BS EN 15048-1:2016

BSI Standards Publication

Non-preloaded structural bolting assemblies

Part 1: General requirements

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National foreword

This British Standard is the UK implementation of EN 15048-1:2016. It supersedes BS EN 15048-1:2007 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee FME/9, Fasteners.

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

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Garnituren für nicht vorgespannte Schraubverbindungen im Metallbau - Teil 1: Allgemeine Anforderungen

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European foreword

This document (EN 15048-1:2016) 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of an identical text or by endorsement, at the latest by January 2017, and conflicting national standards shall be withdrawn at the latest by April 2018.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 15048-1:2007.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports basic work requirements of Regulation (EU) No 305/2011.

For relationship with Regulation (EU) No 305/2011 see informative Annex ZA, which is an integral part of this document.

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*.

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

— the standard was revised to meet the new format for harmonized standards and in relation to the Regulation (EU) No. 305/2011 (CPR);

— the requirements of this standard only relate to the product characteristics of bolting assemblies which are necessary for CE marking;

— all clauses dealing with further technical or other requirements have been transferred to EN 15048-2;

— washers are not considered as part of the non-preloaded bolting assemblies, however they can be used as relevant;

— addition of bolting assemblies made in aluminum and aluminum alloys;

— addition of nominal diameters M5 to M10;

— Railway rail fasteners have been excluded.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

Rules for design and execution of bolted connections with non-preloaded structural bolts are defined for instance in EN 1993-1-8 and EN 1090-2 for steel structures or EN 1999-1-1 and EN 1090-3 for aluminium or aluminium alloy structures.

The parts of this European Standard on structural bolting assemblies specify the general requirements which ensure that bolting assemblies comprising bolts and nuts are suitable for use as non-preloaded structural bolting in structural metallic works. They can be used in shear connections and/or in tension connections if no preload is required.

Structural bolting assemblies which meet the requirements of this part of this European Standard have been designed to allow tensile resistance of at least $f_{ub} \times A_s$. For this purpose the tensile test of bolting assemblies specified in EN 15048-2 is a mean to check whether the function of the assembly is fulfilled.

Washers or other elements can be used additionally if necessary.

1 Scope

This part of this European Standard specifies the general requirements for bolting assemblies for non-preloaded structural bolting. Bolting assemblies in accordance with this European Standard are designed to be used in structural bolting connections for shear and/or tensile loading.

The intended use of bolting assemblies in accordance with this European standard is structural metallic works.

It applies to bolts (the term used when bolts partially threaded, screws, studs and stud-bolts are considered all together) and nuts made of carbon steel, alloy steel, stainless steel or aluminium or aluminium alloy with the following property classes:

— bolts made of carbon steel or alloy steel: 4.6, 4.8, 5.6, 5.8, 6.8, 8.8, 10.9 (in accordance with EN ISO 898-1);

— nuts made of carbon steel or alloy steel: 5, 6, 8, 10, 12 (in accordance with EN ISO 898-2);

— bolts made of austenitic stainless steel: 50, 70, 80 (in accordance with EN ISO 3506-1);

— nuts made of austenitic stainless steel: 50, 70, 80 (in accordance with EN ISO 3506-2);

— bolts made of aluminium or aluminium alloy: AL1 to AL6 (in accordance with EN 28839);

— nuts made of aluminium or aluminium alloy: AL1 to AL6 (in accordance with EN 28839).

This European Standard applies to bolting assemblies with ISO metric coarse pitch thread from sizes M12 to M39 for use in steel structures according to EN 1090-2, and from M5 to M39 for use in aluminium or aluminium alloy structures according to EN 1090-3. The use of thread sizes larger than M39 is not precluded provided all applicable requirements of this standard are met.

WARNING — Only bolting assemblies are covered by this harmonized standard: separate bolts or nuts, not tested as part of an assembly lot of bolting assemblies in accordance with EN 15048-2, are not covered by this harmonized standard and cannot be CE marked.

NOTE 1 The property classes 4.8, 5.8 and 6.8 may be subjected to limitations of use.

NOTE 2 High-strength structural bolting assemblies for preloading which meet the requirements of EN 14399–1 are not within the scope of this European Standard but they are also suitable for use in non-preloaded structural bolting.

NOTE 3 Bolts and nuts made of aluminium or aluminium alloys are not designed to be used in steel structures, see EN 1090–2.

Bolting assemblies in accordance with this European Standard are not designed to be welded.

Railway rail fasteners are not covered by this European Standard.

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 1090-2, *Execution of steel structures and aluminium structures — Part 2: Technical requirements for steel structures*

EN 15048-2, *Non-preloaded structural bolting assemblies — Part 2: Suitability test*

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

EN ISO 225, *Fasteners — Bolts, screws, studs and nuts — Symbols and descriptions of dimensions (ISO 225)*

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 4759-1, *Tolerances for fasteners — Part 1: Bolts, screws, studs and nuts — Product grades A, B and C (ISO 4759-1)*

EN ISO 10684:2004, *Fasteners — Hot dip galvanized coatings (ISO 10684:2004)*

ISO 965-1, *ISO general purpose metric screw threads — Tolerances — Part 1: Principles and basic data*

ISO 965-2, *ISO general purpose metric screw threads — Tolerances — Part 2: Limits of sizes for general purpose external and internal screw threads — Medium quality*

ISO 965-3, *ISO general purpose metric screw threads — Tolerances — Part 3: Deviations for constructional screw threads*

ISO 965-4, *ISO general purpose metric screw threads — Tolerances — Part 4: Limits of sizes for hot-dip galvanized external screw threads to mate with internal screw threads tapped with tolerance position H or G after galvanizing*

ISO 965-5, *ISO general purpose metric screw threads — Tolerances — Part 5: Limits of sizes for internal screw threads to mate with hot-dip galvanized external screw threads with maximum size of tolerance position h before galvanizing*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1090-2 and the following apply.

