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Visokotrdnostne strukturne vijačne zveze za prednapetje - 2. del: Primernost za prednapetje

High-strength structural bolting assemblies for preloading - Part 2: Suitability for preloading

Hochfeste vorspannbare Garnituren für Schraubverbindungen im Metallbau - Teil 2: Eignung zum Vorspannen

Boulonnerie de construction métallique à haute résistance apte à la précontrainte - Partie 2: Aptitude à l'emploi pour la mise en précontrainte

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EUROPEAN STANDARD

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High-strength structural bolting assemblies for preloading - Part 2: Suitability for preloading

Boulonnerie de construction métallique à haute résistance
apte à la précontrainte - Partie 2 : Aptitude à l'emploi pour
la mise en précontrainte

Hochfeste vorspannbare Garnituren für
Schraubverbindungen im Metallbau - Teil 2: Eignung zum
Vorspannen

This European Standard was approved by CEN on 18 October 2014.

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Foreword

This document (EN 14399-2:2015) has been prepared by Technical Committee CEN/TC 185 "Fasteners", the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by August 2015 and conflicting national standards shall be withdrawn at the latest by November 2016.

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 14399-2:2005.

In comparison with EN 14399-2:2005, the following modifications have been made:

- technical requirements and delivery conditions for bolting assemblies have been transferred from EN 14399-1;
- Table 1 containing the overview of the composition of bolting assemblies and component marking has been added;
- requirements for necessary information on the use of tightening methods to be stated on the label or packaging have been added;
- requirements for the test report have been revised.

EN 14399 consists of the following parts, under the general title *High-strength structural bolting assemblies for preloading*:

- *Part 1: General requirements*;
- *Part 2: Suitability for preloading*;
- *Part 3: System HR — Hexagon bolt and nut assemblies*;
- *Part 4: System HV — Hexagon bolt and nut assemblies*;
- *Part 5: Plain washers*;
- *Part 6: Plain chamfered washers*;
- *Part 7: System HR — Countersunk head bolt and nut assemblies*;
- *Part 8: System HV — Hexagon fit bolt and nut assemblies*;
- *Part 9: System HR or HV — Direct tension indicators for bolt and nut assemblies*;
- *Part 10: System HRC — Bolt and nut assemblies with calibrated preload*.

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.

EN 14399-2:2015 (E)**Introduction**

This document on structural bolting reflects the situation in Europe where two technical solutions exist to achieve the necessary ductility of bolt/nut/washer(s) assemblies. These solutions consist of two different systems (HR and HV) of bolt/nut/washer assemblies (see Table 1). Both systems are well proven and it is the responsibility of the experts using structural bolting whether they use the one or the other system.

It is, however, important for the performance of the assembly to avoid mixing up the components of both systems. Therefore, bolts and nuts for both systems are standardized in one single part of this European Standard each and the marking of the components of the same system is uniform.

Preloaded bolted assemblies are very sensitive to differences in manufacture and lubrication. Therefore, it is important that the bolting assemblies are supplied by one manufacturer who is always responsible for the functionality of the bolting assemblies.

For the same reason it is important that coating of the bolting assemblies is under the control of one manufacturer.

Beside the mechanical properties of the components, the functionality of the bolting assemblies requires that the specified preload can be achieved if the bolting assemblies are tightened with a suitable procedure. For this purpose, a test method for the suitability of the bolting assemblies for preloading was created, which will demonstrate whether the functionality of the bolting assemblies is fulfilled.

It should be pointed out that compared to ISO 272 the widths across flats (large series) for M12 and M20 have been changed to 22 mm and 32 mm respectively. These changes are justified by the following reasons.

Under the specific conditions of structural bolting, the compressive stresses under the bolt head or nut for the sizes M12 may become too large with the width across flats of 21 mm, especially if the washer is fitted eccentrically to the bolt axis.

