

## Indian Standard

SPECIFICATION FOR  
HIGH STRENGTH STRUCTURAL BOLTS

( Second Revision )

**1. Scope and Field of Application** — 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 M16 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. Dimensions and Tolerances**

**2.1** The dimensions of the bolts shall be as given in Table 1.

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

**2.3** Threads shall conform to tolerance class 6g of IS : 4218 ( Part 6 )-1978 'ISO metric screw threads: Part 6 Limits of sizes for commercial bolts and nuts ( diameter range 1 to 52 mm ) ( first revision )'. In case of hot-dip galvanized bolts, the specified tolerance class shall apply before hot-dip galvanizing.

**3. Grade** — Unless otherwise specified, the bolts shall be of product grade C as specified in IS : 1367 ( Part 2 )-1979 'Technical supply conditions for threaded steel fasteners: Part 2 Product grades and tolerances ( second revision )'.

**4. Mechanical Properties** — The bolts shall be of property class 8.8 or 10.9 as specified in IS : 1367 ( Part 3 )-1979 'Technical supply conditions for threaded steel fasteners: Part 3 Mechanical properties and test methods for bolts, screws and studs with full loadability ( second revision )'.

**4.1** 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.

**4.2** 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.

**5. Finish**

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

**5.2** 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 )-1983 'Technical supply conditions for threaded steel fasteners: Part 13 Hot-dip galvanized coatings on threaded fasteners ( second revision )'. 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 Appendix A.

**Note** — Bolts of property class 10.9 should not be hot-dip galvanized since this may cause hydrogen embrittlement.

**6. General Requirements**

**6.1** In regard to permissible surface discontinuities, the bolts shall conform to IS : 1367 ( Part 9 )-1979 'Technical supply conditions for threaded steel fasteners: Part 9 Surface discontinuities on bolts, screws and studs ( second revision )'.

**6.2** In regard to requirements not covered in the standard, the bolts shall conform to IS : 1367 ( Part 1 )-1980 'Technical supply conditions for threaded steel fasteners: Part 1 Introduction and general information ( second revision )'.

