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भारतीय मानक मसौदा
उच्च शक्ति संरचनात्मक बोल्ट – विशिष्टि
(IS 3757 का तीसरा पुनरीक्षण)

Draft Indian Standard

High Strength Structural Bolts — Specification
(*Third Revision of IS 3757*)

ICS 21.060.20

General Engineering and Fasteners Standards Sectional Committee, PGD 37	Last date for receipt of comment is 11 July 2024
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FOREWORD

(Formal Clauses will be added later)

This standard was first published in 1966 as 'Specification for high tensile friction grip fasteners for structural engineering purposes'. First revision catered for high tensile friction grip bolts only and the corresponding nuts and washers were covered by separate standards. In the second revision, the title of the standard was changed to 'High strength structural bolts' to enable them to be used for both friction-type and bearing type of structural steel connections with the same bolting installation procedure. Further, shorter thread lengths were provided to ensure no thread protrusion in the shear plane so that higher working stresses can be adopted for bearing-type connections. Also, due to technical reasons, the width across flats for M20 size was changed from 32 to 34 mm in line with IS 9519 : 1980 'Width across flats for hexagon head bolts and nuts'.

The third revision of this standard has been taken up to keep pace with the latest technological developments and international practices. In this revision following changes have been made:

- a) Amendment 1 and Amendment 2 have been incorporated,
- b) Size M12 has been added,
- c) Marking requirements have been revised, and
- d) References have been updated.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*).' The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

High Strength Structural Bolts — Specification

(Third Revision of IS 3757)

1 SCOPE

This standard covers the requirements for large series hexagon, high strength structural steel bolts in property classes 8.8 and 10.9 and in the size range M12 to M36 with short thread lengths suitable for use in both friction-type and bearing-type structural steel joints. Bolts to this standard when matched with the appropriate nuts have been designed to provide an assembly with a high level of assurance against 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.

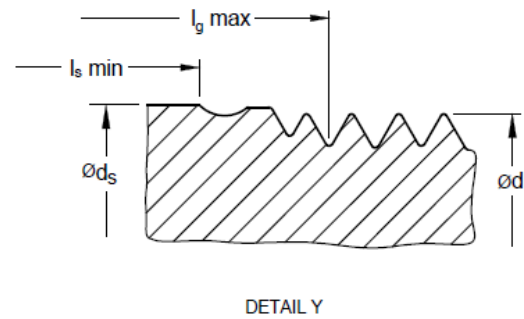
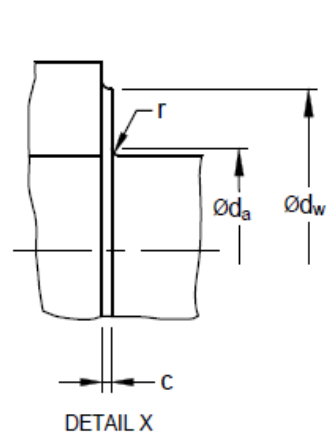
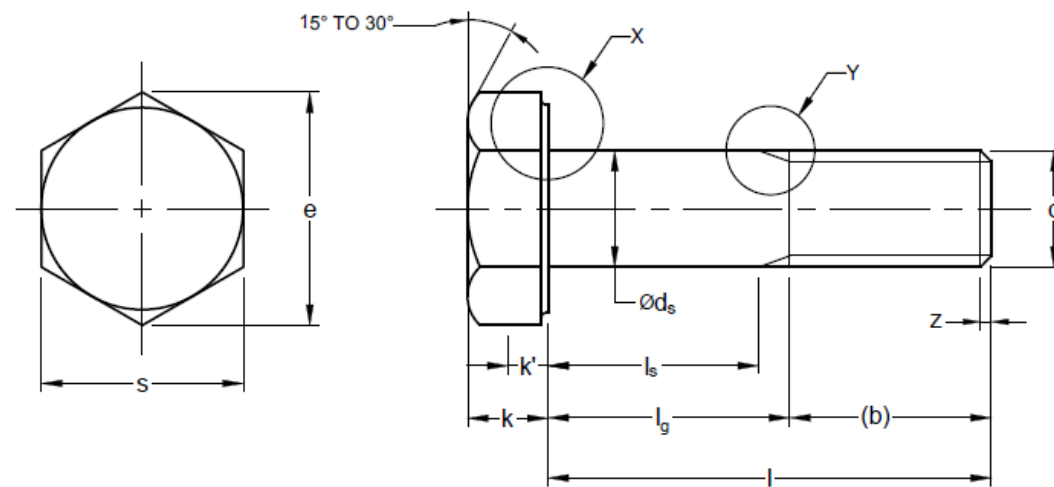
2 REFERENCES

