BRITISH STEEL

Bulb Flats

Light weight corrosion resistant solution for plate stiffening

BUILDING STRONGER FUTURES

Photo courtesy of: Andrew Linnett/MOD

Introducing British Steel

British Steel is a world leader in the production of steel with facilities across the UK and France, supplying high quality steel products around the world.

What makes us different is our approach to business. We build collaborative relationships that create new success for our customers, delivering a wide range of products and services either direct to end users or through our extensive stockist network.

We offer guidance and solutions to our customers from the very early design stage to deliver real benefits through optimisation of fabrication and process routes.

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Introduction to steel bulb flats

Bulb flats are the most cost-effective, efficient and corrosion-resistant solution for plate stiffening requirements. Key advantages include an excellent strength to weight ratio delivering buckling resistance at a lower weight than with flat bars or angles.

The rounded edges of the bulb profile mean there is no need for edge grinding prior to painting, saving time and money during fabrication. Paint degradation and the build up of corrosive debris is also reduced, extending life performance.

Services

- Bulb flats can be shotblasted, to SA2.5, and primed using a range of industry standard pre-frabrication primers for enhanced fabrication performance and product protection.
- Grinding of bulb flats for improved weld edge and width tolerances, making automated fabrication quicker and more accurate .
- Flexible and regular rolling programme of all our products to offer closer project schedule adherence.
- Local representation from our network of international offices.

Traceability

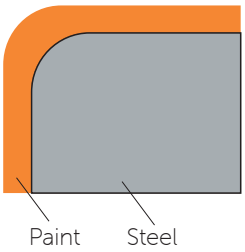
At British Steel, we have complete control of our products from receipt of raw iron ore at our port facility, through our blast furnace & concast steel production, to being rolled into the final product at our mill, in the north east of England. Each bulb flat bar has a unique bar identity which allows complete traceability from steelmaking to the finished product.

We hold a wide range of Ship Society Classification Approvals giving our customers the confidence that their fabrication will be using steel components in full compliance with the relevant industry approval standards.

Our production facilities are certified to ISO9001 and ISO14001.

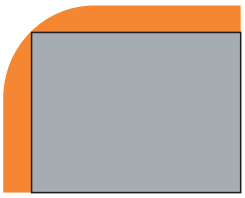
Enhanced paint protection

Bulb flats are manufactured with rounded edges, eliminating the need for the labour-intensive and costly grinding process needed to meet new International Maritime Organistion guidelines and enhancing paint adherance for reduced corrosion.



Bulb flat steel

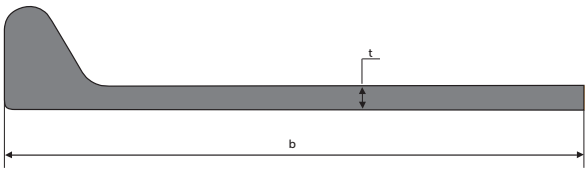
Uniform paint thickness provides longer lasting protection against degradation.



Alternative steel for plate stiffening

Square edge results in uneven paint distribution therefore offers limited protection against degradation.

Dimensions



Width, b (mm)	160-430
Thickness, t (mm)	7-20
Length (m)	6-16.5*

**Short cuts and longer lengths up to 18m available on request.*

Email: specialprofiles@britishsteel.co.uk

Steel types and grades

Special Profiles operations are in accordance with ISO9001:2008
British Steel also have approval of the world's leading classification societies such as:
ABS, BV, DNV and LRS. Other societies available on request.

Our on site LRS inspection and mode 1 approval means material ordered to standard specifications can be available for despatch approx 2 weeks from date of rolling, 3 weeks for all other societies.

Below is a list of sample grades we regularly produce.

Shipbuilding steels

Strength	Grade
	A, B
Normal	D
	E
	A32
	D32
High strength	A36
	D36
	E36

Grades that are held in bloom stock, readily available to roll in the next available capacity

The following grades are within our capability and steel is made to order

Other grades may also be available upon request.

