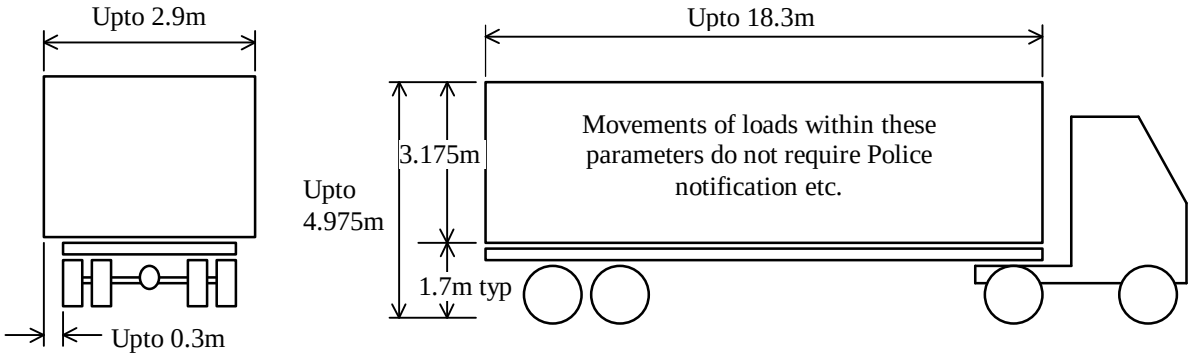
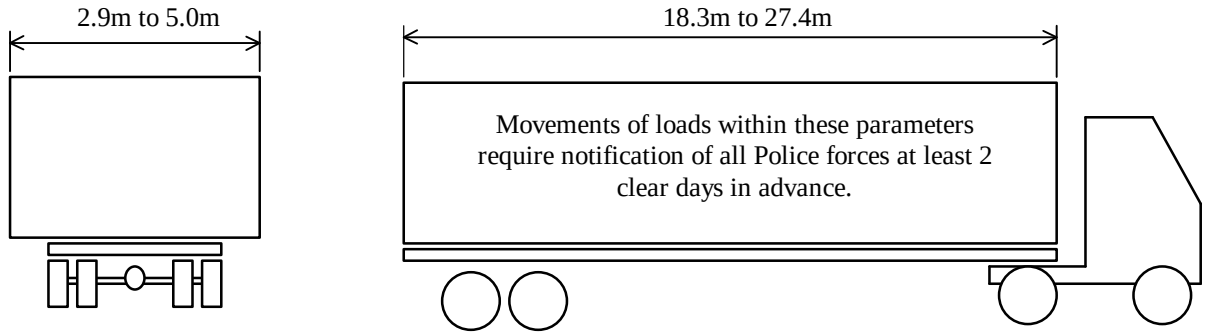
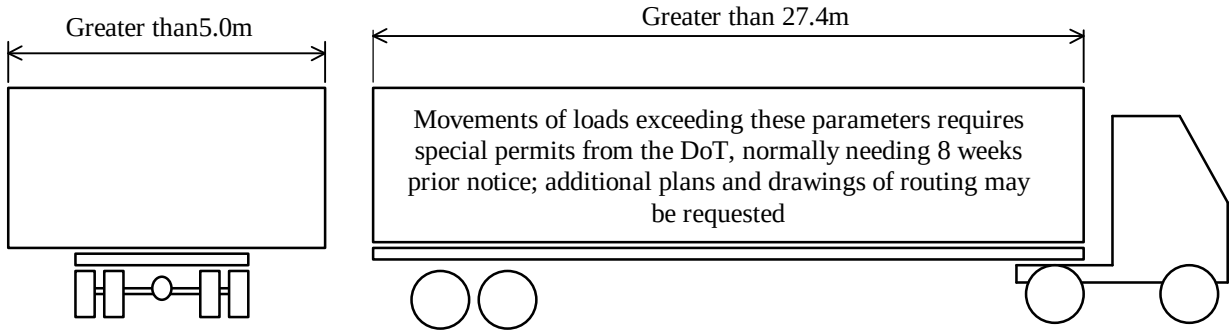
APPENDIX C – USEFUL DESIGN DATA