3.1
bolting assembly
matching bolts (including screws, studs and stud bolts) and nuts

3.2
manufacturing lot
quantity of components of a single designation including product grade, property class, type, and size, manufactured from bar, wire, rod or flat product from a single cast, processed through the same or

similar steps at the same time or over a continuous time period, through the same heat treatment, coating and/or lubrication process, if any

Note 1 to entry: Same process means:

— for a continuous process, the same treatment cycle without any setting modification;

— for a discontinuous process, the same treatment cycle for identical consecutive loads (batches);

Note 2 to entry: The manufacturing lot may be split into a number of manufacturing batches for processing purposes and then re-assembled into the same manufacturing lot.

3.3
single bolting assembly lot
bolting assembly lot containing:

— bolts from a single manufacturing lot,

— nuts from a single manufacturing lot.

3.4
extended bolting assembly lot
bolting assembly lot containing:

— nuts from a single manufacturing lot,

— bolts from several manufacturing lots.

4 Product characteristics

4.1 General

The performance of the structural bolting assemblies depends on properties of their matched components. Therefore, the requirements specified in 4.2, 4.3 and 4.4 are assessed through the verification of the properties of the involved components and/or bolting assemblies, as applicable.

4.2 Type (bolting assemblies)

4.2.1 General

Type "SB" linked with the property class of the bolt covers the axial load of the structural bolting assembly assumed in design.

The geometry of the head is relevant for the ability of the bolting assembly to be loaded by tension.

The cross section of the shank is relevant for the ability of the bolting assembly to be loaded by shear.

Any suitable head shape and shank dimensions may be used provided that the requirements for tensile resistance are met.

4.2.2 Axial load (bolting assemblies)

Bolting assemblies shall be assessed in accordance with 5.2. The minimum tensile resistance of the bolting assembly shall comply with the values specified in Table 1, Table 2 and Table 3. The values correspond to the minimum tensile strength $R_{m,min}$ for the relevant property class of the structural bolting assembly, as specified in EN ISO 898-1, EN ISO 3506-1 or EN 28839 as appropriate.

Table 1 — Tensile resistance of bolt/nut assemblies made of carbon steel or alloy steel

Structure	Thread	Nominal stress area $A_{s,nom}$ mm²	Property class of the bolt						
			4.6	4.8	5.6	5.8	6.8	8.8	10.9
			Minimum tensile resistance $F_{ub,min}$, N ($A_{s,nom} \times R_{m,min}$)						
For aluminium structures	M5[a]	14,2	5 680	5 960	7 100	7 380	8 520	11 350	14 800
	M6[a]	20,1	8 040	8 440	10 000	10 400	12 100	16 100	20 900
	M7[a]	28,9	11 600	12 100	14 400	15 000	17 300	23 100	30 100
	M8[a]	36,6	14 600	15 400	18 300	19 000	22 000	29 200	38 100
	M10[a]	58,0	23 200	24 400	29 000	30 200	34 800	46 400	60 300
For steel and aluminium structures	M12[b]	84,3	33 700	35 400	42 200	43 800	50 600	70 000	87 700
	M14[b]	115	46 000	48 300	57 500	59 800	69 000	95 500	120 000
	M16[b]	157	62 800	65 900	78 500	81 600	94 000	130 000	163 000
	M18[b]	192	76 800	80 600	96 000	99 800	115 000	159 000	200 000
	M20[b]	245	98 000	103 000	122 000	127 000	147 000	203 000	255 000
	M22[b]	303	121 000	127 000	152 000	158 000	182 000	252 000	315 000
	M24[b]	353	141 000	148 000	176 000	184 000	212 000	293 000	367 000
	M27[b]	459	184 000	193 000	230 000	239 000	275 000	381 000	477 000
	M30[b]	561	224 000	236 000	280 000	292 000	337 000	466 000	583 000
	M33[b]	694	278 000	292 000	347 000	361 000	416 000	576 000	722 000
	M36[b]	817	327 000	343 000	408 000	425 000	490 000	678 000	850 000
	M39[b]	976	390 000	410 000	488 000	508 000	586 000	810 000	1 020 000

[a] When tested in accordance with EN 15048-2, hot dip galvanized structural bolting assemblies below M12 cannot meet the requirements for tensile resistance.

[b] To achieve full tensile resistance, hot dip galvanized bolting assemblies can require special measures, see EN ISO 10684:2004, Annex F.

Table 2 — Tensile resistance of bolt/nut assemblies made of stainless steel

Thread	Nominal stress area $A_{s,nom}$ mm²	Property class of the bolt		
		50	70	80
		Minimum tensile resistance $F_{ub,min}$, N ($A_{s,nom} \times R_{m,min}$)		
M5	14,2	7 100	9 900	11 400
M6	20,1	10 000	14 100	16 100
M7	28,9	14 400	20 200	23 100
M8	36,6	18 300	25 600	29 300
M10	58,0	29 000	40 600	46 400
M12	84,3	42 200	59 000	67 400
M14	115	57 500	80 500	92 000
M16	157	78 500	110 000	126 000
M18	192	96 000	134 000	154 000
M20	245	122 000	172 000	196 000
M22	303	152 000	212 000	242 000
M24	353	176 000	247 000	282 000
M27	459	230 000	321 000[a]	367 000[a]
M30	561	280 000	393 000[a]	449 000[a]
M33	694	347 000	486 000[a]	555 000[a]
M36	817	408 000	572 000[a]	654 000[a]
M39	976	488 000	683 000[a]	781 000[a]

[a] These sizes might not be available as bolt and nut assemblies, so studs or stud bolts with nuts may be used.

