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Steel structures — Execution of structural steelwork —

Part 6: **Bolting**

Structures en acier – Exécution des charpentes et ossatures en acier —
Partie 6: Boulonnage

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 167, *Steel and aluminium structures*.

This first edition cancels and replaces ISO 10721-2:1999, which has been technically revised.

A list of all parts in the ISO 17607 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Specific requirements for the achievement of structures that are optimal with respect to safety, the state of the economy, development and general values of a nation are given in the appropriate regional or national standards, if they exist.

Many nations do not have their own standards for structural steelwork. Some reference other national or regional standards. Some permit the project's standard to be selected by the owner, designer or constructor of the structure. Some do not require any standards to be followed.

The ISO 17607 series of standards on the execution of structural steelwork was developed to serve as a means to provide a set of requirements and guidance for projects that are constructed without a governing regional or national standard. The ISO 17607 series can also serve to reduce trade barriers.

Additional requirements to be addressed in the execution of structural steelwork, as structures or as fabricated components, can be found in the other parts of the series:

— ISO 17607-1 (General requirements and terms and definitions);

— ISO 17607-2 (Steels);

— ISO 17607-3 (Fabrication);

— ISO 17607-4 (Erection);

— ISO 17607-5 (Welding).

Steel structures — Execution of structural steelwork —

Part 6: Bolting

1 Scope

This document defines the general requirements for structural bolting in the execution of structural steelwork as structures or as fabricated components, in conjunction with ISO 17607-1.

Additional requirements to be addressed in the execution of structural steelwork, as structures or as fabricated components, can be found in other parts of ISO 17607.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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 898-2, *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 898-3, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 3: Flat washers with specified property classes*

ISO 2859-5, *Sampling procedures for inspection by attributes — Part 5: System of sequential sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

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

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

ISO 4014, *Hexagon head bolts - Product grades A and B*

ISO 4017, *Fasteners – Hexagon head screws – Product grades A and B*

ISO 4032, *Hexagon nuts (style 1) - Product grades A and B*

ISO 4033, *Hexagon nuts, (style 2) - Product grades A and B*

ISO 4042, *Fasteners — Electroplated coating systems*

ISO 6789-1, *Assembly tools for screws and nuts — Hand torque tools — Requirements and test methods for design conformance testing, quality conformance testing and recalibration procedure*

ISO 7089, *Plain washers — Normal series — Product grade A*

ISO 7090, *Plain washers, chamfered — Normal series — Product grade A*

ISO 7091, *Plain washers — Normal series — Product grade C*

ISO 7092, *Plain washers — Small series — Product grade A*

ISO 7093-1, *Plain washers — Large series — Part 1: Product grade A*

ISO 7093-2, *Plain washers — Large series — Part 2: Product grade C*

ISO 7094, *Plain washers — Extra large series — Product grade C*

ISO 10683, *Fasteners — Non-electrolytically applied zinc flake coating systems*

ISO 10684, *Fasteners — Hot dip galvanized coatings*

ISO 14713-3, *Zinc coatings — Guidelines and recommendations for the protection against corrosion of iron and steel in structures — Part 3: Sherardizing*

ISO 16228, *Fasteners — Types of inspection documents*

ISO 17607-1, *Steel structures — Execution of structural steelwork — Part 1: General requirements and vocabulary*

ISO 17607-2, *Steel structures — Execution of structural steelwork — Part 2: Steels*

ISO 17607-3, *Steel structures — Execution of structural steelwork — Part 3: Fabrication*

ISO 17607-4, *Steel structures — Execution of structural steelwork — Part 4: Erection*

ISO 17607-5, *Steel structures — Execution of structural steelwork — Part 5: Welding*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17607-1 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Execution specification and quality requirements

4.1 General

See ISO 17607-1 for execution levels, identification, traceability, and quality requirements.

4.2 Execution specification

National standards and documents that provide technically equivalent conditions may be used, in whole or in part, in place of referenced ISO standards or requirements of this document. In these cases, the technically equivalent national standards and documents, and deviations from the requirements of this document, shall be referenced in the execution specification.

