEN/TC 185 “Fasteners”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2017, and conflicting national standards shall be withdrawn at the latest by January 2017.

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This document supersedes EN 15048-2:2007.

Compared to the previous version, the modifications are the following:

- technical requirements and delivery conditions for bolting assemblies have been transferred from EN 15048-1;
- relevant product standards are specified by reference to a priority list, see 5.2;
- the use of complementary washers has been added;
- requirements for the test report have been revised.

EN 15048 consists of the following parts, under the general title *Non-preloaded structural bolting assemblies*:

- *Part 1: General requirements*;
- *Part 2: Fitness for purpose*.

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Introduction

This European Standard specifies the requirements to ensure that non preloaded structural bolting assemblies (bolts + nuts) are fit for purpose in structural metallic works. Structural bolting assemblies which meet the requirements of this European Standard have been designed to allow tensile loading of at least $f_{ub} \times A_s$.

Since the tensile resistance of bolting assemblies is very sensitive to differences in manufacture, it is important that the bolting assemblies are supplied by one manufacturer who is always responsible for the function of the bolting assembly. For the same reason it is important that the coating of the bolting assemblies is under the control of the manufacturer.

1 Scope

This European Standard specifies the technical requirements for structural bolting assemblies in order to ensure the suitability for non-preloaded bolted connections in steel structures or aluminium structures.

A suitability test is specified to check the behaviour of the structural bolting assemblies.

It applies to bolting assemblies specified in EN 15048-1.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1993-1-8:2005, *Eurocode 3: Design of steel structures — Part 1-8: Design of joints*

EN 15048-1:2016, *Non-preloaded structural bolting assemblies — Part 1: General requirements*

EN 28839, *Mechanical properties of fasteners — Bolts, screws, studs and nuts made of non-ferrous metals (ISO 8839:1986)*

EN ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread (ISO 898-1)*

EN ISO 898-2, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 2: Nuts with specified property classes — Coarse thread and fine pitch thread (ISO 898-2)*

EN ISO 3506-1, *Mechanical properties of corrosion-resistant stainless steel fasteners — Part 1: Bolts, screws and studs (ISO 3506-1)*

EN ISO 3506-2, *Mechanical properties of corrosion-resistant stainless steel fasteners — Part 2: Nuts (ISO 3506-2)*

EN ISO 4014, *Hexagon head bolts — Product grades A and B (ISO 4014)*

EN ISO 4016, *Hexagon head bolts — Product grade C (ISO 4016)*

EN ISO 4017, *Fasteners — Hexagon head screws — Product grades A and B (ISO 4017)*

EN ISO 4018, *Hexagon head screws — Product grade C (ISO 4018)*

EN ISO 4032, *Hexagon regular nuts (style 1) — Product grades A and B (ISO 4032)*

EN ISO 4033, *Hexagon high nuts (style 2) — Product grades A and B (ISO 4033)*

EN ISO 4034, *Hexagon regular nuts (style 1) — Product grade C (ISO 4034)*

EN ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1)*

EN ISO 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system (ISO 7500-1)*

ISO 273, *Fasteners — Clearance holes for bolts and screws*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 15048-1 apply.

4 Symbols

For the purposes of this document, the following symbols apply.

$A_{s,nom}$ nominal stress area of the bolt, in mm²

d nominal thread diameter, in mm

F_b force in the bolting assembly during the test, in N

$F_{bi,max}$ individual value of the maximum force reached by the assembly during the test, in N

F_{ub} tensile resistance, in N

l bolt length, in mm

$R_{m,min}$ minimum tensile strength, in MPa

NOTE A_s in accordance with EN 1993-1-8 means $A_{s,nom}$ in accordance with this standard.

5 Technical requirements for bolting assemblies

5.1 Composition of structural bolting assemblies

The performance of structural bolting assemblies depends on the properties of their specific components. Therefore, the essential characteristics listed in EN 15048-1 are assessed through the verification of the properties of the involved components and/or bolting assemblies, as applicable. Other aspects dealing with marking and delivery conditions are assessed through inspection of the involved components and/or bolting assemblies, as applicable.

5.2 Product requirements

Dimensions, tolerances on dimensions, form and position shall be in accordance with the relevant product standards. Components of structural bolting assemblies shall be selected by the manufacturer with the following priority order.

a) General reference to published EN standards:

For hexagon components, the following standards shall apply:

- 1) EN ISO 4014, EN ISO 4017, EN ISO 4032 and EN ISO 4033 for hexagon products of product grades A and B;
- 2) EN ISO 4016, EN ISO 4018 and EN ISO 4034 for hexagon products of product grade C;
- 3) when required, prevailing torque nuts in accordance with EN ISO 2320 and EN ISO 7040, ISO 7041, EN ISO 7042 or EN ISO 7719 may be used.

- b) General reference to ETAs,
- c) General reference to published ISO standards,
- d) When none of these standards/ETAs exist, then reference to national standards is permitted.