Table 3 — Tensile resistance of bolt/nut assemblies made of aluminium or aluminium alloy

Thread	Nominal stress area $A_{s,nom}$ mm²	Property class of the bolt					
		AL1	AL2	AL3	AL4	AL5	AL6
		Minimum tensile resistance $F_{ub,min}$, N ($A_{s,nom} \times R_{m,min}$)					
M5	14,2	3 830	4 400	4 540	5 960	6 530	7 240
M6	20,1	5 430	6 230	6 430	8 440	9 250	10 250
M7	28,9	7 800	8 960	8 960	12 140	13 290	14 740
M8	36,6	9 880	11 350	11 350	15 370	16 840	18 670
M10	58,0	15 660	17 980	17 980	24 360	26 680	29 580
M12	84,3	21 080	26 130	26 130	32 030	38 780	42 990
M14	115	28 750	35 650	35 650	43 700	52 900	58 650
M16	157	39 250	43 960	48 670	59 660	72 220	80 070
M18	192	48 000	53 760	59 520	72 960	88 320	97 920
M20	245	61 250	68 600	75 950	93 100	112 700	124 900
M22	303	–	84 840	93 930	115 100	139 400	154 500
M24	353	–	98 840	109 400	134 100	162 400	180 000
M27	459	–	128 500	142 300	174 400	211 100	234 100
M30	561	–	157 100	173 900	213 200	258 100	286 100
M33	694	–	194 300	215 100	263 700	319 200	353 900
M36	817	–	228 800	253 300	310 500	375 800	416 700
M39	976	–	–	302 600	370 900	449 000	497 800

4.3 Property class (bolting assemblies)

4.3.1 General

Property class expresses in a concise way a set of mechanical characteristics of the components. It is relevant for the ability of components to be matched together in order to obtain the declared performances of the bolting assemblies.

The tensile resistance specified in Table 1, Table 2 and Table 3 shall apply to any bolt/nut combination as specified in Table 4.

Table 4 — Appropriate combinations of bolts and nuts with regard to property classes

Bolting assemblies made of carbon steel or alloy steel intended to be used in accordance with EN 1090–2 or EN 1090–3		
Bolts		Nuts
Property class		Property class
4.6		5, 6 or 8
4.8		
5.6		5, 6 or 8
5.8		
6.8		6 or 8
8.8		8 or 10
10.9		10 or 12
Bolting assemblies made of stainless steel intended to be used in accordance with EN 1090–2 or EN 1090–3		
Grade	Bolts	Nuts
	Property class	Property class
A2, A3, A4 or A5	50	50, 70 or 80
	70	70 or 80
	80	80
Bolting assemblies made of aluminium or aluminium alloy intended to be used in accordance with EN 1090–3 only		
Bolts		Nuts
Grade		Grade
AL1 to AL4		AL1 to AL6
AL5		AL3 to AL6
AL6		AL4 to AL6

Nuts of higher property class may replace nuts of lower property class.

4.3.2 Elongation under tensile load (bolts)

Bolts shall be assessed in accordance with 5.3.2. The results for elongation shall meet the requirements specified in EN ISO 898-1, EN ISO 3506-1 or EN 28839 for the relevant property class or material grade.

4.3.3 Tensile strength (bolts)

Bolts shall be assessed in accordance with 5.3.3. The results for tensile strength shall meet the requirements specified in EN ISO 898-1, EN ISO 3506-1 or EN 28839 for the relevant property class or material grade.

4.3.4 Strength under wedge loading (bolts)

Bolts shall be assessed in accordance with 5.3.4. The results for strength under wedge loading shall meet the requirements specified in EN ISO 898-1 for the relevant property class.

NOTE There is no requirement for bolting assemblies manufactured from aluminium, aluminium alloy or stainless steel.

4.3.5 Tensile yield strength (bolts)

Bolts shall be assessed in accordance with 5.3.5. The results for tensile yield strength shall meet the requirements specified in EN ISO 898-1, EN ISO 3506-1 or EN 28839 for the relevant property class or material grade.

4.3.6 Proof load (nuts and bolts)

Bolts and nuts shall be assessed in accordance with 5.3.6. The results shall for proof load meet the requirements specified in EN ISO 898-1, EN ISO 898-2, EN ISO 3506-1 or EN ISO 3506-2 for the relevant property class.

NOTE There is no requirement for bolting assemblies manufactured from aluminium or aluminium alloy.

4.3.7 Impact strength (bolts)

Bolts shall be assessed in accordance with 5.3.7. The results for impact strength shall meet the requirements specified in Table 5 for the relevant property class.

NOTE There is no requirement for bolting assemblies manufactured from aluminium or aluminium alloy.

Table 5 — Minimum impact strength of bolts

Characteristic	Property class		
	carbon steel and alloy steel		stainless steel
	4.6, 5.6, 8.8, 10.9	4.8, 5.8, 6.8	50, 70, 80
Impact strength $K_{V,min}$ at −20 °C[a]	27 J	–	27 J
Impact strength $K_{V,min}$ at +20 °C[a]	–	27 J	–

[a] Impact strength may be tested at lower temperature, in this case the minimum impact strength value shall be K_V = 27 J.

4.3.8 Hardness (bolts and nuts)

Bolts and nuts shall be assessed in accordance with 5.3.8. The results for hardness shall meet the requirements specified in EN ISO 898-1 or EN ISO 898-2 for the relevant property class.

NOTE There is no requirement for bolting assemblies manufactured from aluminium, aluminium alloy or stainless steel.

4.4 Product grade (bolts and nuts)

4.4.1 General

Product grade covers tolerances on dimensions and shape for bolts and nuts. It is relevant for the ability of components to be matched together in order to provide the declared performances of the bolting assemblies.