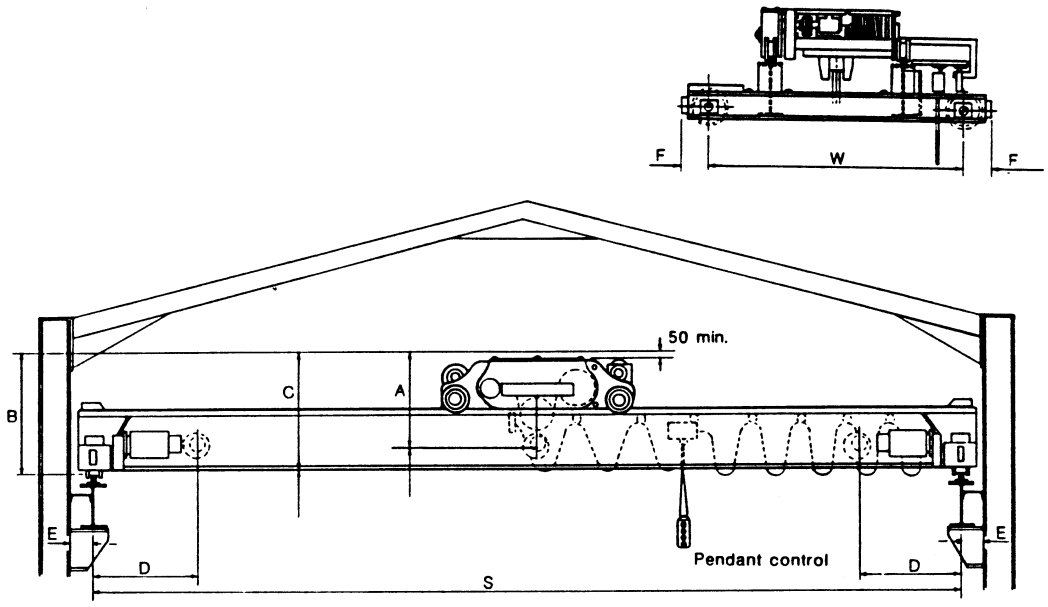
C.1 **Road transport limitations (simplified) (in the UK)**







C.2 **Craneage data – double girder**

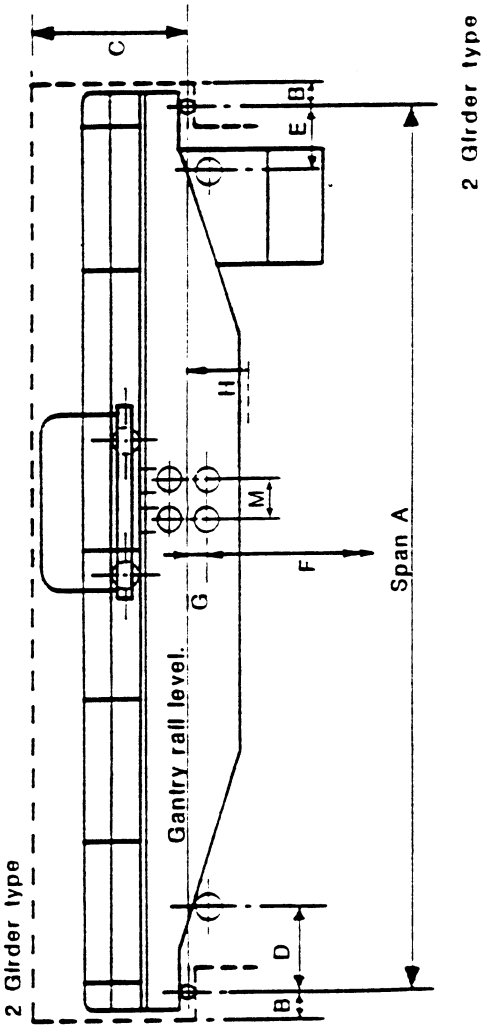


Double girder pendant controlled cranes for loading class Q2 to BS 446 and BS 2573: Part 1[1]

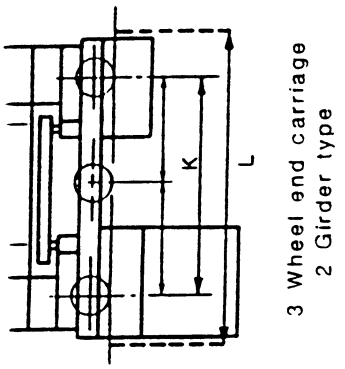
Capacity tonnes	Span S metres	A mm	B mm	C mm	D mm	E mm	F mm	H mm	W mm	Crab wt. tonnes	Crane wt. tonnes	Wheel load tonnes
10	8	920	1250	1225	970	200	430	9700	2500	1.70	5.18	6.19
	10	920	1250	1225					2500		5.84	6.47
	12	920	1278	1255					2500		7.98	6.98
	14	920	1280	1255					3100		8.82	7.26
	16	920	1375	1325					3700		10.68	7.77
	18	920	1375	1325					3700		11.60	8.04
	20	950	1535	1485					3700		11.11	7.91
	22	950	1715	1665					3700		12.67	8.30
	24	950	1715	1665					4300		13.65	8.61
	26	950	1865	1815					4300		15.17	8.99
25	8	1650	1650	1540	1150	220	500	8000	4300	4.00	11.40	14.90
	10		1650	1540		220	500		4300		11.97	15.04
	12		1650	1540		220	500		4300		13.14	15.62
	14		1800	1690		220	500		4300		14.36	16.13
	16		1800	1690		220	500		4300		15.22	16.49
	18		1950	1840		220	500		4300		18.83	17.52
	20		1950	1840		220	500		4300		20.03	17.92
	22		2100	1990		220	520		4900		22.54	18.64
	24		2100	1990		235	600		4900		24.53	19.20
	26		2125	2035		235	600		4900		27.78	20.08

