
International Standard



7411

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Hexagon bolts for high-strength structural bolting with large width across flats (thread lengths according to ISO 888) — Product grade C — Property classes 8.8 and 10.9

Vis à tête hexagonale à serrage contrôlé pour constructions métalliques, à surplats série large (longueurs filetées conformes à l'ISO 888) — Grade C — Classes de qualité 8.8 et 10.9

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ISO 7411-1984 (E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 7411 was prepared by Technical Committee ISO/TC 2, *Fasteners*.

Hexagon bolts for high-strength structural bolting with large width across flats (thread lengths according to ISO 888) — Product grade C — Property classes 8.8 and 10.9

0 Introduction

This International Standard is part of the complete ISO product standard series on hexagon drive fasteners. The series comprises:

- a) hexagon head bolts (ISO 4014, ISO 4015 and ISO 4016);
- b) hexagon head screws (ISO 4017 and ISO 4018);
- c) hexagon nuts (ISO 4032, ISO 4033, ISO 4034, ISO 4035 and ISO 4036);
- d) hexagon flanged bolts;¹⁾
- e) hexagon flanged screws;¹⁾
- f) hexagon flanged nuts (ISO 4161);
- g) structural bolting (ISO 4775 and ISO 7411 to ISO 7417).

1 Scope and field of application

This International Standard gives specifications for large series hexagon, high-strength structural bolts with metric dimensions in property classes 8.8 and 10.9, and thread sizes from M12 up to and including M36, with thread lengths according to ISO 888.

If in special cases specifications other than those listed in this International Standard are required, it is recommended that they are selected from existing International Standards, for example, ISO 261, ISO 888, ISO 898 and ISO 965.

Bolts to this International Standard when matched with the appropriate nut (see ISO 4775) have been designed to provide an assembly with a high level of assurance against failure by

thread stripping on overtightening. This applies to all property classes and finishes except 8.8S U²⁾ and 10.9S U²⁾ bolts which may be adopted by agreement between the purchaser and the supplier. 8.8S U and 10.9S U bolts must be matched with 6H galvanized nuts to ISO 4775 and the resulting assembly may show failure by thread stripping on overtightening.

NOTE — Attention is drawn to the importance of ensuring that the bolts are correctly used if satisfactory results are to be obtained. For recommendations concerning proper application, reference should be made to an appropriate bolting code.

2 References

ISO 261, *ISO general purpose metric screw threads — General plan.*

ISO 888, *Bolts, screws and studs — Nominal lengths, and thread lengths for general purpose bolts.*

ISO 898, *Mechanical properties of fasteners.*

ISO 965, *ISO general purpose metric screw threads — Tolerances.*

ISO 1461, *Metallic coatings — Hot dip galvanized coatings on fabricated ferrous products — Requirements.*

ISO 3269, *Fasteners — Acceptance inspection.*

ISO 4753, *Fasteners — Ends of parts with external metric ISO thread.*

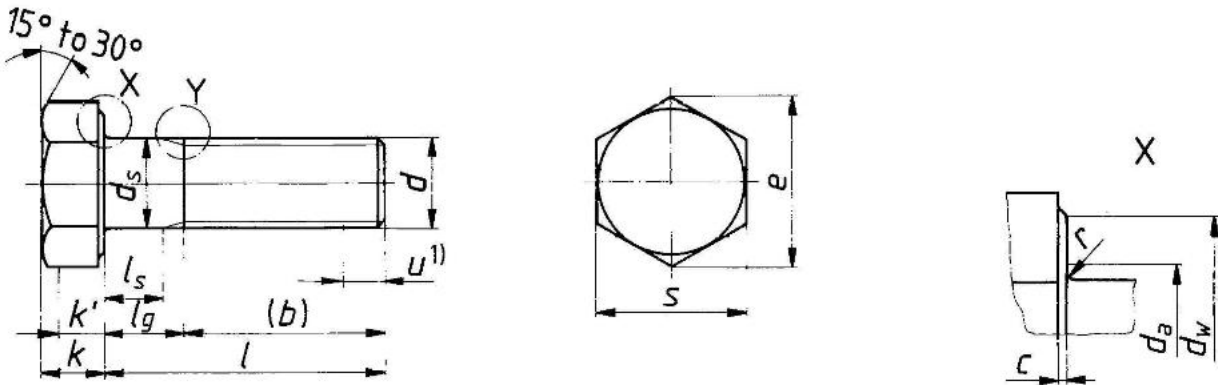
ISO 4759/1, *Tolerances for fasteners — Part 1: Bolts, screws and nuts, with thread diameters > 1,6 and < 150 mm and product grades A, B and C.*

ISO 4775, *Hexagon nuts for high-strength structural bolting with large width across flats — Product grade B — Property classes 8 and 10.*

1) These will be the subject of a future International Standard.

