SLOVENSKI STANDARD
SIST EN 14399-3:2015

01-maj-2015

Nadomešča:
SIST EN 14399-3:2005

Visokotrdnostne strukturne vijačne zveze za prednapetje - 3. del: Sistem HR - Zveze vijakov s šestrobo glavo in šestrobo matico

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

Hochfeste vorspannbare Garnituren für Schraubverbindungen im Metallbau - Teil 3: System HR - Garnituren aus Sechskantschrauben und -muttern

Boulonnerie de construction métallique à haute résistance apte à la précontrainte - Partie 3: Système HR - Boulons à tête hexagonale (vis + écrou)

Ta slovenski standard je istoveten z: **EN 14399-3:2015**

ICS:

21.060.10	Sorniki, vijaki, stebelni vijaki	Bolts, screws, studs
21.060.20	Matice	Nuts

SIST EN 14399-3:2015 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 14399-3

February 2015

ICS 21.060.01

Supersedes EN 14399-3:2005

English Version

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

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

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN 14399-3:2015) 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of an identical text or by endorsement, at the latest by August 2015 and conflicting national standards shall be withdrawn at the latest by November 2016.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 14399-3:2005.

In comparison with EN 14399-3:2005, the following modifications have been made:

— Table 1 containing the overview of the composition of bolting assemblies and component marking has been added;

— the coefficient of variation of the *k*-factor, V_k, was changed from 0,10 to 0,06;

— specifications for the designation of the bolting assemblies have been revised;

— Annex A with detailed specifications on clamp lengths and grip lengths has been added.

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.

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.

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.

1 Scope

This European Standard specifies, together with EN 14399-1 and EN 14399-2, the requirements for assemblies of high-strength structural bolts and nuts of system HR suitable for preloaded joints with large widths across flats, thread sizes M12 to M36 and property classes 8.8/8 or 8.8/10 and 10.9/10.

Bolting assemblies in accordance with this document have been designed to allow preloading of at least $0{,}7\,f_{ub} \times A_s$ [1)] according to EN 1993-1-8 (Eurocode 3) and to obtain ductility predominantly by plastic elongation of the bolt. For this purpose the components have the following characteristics:

— normal nut height (style 1), see EN ISO 4032;

— thread length of the bolt according to ISO 888.

Bolting assemblies in accordance with this document include washers according to EN 14399-6 or to EN 14399-5 (under the nut only).

NOTE Attention is drawn to the importance of ensuring that bolting assemblies are correctly used if satisfactory results are to be obtained. For recommendations concerning proper application, reference to EN 1090-2 is made.

General requirements and requirements for suitability for preloading are specified in EN 14399-2.

Clamp lengths and grip lengths for the bolting assemblies are specified in the normative Annex A.

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

EN 14399-2, *High-strength structural bolting assemblies for preloading - Part 2: Suitability for preloading*

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 26157-1, *Fasteners - Surface discontinuities - Part 1: Bolts, screws and studs for general requirements (ISO 6157-1)*

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 3269, *Fasteners - Acceptance inspection (ISO 3269)*

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 6157-2, *Fasteners - Surface discontinuities - Part 2: Nuts (ISO 6157-2)*

1) f_{ub} is the nominal tensile strength (R_m) and A_s the nominal stress area of the bolt.