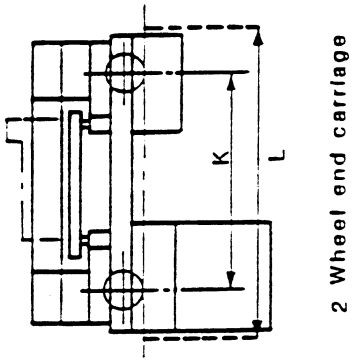
1. Dimension B is based upon construction where end carriages are built into bridges member for maximum rigidity and compact headroom dimension. Alternative end constructions can be provided to either increase or reduce dimension B to suit existing building condition
2. The height of lift, H or hook path dimension, is based upon a standard crab unit. Alternative crabs are available in all capacities for extended heights of lift.
3. Crane weights include the crab.
4. Weights of crane and crab are with unloaded hooks.
5. Wheel loads are for static conditions with maximum working load and minimum crab approach.
6. Above information is approximate only and is intended for guidance. Exact information should be obtained from manufactures' publication.

C.3 **Craneage data – double hoist**



Double hoist cranes for loading class Q2 to BS 466 and BS 2573: Part 1[1]





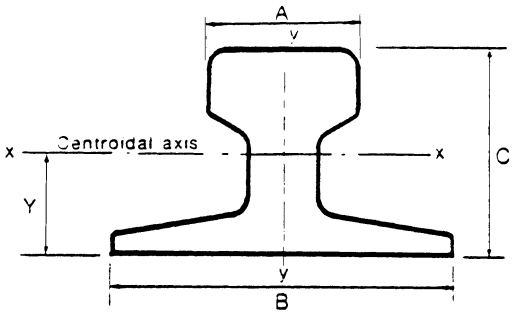
Capacity tonnes	A m	B mm	C m	D m	E m	F m	G m	H m	K m	L m	M M	Crab wt. tonnes	Crane wt. tonnes	Wheel load tonnes	Wheels in end carriage
50/10	10	330	2.6	1.5	2.0	16	0.6	0.8	4.3	5.5	1.1	20	21.0	30.0	2
	12.5	330	2.6					1.0	4.6	5.8			35.0	32.0	
	16	330	2.6					1.1	4.7	5.9			30.0	34.2	
	20	340	2.7					1.3	4.9	6.1			35.0	37.0	
	25	340	2.7					1.4	5.0	6.2			41.0	40.0	
	32	340	2.7					1.6	5.2	6.4			50.0	43.0	

1. Crane weights include the weight of the crab.
2. Weights of crane and crab are with unloaded hooks.
3. Wheel loads are for static conditions with maximum working load and minimum crab approach.
4. Above information is approximate only and is intended for guidance. Exact information should be obtained from manufactures' publication.

C.4 **Standard rail sections**

Section	Mass/ unit length Kg/m	Dimension mm			Area	Y	I_{xx}	I_{yy}	Z_{xx}	Z_{yy}
		Head width A	Base width B	Height C	cm^2	mm	cm^4	cm^4	cm^3	cm^3
13 bridge	13.31	36.0	92	47.5	16.95	21.5	39.01	74.38	14.70	16.17
16 bridge	15.97	44.5	108	54.0	20.34	24.3	64.01	116.34	21.55	21.54
20 bridge	19.86	50.0	127	55.5	25.30	25.8	82.10	192.76	27.66	30.36
28 bridge	28.62	50.0	152	67.0	36.46	28.9	167.45	371.37	44.05	48.86
35 bridge	35.38	58.0	160	76.0	45.06	34.4	265.67	505.23	63.79	63.15
50 bridge	50.18	58.5	165	76.0	63.92	29.3	325.83	719.67	69.81	87.23
56 bridge	55.91	76.0	171	102.0	71.22	43.8	794.38	685.90	141.24	80.67
89 crane	88.93	102.0	178	114.0	113.29	53.3	1493.04	1415.91	245.91	159.09
101 crane	100.38	100.0	165	155.0	127.88	73.9	3410.78	1266.34	420.47	153.50
164 crane	165.92	140.0	230	150.0	211.37	67.7	4776.95	5121.70	580.59	445.37