The tolerances on dimensions and shape shall meet the requirements specified in EN ISO 4759-1. Bolts of product grade A, B or C can be combined with nuts of any product grade A, B or C.

4.4.2 Shank diameter

Bolts shall be assessed in accordance with 5.4.2.

4.4.3 Thread tolerance

Bolts and nuts shall be assessed in accordance with 5.4.2.

The thread tolerance classes for mated bolts and nuts shall be in accordance with ISO 965-1, ISO 965-2, ISO 965-3, ISO 965-4 or ISO 965-5 as appropriate for product grade and/or coating, to ensure that the requirements for tensile resistance of the bolting assemblies specified in 4.2.2 are met.

5 Testing and assessment methods

5.1 General

The geometry of test specimens, test apparatus, testing procedure and evaluation of test results are specified in supporting standards for each component of the bolting assembly and for their combinations as bolting assemblies.

5.2 Type (bolting assemblies) - Axial load (bolting assemblies)

Suitability for axial loading of bolting assemblies shall be carried out in accordance with the tensile test of bolting assemblies specified in EN 15048-2.

5.3 Property class (bolting assemblies)

5.3.1 General

The applicability of each test procedure is specified in EN ISO 898-1, EN ISO 898-2, EN ISO 3506-1, EN ISO 3506-2 and EN 28839 depending on the size of the components. Even if a single property is not listed in the following clauses or cannot be tested due to its size, all the requirements apply and can be demonstrated by means of the internal production control for comparable manufacturing lots.

5.3.2 Elongation under tensile load (bolts)

Tensile testing shall be carried out in accordance with EN ISO 898-1, EN ISO 3506-1 or EN 28839 as relevant.

5.3.3 Tensile strength (bolts)

Tensile testing shall be carried out in accordance with EN ISO 898-1, EN ISO 3506-1 or EN 28839 as relevant.

5.3.4 Strength under wedge loading (bolts)

Tensile test under wedge loading shall be carried out in accordance with EN ISO 898-1.

NOTE There is no requirement for bolting assemblies manufactured from aluminium, aluminium alloy or stainless steel.

5.3.5 Tensile yield strength (bolts)

Tensile testing shall be carried out in accordance with EN ISO 898-1, ISO 3506-1 or EN 28839 as relevant.

5.3.6 Proof load (nuts and bolts)

Proof load testing of bolts shall be carried out in accordance with EN ISO 898-1 or EN ISO 3506-1.

Proof load testing of nuts shall be carried out in accordance with EN ISO 898-2 or EN ISO 3506-2.

NOTE There is no requirement for bolting assemblies manufactured from aluminium, aluminium alloy or stainless steel.

5.3.7 Impact strength (bolts)

Impact testing shall be carried out in accordance with EN ISO 898-1.

NOTE There is no requirement for bolting assemblies manufactured from aluminium, aluminium alloy or stainless steel.

5.3.8 Hardness (bolts and nuts)

Hardness testing of bolts shall be carried out in accordance with EN ISO 898-1.

Hardness testing of nuts shall be carried out in accordance with EN ISO 898-2.

NOTE There is no requirement for bolting assemblies manufactured from aluminium, aluminium alloy or stainless steel.

5.4 Product grade (bolts and nuts)

5.4.1 General

Each individual characteristic covered by product grade needs to be checked by means of appropriate measuring or gauging as relevant.

5.4.2 Bolts and nuts

Assessment shall be carried out in accordance with EN ISO 4759-1 before any coating of the components; the thread shall also be checked after any coating.

The tolerances of the components shall be checked by appropriate gauges or measuring equipment of the required accuracy as specified in Table 6 and Table 7.

Table 6 — Bolts

Critical dimension[a]	Accuracy	Method
Width across flats (s) or head diameter (d_k)	≤ 0,05 mm	Measurement
Width across corners (e)	≤ 0,05 mm	Measurement
Head height (k)	≤ 0,05 mm	Measurement
Shank diameter (d_s)	≤ 0,05 mm	Measurement
Length (l)	≤ 0,1 mm	Measurement
Shank length (l_s)	≤ 0,1 mm	Measurement
Grip length (l_g)	≤ 0,1 mm	Measurement
Thread dimensions	_b	Gauge
Head angle (of countersunk bolts) (α)	≤ 0,5°	Measurement

a Symbols and descriptions of dimensions as defined in EN ISO 225.

b The use of GO/NO-GO gauges does not permit the specification of a value of accuracy.

Table 7 — Nuts

Critical dimension[a]	**Accuracy** (mm)	Method
Width across flats (s)	≤ 0,05	Measurement
Width across corners (e)	≤ 0,05	Measurement
Nut height (m)	≤ 0,05	Measurement
Thread dimensions	_b	Gauge

a Symbols and descriptions of dimensions as defined in EN ISO 225.

b The use of GO/NO-GO gauges does not permit the specification of a value of accuracy.

6 Assessment and Verification of Constancy of Performance (AVCP)

6.1 General

The compliance of structural bolting assemblies with the requirements of this standard and with the performances declared by the manufacturer in the Declaration of Performance (DoP) shall be demonstrated by:

— determination of the product-type (type-testing);

— factory production control by the manufacturer, including product assessment.

The manufacturer shall always retain the overall control and shall have the necessary means to take responsibility for the conformity of the product with its declared performance(s).

6.2 Type-testing

6.2.1 General

All performances related to characteristics included in this standard shall be determined when the manufacturer intends to declare the respective performances unless the standard gives provisions for declaring them without performing tests (e.g. use of previously existing data, classification without further testing and conventionally accepted performance).

Assessment previously performed in accordance with the provisions of this standard, may be taken into account provided that they were made to the same or a more rigorous test method, under the same AVCP system on the same product or products of similar design, construction and functionality, such that the results are applicable to the product in question.