The necessary information and technical requirements for execution of structural bolting shall be agreed on and complete before commencement.

The execution specification shall include the following items (see Annex A) as relevant:

a) required additional information, see A.1;

b) options that may be specified, see A.2;

c) quality requirements related to execution levels, see A.3.

There shall be procedures for making alterations to a previously agreed execution specification.

5 Constituent products

5.1 General

5.1.1 Selection of constituent products

See ISO 17607-1 for selection of constituent products.

5.1.2 Verification of conformance

See ISO 17607-1 for verification of conformance with the order and either relevant standards or specified requirements, or both.

Inspection documents shall be supplied in accordance with ISO 16228, as listed in Table 2, with the information in Table 1 as required.

Table 1 — Inspection reporting for structural bolting products, by requirement

Type of requirement Method of control	Required limit(s) expressed as:	Reported
Chemical composition	Min and max, as applicable	Measured value
Mechanical properties (yield strength, tensile strength, hardness)	Min	Minimum value measured
	Max if applicable	Maximum value measured
	Min and max	Minimum and maximum value measured
Mechanical property (proof load)	Pass/Fail	Conform
Surface condition (carburization/decarburization)	Pass/Fail	Conform
Measurement (Geometry, tolerances)	Min	Minimum value measured
	Max	Maximum value measured
	Min & max	Minimum and maximum value measured
Dimensional attribute (gauge)	Go	Conform
	No-Go	
	Go/No-Go	
Bolting assemblies for preloading (k-value or COV, or both, if required)	k-class, if applicable	k-class
Inspection (VT, MT)	Pass/Fail	Conform

Table 2 — Inspection documents for structural bolting products according to ISO 16228

Constituent product	Inspection documents [a]
Structural bolting assemblies suitable for pretensioning	F3.1[b]
Structural bolting assemblies	F2.1
Bolts[c], nuts[c], or washers[c]	F2.1

[a] If assemblies are marked with a manufacturing lot number and the manufacturer can trace the measured characteristic values from the internal (factory) production control records on the basis of this number, the F3.1 inspection certificate or F2.1 declaration of conformity may be omitted.

[b] The inspection documents shall include the results of the suitability tests, if required.

[c] Applicable if bolts, nuts or washers are supplied for use in non-pretensioned applications, or not as a component of a bolting assembly.

5.2 Structural bolting products

5.2.1 Property classes

Property classes of bolts and nuts and, if appropriate, coatings, shall be specified together with any required options within the product standard.

Structural bolting components and assemblies shall be selected from Annex B.

The mechanical properties shall be specified for:

a) carbon and alloy steel bolting assemblies with larger diameters than those specified in ISO 898-1, ISO 898-2 and ISO 898-3;

b) austenitic or austenitic-ferritic stainless-steel bolting assemblies with larger diameters than those specified in ISO 3506-1 and ISO 3506-2, or those specified in other relevant national standards;

c) atmospheric corrosion-resistant bolting assemblies.

5.2.2 Structural bolting assemblies for non-pretensioned applications

Bolts, nuts, washers, and bolting assemblies that conform to the appropriate product standards as given in Table B.1 through Table B.5 may be used for non-pretensioned applications.

5.2.3 Structural bolting assemblies for pretensioned applications

High-strength structural bolts, nuts, washers and bolting assemblies that conform to the appropriate product standards as given in Table B.1 through Table B.3 may be used for pretensioned applications.

Unless specified in the execution specification, stainless-steel bolts shall not be used in pretensioned applications. If used in pretensioned applications, they shall be treated as special fasteners.

5.2.4 Washers

5.2.4.1 General

Washers that conform to the appropriate product standards as given in Table B.3, or are included as a part of bolting assemblies as given in Table B.1 or Table B.2, may be used for pretensioned applications.

Washers that conform to the appropriate product standards as given in Table B.3 or Table B.5, or are included as a part of bolting assemblies as given in Table B.1, Table B.2, or Table B.4, may be used for non-pretensioned applications.

5.2.4.2 Taper washers

Taper washers shall conform with the relevant product standard for flat washers, except for dimensions applicable to shape, which shall be specified.