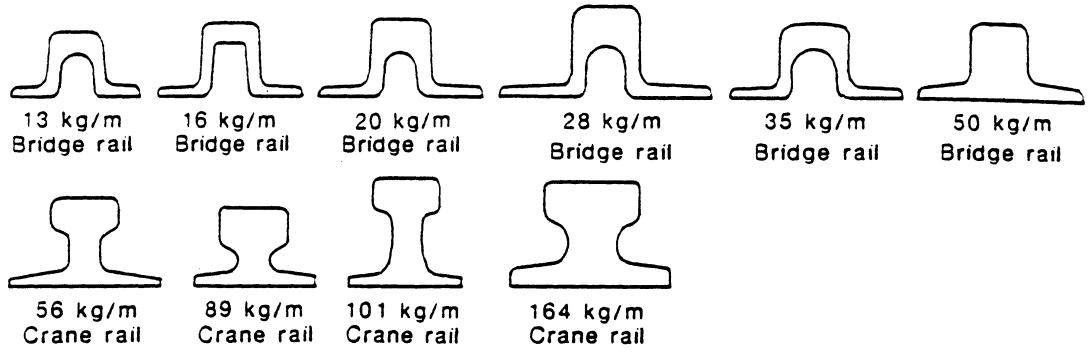
For A, B and C see figure below



Rail dimensions

Maximum lengths for individual Bridge and crane rail sections

Section	Length (m)
13 bridge	9.144
16 bridge	9.144
20 bridge	9.144
28 bridge	15.000
35 bridge	15.000
50 bridge	15.000
56 bridge	15.000
89 crane	15.000
101 crane	12.192
164 crane	9.144



Profiles of bridge and crane rails

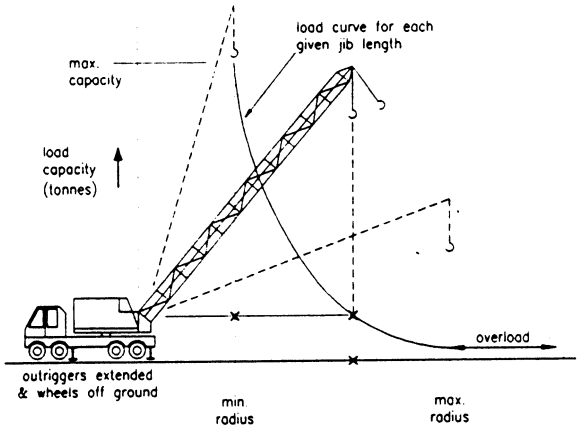
C.5 **Typical bend radii – rolled sections**

Typical recommended bend radii

Serial size	Typical possible bend radii	
	X-X Axis (metres)	Y-Y Axis (meters)
533 x 210 x 122 UB	25	2.5
406 x 178 x 74 UB	18	2.25
305 x 165 x 54 UB	7	2
254 x 146 x 43 UB	5	1.75
203 x 133 x 30 UB	4	1.5
178 x 102 x 19 UB	4	1.25
152 x 89 x 16 UB	2.5	1
127 x 76 x 13 UB	2	1
254 x 203 x 81.85 RSJ	4	2.25
203 x 152 x 52.09 RSJ	2.5	1.75
152 x 127 x 37.20 RSJ	1.5	1.5
305 x 305 x 283 UC	6	3.5
254 x 254 x 167 UC	4.5	3
203 x 203 x 86 UC	3	2.25
152 x 127 x 37 UC	2	1.75
250 x 250 x 16 SHS	10	10
200 x 200 x 12.5 SHS	7	7
200 x 100 x 10 RHS	4	6
150 x 100 x 10 RHS	2.5	4
120 x 80 x 10 RHS	2	3
219.1 x 12.5 CHS	3	3
168.3 x 10 CHS	1.5	1.5
114.3 x 6.3 CHS	1.25	1.25
60.3 x 5 CHS	0.75	0.75

The examples shown are not the minimum radii possible

C.6 **Safe load for 25 tonne capacity mobile crane**



Main boom capacities (tonnes) – through full 360° circle slew – with outriggers fully extended

	Boom length						
Radius in meters	10.07m fully retracted	10.07m to 12.50m	12.50m to 15.00m	15.00m to 17.50m	17.50m to 20.00m	20.00m to 22.50m	22.50m to 24.57m
3.0m	25.40	20.70	20.10	20.10			
3.5m	22.00	20.00	19.00	18.80	16.00		
4.0m	19.50	18.00	17.80	17.60	15.50		
4.5m	17.00	16.80	16.70	16.50	14.90	12.70	
5.0m	15.30	15.30	15.30	15.00	13.90	12.30	10.40
6.0m	13.00	12.80	12.40	12.40	12.20	11.60	9.80
7.0m	10.50	10.50	10.50	10.50	10.50	10.50	9.40
8.0m		8.30	8.30	8.30	8.30	8.30	8.30
10.0m		5.35	5.35	5.35	5.35	5.35	5.35
12.0m			3.85	3.85	3.85	3.85	3.85
14.0m				2.80	2.80	2.80	2.80
16.0m					2.15	2.15	2.15
18.0m						1.70	1.70
20.0m						1.30	1.30
22.0m							0.90