For the size M20, the width across flats of 34 mm is very difficult to be produced. The change to 32 mm is primarily motivated by economics but it should also be pointed out that the width across flats of 32 mm was common practice in Europe.

1 Scope

This European Standard specifies the technical requirements for high-strength structural bolting assemblies in order to ensure the suitability for preloading of bolted connections in metallic structures.

A suitability test is specified to check the behaviour of the structural bolting assemblies so as to ensure that the required preload can be reliably obtained by the tightening methods specified in EN 1090-2 with sufficient margins against overtightening and against failure.

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 14399-1:2015, *High-strength structural bolting assemblies for preloading - Part 1: General requirements*

EN 14399-3, *High-strength structural bolting assemblies for preloading - Part 3: System HR - Hexagon bolt and nut assemblies*

EN 14399-4, *High-strength structural bolting assemblies for preloading - Part 4: System HV - Hexagon bolt and nut assemblies*

EN 14399-5, *High-strength structural bolting assemblies for preloading - Part 5: Plain washers*

EN 14399-6, *High-strength structural bolting assemblies for preloading - Part 6: Plain chamfered washers*

EN 14399-7, *High-strength structural bolting assemblies for preloading - Part 7: System HR - Countersunk head bolt and nut assemblies*

EN 14399-8, *High-strength structural bolting assemblies for preloading - Part 8: System HV - Hexagon fit bolt and nut assemblies*

EN 14399-9, *High-strength structural bolting assemblies for preloading - Part 9: System HR or HV - Direct tension indicators for bolt and nut assemblies*

EN 14399-10, *High-strength structural bolting assemblies for preloading - Part 10: System HRC - Bolt and nut assemblies with calibrated preload*

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)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14399-1:2015 apply.

EN 14399-2:2015 (E)

4 Symbols and units

A	elongation, (mm)
A_s	nominal stress area of the bolt, (mm^2) (see EN ISO 898-1)
d	nominal thread diameter, (mm)
F_b	bolt force during the test, (kN)
F_{bi}	individual value of the bolt force related to a given nut rotation, torque or bolt elongation, (kN)
F_{bm}	mean value of F_{bi} values, (kN)
$F_{bi,max}$	individual value of the maximum bolt force reached during the test, (kN)
$F_{p,C}$	required preload of $0,7 f_{ub} A_s$, (kN)
f_{ub}	nominal tensile strength ($R_{m,nom}$), (MPa)
k	k -factor
k_i	individual value of the k -factor
k_m	mean value of the k -factor
$l_{b,eff}$	effective preloaded bolt length given as the clamp length (Σt) plus half the nominal nut height, (mm)
M	torque applied during the test, (Nm)
M_i	individual value of the torque applied during the test, (Nm)
M_{pi}	individual value of the torque at which the bolt force has first reached the value of $F_{p,C}$, (Nm)
M_{spec}	specified value of the torque to be applied to the bolting assemblies, (Nm)
n	number of test results
s_F	estimated standard deviation of the F_{bi} values for a tightening torque M_{spec}
s_k	estimated standard deviation of the k_i values for the preload $F_{p,C}$
V_k	coefficient of variation of the k -factor for the preload $F_{p,C}$
θ	angle of rotation of the nut relative to the bolt, ($^\circ$)
θ_{pi}	individual value of the angle θ at which the bolt force has first reached the value of $F_{p,C}$, ($^\circ$)
θ_{1i}	individual value of the angle θ at which the bolt force has reached its maximum value $F_{bi,max}$, ($^\circ$)
θ_{2i}	individual value of the angle θ , ($^\circ$)
$\Delta\theta_{1i}$	individual angle difference ($\theta_{1i} - \theta_{pi}$), ($^\circ$)
$\Delta\theta_{2i}$	individual angle difference ($\theta_{2i} - \theta_{pi}$), ($^\circ$)
$\Delta\theta_{2min}$	minimum required value of the angle difference $\Delta\theta_{2i}$ as specified in the relevant product standard ($^\circ$)
Σt	clamp length given as the total thickness of the clamped parts between the nut bearing face and the bolt head bearing face, (mm)

5 Technical requirements for structural bolting assemblies

5.1 Composition of bolting assemblies

The performance of the high-strength structural bolting assemblies as specified in Table 1 depends on the properties of their specific components. Therefore, the essential characteristics listed in EN 14399-1 are assessed through the verification of the properties of the 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.

