

BOLT LENGTHS (GRIP LENGTHS) FOR PRELOAD FASTENERS



There are three standards for the design of steelwork –

- **BS 5950** - Structural use of steelwork in buildings.
- **BS 8100** - Lattice Towers and Masts
- **BS 5400** - Steel, Concrete and Composite Bridges.
- **BS EN 1993** - Design of Steel Structures.

At some point in the future BS EN 1993 will be the only standard that can be used for the design of steelwork. This has issues for Direct Tension Indicators –

- **BS 7644 Pt 1 DTI** - Can be used on BS 5950 and BS 5400 designed steelwork. Sizes M12-M24 achieve the preload requirements of BS EN 1993.
- **BS EN 14399 Pt 9 DTI** - Can be used on BS 5950, BS 5400 and BS EN 1993 designed steelwork.

BS 5950 and BS EN 1090 Pt 2 (with reference to BS EN 1993 designs using HR8.8/PT1 fasteners) states that 1 thread plus thread run out should protrude the outer face of the Nut and the end of the Bolt. Also for pre-loaded bolts according to EN 14399-3 and EN14399-7, at least four full threads (in addition to the thread run out) should remain clear between the bearing surface of the nut and the unthreaded part of the shank. BS 4604 Pt 1 contains a table which states what the length of Bolt should be based on the use of one Nut and one Washer (based on BS 4395 dimensions).

The table below shows you the thickness of various components for the Bolt Length (Grip Length) to be calculated (all dimensions are in millimetres) –

TABLE ONE -

BLACK = BS 5950/BS 5400 designs using BS 4395 Pt 1 Fullnuts, Hard Flat Washer, BS 7644 Pt 1 DTI & BS 7644 Pt 2 Nut & Bolt Face Washers								RED = BS EN 1090 Pt 2 designs using BS EN 14399 Pt 3 Fullnuts, BS EN 14399 Pt 6 Washers & BS EN 14399 Pt 9 DTI, Nut & Bolt Face Washers								
Component Maximum Thickness	M12 Pt 1	M12 HR8.8	M16 Pt 1	M16 HR8.8	M20 Pt 1	M20 HR8.8	M22 Pt 1	M22 HR8.8	M24 Pt 1	M24 HR8.8	M27 Pt 1	M27 HR8.8	M30 Pt 1	M30 HR8.8	M36 Pt 1	M36 HR8.8
Fullnut	11.55	10.80	15.55	14.80	18.55	18.00	19.65	19.40	22.65	21.50	24.65	23.80	26.65	25.60	31.80	31.00
Washer	2.80	3.30	3.40	4.30	3.70	4.30	4.20	4.30	4.20	4.30	4.20	5.60	4.20	5.60	4.60	6.60
Nut and Bolt Face Washer	4.60	4.30*	4.60	4.30	4.60	4.30	4.60	4.30	4.60	4.30	4.60	5.60	4.60	5.60	4.60	6.60
DTI (flattened) min.	2.50	2.50	3.00	3.00	3.50	3.50	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Reference Infor-DTI (not installed) min.	5.50	5.50	6.00	6.00	6.50	6.50	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.50	7.50
Thread Clearance (pitch) min	1.75	1.75	2.00	2.00	2.50	2.50	2.50	2.50	3.00	3.00	3.00	3.00	3.50	3.50	4.00	4.00
The use of one thread clearance should be regarded as the minimum for good practice, however due to tolerances on Bolt lengths (please see table two) etc AT LEAST ONE further full thread pitch should be used.																
BS 4604 Part One**	22		26		30		34		36		39		42		48	

* BS EN 14399 Pt 10 has a typing error and will be amended to state 4.30 mm instead of 3.30 mm. ** BS 4604 Pt 1 (reference to BS 5400) contains Bolt Length Allowances when using one nut and one flat washer and for sufficient protrusion of the bolt end using BS 4395 products. A calculation was used to determine the thread clearance which is different to BS 5950.

To calculate the Bolt Length (Grip length):- Calculate the maximum thickness dimension of the components to be used, the thread clearance and the thickness of the members to be bolted. If the length calculated is between bolt lengths, use the next longer bolt length.

MAXIMUM THICKNESS OF COMPONENTS + THREAD CLEARANCE + THICKNESS OF MEMBERS TO BE BOLTED = BOLT LENGTH Issue -

TABLE TWO - TOLERANCE ON BOLT LENGTHS

Bolt Length	BS 4395 PT 1		BS EN 14399 HR8.8	
	min.	max.	min.	max.
30	28.75	31.25	28.95	31.05
35	33.75	36.25	33.75	36.25
40	38.75	41.25	38.75	41.25
45	43.75	46.25	43.75	46.25
50	48.75	51.25	48.75	51.25
55	53.5	56.5	53.5	56.5
60	58.5	61.5	58.5	61.5
65	63.5	66.5	63.5	66.5
70	68.5	71.5	68.5	71.5
75	73.5	76.5	73.5	76.5
80	78.5	81.5	78.5	81.5
85	83.25	86.75	83.25	86.75
90	88.25	91.75	88.25	91.75
95	93.25	96.75	93.25	96.75
100	98.25	101.75	98.25	101.75
110	108.25	111.75	108.25	111.75
120	118.25	121.75	118.25	121.75
130	128	132	128	132
140	138	142	138	142
150	148	152	148	152
160	158	162	156	164
170	168	172	166	174
180	178	182	176	184
190	187.7	192.3	186	194
200	197.7	202.3	196	204

TABLE THREE - DIMENSIONS OF HOLES

Bolt Diameter	Standard Clearance Hole	Oversize Hole		Short Slotted Hole		Long Slotted Hole	
	Diameter mm	BS	BSEN	Width mm	Length mm	Width mm	Length mm
16	18	20		18	22	18	40
20	22	25	24	22	26	22	50
22	24	27	26	24	28	24	55
24	26	30		26	32	26	60
≥ 27	d + 3	d + 8		d + 3	d + 10	d + 3	2.5 d

d is the nominal diameter of the bolt in mm.