For the purposes of assessment, the manufacturer's products may be grouped into families, where it is considered that the results for one or more characteristics from any one product within the family are representative for that same characteristics for all products within that same family.

Products may be grouped in different families for different characteristics.

Reference to the assessment method standards should be made to allow the selection of a suitable representative sample.

In addition, the determination of the product-type shall be performed for all characteristics included in the standard for which the manufacturer declares the performance:

— at the beginning of the production of a new or modified structural bolting assemblies (unless a member of the same product range), or

— at the beginning of a new or modified method of production (where this may affect the stated properties), or

— it shall be repeated for the appropriate characteristic(s), whenever a change occurs in the structural bolting assemblies design, in the raw material or in the supplier of the components, or in the method of production (subject to the definition of a family), which would affect significantly one or more of the characteristics.

Where components are used whose characteristics have already been determined, by the manufacturer or his subcontractor, on the basis of assessment methods of other product standards, these characteristics need not be re-assessed. The specifications of these components shall be documented.

Products bearing regulatory marking in accordance with appropriate harmonized European specifications may be presumed to have the performances declared in the DoP, although this does not replace the responsibility on the structural bolting assemblies manufacturer to ensure that the structural bolting assemblies as a whole is correctly manufactured and its component products have the declared performance values.

6.2.2 Test samples, testing and compliance criteria

The number of samples of structural bolting assemblies to be tested and/or assessed shall be in accordance with Table 8.

Table 8 — Number of samples to be tested and/or assessed compliance criteria

Characteristic	Requirement	Assessment method	Number of samples	Compliance criteria
Type	4.2	5.2	a	All samples tested shall pass the test.
Property class	4.3	5.3	a	All samples tested shall pass the test.
Product grade	4.4	5.4	a	All samples tested shall pass the test.

a 5 tests for each required characteristic
- 4 different nominal diameters which should reflect the different manufacturing methods (if any);
- each property class/property designation;
- each type of coating;
- each type and source of material.

6.2.3 Test reports

The results of the determination of the product-type shall be part of the test reports. All test reports shall be retained by the manufacturer for at least 10 years after the last date of production of the structural bolting assemblies to which they relate.

6.3 Factory production control (FPC)

6.3.1 General

The manufacturer shall establish, document and maintain an FPC system to ensure that the products placed on the market comply with the declared performances related to the essential characteristics.

The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control raw and other incoming materials and components, equipment, the production process and the product.

All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures.

This factory production control system documentation shall ensure a common understanding of the evaluation of the constancy of performance and shall enable the achievement of the required product performances and the effective operation of the production control system to be checked. Factory production control therefore brings together operational techniques and all measures allowing maintenance and control of the compliance of the product with the declared performances related to the essential characteristics.

6.3.2 Requirements

6.3.2.1 General

The manufacturer is responsible for organizing the effective implementation of the FPC system in line with the content of this European standard. Tasks and responsibilities in the production control organization shall be documented and this documentation shall be kept up-to-date.

The responsibility, authority and the relationship between personnel that manages, performs or verifies work affecting product constancy, shall be defined. This applies in particular to personnel that need to initiate actions preventing product non-constancies from occurring, actions in case of non-constancies and to identify and register product constancy problems.

Personnel performing work affecting the constancy of performance of the product shall be competent on the basis of appropriate education, training, skills and experience for which records shall be maintained.

In each factory the manufacturer may delegate the action to a person having the necessary authority to:

— identify procedures to demonstrate constancy of performance of the product at appropriate stages;

— identify and record any instance of non-constancy;

— identify procedures to correct instances of non-constancy.

The manufacturer shall draw up and keep up-to-date documents defining the factory production control. The manufacturer's documentation and procedures should be appropriate to the product and manufacturing process. The FPC system should achieve an appropriate level of confidence in the constancy of performance of the product. This involves:

a) the preparation of documented procedures and instructions relating to factory production control operations, in accordance with the requirements of the technical specification to which reference is made;

b) the effective implementation of these procedures and instructions;

c) the recording of these operations and their results;

d) the use of these results to correct any deviations, repair the effects of such deviations, treat any resulting instances of non-conformity and, if necessary, revise the FPC to rectify the cause of non-constancy of performance.

Where subcontracting takes place, the manufacturer shall retain the overall control of the product and ensure that he receives all the information that is necessary to fulfil his responsibilities in accordance with this European standard.

If the manufacturer has part of the product designed, manufactured, assembled, packed, processed and/or labelled by subcontracting, the FPC of the subcontractor may be taken into account, where appropriate for the product in question.

The manufacturer who subcontracts all of his activities may in no circumstances pass the above responsibilities on to a subcontractor.

NOTE Manufacturers having an FPC system, which complies with EN ISO 9001 standard and which addresses the provisions of the present European standard are considered as satisfying the FPC requirements of the Regulation (EU) No 305/2011.

6.3.2.2 Equipment

6.3.2.2.1 Testing

All weighing, measuring and testing equipment shall be calibrated and regularly inspected in accordance with documented procedures, frequencies and criteria.

6.3.2.2.2 Manufacturing

All equipment used in the manufacturing process shall be regularly inspected and maintained to ensure use, wear or failure does not cause inconsistency in the manufacturing process. Inspections and maintenance shall be carried out and recorded in accordance with the manufacturer’s written procedures and the records retained for the period defined in the manufacturer's FPC procedures.

6.3.2.3 Raw materials and components

The specifications of all incoming raw materials and components shall be documented, as shall the inspection scheme for ensuring their compliance.