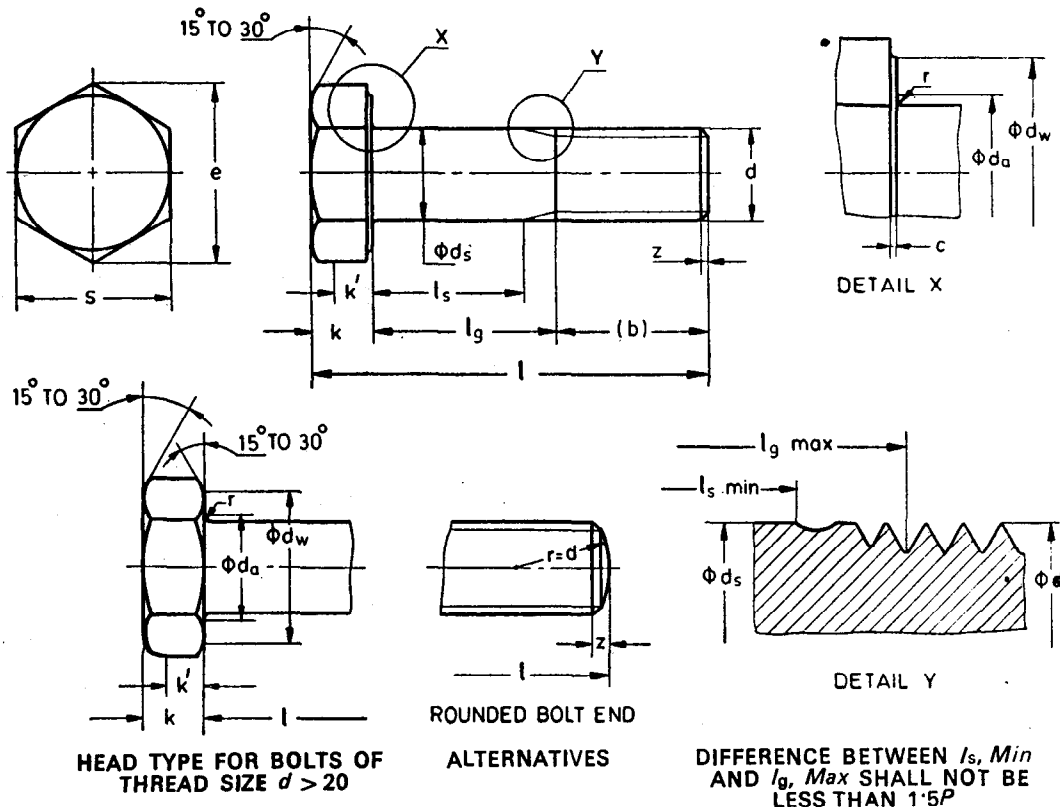
Adopted 26 July 1985

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TABLE 1 DIMENSIONS FOR HIGH STRENGTH STRUCTURAL BOLTS  
( Clause 2.1 )

All dimensions in millimetres.



Thread Size $d$	M16	M20	(M22)*	M24	(M27)*	M30	M36
$p$ Pitch of thread	2	2.5	2.5	3	3	3.5	4
$b_{ref}$ For length $l$ Nom $\leq 100$	31	36	38	41	44	49	56
$b_{ref}$ For length $l$ Nom $> 100$	38	43	45	48	51	56	63
$c$ Max	0.8	0.8	0.8	0.8	0.8	0.8	0.8
$c$ Min	0.4	0.4	0.4	0.4	0.4	0.4	0.4
$d_a$ Max	18.7	23.24	25.24	27.64	31.24	34.24	41.00
$d_s$ Max	16.70	20.84	22.84	24.84	27.84	30.84	37.00
$d_s$ Min	15.30	19.16	21.16	23.16	26.16	29.16	35.00
$d_w$ Max	†	†	†	†	†	†	†
$d_w$ Min	24.9	31.4	33.3	38.0	42.8	46.5	55.9
$e$ Min	29.56	37.29	39.55	45.20	50.85	55.37	66.44
$k$ Nom	10	12.5	14	15	17	18.7	22.5
$k$ Max	10.75	13.40	14.90	15.90	17.90	19.75	23.55
$k$ Min	9.25	11.60	13.10	14.10	16.10	17.65	21.45
$k'$ Min	6.5	8.1	9.2	9.9	11.3	12.4	15.0
$r$ Min	0.6	0.8	0.8	1.0	1.2	1.2	1.5
$s$ Max	27	34	36	41	46	50	60
$s$ Min	26.16	33	35	40	45	49	58.8
Chamfer length $z$ Max	3	3.8	3.8	4.5	4.5	5.3	6

Note — Sizes shown in brackets are at second preference.

\*For galvanized bolts, dimensions apply before galvanizing.

†  $d_w, \text{Max} = s$  actual.

TABLE 2 RECOMMENDED LENGTH-SIZE COMBINATIONS FOR HIGH STRENGTH STRUCTURAL BOLTS

( Clause 2.2 )

All dimensions in millimetres.