The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below:

<i>IS</i>	<i>Title</i>
IS 1367 (Part 1) : 2014/ ISO 8992 : 2005	Technical supply conditions for threaded steel fasteners: Part 1 Introduction and general information (<i>fourth revision</i>)
IS 1367 (Part 2) : 2002/ ISO 4759-1:2000	Technical supply conditions for threaded steel fasteners: Part 2 Tolerances for fasteners — Bolts, screws, studs and nuts — Product grades A, B and C (<i>third revision</i>)
IS 1367 (Part 3) : 2017/ ISO 898-1 : 2013	Technical supply conditions for threaded steel fasteners: Part 3 Mechanical properties of fasteners made of carbon steel and bolts, screws and studs (<i>fifth revision</i>)
IS 1367 (Part 9/Sec 1) : 1993	Technical supply conditions for threaded steel fasteners: Part 9 Surface discontinuities, Section 1 Bolts, screws and studs (<i>third revision</i>)
IS 1367 (Part 13) : 2020/ ISO 10684 : 2004	Technical supply conditions for threaded steel fasteners: Part 13 Hot dip galvanized coatings on threaded fasteners (<i>third revision</i>)
IS 1367 (Part 17) : 2005/ ISO 3269 : 2000	Technical supply conditions for threaded steel fasteners: Part 17 Inspections, sampling and acceptance procedure (<i>fourth revision</i>)
IS 1367 (Part 18) : 1996	Industrial fasteners — Threaded steel fasteners — Technical supply conditions: Part 18 Packaging (<i>third revision</i>)
IS 6623 : 2004	High strength structural nuts — Specification (<i>second revision</i>)
IS 6649 : 2024	Hardened and tempered washers for high strength structural bolts and nuts — Specification (<i>third revision</i>)
IS 14962 (Part 2) : 2001/ ISO 965-2:1998	ISO general purpose metric screw threads — Tolerances: Part 2 Limits of sizes for general purpose external and internal screw threads — Medium quality

3 DIMENSIONS AND TOLERANCES

3.1 The dimensions of the bolts shall be as given in Fig. 1 and Fig. 2 and Table 1.



Note:- The difference between l_g Max and l_s Min must not be less than 1.5 P.