Any suitable head shape, shank dimension, thread length, etc. may be used provided that all requirements of EN 15048-1 and EN 15048-2 are met.

NOTE Additional requirements for design and/or execution are defined for instance in EN 1993-1-8, and EN 1090-2 for steel structures or EN 1090-3 for aluminium structures.

If washers are specified for use with non-preloaded structural bolting assemblies, washers of product grade A or C can be combined with any product grade of bolting assemblies. Washers with a minimum hardness of 100 HV¹⁾ can be combined with any property class of bolting assemblies made of the same type (steel, alloy steel, stainless steel) of material. Washers made of carbon steel or alloy steel, a minimum hardness of 300 HV is required for property classes 8.8 and 10.9 in a single lap joint with only one bolt or single row of bolts, in accordance with EN 1993-1-8:2005, 3.6.1.

5.3 Manufacturing process

5.3.1 Material

Free cutting steel shall not be used for the manufacture of bolts and nuts for structural bolting.

5.3.2 Nuts

Hot dip galvanized nuts shall be galvanized before they are threaded.

Nuts shall not be re-threaded after galvanizing.

5.3.3 Bolts

The manufacturing process for bolts of property class 10.9 shall take due care of the risk of hydrogen embrittlement, especially during the coating process. Appropriate processes shall be considered when the risk of hydrogen embrittlement cannot be avoided.

5.3.4 Finish and coating

Finish and coating, if applied, shall be as specified in the relevant coating standards. Coatings shall not impair the mechanical properties or the functional characteristics of the bolting assembly.

Coating of all components of a bolting assembly shall be compatible and shall have equivalent corrosion resistance.

Coating of each component shall be under the control of the manufacturer of the bolting assemblies.

5.4 Marking

5.4.1 Bolts

Bolts, screws or studs in accordance with this European Standard shall be marked with:

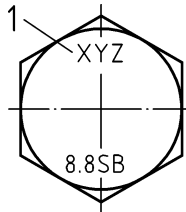
- the property class marking in accordance with EN ISO 898-1 for bolts manufactured from carbon steel and alloy steel or EN ISO 3506-1 for bolts manufactured from stainless steel, and

¹⁾ No minimum hardness requirement exists for washers made of aluminium or aluminium alloy.

- the grade marking in accordance with EN 28839 for bolts manufactured from aluminium or EN ISO 3506-1 for bolts manufactured from stainless steel, and
- the identification mark of the manufacturer of the bolting assemblies, and
- the special marking „SB“ (for use in Structural Bolting).

The marking may be either embossed or indented on the top surface of the head or on the end of studs and stud bolts.

An example of bolt marking is shown in Figure 1.



Key

- 1 identification mark of the manufacturer of the bolting assembly

Figure 1 — Example of bolt marking

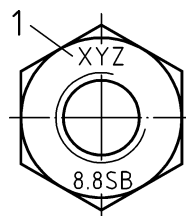
5.4.2 Nuts

Nuts in accordance with this European Standard shall be marked with:

- the grade marking in accordance with EN 28839 for nuts manufactured from aluminium or aluminium alloy or EN ISO 3506-2 for nuts manufactured from stainless steel, and
- the property class marking in accordance with EN ISO 898-2 for nuts manufactured from carbon or alloy steel or EN ISO 3506-2 for nuts manufactured from stainless steel, and
- the identification mark of the manufacturer of the bolting assemblies, and
- the special marking „SB“ (for use in Structural Bolting).

The marking may be either indented or embossed on one of the bearing surfaces.

An example of nut marking is shown in Figure 2.



Key

- 1 identification mark of the manufacturer of the bolting assembly

Figure 2 — Example of nut marking

5.4.3 Washers

If washers are specified for use with non-preloaded structural bolting assemblies, marking of washers is not required.

5.5 Delivery conditions

The manufacturer shall supply the bolting assemblies either in an original unopened single sealed container, or alternatively in original unopened separate sealed containers. The suitability for tensile loading of the bolting assemblies supplied to the purchaser shall be demonstrated by the tensile test in accordance with this standard.

Containers of bolting assemblies or their components in accordance with this European Standard shall be labelled with the complete designation of the fasteners including:

- additional letters „SB“ (for use in Structural Bolting), and
- relevant lot number(s), and
- identification mark or name of the manufacturer of the bolting assemblies.

Bolting assemblies shall be supplied in one of the following alternatives:

- Bolts and nuts supplied together as a set by one manufacturer. The components of the bolting assemblies shall be packed together in one package that shall be labelled with the single bolting assembly lot number and the manufacturer's identification. The suitability test shall be performed on each single bolting assembly lot by use of representative sample testing, as specified in EN 15048-1:2016, 6.3.
- Bolts and nuts supplied by one manufacturer. Each type of component may be packed in separate packages that shall be labelled with the manufacturing lot number of the components and the manufacturer's identification. The components of the bolting assemblies are interchangeable within the deliveries of an extended bolting assembly lot. The suitability test shall be performed on each extended bolting assembly lot by use of representative sample testing, as specified in EN 15048-1:2016, 6.3.

