



SLOVENSKI STANDARD

SIST EN 14399-2:2005

01-maj-2005

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

Hochfeste planmäßig vorspannbare Schraubenverbindungen für den Metallbau - Teil 2: Prüfung der Eignung zum Vorspannen

Boulonnerie de construction métallique a haute résistance apte a la précontrainte - Partie 2 : Essai d'aptitude a l'emploi pour la mise en précontrainte

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EUROPEAN STANDARD

EN 14399-2

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

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

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Schraubenverbindungen für den Metallbau - Teil 2: Prüfung
der Eignung zum Vorspannen

This European Standard was approved by CEN on 30 April 2004.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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Foreword

This document (EN 14399-2:2005) has been prepared by Technical Committee CEN/TC 185, "Threaded and non-threaded mechanical fasteners and accessories", 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 September 2005, and conflicting national standards shall be withdrawn at the latest by September 2005.

Rules for design and execution of bolted connections with preloaded high-strength structural bolts are respectively defined in ENV 1993-1-1 (Eurocode 3) and ENV 1090-1 for general rules and rules for buildings.

This test, which determines the functional characteristics identified in the relevant product standards, has been developed to confirm the suitability of a high strength bolt/nut/washer assembly for preloaded bolted connections in civil engineering structures.

This document includes a Bibliography.

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

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EN 14399-2:2005 (E)**1 Scope**

This document specifies a tightening test to verify the suitability of high strength bolt/nut/washer assemblies for pre-loaded bolted connection in metallic structures.

The purpose of this test is to check the behaviour of the fastener assembly so as to ensure that the required preload can be reliably obtained by the tightening methods specified in ENV 1090-1 with sufficient margins against over tightening and against failure.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 14399-1:2005, *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 ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs (ISO 898-1:1999).*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 14399-1:2005 apply.

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	specified 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_{spec}	specified value of the torque to be applied to the bolt, (Nm)
n	number of test results
s_F	estimated standard deviation of the F_{bi} values
s_k	estimated standard deviation of the k_i -values
t	thickness of a clamped part, (mm)
V_F	coefficient of variation of the F_{bi} values
V_k	coefficient of variation of the k_i -values
θ	angle of rotation of the nut relative to the bolt, (°)
θ_{pi}	individual value of the angle θ at which the bolt force has first reached the value of F_p , (°)
θ_{1i}	individual value of the angle θ at which the bolt force has reached its maximum value $F_{bi, max}$, (°)
θ_{2i}	individual value of the angle θ at which the test is stopped, (°)
$\Delta\theta_{1i}$	individual angle difference ($\theta_{1i} - \theta_{pi}$), (°)
$\Delta\theta_{2i}$	individual angle difference ($\theta_{2i} - \theta_{pi}$), (°)
$\Delta\theta_{2 min}$	minimum required value of the angle difference $\Delta\theta_{2i}$ as specified in the relevant product standard (°)
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 Principle of the test

The principle of the test is to tighten the assembly and to measure, during tightening, the following parameters:

- the bolt force;
- the relative rotation between the nut and the bolt;
- the torque, if required;
- the bolt elongation, if required.

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6 Test apparatus

The test apparatus shall be made of steel.

The block on which the assembly is mounted shall be sufficiently rigid.

NOTE Hydraulic measuring devices do not normally meet this requirement.

It is recommended that the stiffness of the test set-up be as high as practicable.

The length of the bolt between the head and the nut shall be adjusted by the use of shims as specified in Table 1. The number of shims shall not exceed four.

Table 1 — Characteristics of shims

Dimensions in millimetres

Nominal bolt diameter	Hole diameter	Outside diameter	Thickness	Hardness for the outside shim	Parallelism
$d \leq M14$	$d + 1$	Not less than the outside assembly washer diameter and sufficient to distribute load adequately to the device	≥ 2	45 HRC to 50 HRC through hardened	$\leq 1 \%$
$M14 < d \leq M24$	$d + 2$				
$d > M24$	$d + 3$				

The bolt force shall be measured by a calibrated device (e.g. dynamometer) with uncertainty of $\pm 2 \%$ of the actual value and a repeatability error of $\pm 1 \%$.