Additional project specs may be considered for larger volume orders

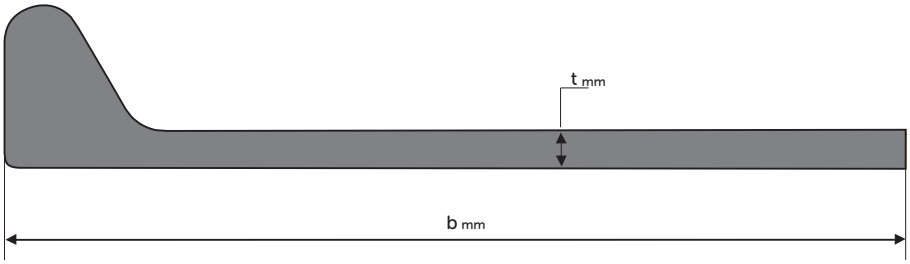
Structural steels

Euronorm	Grade
ASTM	A572 Gr50
	S235JR+AR
	S235J0+AR
	S235J2+AR
	S275JR+AR
EN10025-2	S275J0+AR
	S275J2+AR
	S355JR+AR
	S355J0+AR
	S355J2+AR
EN10025-4	S355M
EN10225	G11
	G12

Photo courtesy of: Aircraft Carrier Alliance

Dimensional tolerances

1.0 Dimensions



1.1 Width

Width b, (mm)	EN10067 Standard	Special 1	Special 2
≥ 160 ≤ 180	±2.0mm	±2.0mm	±1.5 mm
≥ 180 ≤ 300	±3.0mm	±2.2mm	±1.7 mm
≥ 300 ≤ 430	±4.00mm	±3.0mm	±2.0 mm

Our special width tolerances are achieved through an offline 100% weld edge grinding process. This ensures clean flat edges for superior welding.

Even closer tolerances may be accepted after special agreement.

1.2 Thickness

Thickness **t** tolerances for different widths ranges.

Width b, (mm)	EN10067 Standard	Special 1
≥ 160 ≤ 180	-0.3 /+ 1.0mm	-0.2 / + 0.6mm
> 180 ≤ 300	-0.4/ + 1.0mm	-0.3 / + 0.6mm
> 300 ≤ 430	-0.4/ + 1.2mm	-0.3 / + 0.6mm

1.3 Length

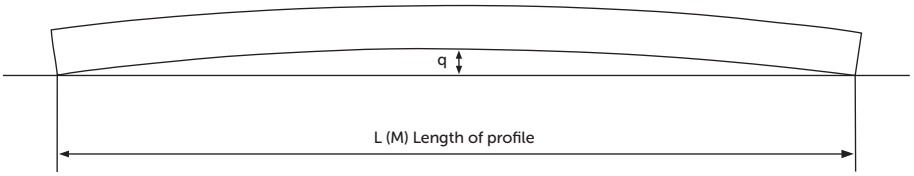
Closer tolerances may be achieved by special agreement.

Length, L	EN10067 Standard
All	-0 / + 100 mm

Individual lengths between 6m and 16.5m are available as a standard stackable length. Lengths outside this range (1.5m to 18m) may be available on request on a limited tonnage basis.

1.4 Straightness - bow and camber

As measured over the length of the bar.