2) See clause 7.

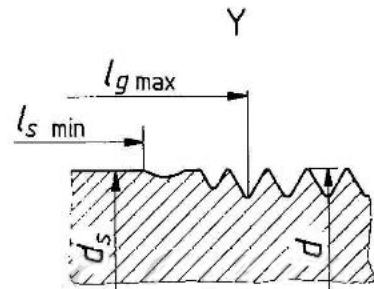
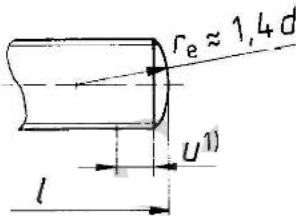
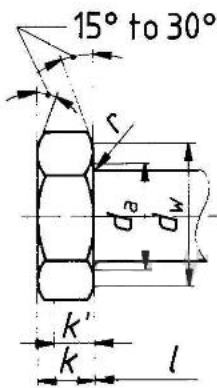
3 Dimensions



Alternatives

Head type for bolts of thread size $d > M20$

Rounded bolt end



NOTE - The difference between $l_g \text{ max}$ and $l_s \text{ min}$ shall not be less than $1,5 P$.

1) Incomplete thread $u < 2 P$.

Table 1 — General dimensions¹⁾

Dimensions in millimetres

Thread size, <i>d</i>		M12 ²⁾	M16	M20	(M22) ³⁾	M24	(M27) ³⁾	M30	M36										
<i>P</i> ⁴⁾		1,75	2	2,5	2,5	3	3	3,5	4										
<i>b_{ref}</i>	5)	30	38	46	50	54	60	66	78										
	6)	—	44	52	56	60	66	72	84										
	7)	—	—	65	69	73	79	85	97										
<i>c</i>	max.	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,8										
	min.	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4										
<i>d_a</i>	max.	14,7	18,7	23,24	25,24	27,64	31,24	34,24	41,00										
<i>d_s</i>	max.	12,70	16,70	20,84	22,84	24,84	27,84	30,84	37,00										
	min.	11,30	15,30	19,16	21,16	23,16	26,16	29,16	35,00										
<i>d_w</i>	max.	8)	8)	8)	8)	8)	8)	8)	8)										
	min.	19,2	24,9	31,4	33,3	38,0	42,8	46,5	58,9										
<i>e</i>	min.	22,78	29,56	37,29	39,55	45,20	50,85	55,37	66,44										
<i>k</i>	nom.	7,5	10	12,5	14	15	17	18,7	22,5										
	max.	7,95	10,75	13,40	14,90	15,90	17,90	19,75	23,55										
	min.	7,05	9,25	11,60	13,10	14,10	16,10	17,65	21,45										
<i>k'</i>	min.	4,9	6,5	8,1	9,2	9,9	11,3	12,4	15,0										
<i>r</i>	min.	0,6	0,6	0,8	0,8	1,0	1,2	1,2	1,5										
<i>s</i>	max.	21	27	34	36	41	46	50	60										
	min.	20,16	26,16	33	35	40	45	49	58,8										
<i>l</i>		<i>l_s</i> and <i>l_g</i> ^{9), 10)}																	
nom.	min.	max.	<i>l_s</i> min.	<i>l_g</i> max.	<i>l_s</i> min.	<i>l_g</i> max.	<i>l_s</i> min.	<i>l_g</i> max.	<i>l_s</i> min.	<i>l_g</i> max.	<i>l_s</i> min.	<i>l_g</i> max.	<i>l_s</i> min.	<i>l_g</i> max.	<i>l_s</i> min.	<i>l_g</i> max.	<i>l_s</i> min.	<i>l_g</i> max.	
30	28,95	31,05																	
35	33,75	36,25	6	11,25															
40	38,75	41,25	6	11,25	8	14													
45	43,75	46,25	7,1	15	8	14	10	17,5											
50	48,75	51,25	12,1	20	8	14	10	17,5	11	18,5									
55	53,5	56,5	17,1	25	8	17	10	17,5	11	18,5	12	21							
60	58,5	61,5	22,1	30	13	22	10	17,5	11	18,5	12	21	13,5	22,5					
65	63,5	66,5	27,1	35	18	27	10	17,5	11	18,5	12	21	13,5	22,5					
70	68,5	71,5	32,1	40	23	32	12,7	24	11	18,5	12	21	13,5	22,5	15	25,5			
75	73,5	76,5	37,1	45	28	37	17,7	29	13,7	25	12	21	13,5	22,5	15	25,5			
80	78,5	81,5	42,1	50	33	42	22,7	34	18,7	30	12,5	26	13,5	22,5	15	25,5			
85	83,25	86,75	47,1	55	38	47	27,7	39	23,7	35	17,5	31	13,5	22,5	15	25,5	18	30	
90	88,25	91,75	52,1	60	43	52	32,7	44	28,7	40	22,5	36	16,5	30	15	25,5	18	30	
95	93,25	96,75	57,1	65	48	57	37,7	49	33,7	45	27,5	41	21,5	35	15	25,5	18	30	
100	98,25	101,75	62,1	70	53	62	42,7	54	38,7	50	32,5	46	26,5	40	18,2	34	18	30	
110	108,25	111,75			63	72	52,7	64	48,7	60	42,5	56	36,5	50	28,2	44	18	30	
120	118,25	121,75			73	82	62,7	74	58,7	70	52,5	66	46,5	60	38,2	54	24	42	
130	128	132			77	86	66,7	78	62,7	74	56,5	70	50,5	64	42,2	58	28	46	
140	138	142			87	96	76,7	88	72,7	84	66,5	80	60,5	74	52,2	68	38	56	
150	148	152			97	106	86,7	98	82,7	94	76,5	90	70,5	84	62,2	78	48	66	
160	156	164									86,5	100	80,5	94	72,2	88	58	76	
170	166	174									96,5	110	90,5	104	82,2	98	68	86	
180	176	184									106,5	120	100,5	114	92,2	108	78	96	
190	186	194									116,5	130	110,5	124	102,2	118	88	106	
200	196	204									126,5	140	120,5	134	112,2	128	98	116	