6 Tensile test of bolting assemblies for determination of tensile resistance

6.1 Principle

The principle of the test is to tensile load the bolt and nut assembly and to measure the force in the bolting assembly during the tensile test.

6.2 Test conditions

6.2.1 General

The test shall be carried out in accordance with 6.2.2 to 6.2.5.

Other conditions may be specified, see Annex A.

6.2.2 Test apparatus

The tensile testing machine shall be in accordance with EN ISO 7500-1. Side thrust on the fastener shall be avoided, e.g. by self-aligning grips.

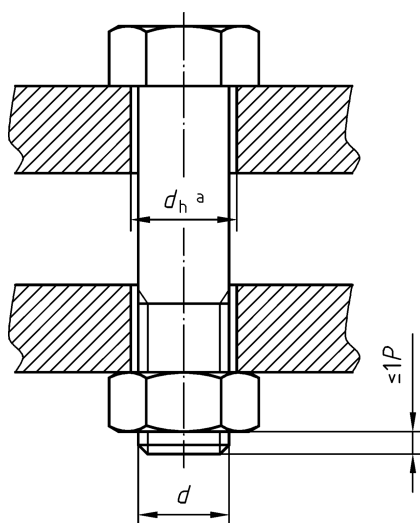
6.2.3 Test assemblies

The test shall be carried out on a bolt/nut assembly without washers. Test assemblies shall be taken from a single assembly lot or extended assembly lot (see EN 15048-1). Each component of a test assembly shall be tested in the as received condition and shall be used once only.

6.2.4 Test set-up

Usually tests can be carried out on bolts or screws with $l > 3d$ or studs with $l > 4d$. The test bolting assemblies shall be positioned in a test set-up as shown in Figure 3 such that the clamp length is the maximum allowed in practice. The end of the bolt shall protrude not more than one pitch ($1P$) beyond the unloaded face of the nut.

To be suitable for bolts with specific geometry (fitted or countersunk head bolt) the test setup shall be adapted.



Key

a d_h in accordance with ISO 273, medium series

Figure 3 — Typical test set-up

6.2.5 Test procedure

The test shall be carried out at an ambient temperature range of 10 °C to 35 °C.

The tensile test shall be carried out in a continuous manner in accordance with EN ISO 6892-1 and the actual force in the bolted assembly, F_b , shall be measured continuously throughout the test. The speed of testing shall not exceed 20 mm/min.

6.3 Required failure mode

Failure of an assembly with components of carbon steel, alloy steel or aluminium alloy shall occur by fracture in the free threaded length or by stripping the engaged threads but not in the shank or at the junction of the head to the shank or the thread or in the head.

The failure of an assembly with components of stainless steel shall occur by fracture in the shank or in the free threaded length or by stripping the engaged threads but not by fracture at the junction of the head to the shank or the thread or in the head.

6.4 Required tensile resistance

In each tensile test the individual value of the maximum force reached by the assembly $F_{bi,max}$ shall not be less than the minimum tensile resistance F_{ub} specified in EN 15048-1:

$$F_{bi,max} \geq F_{ub} \quad (1)$$

where

$$F_{ub} = R_{m,min} \times A_{s,nom}$$

7 Test report

The following minimum information shall be included in the test report when tested at the bolting assemblies manufacturer:

- date of testing;
- details of the test equipment;
- the single assembly lot number, or the extended assembly lot number;
- number of bolting assemblies tested;
- designation of the bolting assemblies;
- marking of the components of the bolting assembly;
- test clamp length;
- remarks concerning the execution of tests (including, if any, those on special testing conditions and procedures, see Annex A);
- tests results in accordance with this standard;
- conclusions.

When the tests are not carried out by the bolting assemblies manufacturer, the following additional information shall be given:

- identification of the laboratory;
- identification of the organization ordering the test;
- date of reception of the assemblies.

Annex A

(informative)

Special testing conditions and procedures

By agreement between the supplier and the purchaser, the following special conditions may be specified:

a) Short or long bolts:

If the bolts are too short to meet the testing conditions defined in 6.2 or too long to be placed in the test apparatus, bolts with appropriate length from the same production run may be tested with standard test conditions.

b) Loading:

The speed of testing may be altered or discontinuous loading may be carried out.

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- [4] EN ISO 7040, *Prevailing torque type hexagon regular nuts (with non-metallic insert) — Property classes 5, 8 and 10 (ISO 7040)*
- [5] EN ISO 7042, *Prevailing torque type all-metal hexagon high nuts — Property classes 5, 8, 10 and 12 (ISO 7042)*
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- [7] EN ISO 7094, *Plain washers — Extra large series — Product grade C (ISO 7094)*
- [8] EN ISO 7719, *Prevailing torque type all-metal hexagon regular nuts — Property classes 5, 8 and 10 (ISO 7719)*
- [9] ISO 7041, *Prevailing torque type hexagon nuts (with non-metallic insert), style 2 — Property classes 9 and 12*

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