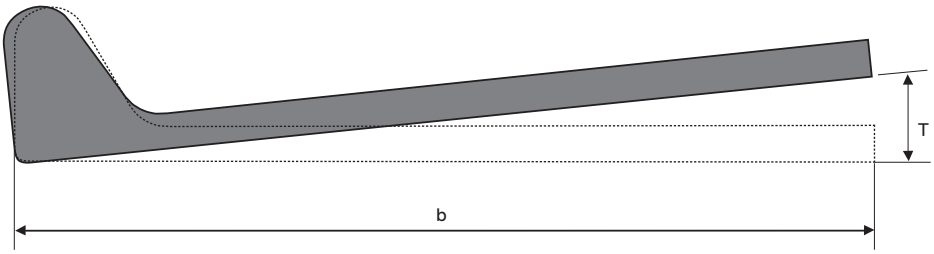
Length	EN10067 Standard	Special 1	Special 2
L ≤ 18m	q ≤ 0.0035 x L	q ≤ 0.0025 x L	q ≤ 0.00125 x L

1.5 Twist

The permissible degree of twist is given as the following:

Length	Standard	Special 1
All	0.5°/m	0.35°/m

Twist can be difficult to measure and is easiest to measure converted into Torsion by measuring the Torsion **T** in mm and applying the following calculations:



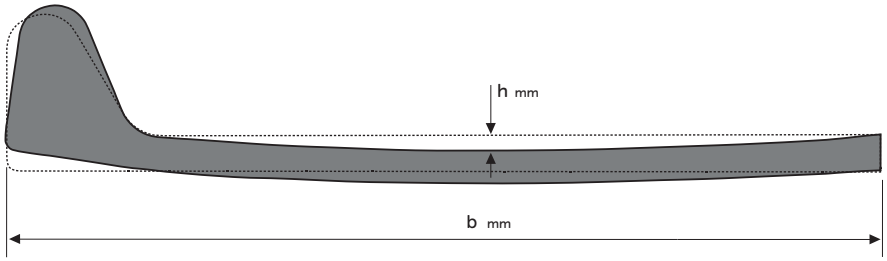
Torsion, T (mm) = width (mm) x sin tol degree, x length (M)
Torsion: T = b x sin 0.35º x L - Special steel 1
Torsion: T = b x sin 0.5º x L - Standard steel

Length, L	6m		10m		12m		15m		18m	
Permitted twist	0.35°	0.5°	0.35°	0.5°	0.35°	0.5°	0.35°	0.5°	0.35°	0.5°
Width, b (mm)	Torsion, T (mm)									
160	5.86	8.38	9.77	13.96	11.73	16.75	14.66	20.94	17.59	25.13
180	6.60	9.42	11.00	15.71	13.19	18.85	16.49	23.56	19.79	28.27
200	7.33	10.47	12.22	17.45	14.66	20.94	18.33	26.18	21.99	31.42
220	8.06	11.52	13.44	19.20	16.13	23.04	20.16	28.80	24.19	34.56
240	8.80	12.57	14.66	20.94	17.59	25.13	21.99	31.42	26.39	37.70
260	9.53	13.61	15.88	22.69	19.06	27.23	23.82	34.03	28.59	40.84
280	10.26	14.66	17.10	24.43	20.52	29.32	25.66	36.65	30.79	43.98
300	11.00	15.71	18.33	26.18	21.99	31.42	27.49	39.27	32.99	47.12
320	11.73	16.75	19.55	27.92	23.46	33.51	29.32	41.89	35.19	50.26
340	12.46	17.80	20.77	29.67	24.92	35.60	31.15	44.51	37.38	53.41
370	13.56	19.37	22.60	32.29	27.12	38.75	33.90	48.43	40.68	58.12
400	14.66	20.94	24.43	34.91	29.32	41.89	36.65	52.36	43.98	62.83
430	15.76	22.51	26.27	37.52	31.52	45.03	39.40	56.29	47.28	67.54

1.6 Flatness

The flatness tolerance **h** is 0.3% of the bulb flat width **b** and is measured as shown below.