FIG.1 DIMENSIONS

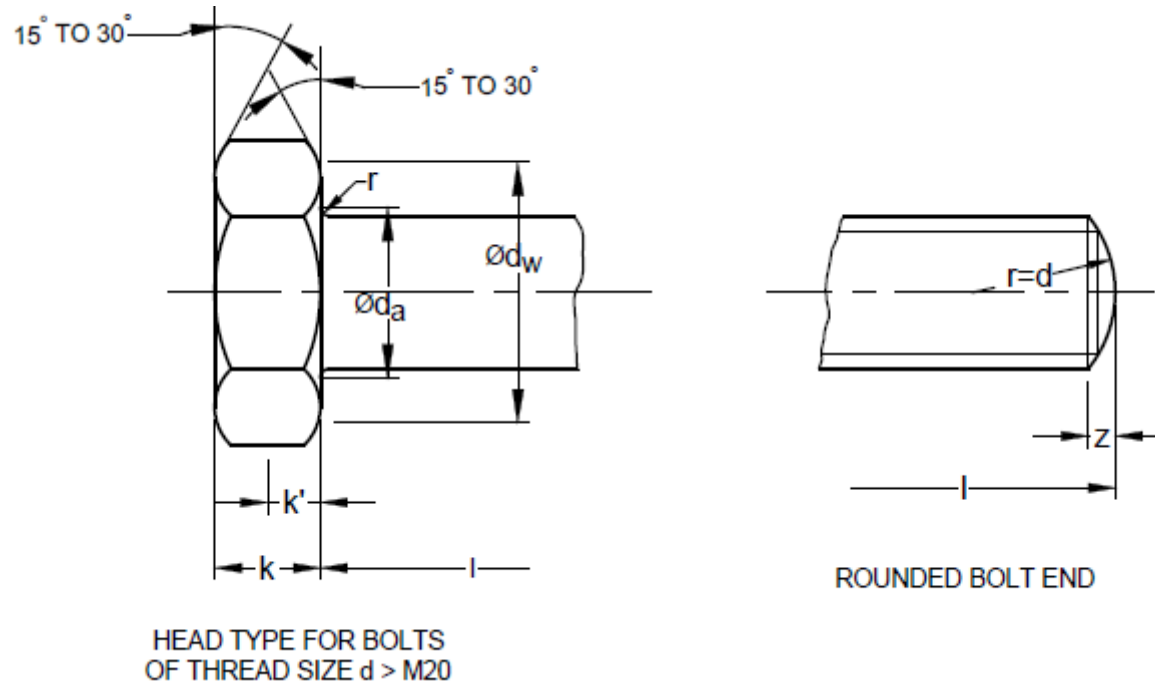


FIG. 2 HIGH STRENGTH STRUCTURAL BOLTS (ALTERNATE DESIGN)

Table 1 Dimensions for High Strength Structural Bolts

(Clause 3.1)

All dimensions are in millimetres

SI No.	Thread Size d	M12	M16	M20	(M22)	M24	(M27)	M30	M36	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
i)	Pitch of thread, P	1.75	2	2.5	2.5	3	3	3.5	4	
ii)	b_{ref} for length l <i>Nom</i>	≤ 100	25	31	36	38	41	44	49	56
		> 100	32	38	43	45	48	51	56	63
iii)	c	<i>Max</i>	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
		<i>Min</i>	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
iv)	d_a	<i>Max</i>	14.7	18.7	23.24	25.24	27.64	31.24	34.24	41.00
v)	d_s	<i>Max</i>	12.70	16.70	20.84	22.84	24.84	27.84	30.84	37.00
		<i>Min</i>	11.30	15.30	19.16	21.16	23.16	26.16	29.16	35.00
vi)	d_w	<i>Max</i>	1) ¹⁾	1) ¹⁾	1) ¹⁾	1) ¹⁾	1) ¹⁾	1) ¹⁾	1) ¹⁾	1) ¹⁾
		<i>Min</i>	19.2	24.9	31.4	33.3	38.0	42.8	46.5	55.9
vii)	e	<i>Min</i>	22.78	29.56	37.29	39.55	45.20	50.85	55.37	66.44
viii)	k	<i>Nom</i>	7.5	10	12.5	14	15	17	18.7	22.5
		<i>Max</i>	7.95	10.75	13.40	14.90	15.90	17.90	19.75	23.55
		<i>Min</i>	7.05	9.25	11.60	13.10	14.10	16.10	17.65	21.45
ix)	k'	<i>Min</i>	4.9	6.5	8.1	9.2	9.9	11.3	12.4	15.0
x)	r	<i>Min</i>	0.6	0.6	0.8	0.8	1.0	1.2	1.2	1.5
xi)	s	<i>Max</i>	21	27	34	36	41	46	50	60
		<i>Min</i>	20.16	26.16	33	35	40	45	49	58.8
xii)	Chamfer length z	<i>Max</i>	2.6	3	3.8	3.8	4.5	4.5	5.3	6

¹⁾ $d_{w, Max} = S_{actual}$.