C.7 **Standard durbar plate sections**

Standard Sizes

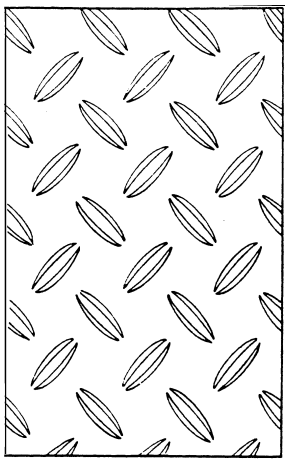
Width mm	Thickness range on plain mm				
1000	4.5	6.0	8.0	10.0	12.5
1250	4.5	6.0	8.0	10.0	12.5
1500	4.5	6.0	8.0	10.0	12.5
1750	4.5	6.0	8.0	10.0	12.5
1830	-	6.0	8.0	10.0	12.5

Consideration will be given to requirements other than standard sizes where they represent a reasonable tonnage per size, i.e. in one length and one width. Lengths up to 10 meters can be supplied for plate 6mm & over

Mass per square metre of durbar plates

Thickness on plain mm*	Kg/m^2
4.5	37.97
6.0	49.74
8.0	65.44
10.0	81.14
12.5	100.77

Depth of pattern ranging from 1.9 mm to 2.4 mm.
*Thickness as measured through body of the plate



Ultimate load capacity (kN/m^2) for plates simply supported on two sides, stressed to 275 N/mm^2

Thickness on plain mm	Span (mm)							
	600	800	1000	1200	1400	1600	1800	2000
4.5	20.48	11.62	7.45	5.17	3.80	2.95	2.28	1.87
6.0	36.77	20.68	13.28	9.20	6.73	5.20	4.07	3.30
8.0	65.40	36.87	23.48	16.38	11.97	9.23	7.23	5.93
10.0	102.03	57.42	36.67	25.55	18.70	14.45	11.30	9.25
12.5	159.70	89.85	57.40	39.98	29.27	22.62	17.68	14.50

Stiffeners should be used for spans in excess of 1100mm to avoid excessive deflections

C.8 **RHS sections – standard lengths**

Length ranges and tolerances for rectangular hollow sections (RHS)

Size		Welded		Seamless		Length tolerance mm
Square mm	Rectangular mm	Standard mill lengths m	Special mill lengths m	Standard lengths m	Maximum exact lengths m	
20 x 20	-	6.4	5.4 – 7.5			+150 - 0
25 x 25 & 30 x 30	-	6.4 & 7.5				
	50 x 25	7.5				
40 x 40 up to 100 x 100 x 8	50 x 30 up to 120 x 80 x 8	7.5, 10 & 12	5.4 – 13.7			
100 x 100 x 10 up to 150 x 150 x 12.5	120 x 80 x 10 up to 200 x 100 x 12.5	7.5, 10 & 12	6.1 – 14.6			
150 x 150 x 16	200 x 100 x 16			10 - 11.2	5.6 - 11.2	+300 – 0
180 x 180 up to 400 x 400 x 16	250 x 150 up to 500 x 300 x 16	10 & 12	9 – 14.8			+300 – 0
400 x 400 x 20	500 x 300 x 20	8.5-9.0 random				

C.9 **CHS sections – standard lengths**

Length ranges and tolerances for circular hollow section (CHS)

Size (mm)		Welded		Seamless	Length tolerance mm
O.D.	Thickness	Standard mill lengths m	Special mill lengths m	Standard mill lengths m	
21.3 & 26.9	All	6.0 & 6.4	5.4 – 7.5		+150 – 0
33.7 - 48.3	All	6.0, 6.4 & 7.5	5.4 – 7.5		+150 – 0
60.3 – 114.3	All	6.0, 6.4, 7.5 & 10	5.4 – 12		+150 – 0
139.7 – 168.3	All	7.5, 10 & 12	6.1 – 14.6		+150 – 0
193.7	Up to 12.5	7.5, 10, & 12	6.1 – 14.6		+150 – 0
	16.0			8, 10 & 12	+300 – 0
219.1	Up to 12.5	10 & 12	9 – 14.8		+300 - 0
	16.0 20.0			8, 10 6, 8 & 10	
244.5	6.3 – 16 8 – 12.5	10 & 12	9 – 14.8	8, 10 & 12 10, 12 & 14	+300 - 0
	20.0			6, 8 & 10	
273	6.3 – 16	10 & 12	9 – 14.8		+300 - 0
	20.0 25.0			6, 8 & 10 4, 6 & 8	
323.9	6.3 – 16.0	10 & 12	9 – 14.8		+300 - 0
	20.0 25.0			6, 8 & 10 4, 6 & 8	
355.6	8.0 – 16.0	10 & 12	9 – 14.8		+300 - 0
	20.0 25.0			6, 8 & 10 4, 6 & 8	
406.4	10.0 – 16.0	10 & 12	9 – 14.8		+300 - 0
	20.0 25.0 32.0			8, 10 & 12 4, 6 & 8 2, 4 & 6	
457	10.0 – 16.0	10 & 12	9 – 14.8		+300 - 0
	20.0 25.0 32.0 40.0			8, 10 & 12 6, 8 & 10 4, 6 & 8 2, 4 & 6	
508	10.0 – 16.0	10 & 12	9 – 14.8		+300 - 0
	20 & 25 32 40 50			6, 8 & 10 4, 6 & 8 2, 4 & 6 3, 4 & 5	