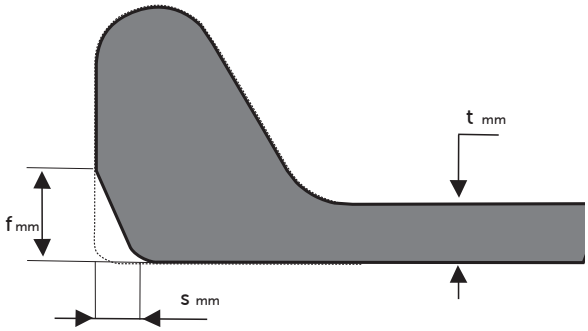
Flatness tolerance: h ≤ 0.003 x b



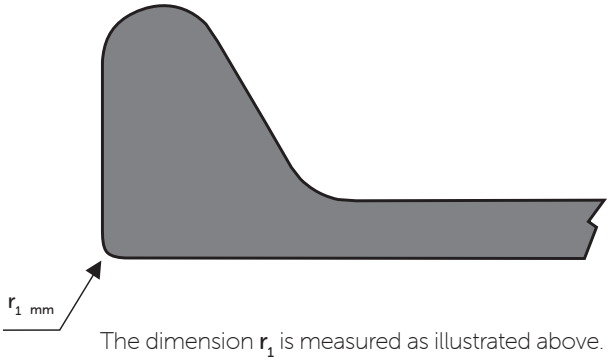
The bulb flatness tolerance of the heel is **n** measured as shown below with a 2mm maximum.

Bulb flatness tolerance: n ≤ 2.0 mm

1.7 Shape



The dimensions **s** and **f** are measured as illustrated above.



The dimension r_1 is measured as illustrated above.

Bulb head corner tolerances s

Thickness	Tolerance
t ≤ 9 mm	s ≤ 2.0mm
9 < t ≤ 13 mm	s ≤ 3.0mm
t > 13 mm	s ≤ 4.0mm

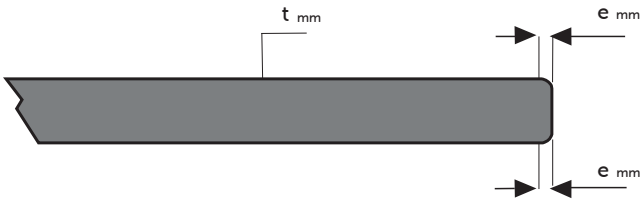
Bulb head corner tolerances f

Thickness	Tolerance
t > 7 mm	f ≤ 0.75 S

Bulb head corner tolerances radius r_1

Radius of curvature of corners r_1 for thickness

Thickness	r_1 ≤
5 < t ≤ 9	2.0mm
9 ≤ t < 13	3.0mm
13 ≤ t ≤ 20	4.0mm

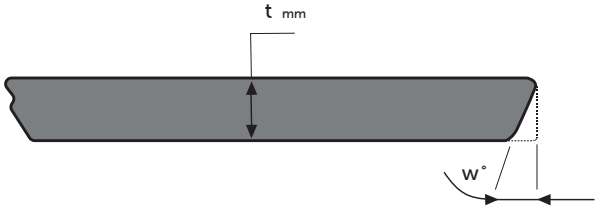


The dimension **e** is measured as illustrated above.

Web edge tolerances e

Thickness	EN10067 - Standard
t ≤ 9 mm	e ≤ 2.0mm
9 < t ≤ 13 mm	e ≤ 3.0mm
t > 13 mm	e ≤ 4.0mm

Tighter tolerances may be available on request through grinding of the web edge.



The dimension **w** is measured as illustrated above.

Web edge tolerances angle w

Thickness	Tolerance
t ≤ 9 mm	w ≤ 4º
9 < t ≤ 13 mm	w ≤ 4º
t > 13 mm	w ≤ 4º

Tighter tolerance on web edge tolerance **e** and angle **w** may be available on request through offline grinding of the web edge.