NOTES

1 Sizes shown in brackets are of second preference.

2 For hot-dip galvanized bolt, the above dimensions apply before galvanizing.

3.2 The recommended length-size combinations shall be as given in Table 2.

Table 2 Recommended Length-Size Combinations for High Strength Structural Bolts

(Clause 3.2)

All dimensions are in mm

Sl No.	Thread Size d			M12		M16		M20		M22		M24		M27		M30		M36	
	(1)	(2)			(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
i)	Length l			l_s	l_g	l_s	l_g	l_s	l_g	l_s	l_g	l_s	l_g	l_s	l_g	l_s	l_g	l_s	l_g
ii)	<i>Nom</i>	<i>Min</i>	<i>Max</i>	<i>Min</i>	<i>Max</i>	<i>Min</i>	<i>Max</i>	<i>Min</i>	<i>Max</i>	<i>Min</i>	<i>Max</i>	<i>Min</i>	<i>Max</i>	<i>Min</i>	<i>Max</i>	<i>Min</i>	<i>Max</i>	<i>Min</i>	<i>Max</i>
iii)	30	28.95	31.05	-	-														
iv)	35	33.75	36.25	4.8	10														
v)	40	38.75	41.25	9.8	15	3	9												
vi)	45	43.75	46.25	14.8	20	8	14	4	11.5										
vii)	50	48.75	51.25	19.8	25	13	19	6.5	14	4	11.5								
viii)	55	53.5	56.5	24.8	30	18	24	11.5	19	9.5	17	5	14						
ix)	60	58.5	61.5	29.5	35	23	29	16.5	24	14.5	22	10	19	5	14				
x)	65	63.5	66.5	34.8	40	28	34	21.5	29	19.5	27	15	24	12	21	6	16.5		
xi)	70	68.5	71.5	39.8	45	33	39	26.5	34	24.5	32	20	29	17	26	10.5	21		
xii)	75	73.5	76.5	44.8	50	38	44	31.5	39	29.5	37	25	34	22	31	15.5	26	6	18
xiii)	80	78.5	81.5	49.8	55	43	49	36.5	44	34.5	42	30	39	27	36	20.5	31	12	24
xiv)	85	83.25	86.75	54.8	60	48	54	41.5	49	39.5	47	35	44	32	41	25.5	36	17	29
xv)	90	88.25	91.75	59.8	65	53	59	46.5	54	44.5	52	40	49	37	46	30.5	41	22	34
xvi)	95	93.25	96.75	64.8	70	58	64	51.5	59	49.5	57	45	54	42	51	35.5	46	27	39
xvii)	100	98.25	101.75	69.8	75	63	69	56.5	64	54.5	62	50	59	47	56	40.5	51	32	44
xviii)	110	108.25	111.75	-	-	66	72	59.5	67	57.5	65	53	62	50	59	43.5	54	35	47
xix)	120	118.25	121.75	-	-	76	82	69.5	77	67.5	75	63	72	60	69	53.5	64	45	57
xx)	130	128	132	-	-	86	92	79.5	87	77.5	85	73	82	70	79	63.5	74	55	67
xxi)	140	138	142	-	-	96	102	89.5	97	87.5	95	83	92	80	89	73.5	84	65	77
xxii)	150	148	152	-	-	106	112	99.6	107	97.5	105	93	102	90	99	83.5	94	75	87
xxiii)	160	156	164	-	-	116	122	109.5	117	107.5	115	103	112	100	109	93.5	104	85	97
xxiv)	170	166	174	-	-	126	132	119.5	127	117.5	125	113	122	110	119	103.5	114	95	107