NOTE Taper washers are also known as bevelled washers.

5.2.4.3 Plate washers

Plate washers shall be dimensioned with nominal clearances according to Annex C and have dimensions that ensure that the washer overlaps the connected component by at least as much as a standard plain washer would when used with standard round holes.

5.2.5 Direct tension indicators

Direct tension indicators and associated hardened nut face and bolt face washers that conform to the appropriate product standards as given in Table B.6 may be used.

When direct tension indicators are used with bolts loaded in axial tension, the potential loss of pretension should be considered[91].

Direct tension indicators shall not be used with stainless-steel bolts.

If direct tension indicators are used with atmospheric corrosion-resistant bolts, the direct tension indicators shall also be atmospheric corrosion resistant.

NOTE Type 3 direct tension indicators in accordance with ASTM F959/F959M can be suitable as atmospheric corrosion resistant.

5.2.6 Alternative direct tension indicators

Alternative direct tension indicators other than those listed in Table B.6 may be used if permitted by the execution specification.

a) Detailed installation instructions shall be available in a supplemental specification that shall provide, as a minimum, for the:

   1) required character and frequency of pre-installation verification;

   2) alignment of bolt holes to permit insertion of the bolt without undue damage to the threads;

   3) placement of bolting assemblies in all types and sizes of holes, including placement and orientation of the direct tension indicator and other washers;

   4) systematic assembly of the joint, progressing from the most rigid part of the joint until the connected plies are in firm contact;

   5) subsequent systematic pretensioning of all bolts in the joint, progressing from the most rigid part of the joint in a manner that will minimize relaxation of previously pretensioned bolts.

b) Detailed inspection instructions shall be available in a supplemental specification that shall provide, as a minimum, for:

   1) observation of the required pre-installation verification testing;

   2) subsequent routine observation to ensure the proper use of alternative direct tension indicators.

5.2.7 Coated structural bolting components

The corrosion resistance of coated structural bolting components shall be comparable to that specified for the connected components.

Hot-dip galvanized coatings, non-electrolytically applied zinc flake coatings, electroplated coatings, or other coatings of structural bolting components appropriate with the product standards given in Table B.9 may be used, or, in the absence thereof, with the bolting component manufacturer's recommendation.

Protective coatings of structural bolting components shall conform with the requirements of the relevant product standard or, in the absence thereof, with the manufacturer's recommendation.

For bolts of property class 10.9 or equivalent tensile strength or higher, electroplated coatings shall not be used.

NOTE Attention is drawn to the risk of hydrogen embrittlement of electroplated or hot dip galvanized bolts of property class 10.9 or equivalent tensile strength or higher.

5.2.8 Atmospheric corrosion-resistant structural bolting components

The chemical composition of the material of atmospheric corrosion-resistant structural bolting components shall be specified.

5.2.9 Locking devices

If required, devices shall be specified that effectively prevent loosening or loss of pretension of the assembly if subjected to impact, significant vibration, or cyclic loading.

NOTE 1 The use of wedge-locking washers, and the use of double-nutting with proper tightening techniques, have been shown to minimize loss of bolt pretension from self-loosening. Locking devices cannot prevent loss of pretension from relaxation or creep.

To prevent nuts from becoming disengaged from bolts, prevailing torque nuts from ISO 7040, ISO 7042, ISO 7719, and ISO 10511, and the performance requirements given in ISO 2320, can be used unless otherwise specified.

NOTE 2 ISO 2320 includes a test to determine either the performance properties or the torque/clamp force properties, or both, for prevailing torque type steel nuts.

5.2.10 Special structural fasteners

When permitted by the execution specification, special structural fasteners may be used:

— if the property class does not exceed grade 10.9 (or equivalent tensile strength);

— if the bolting component type is subjected to initial testing representative of the product type to demonstrate that its performance is suitable.

Initial testing parameters should include relevant testing requirements for comparable products listed in Annex B.

Detailed installation instructions shall be available in a supplemental specification in accordance with 7.9.

NOTE 1 The use of special fasteners is addressed in 7.9.

NOTE 2 Resin injection bolts are classified as special fasteners and are addressed in EN 1090-2.