Thread Size <i>d</i>			M16		M20		(M22)		M24		(M27)		M30		M36	
Length <i>l</i>			<i>l<sub>s</sub></i>	<i>l<sub>g</sub></i>	<i>l<sub>s</sub></i>	<i>l<sub>g</sub></i>	<i>l<sub>s</sub></i>	<i>g</i>	<i>l<sub>s</sub></i>	<i>l<sub>g</sub></i>	<i>l<sub>s</sub></i>	<i>l<sub>g</sub></i>	<i>l<sub>s</sub></i>	<i>l<sub>g</sub></i>	<i>l<sub>s</sub></i>	<i>l<sub>g</sub></i>
<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>
40	38.75	41.25	3	9												
45	43.75	46.25	8	14	4	11.6										
50	48.75	51.25	13	19	6.5	14	4	11.5								
55	53.5	56.5	18	24	11.5	19	9.5	17	5	14						
60	58.5	61.5	23	29	16.5	24	14.5	22	10	19	5	14				
65	63.5	66.5	28	34	21.5	29	19.5	27	15	24	12	21	6	16.5		
70	68.5	71.5	33	39	26.5	34	24.5	32	20	29	17	16	10.5	21		
75	73.5	76.5	38	44	31.5	39	29.5	37	25	34	22	31	15.5	26	6	18
80	78.5	81.5	43	49	36.5	44	34.5	42	30	39	27	36	20.5	31	12	24
85	83.25	86.75	48	54	41.5	49	39.5	47	35	44	32	41	25.5	36	17	29
90	88.25	91.75	53	59	46.5	54	44.5	52	40	49	37	46	30.5	41	22	34
95	93.25	96.75	58	64	51.5	59	49.5	57	45	54	42	51	35.5	46	27	39
100	98.25	101.75	63	69	56.5	64	54.5	62	50	59	47	56	40.5	51	32	44
110	108.25	111.75	66	72	59.5	67	57.5	65	53	62	50	59	43.5	54	35	47
120	118.25	121.75	76	82	69.5	77	67.5	75	63	72	60	69	53.5	64	45	57
130	128	132	86	92	79.5	87	77.5	85	73	82	70	79	63.5	74	55	67
140	138	142	96	102	89.5	97	87.5	95	83	92	80	89	73.5	84	65	77
150	148	152	106	112	99.5	107	97.5	105	93	102	90	99	83.5	94	75	87
160	156	164	116	122	109.5	117	107.5	115	103	112	100	109	93.5	104	85	97
170	166	174	126	132	119.5	127	117.5	125	113	122	110	119	103.5	114	95	107
180	176	184	136	142	129.5	137	127.5	135	123	132	120	129	113.5	124	105	117
190	186	194	146	152	139.5	147	137.5	145	133	142	130	139	123.5	134	115	127
200	196	204	156	162	149.5	157	147.5	155	143	152	140	149	133.5	144	125	137
210	206	214	166	172	159.5	167	157.5	165	153	162	150	159	143.5	154	135	147
220	216	224	176	182	169.5	177	167.5	175	163	172	160	169	153.5	164	145	157
230	226	234	186	192	179.5	187	177.5	185	173	182	170	179	163.5	174	155	167
240	236	244	196	202	189.5	197	187.5	195	183	192	180	189	173.5	184	165	177
250	246	254	206	212	199.5	207	197.5	205	193	202	190	199	183.5	194	175	187
260	256	264	216	222	209.5	217	207.5	215	203	212	200	209	193.5	204	185	197
270	266	274	226	232	219.5	227	217.5	225	213	222	210	219	203.5	214	195	207
280	276	284	236	242	229.5	237	227.5	235	223	232	220	229	213.5	224	205	217
290	286	294	246	252	239.5	247	237.5	235	233	242	230	239	223.5	234	215	227
300	296	304	256	262	249.5	257	247.5	245	243	252	240	249	233.5	244	225	237

Note 1 — Recommended lengths are below the bold stepped line.

Note 2 — Sizes shown in brackets are of second preference.

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

For bolts with lengths above the bold line,

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

## IS : 3757 - 1985

6.3 The high strength structural nuts to be used with these bolts shall conform to the requirements of IS : 6623-1985 'High strength structural nuts ( *first revision* )'.

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

### *Bolt Property Class and Finish*

8'8S, dull black  
8'8S, hot-dip galvanized  
10'9S, dull black

### *Nut Property Class and Finish*

8S or 10S, dull black  
10S, hot-dip galvanized  
10S, dull black

6.4 Hardened and tempered washers to be used with these bolts shall conform to the requirements of IS : 6649-1985 'Hardened and tempered washers for high strength structural bolts and nuts ( *first revision* )'.