Surface condition

The surface requirements and repair conditions for shipbuilding profiles are in accordance with EN10163-3:2004, subclass 3, class C. Maximum permissible depth of discontinuities and grinding allowance below minimum specified thickness are given in the table below:

Nominal thickness of the Product, t	Maximum permissible depth of discontinuities (mm)
3 ≤ t < 6	20% of t
6 ≤ t < 20	1.2
20 ≤ t < 40	1.7

Requirements for blast-cleaned and primed material

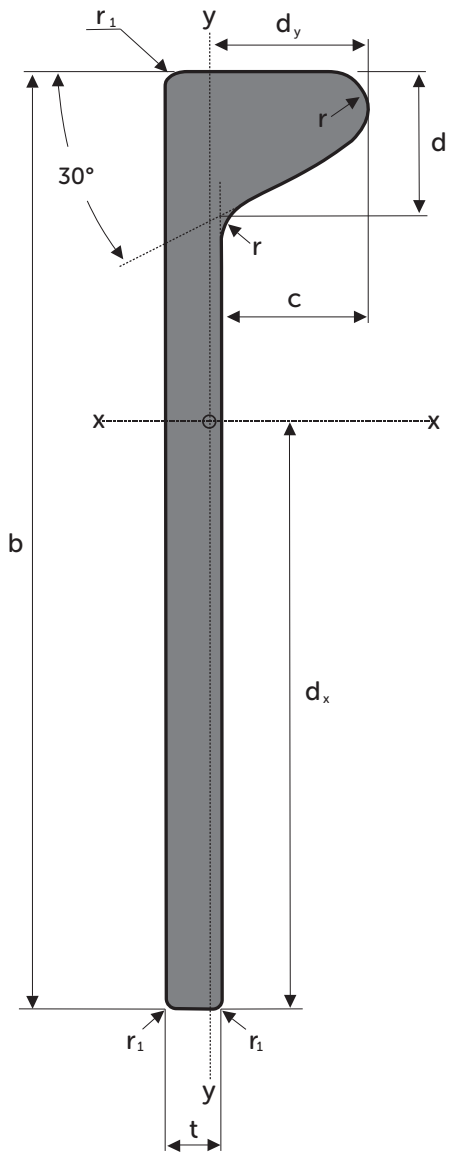
The material can be delivered in blast-cleaned and primed condition in accordance with EN10238:1996. The standard supply conditions are as follows:

Preparation grade: Sa 2½
Surface roughness: M (medium in acc. with ISO 8503-2)
Dry film thickness: 20µm ± 5µm
Types of primers: British Steel have painting facilities capable of applying a wide range of primes and can accommodate most customers preferred paints.