C.10 **Carbon steel plate sections – British Steel standard sizes**

Typical size range of carbon steel plates (maximum length in m)

Width (mm) / Thickness	1220 - 1250	1250 - 1300	1300 - 1500	1500 - 1600	1600 - 1750	1750 - 1800	1800 - 2000	2000 - 2100	2100 - 2250	2250 - 2500	2500 - 2750	2750 - 3000	3000 - 3050	3050 - 3250	3250 - 3460	3460 - 3500	3500 - 3750	3750 - 3960
5	12	12	12	12	12	12	12	12	12	12	-	-	-	-	-	-	-	-
6	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	12.5	12.5	-	-	-	-	-	-
7	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	-	-	-	-	-
8	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	11	-	-	-	-
9	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	-	-	-	-
10	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	18.3	10	-	-	-
12.5	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	-
15	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	-
20	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
25	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
30	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
35	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
40	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
45	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
50	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	16.3	15.4
60	15.3	17	17	17	17	17	17	17	17	17	17	16.9	15.6	15.6	14.6	14.6	13.6	12.8
65	13.1	17	17	17	17	17	17	17	17	17	15.9	14.6	13.4	13.4	12.5	12.5	11.6	11
70	13.1	17	17	17	17	17	17	17	17	17	15.9	14.6	13.4	13.4	12.5	12.5	11.6	11
75	8.4	17	17	16.8	16.8	17	17	17	17	15.3	13.9	12.7	11.6	11.6	10.9	10.9	10.2	9.7
80	7.9	17	17	16.8	16.8	17	17	17	17	15.3	13.9	12.7	11.6	11.6	10.9	10.9	10.2	9.7
90	-	17	17	15	15	17	17	15.1	15.1	13.6	12.4	11.3	10.5	10.5	9.7	9.7	9.1	8.6
100	-	15.7	15.7	13.5	15.3	15.3	13.6	13.6	12.2	11.1	10.2	9.4	9.4	8.7	8.7	8.7	8.2	7.7
120	-	13.1	13.1	11.2	11.2	12.7	12.7	11.3	11.3	10.2	9.3	8.5	7.8	7.8	7.3	7.3	6.8	6.4
140	-	11.2	11.2	9.6	9.6	10.9	10.9	9.7	9.7	8.7	7.9	7.3	6.7	6.7	6.2	6.2	5.8	-
160	-	9.8	9.8	8.4	9.6	9.6	8.5	8.5	8.5	7.6	6.9	6.4	5.9	5.9	5.5	5.5	5.1	-
180	-	8.7	8.7	7.5	7.5	8.5	8.5	7.5	7.5	6.8	6.2	5.7	5.2	5.2	4.9	4.9	4.5	-
200	-	7.9	7.9	6.7	6.7	7.6	7.6	6.8	6.8	6.1	5.6	5.1	4.7	4.7	4.4	4.4	4.1	-
250	-	4	4	4	4	4	4	4	4	3.9	3.5	3.2	-	-	-	-	-	-
300	-	4	4	4	4	4	4	3.6	3.6	3.2	-	-	-	-	-	-	-	-
350	-	4	4	4	4	3.5	3.5	3.1	3.1	-	-	-	-	-	-	-	-	-

- indicates size not available

C.11 **Carbon and carbon manganese wide flats – British Steel standard sizes**

Typical size range of carbon and carbon-manganese wide flats (max length in m)