- 1) For hot-dip galvanized bolts, the above dimensions apply before galvanizing.
- 2) Non-preferred for technical reasons.
- 3) Indicates second choice diameter.
- 4) *P* = pitch of thread
- 5) For lengths $l_{nom} < 100$ mm.
- 6) For lengths $100 \text{ mm} < l_{nom} < 200$ mm.

7) For lengths $l_{nom} > 200$ mm.

8) $d_w \text{ max} = s_{\text{actual}}$

9) $l_g \text{ max} = l_{nom} - d_{ref}$
 $l_s \text{ min} = l_g \text{ max} - 3P$

10) When $l_s \text{ min}$ is less than $0,5d$ as calculated by the formula in 9) then its values shall be $0,5d$. Bolts with shortened thread length are shown above the dotted line. Above this line $l_g \text{ max} = l_s \text{ min} + 3P$.

NOTE — The popular lengths are shown between heavy lines.

4 Specifications and reference standards

Table 2 — Specifications and reference standards

Material		Steel	
Thread	Tolerance	6 g ¹⁾	
	International Standard	ISO 261, ISO 965	
Mechanical properties	Class	8.8	10.9
	International Standard	ISO 898/1	
Surface finish	normal	Black oxide ²⁾	
	optional ³⁾	Zinc electroplated ⁴⁾	Zinc electroplated ⁵⁾
		Cadmium electroplated ⁴⁾	Cadmium electroplated ⁵⁾
		Hot-dip galvanized to ISO 1461	Hot-dip galvanized to ISO 1461 ⁶⁾
Tolerances	Product grade	C except: $c, d_w \min (0,95 s_{\min})$ and r . Tolerance for lengths over 180 mm: $\pm 4,0$ mm	
	International Standard	ISO 4759/1	
Acceptability		For acceptance procedure, see ISO 3269.	
Associated nuts		ISO 4775	
Associated plain hole washers		ISO 7415	
Associated chamfered hole washers		ISO 7416	

1) The tolerance class specified applies before electroplating or hot-dip galvanizing. Hot-dip galvanized bolts may also be supplied by agreement between the user and the manufacturer, having screw threads which after galvanizing shall be accepted by a GO gauge of the basic thread size, i.e. the bolt threads are undersized before galvanizing to tolerance class 6az to accommodate the zinc coating. These bolts are designated and marked 8.8S U or 10.9S U (see also clauses 6 and 7). Tolerance class 6az is in the course of preparation, but in the interim the screw thread dimensions are given in annex A.

2) Black oxide means the normal finish resulting from manufacture with a light coating of oil.

3) Other coatings may be negotiated between the purchaser and the manufacturer provided they do not impair the mechanical properties.

4) This will be the subject of a future International Standard.

5) Precautions to avoid hydrogen embrittlement may be necessary. Reference should be made to the future International Standard dealing with electroplating of threaded components.

6) Precautions to avoid hydrogen embrittlement may be necessary.

5 Lubricant coating for zinc coated fasteners

For fasteners with zinc electroplated or hot-dip galvanized coatings the manufacturer shall apply a suitable lubricant coating on the bolts, or the mating nuts, to ensure that seizure shall not take place in assembly. Information on a suitable test for the effectiveness of the lubricant coating is given in annex B.