EN ISO 10684, *Fasteners - Hot dip galvanized coatings (ISO 10684)*

ISO 261, *ISO general purpose metric screw threads - General plan*

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*

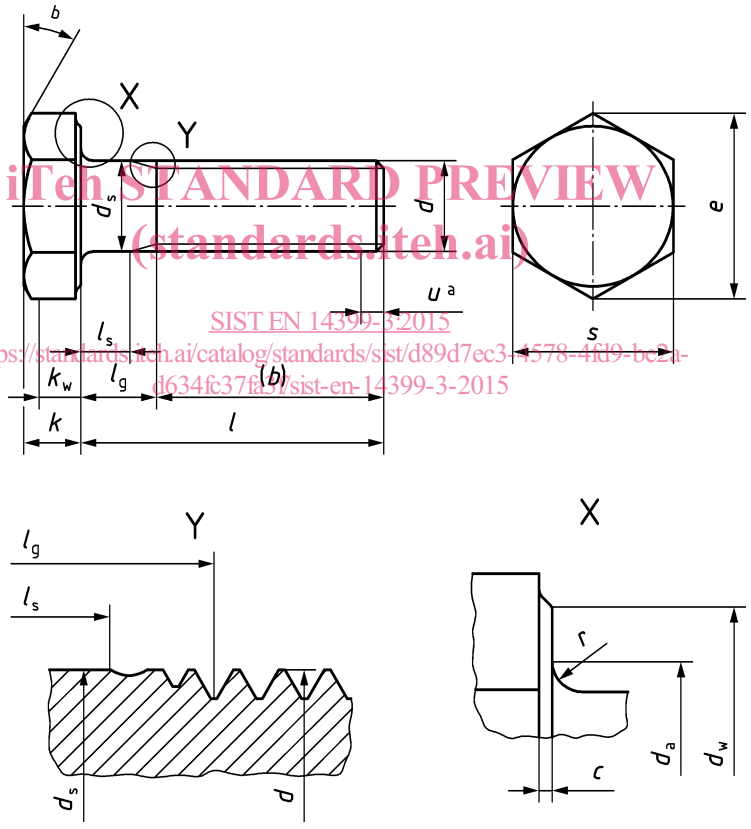
ISO 965-5, *ISO general purpose metric screw threads - Tolerances - Part 5: Limits of sizes for internal screw threads to mate with hot-dip galvanized external screw threads with maximum size of tolerance position h before galvanizing*

ISO 3508, *Thread run-outs for fasteners with thread in accordance with ISO 261 and ISO 262*

3 Bolts

3.1 Dimensions of bolts

See Figure 1 and Table 2.



Key

a incomplete thread $u \leq 2P$

b 15° to 30°

Figure 1 — Dimensions of bolts

The difference between l_g and l_s should not be less than 1,5 P.

For coated bolts, the dimensions apply prior to coating.

Table 2 — Dimensions of bolts

Dimensions in millimetres

Thread *(d)*		M12	(M14)[a]	M16	(M18)[a]	M20
P[b]		1,75	2	2	2,5	2,5
b (ref.)	[c]	30	34	38	42	46
	[d]	–	40	44	48	52
	[e]	–	–	–	–	65
c	max.	0,8	0,8	0,8	0,8	0,8
	min.	0,4	0,4	0,4	0,4	0,4
d_a	max.	15,2	17,2	19,2	21,7	24,4
d_s	max.	12,70	14,70	16,70	18,70	20,84
	min.	11,30	13,30	15,30	17,30	19,16
d_w	max.	[f]	[f]	[f]	[f]	[f]
	min.	20,1	22,0	24,9	27,7	29,5
e	min.	23,91	26,17	29,56	32,95	35,03
k	nom.	7,5	8,8	10	11,5	12,5
	max.	7,95	9,25	10,75	12,40	13,40
	min.	7,05	8,35	9,25	10,60	11,60
k_w	min.	4,90	5,85	6,50	7,42	8,10
r	min.	1,2	1,2	1,2	1,5	1,5
s	max.	22	24	27	30	32
	min.	21,16	23,16	26,16	29,16	31,00

l			l_s and l_g[g, h]									
			l_s	l_g	l_s	l_g	l_s	l_g	l_s	l_g	l_s	l_g
nom.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
35	33,75	36,25	–	7								
40	38,75	41,25	–	7			–	8				
45	43,75	46,25	6,25	15			–	8				
50	48,75	51,25	11,25	20	–	8	–	8			–	10
55	53,5	56,5	16,25	25	11	21	–	8			–	10
60	58,5	61,5	21,25	30	16	26	12	22	–	10	–	10
65	63,5	66,5	26,25	35	21	31	17	27	10,5	23	–	10
70	68,5	71,5	31,25	40	26	36	22	32	15,5	28	11,5	24
75	73,5	76,5	36,25	45	31	41	27	37	20,5	33	16,5	29
80	78,5	81,5	41,25	50	36	46	32	42	25,5	38	21,5	34
85	83,25	86,75	46,25	55	41	51	37	47	30,5	43	26,5	39
90	88,25	91,75	51,25	60	46	56	42	52	35,5	48	31,5	44
95	93,25	96,75	56,25	65	51	61	47	57	40,5	53	36,5	49
100	98,25	101,75	61,25	70	56	66	52	62	45,5	58	41,5	54