6.3.2.4 Traceability and marking

Individual components of structural bolting assemblies as well as their packages shall be identifiable and traceable with regard to their manufacture (manufacturer's identification mark). The manufacturer shall have written procedures ensuring that processes related to affixing traceability codes on labels and markings on structural bolting assemblies are inspected regularly.

6.3.2.5 Controls during manufacturing process

The manufacturer shall plan and carry out production under controlled conditions.

6.3.2.6 Product testing and evaluation

The manufacturer shall establish procedures to ensure that the stated values of the characteristics he declares are maintained. The characteristics, and the means of control, are specified in Table 9:

— Type: shall be subject to the tests specified in 5.2, the minimum frequency of testing shall be as specified in Table 9.

— Property class: shall be subject to the tests specified in 5.3, the minimum frequency of testing shall be as specified in Table 9.

— Product grade: shall be subject to the tests specified in 5.4, the minimum frequency of testing shall be as specified in Table 9.

Table 9 — Frequency of testing for product testing and evaluation as part of FPC

Characteristic		Clause for relevant test	Minimum number of samples and minimum test frequency	
			Delivery condition for single bolting assembly lot	Delivery condition for extended bolting assembly lot
Type	**Bolting assemblies** Axial load ($F_{bi,max}$)	5.2	5 bolting assemblies per bolting assembly lot	1 bolting assembly per bolt manufacturing lot but at least 5 bolting assemblies per extended bolting assembly lot independent of bolt length (i.e. the extended bolting assembly lot may include different bolt lengths but shall only include one manufacturing lot of nuts)
Property class	**Bolts** Tensile strength or Strength under wedge loading or hardness	5.3.3 / 5.3.4 [b] / 5.3.8 [a, b]	1 piece per hour for continuous heat treatment or 1 piece per batch	1 piece per hour for continuous heat treatment or 1 piece per batch
	Nuts proof load or Hardness	5.3.6 [a] / 5.3.8 [a, b]		
Product grade	**Bolting assemblies**	5.4	no mandatory testing	no mandatory testing

a There is no requirement for bolts or nuts manufactured from aluminium or aluminium alloy.

b There is no requirement for bolts or nuts manufactured from aluminium, aluminium alloy or stainless steel.

6.3.2.7 Non-complying products

The manufacturer shall have written procedures which specify how non-complying products shall be dealt with. Any such events shall be recorded as they occur and these records shall be kept for the period defined in the manufacturer's written procedures.

Where the product fails to satisfy the acceptance criteria, the provisions for non-complying products shall apply, the necessary corrective action(s) shall immediately be taken and the products or lots not complying shall be isolated and properly identified.

Once the fault has been corrected, the test or verification in question shall be repeated.

The results of controls and tests shall be properly recorded. The product description, date of manufacture, test method adopted, test results and acceptance criteria shall be entered in the records under the signature of the person responsible for the control/test.

With regard to any control result not meeting the requirements of this European standard, the corrective measures taken to rectify the situation (e.g. a further test carried out, modification of manufacturing process, scrapping or rectification of product) shall be indicated in the records.

6.3.2.8 Corrective action

The manufacturer shall have documented procedures that instigate action to eliminate the cause of non-conformities in order to prevent recurrence.

6.3.2.9 Handling, storage and packaging

The manufacturer shall have procedures providing methods of product handling and shall provide suitable storage areas preventing damage or deterioration.

6.3.3 Product specific requirements

The FPC system shall address this European Standard and ensure that the products placed on the market comply with the declaration of performance.

The FPC system shall include a product specific FPC, which identifies procedures to demonstrate compliance of the product at appropriate stages, i.e.

a) the controls and tests to be carried out prior to and/or during manufacture in accordance with a frequency laid down in the FPC test plan,

and/or

b) the verifications and tests to be carried out on finished products in accordance with a frequency laid down in the FPC test plan.

If the manufacturer carries out verifications and tests only on finished products, the operations under b) shall lead to an equivalent level of compliance of the product as if FPC had been carried out during the production.

If the manufacturer carries out parts of the production himself, the operations under b) may be reduced and partly replaced by operations under a). Generally, the more parts of the production that are carried out by the manufacturer, the more operations under b) may be replaced by operations under a).

In any case the operation shall lead to an equivalent level of compliance of the product as if FPC had been carried out during the production.

NOTE Depending on the specific case, it can be necessary to carry out the operations referred to under a) and b), only the operations under a) or only those under b).

The operations under a) refer to the intermediate states of the product as on manufacturing machines and their adjustment, and measuring equipment etc. These controls and tests and their frequency shall be chosen based on product-type and composition, the manufacturing process and its complexity, the sensitivity of product features to variations in manufacturing parameters etc.

The manufacturer shall establish and maintain records that provide evidence that the production has been sampled and tested. These records shall show clearly whether the production has satisfied the defined acceptance criteria and shall be available for at least three years.

6.3.4 Initial inspection of factory and of FPC

Initial inspection of factory and of FPC shall be carried out when the production process has been finalized and in operation. The factory and FPC documentation shall be assessed to verify that the requirements of 6.3.2 and 6.3.3 are fulfilled.

During the inspection it shall be verified:

a) that all resources necessary for the achievement of the product characteristics included in this European standard are in place and correctly implemented,

and

b) that the FPC-procedures in accordance with the FPC documentation are followed in practice,

and

c) that the product complies with the product-type samples, for which compliance of the product performance to the DoP has been verified.

All locations where final assembly or at least final testing of the relevant product is performed shall be assessed to verify that the above conditions a) to c) are in place and implemented. If the FPC system covers more than one product, production line or production process, and it is verified that the general requirements are fulfilled when assessing one product, production line or production process, then the assessment of the general requirements does not need to be repeated when assessing the FPC for another product, production line or production process.

All assessments and their results shall be documented in the initial inspection report.