6 Designation

Example for the designation of a high-strength structural bolt with a large series hexagon head and thread length in accordance with ISO 888 with a thread size $d = M16$, nominal length $l = 80$ mm and property class 8.8:

Hexagon bolt ISO 7411 - M16 × 80 - 8.8

NOTES

- 1 If surface finishes other than normal are used, the specified surface shall be added to the designation.
- 2 If bolts with undersized threads are required the letter "U" shall be added to the designation (see clause 7).

7 Marking

High-strength structural bolts shall be marked in the following manner:

a) designation symbols

- 1) a strength grade marking in accordance with ISO 898/1,
- 2) the letter S to denote a high-strength structural bolt with a large series hexagon head,
- 3) the letter U to indicate when, by agreement between the manufacturer and the user, bolts have been made with threads undersized before galvanizing;

Example

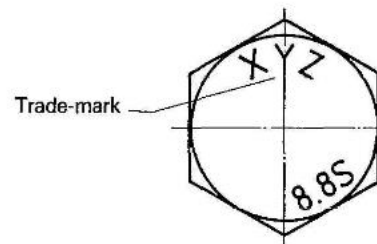
8.8S or 10.9S, or

8.8S U or 10.9S U

b) the manufacturer's identification mark.

It is permissible for the marking to be either embossed or indented on the top surface of the head.

Example of bolt marking



Annex A

Deviations for external threads tolerance class 6az

This annex gives information on the screw thread limits for hot-dip galvanized bolts with a thread tolerance class 6az. The limits given in table 3 apply before the hot-dip galvanized coating has been applied. After galvanizing the bolt threads shall be accepted by a GO gauge of basic size, i.e. deviation h.

The deviation az in micrometres is based on the following formula:

$$es_{az} = -(300 + 20P)$$

Table 3 — Screw thread limits for tolerance class 6az

Dimensions in millimetres

Thread size <i>d</i>	Length of thread engagement		Major diameter		Pitch diameter		Minor diameter	Root radius
	over	up to and including	max.	min.	max.	min.	max. ¹⁾	min.
M 12	6	18	11,665	11,400	10,528	10,378	9,771	0,175
M 16	8	24	15,660	15,380	14,361	14,201	13,495	0,200
M 20	10	30	19,650	19,315	18,026	17,856	16,944	0,250
(M 22)	10	30	21,650	21,315	20,026	19,856	18,944	0,250
M 24	12	36	23,640	23,265	21,691	21,491	20,392	0,300
(M 27)	12	36	26,640	26,265	24,691	24,491	23,392	0,300
M 30	15	45	29,630	29,205	27,357	27,145	25,841	0,350
M 36	18	53	35,620	35,145	33,022	32,798	31,290	0,400

1) Refers to the imaginary coaxial cylinder through the points where the requirement with regard to straightness of flank ceases.

Annex B

Anti-seizing test for zinc electroplated and hot-dip galvanized fasteners

A method for testing the effectiveness of the lubricant coating applied to zinc electroplated and hot-dip galvanized assemblies is as follows:

a) The test shall be carried out on bolts and nuts in the condition as supplied by the manufacturer and shall be in accordance with, and include a lubricant coating as required by clause 5. There shall be no other lubricant applied for the purpose of this test. In cases where the two foregoing criteria cannot be met, then the anti-seizing test shall be by agreement between the manufacturer and the user, but a lubricant coating must still be applied. If the test is performed by the user it shall be carried out immediately after receipt of the bolts and nuts from the manufacturer.

b) The bolt with nut and washer selected for testing shall be placed with the washer directly under the nut in a steel joint with total thickness so that, where thread length permits, there are not less than six full bolt threads located between the bearing surface of the bolt head and nut. The diameter of the holes in the assembly shall be 1 to 2 mm larger than that of the bolt.

c) The nut shall be initially tightened to produce a load in the bolt not less than 10 % of the specified proof load. After this initial tightening, the bolt and the nut position shall be marked to provide the starting point for the rotational movement to be measured. During nut rotation the bolt head shall be restrained from turning, and the final tensioning shall be completed without stopping the motion of the nut. The nut shall be rotated in accordance with the requirements of table 4 from the initial tightening position without fracture of the bolt, or stripping of the bolt or nut thread.

This test may be replaced with an alternative test by agreement between the manufacturer and the user.

Table 4 — Nut rotation requirements

Bolt length (nominal)	Nut rotation (minimum)
$l < 2d$	180°
$2d < l < 3d$	240°
$3d < l < 4d$	300°
$4d < l < 8d$	360°
$l > 8d$	420°