xxv)	180	176	184	-	-	136	142	129.5	137	127.5	135	123	132	120	129	113.5	124	105	117
xxvi)	190	186	194	-	-	146	152	1639.5	147	137.5	145	133	142	130	139	123.5	134	115	127
xxvii)	200	196	204	-	-	156	162	149.5	157	147.5	155	143	152	140	149	133.5	144	125	137
xxviii)	210	206	214	-	-	166	172	159.5	167	157.5	165	153	162	150	159	143.5	154	135	147
xxix)	220	216	224	-	-	176	182	169.5	177	167.5	175	163	172	160	169	153.5	164	145	157
xxx)	230	226	234	-	-	186	192	179.5	187	177.5	185	173	182	170	179	163.5	174	155	167
xxxi)	240	236	244	-	-	196	202	189.5	197	187.5	195	183	192	180	189	173.5	184	165	177
xxxii)	250	246	256	-	-	206	212	199.5	207	197.5	205	193	202	190	199	183.5	194	175	187
xxxiii)	260	256	264	-	-	216	222	209.5	217	207.5	215	203	212	200	209	193.5	204	185	197
xxxiv)	270	266	274	-	-	226	232	219.5	227	217.5	225	213	222	210	219	203.5	214	195	207
xxxv)	280	276	284	-	-	236	242	229.5	237	227.5	235	223	232	220	229	213.5	224	205	217
xxxvi)	290	286	294	-	-	246	252	239.5	247	237.5	245	233	242	230	239	223.5	234	215	227
xxxvii)	300	296	304	-	-	256	262	249.5	257	247.5	255	243	252	240	249	233.5	244	225	237

NOTES

1 Recommended length are below the bold stepped line.

2 Sizes shown in brackets are of second preference.

3 Formulae: $l_{g,Max} = l_{nom} - b_{ref}$

$$l_{s,Min} = l_{g,Max} - 3P$$

For bolts with lengths above the bold line,

$$l_{s,Min} = 1.5P \text{ and } l_{g,Max} = l_{s,Min} + 3P$$

3.3 Threads shall conform to tolerance class 6g of IS 14962 (Part 2). In case of hot-dip galvanized bolts, the specified tolerance class shall apply before hot dip galvanizing.

4 PRODUCT GRADE

Unless otherwise specified, the bolts shall be of product grade C as specified in IS 1367 (Part 2).

5 MECHANICAL PROPERTIES

5.1 The bolts shall be of property class 8.8 or 10.9 as specified in IS 1367 (Part 3).

5.1 For tensile, proof load and wedge loading test on full size bolts only four threads shall be exposed between the grips. This is obtained by freely running the nut or fixture to the fullest extent and then unscrewing the specimen four full turns.

5.2 For test purposes, the screw threads on hot-dip galvanized bolts shall be chemically stripped to permit assembly with a standard threaded grip or nut, that is, thread class 6H.

6 FINISH

6.1 Unless specified otherwise, the bolts shall be supplied in the dull black heat-treated condition with a residual coating of light oil.

6.2 Where property class 8.8 bolts are required to be hot-dip galvanized, they shall be galvanized in accordance with the requirements of IS 1367 (Part 13). For fasteners with hot-dip galvanized coatings, the bolts or the mating nuts shall be provided with a suitable lubricant which shall be clean and dry to the touch to ensure that seizure shall not take place in assembly. The hot-dip galvanized bolts shall be subjected to the anti-seizing test as specified in Annex A.

NOTE — For bolts of property class 10.9, care should be taken, since this may cause hydrogen embrittlement in regular hot dip galvanisation process. To avoid hydrogen embrittlement, cleaning shall be done by using inhibited acid, alkaline or mechanical cleaning and baking should be done.