The rotation shall be measured to an uncertainty of $\pm 1^\circ$.

The torque shall be measured by a calibrated torque measuring device with an uncertainty of the value and a repeatability error of $\pm 1 \%$.

The bolt elongation shall be measured to an uncertainty of $\pm 1/100$ mm. Ball bearings may be fitted at the ends of the bolt to facilitate these measurements.

7 Test assemblies

The test shall be carried out on assemblies that include at least a washer under the nut.

Test assemblies shall be taken from a single assembly lot or extended assembly lot (see EN 14399-1). Associated bolts, nuts and washers shall be in accordance with one of the following:

- EN 14399-3 for the HR bolt and nut system associated with washers either according to EN 14399-5 or to EN 14399-6;
- EN 14399-4 for the HV bolt and nut system associated with washers either according to EN 14399-5 or to EN 14399-6.

Each component of a test assembly shall be used once only.

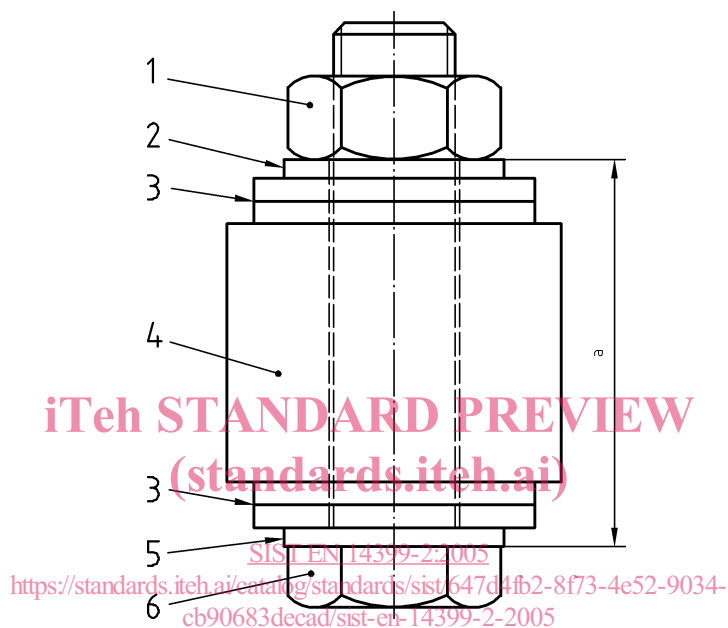
Unless otherwise agreed between the supplier and the purchaser (see Annex A), the tests shall be carried out on test assemblies in the condition of delivery without alteration of the lubrication of the various components.

8 Test set-up

The test set-up (see Figure 1) may include shims (see Table 1) needed to suit the measuring device.

The test assemblies and shims shall be positioned such that:

- a washer of the assembly is placed under the nut;
- a chamfered washer or a chamfered shim is placed under the bolt head;
- the clamp length including shims and washer(s) is the minimum allowed in the relevant product standard.



Key

- 1 Nut: turned during tightening
- 2 Washer of the assembly: prevented from rotating
- 3 Shim(s)
- 4 Calibrated bolt force measuring device
- 5 Chamfered washer of the assembly or chamfered shim
- 6 Bolt head: prevented from rotating

^a Clamp length Σl

Figure 1 — Test set-up

9 Test procedure

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

The tightening shall be carried out by rotation of the nut in a continuous manner and measurements shall be recorded throughout the test.

The speed of rotation of the test shall be between 1 min⁻¹ and 10 min⁻¹.

Neither the bolt nor the washer under the nut shall rotate during the test. If either of them rotates during tightening, the phenomena shall be noted and a new test shall be carried out to replace the test in question.

The test shall be stopped when any one of the following conditions is first satisfied:

- the angle of nut rotation exceeds $(\theta_{pi} + \Delta\theta_{2\text{ min}})$;
- the bolt force drops to F_p ;