6.3.5 Continuous surveillance of FPC

Surveillance of the FPC shall be undertaken once per year. The surveillance of the FPC shall include a review of the FPC test plan(s) and production processes(s) for each product to determine if any changes have been made since the last assessment or surveillance. The significance of any changes shall be assessed.

Checks shall be made to ensure that the test plans are still correctly implemented and that the production equipment is still correctly maintained and calibrated at appropriate time intervals.

The records of tests and measurement made during the production process and to finished products shall be reviewed to ensure that the values obtained still correspond with those values for the samples submitted to the determination of the product-type and that the corrective actions have been taken for non-compliant products.

6.3.6 Procedure for modifications

If modifications are made to the product, production process or FPC system that could affect any of the product characteristics declared in accordance with this standard, then all the characteristics for which the manufacturer declares performance, which may be affected by the modification, shall be subject to the type-testing, as described in 6.2.1.

Where relevant, a re-assessment of the factory and of the FPC system shall be performed for those aspects, which may be affected by the modification.

All assessments and their results shall be documented in a report.

Annex ZA
(informative)

Clauses of this European Standard addressing the provisions of the EU Construction Products Regulation

ZA.1 Scope and relevant characteristics

This European Standard has been prepared under Mandate M/120 "Structural metallic products and ancillaries" given to CEN by the European Commission and the European Free Trade Association.

If this European Standard is cited in the Official Journal of the European Union (OJEU), the clauses of this standard, shown in this annex, are considered to meet the provisions of the relevant mandate, under the Regulation (EU) No 305/2011.

This annex deals with the CE marking of the Non-preloaded structural bolting assemblies intended for the uses indicated in Table ZA.1 and shows the relevant clauses applicable.

This annex has the same scope as in Clause 1 of this standard related to the aspects covered by the mandate and is defined by Table ZA.1.

Table ZA.1 — Relevant clauses for product and intended use

Product:	Non-preloaded structural bolting assemblies
Intended use:	Structural metallic works

Essential Characteristics	Clauses in this and other European Standard(s) related to essential characteristics	Regulatory classes	Notes
Type	4.2	–	type
Property class	4.3	–	class
Product grade	4.4	–	grade

The declaration of the product performance related to certain essential characteristics is not required in those Member States (MS) where there are no regulatory requirements on these essential characteristics for the intended use of the product.

In this case, manufacturers placing their products on the market of these MS are not obliged to determine nor declare the performance of their products with regard to these essential characteristics and the option "No performance determined" (NPD) in the information accompanying the CE marking and in the declaration of performance (see ZA.3) may be used for those essential characteristics.

ZA.2 Procedure for Assessment and Verification of Constancy of Performance (AVCP) of Non-preloaded structural bolting assemblies

ZA.2.1 System of AVCP

The AVCP system of Non-preloaded structural bolting assemblies indicated in Table ZA.1, established by EC Decision(s) 98/214/EC (OJEU L80 of 18.3.1998) as amended by EC Decision 2001/596/EC (OJEU L209 of 2.8.2001) is shown in Table ZA.2 for the indicated intended use.

Table ZA.2 — System of AVCP

Product(s)	Intended use(s)	Level(s) or class(es) of performance	AVCP system
Non-preloaded structural bolting assemblies	Structural metallic works	not applicable	System 2+
System 2+: See Regulation (EU) No. 305/2011 (CPR) Annex V, 1.3 including certification of the factory production control by a notified production control certification body on the basis of initial inspection of the manufacturing plant and of factory production control as well as of continuous surveillance, assessment and evaluation of factory production control.			

The AVCP of the non-preloaded structural bolting assemblies in Table ZA.1 shall be in accordance with the AVCP procedures indicated in Table ZA.3 resulting from application of the clauses of this or other European Standard indicated therein. The content of tasks of the notified body shall be limited to those essential characteristics as provided for, if any, in Annex III of the relevant mandate and to those that the manufacturer intends to declare.

Table ZA.3 — Assignment of AVCP tasks for Non-preloaded structural bolting assemblies under system 2+

Tasks	Content of the task		AVCP clauses to apply
Tasks for the manufacturer	Factory production control (FPC)	Parameters related to essential characteristics of Table ZA.1 relevant for the intended use which are declared	6.3
	determination of the product-type on the basis of type-testing (including sampling), type calculation, tabulated values or descriptive documentation of the product	Parameters related to essential characteristics of Table ZA.1 relevant for the intended use which are declared	6.2.1
	Further testing of samples taken at factory in accordance with the prescribed test plan	Essential characteristics of Table ZA.1 relevant for the intended use which are declared	6.3.2.6, Table 9
Tasks for the notified production control certification body	Initial inspection of the manufacturing plant and of FPC	Parameters related to essential characteristics of Table ZA.1, relevant for the intended use which are declared. Documentation of the FPC.	6.3.4
	Continuous surveillance, assessment and evaluation of FPC	Parameters related to essential characteristics of Table ZA.1, relevant for the intended use which are declared. Documentation of the FPC.	6.3.5

ZA.2.2 Declaration of performance (DoP)

ZA.2.2.1 General

The manufacturer draws up the DoP and affixes the CE marking on the basis of the different AVCP systems set out in Annex V of the Regulation (EU) No 305/2011 on the basis of:

— the determination of the product-type on the basis of type-testing (including sampling), type calculation, tabulated values or descriptive documentation of the product; the factory production control and the testing of samples taken at the factory in accordance with the prescribed test plan, carried out by the manufacturer; and

— the certificate of conformity of the factory production control, issued by the notified production control certification body on the basis of:

  — initial inspection of the manufacturing plant and of factory production control;

  — continuous surveillance, assessment and evaluation of factory production control.

ZA.2.2.2 Content

The model of the DoP is provided in Annex III of the Regulation (EU) No 305/2011.