7. 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

7.1 If the bolt in the above example is required with a hot-dip galvanized high strength structural nut ( *see* IS : 6623-1985 ), the letter N shall be added to the designation as follows:

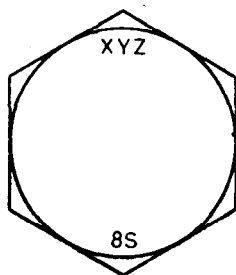
High Strength Structural Bolt M24 x 140 N IS : 3757—8'8S galvanized

8. Sampling — Sampling and criteria of acceptance shall be in accordance with IS : 2614-1969 'Methods for sampling of fasteners ( *first revision* )'.

9. Marking — 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 below:

- The manufacturer's identification symbol, and
- The property class identification symbol 8S for 8'8S or 10S for 10'9S.

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. Mode of Delivery — The bolts shall be delivered in accordance with IS : 1367 (Part 18)-1979 'Technical supply conditions for threaded steel fasteners: Part 18 Marking and mode of delivery ( *second revision* )'.

11. Certification Marking — Details available with the Bureau of Indian Standards.

## APPENDIX A

( Clause 5.2 )

## 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 surfaces 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

Bolt Length ( Nominal )	Nut Rotation ( Min )
$l < 2d$	180°
$2d < l < 3d$	240°
$3d < l < 4d$	300°
$4d < l < 8d$	360°
$l > 8d$	420°

## EXPLANATORY NOTE

IS : 3757 'Specification for high tensile friction grip fasteners for structural engineering purposes' was originally published in 1966. The first revision of IS : 3757 catered for high tensile friction grip bolts only; the corresponding nuts and washers were covered by separate standards. In the present revision of IS : 3757, the title of the standard has been 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 have been 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 has been changed from 32 to 34 mm in line with IS : 9519-1980 'Width across flats for hexagon head bolts and nuts'. It is, however, recognized that some transition period would be essential during which the new across flat size would be introduced and the old across flat size phased out. During this transition period,

## IS : 3757 - 1985

the bolts may be supplied with the old across flat size and other related dimensions as mentioned below as being functionally equivalent. However, bolts with old across flat size should not be supplied with nuts with new across flat size and *vice-versa*.

All dimensions in millimetres.

Thread Size <i>d</i>		M20
<i>s</i>	<i>Max</i>	32
	<i>Min</i>	31
<i>e</i>	<i>Min</i>	35.03
<i>d<sub>w</sub></i>	<i>Max</i>	<i>s</i> actual
	<i>Min</i>	29.5

The standard is based on ISO/DIS 7412 'High strength structural bolts (short thread length type)' issued by the International Organization for Standardization.

**AMENDMENT NO. 1      OCTOBER 1987**  
**TO**  
**IS : 3757 - 1985   SPECIFICATION FOR**  
**HIGH STRENGTH STRUCTURAL BOLTS**

**( *Second Revision* )**

( *Page 1, clause 2.1* ) — Substitute 'of' for 'or'.

( *Page 1, clause 5.1* ) — Substitute ' , ' for ' ; '.

( *Page 1, clause 5.2, Note* ) — Substitute 'of' for 'or'.

( *Page 2, Table 1, title* ) — Add '\*' in the title at the end.

( *Page 2, Table 1* ) — Substitute the figure given on page 2 for the existing figure.

( *Page 2, Table 1, first row* ) — Delete ' \* ' from sizes '( M22 )' and '( M27 )'.

( *Page 2, Table 1, Note* ) — Substitute 'of' for 'at'.

( *Page 2, Table 1, foot-note with '\*' mark* ) — Substitute the following for the existing foot-note:

' \*For hot-dip galvanized bolts, the above dimensions apply before galvanizing.'