Thickness (mm) / Width	10	12	15	20	25	30	35	40	45	50	55	60	65	70	75	80	90	100
150				13	13	13	15	15	15	15	15	15						
180		12	13	13	15	15	15	15	15	15	15	16	16	16	16			
200		12	13	14	15	15	15	15	15	16	16	16	16	16	16			
220		12	13	14	15	15.5	16.5	17	17	17.5	18	18	18	18	18			
250		12	13.5	14	15	15.5	16	16.5	17.5	17.5	17.5	18	18	18	18			
275		12	14	14	15	15.5	16.5	17	17	17.5	18	18	18	18	18			
300		12	14	15	16	18	18	18	18	18	19	19	19	19	19			
325		12	12	15	16	18	18	18	18	18	19	19	19	19	19			
350			12	15	16	18	18	18	18	20	20	20	20	20	20			
375			12	16	16.5	20	20	20	20	20	20	21	21	21	21			
400			12	16	17	21	21	22	22	22.5	22.5	23	23	23	23			
425			12	16	18	21	23	23	23	23	23	23	23	23	23			
450				16	18	21	23	23	23	23	23	23	23	23	23			
475				15	18	21	23	23	23	23	23	23	23	23	23			
500				15	18	21	23	23	23	23	23	23	23	23	23			
525					18	21	23	23	23	23	23	23	23	23	22			
550					18	21	23	23	23	23	23	23	23	22	20			
575					18	21	23	23	23	23	23	23	23	21	19			
600					18	21	23	23	23	23	23	23	22	21	19			
625					18	21	23	23	23	23	23	23	21	20	19			
650					18	21	23	23	23	23	23	22	21	19	18			

Not available

Development range – please consult

May be available with dimensions and material properties by arrangement

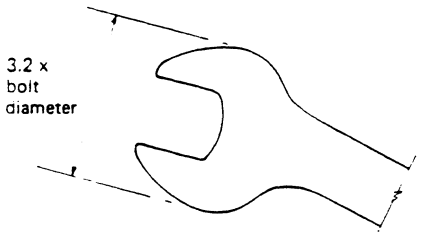
Not normally available except by special arrangement on straightness and flatness tolerances

C.12 **Fasteners – mechanical properties and dimensions of ordinary bolts**

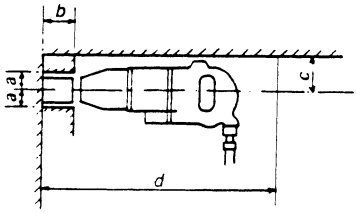
Metric coarse threads		M12	M16	M20	M24	M30	M36
Pitch (mm)		1.74	2.00	2.50	3.00	3.50	4.00
Tensile stress area		84.3	157	245	353	561	817
Basic effective diameter (pitch diameter) (mm)		10.863	14.701	18.376	22.051	27.727	33.402
Grade 4.6	Ultimate load kN	33.1	61.6	96.1	138	220	321
	Proof load	18.7	34.8	54.3	78.2	124	181
Grade 8.8	Ultimate load kN	66.2	123	192	277	439	641
	Proof load	48.1	89.6	140	201	321	466
Length of threads							
= 125mm		30	38	46	54	66	78
> 125mm and = 200mm		36	44	52	60	72	84
> 200mm		49	57	65	73	85	97
= 125mm (short thread length)		-	24	30	36	-	-
Dimensions (mm)							
Maximum width across flats		19.0	24.0	30.0	36.0	46.0	55.0
Maximum width across corners		21.9	27.7	34.6	41.6	53.1	63.5
Nominal head depth of bolts		8.0	10.0	13.0	15.0	19.0	23.0
Nominal depth of nuts		10.0	13.0	16.0	19.0	24.0	29.0

C.13 **Fasteners – clearance for tightening**

Up to and including M20 diameter, tightening is usually best done by hand

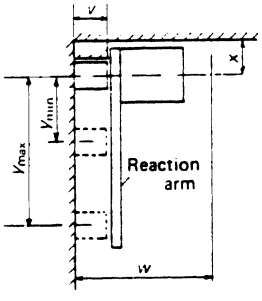


Hand Spanner for Ordinary Bolts



Size of bolt	a	b	c	d- power
M12	23	27	30	500
M16	30	46	60	500
M20	30	46	60	600
M24	36	65	60	600
M30	49	78	70	700
M36	49	97	100	700

Impact wrench for HSFG bolts



Size of bolt	v	w*	x	min. y to max. y
M24	65	250 500	60	82 210
M30	78	270 600	65	89 260
M36	97	300 600	65	89 260

Note that the clearances given are the minimum values for convenient working. Lesser values than these may be used where necessary, after consultation with the equipment manufacturer.