Dimensions and properties

Section description						Mass per metre	Area of section	Surface area per metre	Distance to centre of gravity	
	b mm	t mm	c mm	d mm	r rmm	G Kg/m	A cm^2	U m^2/m	dx mm	dy mm
160x7	160	7.0	22.0	22.2	6.0	11.46	14.58	0.365	96.7	6.5
160x8	160	8.0	22.0	22.2	6.0	12.72	16.18	0.367	95.1	6.8
160x9	160	9.0	22.0	22.2	6.0	13.97	17.78	0.370	93.7	7.1
160x10	160	10.0	22.0	22.2	6.0	15.30	19.34	0.371	92.6	7.5
160x11	160	11.0	22.0	22.2	6.0	16.49	20.94	0.373	91.7	7.9
160x11.5	160	11.5	22.0	22.2	6.0	17.30	21.74	0.374	91.3	8.1
180x8	180	8.0	25.0	25.5	7.0	14.80	18.83	0.412	109.0	7.4
180x9	180	9.0	25.0	25.5	7.0	16.22	20.63	0.414	107.4	7.7
180x10	180	10.0	25.0	25.5	7.0	17.63	22.40	0.416	106.0	8.1
180x11	180	11.0	25.0	25.5	7.0	19.04	24.20	0.418	104.8	8.4
180x11.5	180	11.5	25.0	25.5	7.0	19.70	25.10	0.419	104.3	8.6
200x8.5	200	8.5	28.0	28.8	8.0	17.80	22.63	0.458	122.2	8.2
200x9	200	9.0	28.0	28.8	8.0	18.57	23.63	0.459	121.3	8.4
200x10	200	10.0	28.0	28.8	8.0	20.14	25.60	0.460	119.7	8.7
200x11	200	11.0	28.0	28.8	8.0	21.71	27.60	0.463	118.3	9.0
200x11.5	200	11.5	28.0	28.8	8.0	22.50	28.60	0.464	117.6	9.2
200x12	200	12.0	28.0	28.8	8.0	23.28	29.60	0.465	117.0	9.4
220x9	220	9.0	31.0	32.1	9.0	21.00	26.78	0.504	135.5	9.1
220x10	220	10.0	31.0	32.1	9.0	22.77	28.94	0.505	133.7	9.3
220x11	220	11.0	31.0	32.1	9.0	24.50	31.14	0.507	132.0	9.7
220x11.5	220	11.5	31.0	32.1	9.0	25.30	32.24	0.509	131.2	9.8
220x12	220	12.0	31.0	32.1	9.0	26.22	33.34	0.510	130.5	10.0
230x11	230	11.0	32.5	33.75	9.5	25.06	32.97	0.530	138.9	10.0
240x9.5	240	9.5	34.0	35.4	10.0	24.40	31.23	0.549	148.9	9.9
240x10	240	10.0	34.0	35.4	10.0	25.50	32.43	0.550	147.9	10.0
240x10.5	240	10.5	34.0	35.4	10.0	26.40	33.63	0.551	146.9	10.2
240x11	240	11.0	34.0	35.4	10.0	27.39	34.83	0.552	145.9	10.3
240x11.5	240	11.5	34.0	35.4	10.0	28.30	36.03	0.554	145.1	10.5
240x12	240	12.0	34.0	35.4	10.0	29.27	37.23	0.555	144.3	10.6
260x10	260	10.0	37.0	38.7	11.0	28.35	36.05	0.595	162.3	10.7
260x11	260	11.0	37.0	38.7	11.0	30.39	38.65	0.597	160.1	11.0
260x12	260	12.0	37.0	38.7	11.0	32.43	41.25	0.600	158.2	11.3