In accordance with this Regulation, the DoP shall contain, in particular, the following information:

— the reference of the product-type for which the declaration of performance has been drawn up;

— the AVCP system or systems of the construction product, as set out in Annex V of the CPR;

— the reference number and date of issue of the harmonized standard which has been used for the assessment of each essential characteristic;

— where applicable, the reference number of the Specific Technical Documentation used and the requirements with which the manufacturer claims the product complies.

The DoP shall in addition contain:

a) the intended use for the construction product, in accordance with the applicable harmonized technical specification;

b) the list of essential characteristics, as determined in the harmonized technical specification for the declared intended use;

c) the performance of at least one of the essential characteristics of the construction product, relevant for the declared intended use;

d) where applicable, the performance of the construction product, by levels or classes, or in a description, if necessary based on a calculation in relation to its essential characteristics determined in accordance with the Commission determination regarding those essential characteristics for which the manufacturer shall declare the performance of the product when it is placed on the market or the Commission determination regarding threshold levels for the performance in relation to the essential characteristics to be declared;

e) the performance of those essential characteristics of the construction product which are related to the intended use, taking into consideration the provisions in relation to the intended use where the manufacturer intends the product to be made available on the market;

f) for the listed essential characteristics for which no performance is declared, the letters "NPD" (No Performance Determined).

Regarding the supply of the DoP, Article 7 of the Regulation (EU) No 305/2011 applies.

The information referred to in Article 31 or, as the case may be, in Article 33 of Regulation (EC) No 1907/2006, (REACH) shall be provided together with the DoP.

ZA.2.2.3 Example of DoP

The following gives an example of a filled-in DoP for Non-preloaded structural bolting assemblies

DECLARATION OF PERFORMANCE

(To be given by the manufacturer.)

1. Unique identification code of the product-type:

   (To be given by the manufacturer.)

2. Intended use of the construction product, in accordance with the applicable harmonized technical specification, as foreseen by the manufacturer:

   Structural metallic works

3. Name, registered trade name or registered trade mark and contact address of the manufacturer as required under Article 11(5):

   AnyCo SA,

   PO Box 21

   B-1050 Brussels, Belgium

   Tel. +32987654321

   Fax: +32123456789

   e-mail: anyco.sa@provider.be

4. Where applicable, name and contact address of the authorized representative whose mandate covers the tasks specified in Article 12(2):

   Anyone Ltd

   Flower Str. 24

   West Hamfordshire

   UK-589645 United Kingdom

   Tel. +44987654321

   Fax: +44123456789

   e-mail: anyone.ltd@provider.uk

5. System of assessment and verification of constancy of performance of the construction product as set out in CPR, Annex V:

   System 2+

6. In case of the declaration of performance concerning a construction product covered by a harmonized standard:

   Notified factory production control certification body No. 5678 performed the initial inspection of the manufacturing plant and of factory production control and the continuous surveillance, assessment and evaluation of factory production control and issued the certificate of conformity of the factory production control.

7. Declared performance

Essential characteristics	Performance	Harmonized technical specification
Type	SB	EN 15048–1:2016
Property class	8.8/8	
Product grade	C/B	

8. The performance of the product identified in point 1 is in conformity with the declared performance in point 7.

   This declaration of performance is issued under the sole responsibility of the manufacturer identified in point 3.

   Signed for and on behalf of the manufacturer by:

.....

(name and function)

....

(place and date of issue) (signature)

ZA.3 CE marking and labelling

The CE marking symbol shall be in accordance with the general principles set out in Article 30 of Regulation (EC) No 765/2008 and shall be affixed visibly, legibly and indelibly on the label. For single bolting assembly lots the label shall be attached to the packaging of the bolting assemblies. For extended bolting assembly lots that are supplied as components packed in separate packages the label shall appear on the accompanying document.

The CE marking shall be followed by:

— the last two digits of the year in which it was first affixed;

— the name and the registered address of the manufacturer, or the identifying mark allowing identification of the name and address of the manufacturer easily and without any ambiguity;

— the unique identification code of the product-type;

— the reference number of the declaration of performance;

— the level or class of the performance declared;

— the dated reference to the harmonized technical specification applied;

— the identification number of the notified body;

— the intended use as laid down in the harmonized technical specification applied.

The CE marking shall be affixed before the construction product is placed on the market. It may be followed by a pictogram or any other mark notably indicating a special risk or use.

CE 5678	*CE marking, consisting of the "CE"-symbol* *Identification number of the notified production control certification body*
AnyCo Ltd, PO Box 21, B-1050, Brussels, Belgium **16** (To be given by the manufacturer.)	*name and the registered address of the manufacturer, or identifying mark* *Last two digits of the year in which the marking was first affixed* *Reference number of the DoP*
EN 15048-1:2016 (To be given by the manufacturer.) intended to be used in structural metallic works **Type:** SB **Property class:** 8.8/8 **Product grade:** C/B	*No. of European Standard applied, as referenced in OJEU* *Unique identification code of the product-type* *Intended use of the product as laid down in the European standard applied* *Level or class of the performance declared*

Figure ZA.1 — Example CE marking information of products under AVCP system 2+

Bibliography

[1] Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing council directive 89/106/EEC

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

[3] EN 1999-1-1, *Eurocode 9: Design of aluminium structures — Part 1-1: General structural rules*

[4] EN 14399-1, *High-strength structural bolting assemblies for preloading — Part 1: General requirements*

[5] EN ISO 9001, *Quality management systems — Requirements (ISO 9001)*

[6] EN 1090-3, *Execution of steel structures and aluminium structures — Part 3: Technical requirements for aluminium structures*

[7] EN 10204, *Metallic products — Types of inspection documents*

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