Torque multiplier for HSFG bolts

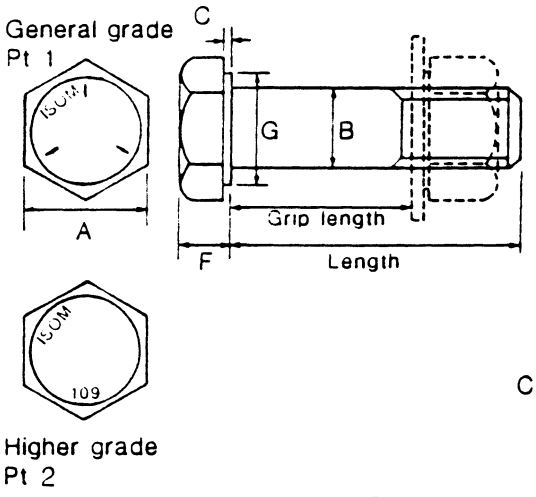
C.14 **Fasteners – high strength friction grip bolts**

Dimensions for high strength friction grip bolts and nuts to BS 4395 parts 1 and 2

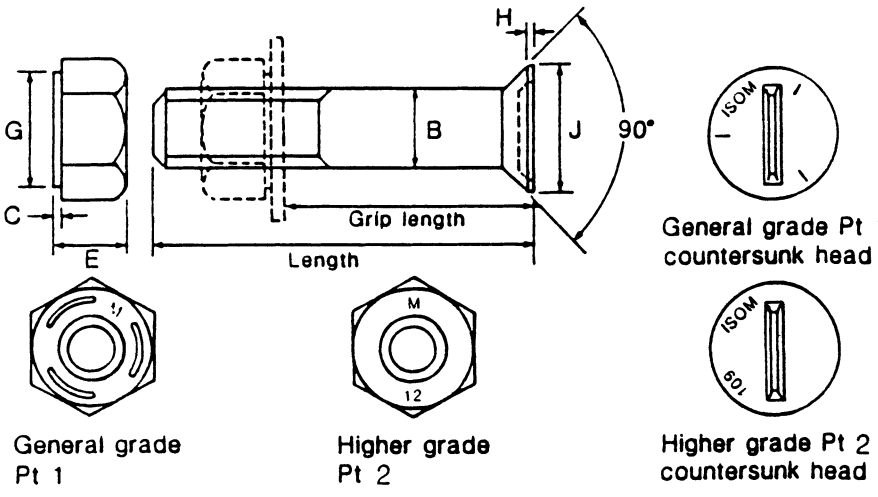
Nominal diameter	Diameter of unthreaded shank B		Pitch (coarse pitch series)	Width across flats A		Depth of washer face C	Thickness of hexagon head F		*Dia of Csk. Head J	Diameter of washer face G		*Depth of Csk. Flash H	Thickness of nuts E		Addition to grip length to give length of bolt required**
mm	Max mm	Min mm	mm	Max mm	Min mm	mm	Max. mm	Min. mm	mm	Max. mm	Min. mm	mm	Max. mm	Min. mm	mm
(M12)	12.70	11.30	1.75	22	21.16	0.4	8.45	7.55	24	22	19.91	2.0	11.55	10.45	22
M16	16.70	15.30	2.0	27	26.16	0.4	10.45	9.55	32	27	24.91	2.0	15.55	14.45	26
M20	20.84	19.16	2.5	32	31.00	0.4	13.90	12.10	40	32	29.75	3.0	18.55	17.45	30
M22	22.84	21.16	2.5	36	35.00	0.4	14.90	13.10	44	36	33.75	3.0	19.65	18.35	34
M24	24.84	23.16	3.0	41	40.00	0.5	15.90	14.10	48	41	38.75	4.0	22.65	21.35	36
M27	27.84	26.16	3.0	46	45.00	0.5	17.90	16.10	54	46	43.75	4.0	24.65	23.35	39
M30	30.84	29.16	3.5	50	49.00	0.5	20.05	17.95	60	50	47.75	4.5	26.65	25.35	42
M33	34.00	32.00	3.5	55	53.80	0.5	22.05	19.95	66	55	52.55	5.0	29.65	28.35	45
M36	37.00	35.00	4.0	60	58.80	0.5	24.05	21.95	72	60	57.75	5.0	31.80	30.20	48

See figures below for the dimensions used in the table
Size shown in brackets is non-preferred
* Countersunk head
** Allows for nut, one flat round washer and sufficient thread protrusion beyond nut.

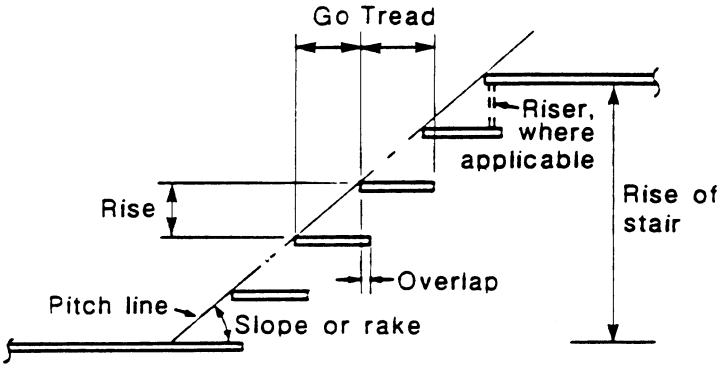
HEXAGON HEAD



COUNTERSUNK HEAD



C.15 **Staircase dimensions**



Stairway terms