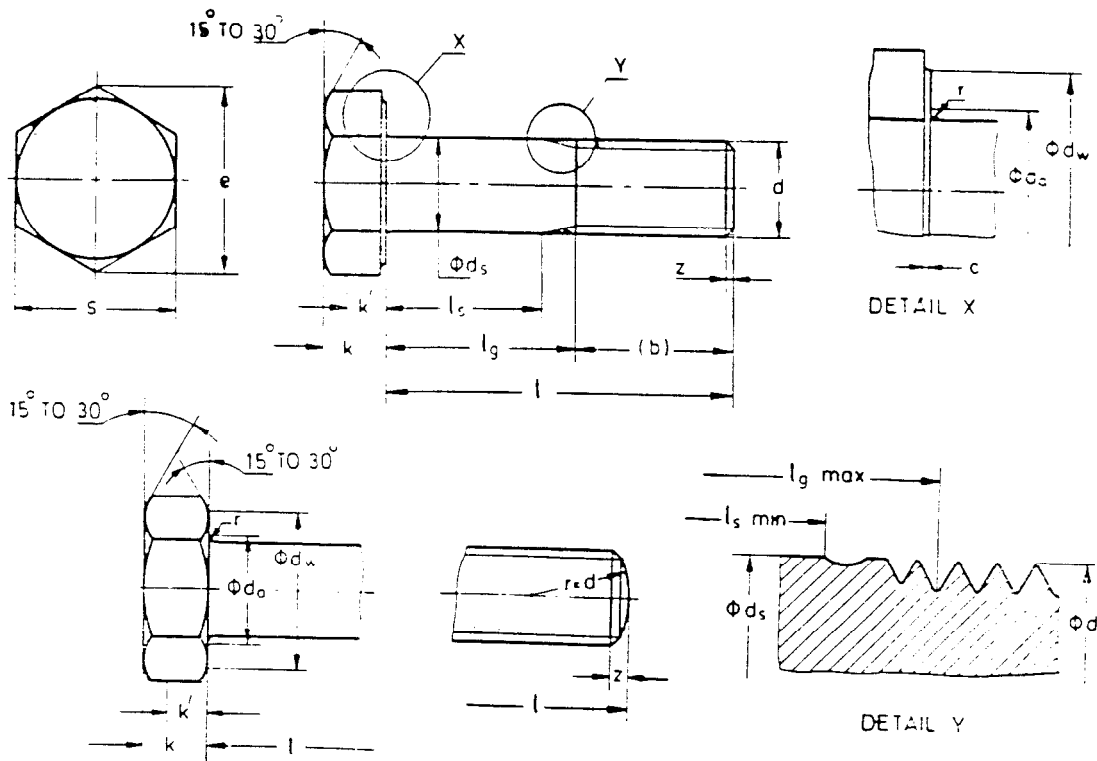
[ *Page 3, Table 2, Thread size ( M22 ), Nominal length 290* ] — Substitute '245' for '235' against lg Max.

[ *Page 3, Table 2, Thread size ( M22 ), Nominal length 300* ] — Substitute '255' for '245' against lg Max.

[ *Page 3, Table 2, Thread size ( M27 ), Nominal length 70* ] — Substitute '26' for '16' against lg Max.

( *Page 4, clause 9, last para, second sentence* ) — Substitute 'markings' for 'marking'.

( EDC 27 )



HEAD TYPE FOR BOLTS  
OF THREAD SIZE  $d > M20$

ROUNDED BOLT END

ALTERNATIVES

**Note** — The difference between  $l_g \text{ Max}$  and  $l_g \text{ Min}$  must not be less than  $1.5 P$ .



**AMENDMENT NO. 2 JULY 1989**  
**TO**  
**IS : 3757 - 1985 SPECIFICATION FOR HIGH**  
**STRENGTH STRUCTURAL BOLTS**

*( Second Revision )*

*( Amendment No. 1, page 2, Note under DETAIL )* — Substitute the following for the existing Note:

‘NOTE — The difference between  $l_g$  Max and  $l_s$  Min shall not be less than 1.5 P.’

( EDC 27 )