7 GENERAL REQUIREMENTS

7.1 In regard to permissible surface discontinuities, the bolts shall conform to IS 1367 (Part 9/Sec 1).

7.2 In regard to requirements not covered in the standard, the bolts shall conform to IS 1367 (Part 1).

7.3 The high strength structural nuts to be used with these bolts shall conform to the requirements of IS 6623.

7.3.1 These nuts shall be of the property class and finish for each type of bolt as follows:

<i>Bolt Property Class and Finish</i>	<i>Nut Property Class and Finish</i>
8.8S, dull black	8S or 10S, dull black
8.8S, hot-dip galvanized	10S, hot-dip galvanized
10.9S, dull black	10S, dull black

7.4 Hardened and tempered washers to be used with these bolts shall conform to the requirement of IS 6649.

8 DESIGNATION

High strength structural bolts shall be designated by name, size, nominal length, the number of this standard and the property class identification symbol 8.8S or 10.9S. The suffix letter S denotes a high strength structural bolt with a large series hexagon head. In case of hot dip galvanized bolts, the word 'galvanized' shall be added to the designation.

Example:

A high strength structural bolt of size M24, length 140 mm, property class 8.8 and galvanized shall be designated as:

High Strength Structural Bolt M24 x 140 IS 3757 — 8.8S galvanized

8.1 If the bolt in the above example is required with a hot-dip galvanized high strength structural nut (*see* IS 6623), the letter N shall be added to the designation as follows:

High Strength Structural Bolt M24 x 140 N IS 3757 — 8.8S galvanized

9 SAMPLING

Sampling and criteria of acceptance shall be in accordance with IS 1367 (Part 17).

10 MARKING

10.1 High strength structural bolts shall be marked with the following symbols on the top surface of the bolt head, either embossed or indented, as shown in Fig.3:

- a) The manufacturer's identification symbol, and
- b) The property class identification symbol 8.8S for 8.8S or 10.9S for 10.9S.

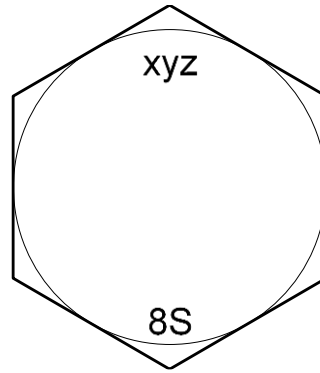


FIG. 3 MARKINGS ON THE BOLT

10.2 Minimum height of markings shall be 4.0 mm. When embossed, marking shall project not less than 0.3 mm above the surface of the head and total head height (head plus markings) shall not exceed the specified maximum head height plus 0.4 mm.

10.3 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the product(s) may be marked with the standard mark.

11 MODE OF DELIVERY

The bolts shall be delivered in accordance with IS 1367 (Part 18).

ANNEX A
(Clause 6.2)

Anti-Seizing Test for Hot-Dip Galvanized Fasteners

A-1 Where bolts and the mating nuts and washers with hot-dip galvanized coating are specified, these shall be subject to the following anti-seizing test for testing the effectiveness of the lubricant coating applied to the hot-dip galvanized bolts or nuts:

- a) The test shall be carried out on bolts, nuts and washers in the condition as supplied by the manufacturer and shall be in accordance with, and include a lubricant coating as required by 5.2. There shall be no other lubricant applied for the purpose of this test. If the test is performed by the user it shall be carried out immediately after receipt of the bolts, nuts and washers 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 three to five full threads of the bolt are located between the bearing surface of the bolt head and nut. The diameter of the holes in the assembly shall have the same nominal diameter as the hole in the washer.

- c) The nut shall be initially tightened to produce a load in the bolt not less than 10 percent 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 3 from the initial tightening position without fracture of the bolt, or stripping of the bolt or nut thread.

Table 3 Nut Rotation Requirements

Sl No.	Bolt Length (Nominal)	Nut Rotation (Min)
(1)	(2)	(3)
i)	$l \leq 2d$	180°
ii)	$2d < l \leq 3d$	240°
iii)	$3d < l \leq 4d$	300°
iv)	$4d < l \leq 8d$	360°
v)	$l > 8d$	420°