260x13	260	13.0	37.0	38.7	11.0	34.40	43.85	0.602	156.5	11.6
280x10.5	280	10.5	40.0	42.0	12.0	32.40	41.22	0.641	175.7	11.6
280x11	280	11.0	40.0	42.0	12.0	33.50	42.62	0.642	174.5	11.7
280x12	280	12.0	40.0	42.0	12.0	35.70	45.42	0.645	172.4	11.9
280x13	280	13.0	40.0	42.0	12.0	37.90	48.22	0.647	170.5	12.2
300x11	300	11.0	43.0	45.3	13.0	36.70	46.73	0.687	189.1	12.4
300x12	300	12.0	43.0	45.3	13.0	39.09	49.73	0.690	186.7	12.7
300x13	300	13.0	43.0	45.3	13.0	41.44	52.73	0.692	184.6	12.9
320x11.5	320	11.5	46.0	48.6	14.0	41.20	52.59	0.733	202.5	13.3
320x12	320	12.0	46.0	48.6	14.0	42.60	54.19	0.735	201.3	13.4
320x12.5	320	12.5	46.0	48.6	14.0	43.80	55.79	0.736	200.1	13.5
320x13	320	13.0	46.0	48.6	14.0	45.09	57.39	0.737	199.0	13.6
320x13.5	320	13.5	46.0	48.6	14.0	46.30	58.94	0.737	198.0	13.7
320x14	320	14.0	46.0	48.6	14.0	47.60	60.54	0.738	197.0	13.9
340x12	340	12.0	49.0	52.0	15.0	46.20	58.78	0.780	216.0	14.1
340x12.5	340	12.5	49.0	52.0	15.0	47.50	60.48	0.781	214.7	14.2
340x13	340	13.0	49.0	52.0	15.0	48.86	62.18	0.782	213.5	14.3
340x14	340	14.0	49.0	52.0	15.0	51.50	65.54	0.784	211.3	14.6
340x15	340	15.0	49.0	52.0	15.0	54.20	68.94	0.786	209.2	14.8
370x12.5	370	12.5	53.5	56.9	16.5	53.10	67.79	0.848	236.9	15.4
370x13	370	13.0	53.5	56.9	16.5	54.70	69.64	0.850	235.5	15.5
370x14	370	14.0	53.5	56.9	16.5	57.60	73.30	0.851	233.0	15.7
370x15	370	15.0	53.5	56.9	16.5	60.50	77.00	0.854	230.7	15.9
370x16	370	16.0	53.5	56.9	16.5	63.50	80.70	0.857	228.6	16.1
400x13	400	13.0	58.0	61.9	18.0	60.80	77.43	0.918	257.9	16.6
400x14	400	14.0	58.0	61.9	18.0	63.96	81.38	0.919	255.1	16.8
400x15	400	15.0	58.0	61.9	18.0	67.10	85.38	0.922	252.5	17.0
400x16	400	16.0	58.0	61.9	18.0	70.20	89.38	0.925	250.2	17.2
430x14	430	14.0	62.5	66.8	19.5	70.60	89.78	0.987	277.5	18.0
430x15	430	15.0	62.5	66.8	19.5	73.90	94.08	0.990	274.6	18.1
430x17	430	17.0	62.5	66.8	19.5	80.70	102.68	0.995	269.6	18.5
430x18	430	18.0	62.5	66.8	19.5	83.90	106.98	0.998	267.4	18.8
430x19	430	19.0	62.5	66.8	19.5	87.40	111.28	1.001	265.4	19.0
430x20	430	20.0	62.5	66.8	19.5	90.80	115.58	1.004	263.5	19.3