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EN 14399-2:2015 (E)

Table 1 — Composition of high-strength structural bolting assemblies and component marking

Type of bolting assembly		System HR				System HV		System HRC	
General requirements		EN 14399-1							
Suitability for preloading		EN 14399-2 and, if any, additional testing specified in the product standard							
Bolt and nut		EN 14399-3		EN 14399-7		EN 14399-4	EN 14399-8	EN 14399-10	
Marking	Bolt	HR8.8	HR10.9	HR8.8	HR10.9	HV10.9	HVP10.9	HRC10.9	
	Nut	HR8 or HR10	HR10	HR8 or HR10	HR10	HV10	HV10	HR10	HRD10
Washer(s)		EN 14399-5 ^a or EN 14399-6				EN 14399-6		EN 14399-5 ^a or EN 14399-6	
Marking		H or HR ^b				H or HV ^b		H or HR ^b	H or HR ^b or HD ^c
Direct tension indicator and nut face washer or bolt face washer, if any		EN 14399-9						Not applicable	
Marking	Direct tension indicator	H8	H10	H8	H10	H10			
	Nut face washer	HN				HN			
	Bolt face washer	HB		Not applicable		HB			
^a EN 14399-5 can only be used under the nut. ^b At the choice of the manufacturer. ^c Mandatory mark for washers with enlarged outer diameter according to EN 14399-5 only.									

In order to contribute to the reduction of the risk of hydrogen embrittlement and other hydrogen related failures, the underhead radius of bolts as specified in EN 14399-3, EN 14399-4, EN 14399-8 or EN 14399-10 shall be used for any bolts of property class 10.9.

HR bolts (see EN 14399-3 or EN 14399-7) and HRC bolts (see EN 14399-10) which are too short threaded to meet the requirements for a minimum of four thread pitches under the nut in the bolting assembly according to EN 1090-2 shall be fully threaded.

5.2 Manufacturing requirements

Finish and coating shall be as specified in the relevant part of this standard. Coatings of all components of a bolting assembly shall be compatible and shall have similar corrosion resistance. Coating of each component shall be under the control of the manufacturer.

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.

Bolts of property class 10.9 shall have rolled threads.

Hot dip galvanized nuts shall be galvanized before they are threaded. Nuts shall not be re-threaded.

5.3 Marking of the components of the bolting assemblies

All components used in assemblies for high-strength structural bolting, which are suitable for preloading, shall be marked during the manufacturing process with at least the following:

a) the identification mark of the manufacturer of the bolting assemblies,

and according to Table 1:

b) with the letter H, and

- 1) for bolts and nuts, with additional letter(s) defining the system and the symbol of the property class in accordance with EN ISO 898-1 and EN ISO 898-2, or
- 2) for direct tension indicators, with the symbol 8 or 10 corresponding to the property class of the bolt, or
- 3) for bolt face or nut face washers, with the symbol B or N respectively.

The marking of each type of component shall be assessed by visual inspection. The marking shall conform to the requirements of this subclause.

5.4 Delivery conditions for the bolting assemblies

All components shall be supplied to the purchaser either in the original unopened, single sealed package or alternatively bolts, nuts, washers and direct tension indicators, if any, in separate sealed packages of the same manufacturer of the bolting assemblies.

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

a) Single bolting assembly lot: Bolts, nuts, washers and if any direct tension indicators and nut face washers or bolt face washers shall be 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 14399-1. The