110	108,25	111,75			66	76	62	72	55,5	68	51,5	64
120	118,25	121,75			76	86	72	82	65,5	78	61,5	74
130	128	132			80	90	76	86	69,5	82	65,5	78
140	138	142			90	100	86	96	79,5	92	75,5	88
150	148	152			100	110	96	106	89,5	102	85,5	98
160	156	164			110	120	106	116	99,5	112	95,5	108

Thread *(d)*		**M22**	**M24**	**M27**	**M30**	**M36**
P^{b}		2,5	3	3	3,5	4
b (ref.)	[c]	50	54	60	66	78
	[d]	56	60	66	72	84
	[e]	69	73	79	85	97
c	max.	0,8	0,8	0,8	0,8	0,8
	min.	0,4	0,4	0,4	0,4	0,4
d_a	max.	26,4	28,4	32,4	35,4	42,4
d_s	max.	22,84	24,84	27,84	30,84	37,00
	min.	21,16	23,16	26,16	29,16	35,00
d_w	max.	[f]	[f]	[f]	[f]	[f]
	min.	33,3	38,0	42,8	46,6	55,9
e	min.	39,55	45,20	50,85	55,37	66,44
k	nom.	14	15	17	18,7	22,5
	max.	14,90	15,90	17,90	19,75	23,55
	min.	13,10	14,10	16,10	17,65	21,45
k_w	min.	9,2	9,9	11,3	12,4	15,0
r	min.	1,5	1,5	2,0	2,0	2,0
s	max.	36	41	46	50	60
	min.	35,0	40,0	45,0	49,0	58,8

l			l_s and l_g [g, h]									
			l_s	l_g	l_s	l_g	l_s	l_g	l_s	l_g	l_s	l_g
nom.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
50	48,75	51,25	–	10								
55	53,5	56,5	–	10								
60	58,5	61,5	–	10	–	12	–	12				
65	63,5	66,5	–	10	–	12	–	12				
70	68,5	71,5	–	10	–	12	–	12	–	14		
75	73,5	76,5	12,5	25	–	12	–	12	–	14		
80	78,5	81,5	17,5	30	–	12	–	12	–	14		
85	83,25	86,75	22,5	35	16	31	–	12	–	14	–	16
90	88,25	91,75	27,5	40	21	36	15	30	–	14	–	16

95	93,25	96,75	32,5	45	26	41	20	35	–	14	–	16
100	98,25	101,75	37,5	50	31	46	25	40	16,5	34	–	16
110	108,25	111,75	47,5	60	41	56	35	50	26,5	44	–	16
120	118,25	121,75	57,5	70	51	66	45	60	36,5	54	22	42
130	128	132	61,5	74	55	70	49	64	40,5	58	26	46
140	138	142	71,5	84	65	80	59	74	50,5	68	36	56
150	148	152	81,5	94	75	90	69	84	60,5	78	46	66
160	156	164	91,5	104	85	100	79	94	70,5	88	56	76
170	166	174			95	110	89	104	80,5	98	66	86
180	176	184			105	120	99	114	90,5	108	76	96
190	186	194			115	130	109	124	100,5	118	86	106
200	196	204			125	140	119	134	110,5	128	96	116

NOTE 1 Preferred lengths are defined in terms of lengths $l_{s,min}$ and $l_{g,max}$.

[a] Non-preferred sizes.

[b] P is the pitch of thread.

[c] For lengths $l_{nom} \leq 125$ mm.

[d] For lengths 125 mm < $l_{nom} \leq 200$ mm.

[e] For lengths $l_{nom} > 200$ mm.

[f] $^{d}w,max = {}^{s}actual$

[g] $l_{g,max} = l_{nom} - b$ $l_{s,min} = l_{g,max} - 5P$

[h] When $l_{s,min}$ as calculated by the formula in [g] is less than $0,5d$ then the bolts be fully threaded, and in this case $l_{g,max}$ is equal to a_{max} as specified in ISO 3508 for product grade C, i.e. $4P$. Fully threaded bolts are shown above the stepped line.