Second moment of inertia		Elastic modulus		Radius of gyration		Warping constant	Torsional constant
Ix cm^4	Iy cm^4	Zx cm^3	Zy cm^3	rx cm	ry cm	Zy $cm^6/10^3$	J cm^4
371.10	5.85	38.4	9.0	5.05	0.63	1.11	3.65
409.27	6.54	43.0	9.7	5.03	0.64	1.15	4.57
446.70	7.31	47.7	10.3	5.01	0.64	1.19	5.73
481.31	8.15	52.0	10.9	4.99	0.65	1.22	7.12
517.81	9.09	56.5	11.5	4.97	0.66	1.26	8.86
535.93	9.60	58.7	11.9	4.96	0.66	1.29	9.85
606.55	9.89	55.6	13.3	5.67	0.72	2.41	6.24
661.09	10.92	61.6	14.1	5.66	0.73	2.47	7.57
711.72	12.03	67.1	14.9	5.64	0.73	2.52	9.15
764.60	13.25	72.9	15.7	5.62	0.74	2.60	11.13
790.81	13.90	75.8	16.1	5.61	0.74	2.64	12.26
901.07	15.06	73.7	18.3	6.31	0.82	4.71	9.20
939.14	15.75	77.4	18.8	6.30	0.82	4.76	10.00
1010.47	17.18	84.4	19.8	6.28	0.82	4.83	11.78
1084.33	18.75	91.7	20.8	6.27	0.82	4.95	14.01
1120.89	19.57	95.3	21.3	6.26	0.83	5.02	15.28
1157.23	20.43	98.9	21.8	6.25	0.83	5.09	16.65
1290.48	22.01	95.2	24.3	6.94	0.91	8.61	13.17
1387.89	23.86	103.8	25.5	6.92	0.91	8.72	15.16
1488.07	25.83	112.7	26.8	6.91	0.91	8.90	17.65
1537.57	26.87	117.2	27.4	6.91	0.91	8.99	19.06
1586.73	27.94	121.6	28.0	6.90	0.92	9.10	20.60
1724.98	30.05	124.2	30.1	7.23	0.95	11.69	19.81
1787.40	31.12	120.0	31.4	7.57	1.00	14.83	18.25
1854.67	32.30	125.4	32.2	7.56	1.00	14.94	19.46
1921.25	33.52	130.8	33.0	7.56	1.00	15.06	20.78
1987.20	34.78	136.2	33.8	7.55	1.00	15.19	22.22
2052.60	36.06	141.5	34.5	7.55	1.00	15.33	23.79
2117.50	37.39	146.8	35.2	7.54	1.00	15.48	25.49
2421.72	42.80	149.2	39.9	8.20	1.09	24.54	24.85
2593.45	45.86	162.0	41.8	8.19	1.09	24.87	27.91
2762.00	49.07	174.6	43.6	8.18	1.09	25.25	31.50
2927.94	52.45	187.0	45.3	8.17	1.09	25.69	35.69
3210.10	57.50	182.7	49.7	8.82	1.18	39.05	33.16
3318.79	59.39	190.2	50.8	8.82	1.18	39.27	34.90
3532.99	63.29	205.0	53.0	8.82	1.18	39.77	38.84
3743.56	67.37	219.6	55.1	8.81	1.18	40.34	43.42
4175.43	75.68	220.8	60.9	9.45	1.27	60.10	43.42
4443.49	80.39	238.0	63.5	9.45	1.27	60.72	47.73
4706.64	85.27	254.9	66.1	9.45	1.27	61.45	52.71
5342.16	97.86	263.8	73.7	10.08	1.36	89.86	55.95
5506.76	100.69	273.6	75.3	10.08	1.36	90.25	58.38
5669.75	103.58	283.4	76.8	10.08	1.36	90.68	60.99
5831.26	106.51	293.1	78.3	10.08	1.36	91.15	63.79
5977.59	109.44	301.9	79.7	10.07	1.36	91.35	66.51
6136.58	112.48	311.5	81.1	10.07	1.36	91.89	69.71
6736.30	124.57	311.9	88.2	10.70	1.46	131.02	71.06
6934.97	127.98	323.1	89.9	10.71	1.45	131.53	73.88
7131.73	131.44	334.1	91.7	10.71	1.45	132.09	76.91
7504.42	138.47	355.2	95.0	10.70	1.45	132.97	83.29
7886.99	145.80	377.0	98.3	10.70	1.45	134.41	90.88
9184.55	172.23	387.8	112.1	11.64	1.59	221.07	97.62
9444.05	176.62	401.0	114.2	11.64	1.59	221.76	101.01
9936.79	185.49	426.5	118.5	11.64	1.59	222.83	108.11
10440.07	194.68	452.5	122.6	11.64	1.59	224.72	116.55
10935.90	204.14	478.4	126.6	11.64	1.59	226.88	126.04
12234.74	232.34	474.5	139.7	12.57	1.73	357.80	131.25
12872.91	243.41	504.7	145.0	12.58	1.73	358.96	139.13
13521.89	254.79	535.5	150.1	12.58	1.73	361.32	148.48
14160.53	266.45	566.1	154.9	12.59	1.73	364.08	158.97
16366.61	313.68	589.9	174.7	13.50	1.87	559.02	177.41
17189.22	327.65	626.0	180.8	13.52	1.87	561.76	187.72
18794.22	356.44	697.1	192.5	13.53	1.86	569.01	212.09
19579.84	371.35	732.2	197.9	13.53	1.86	573.41	226.30
20355.95	386.65	767.0	203.4	13.52	1.86	578.26	241.98
21123.62	402.40	801.6	208.6	13.52	1.87	583.53	259.20



BRITISH STEEL

BRITISHSTEEL.CO.UK

A | PO Box 1, Skinningrove, Saltburn by the Sea, TS13 4ET, United Kingdom
T | +44 (0)1287 593124 E | specialprofiles@britishsteel.co.uk

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