



BS 6323: Part 1: 1982

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**British Standard Specification for
Seamless and welded steel tubes
for automobile, mechanical and
general engineering purposes**

Part 1. General requirements

**Tubes en acier soudés et sans soudure pour l'automobile, la mécanique et la technique générale
Partie 1. Caractéristiques générales**

**Nahtlose und geschweißte Stahlrohre für den Kraftfahrzeugbau, Maschinenbau
und für allgemeine technische Zwecke
Teil 1. Allgemeine Anforderungen**

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Foreword

This British Standard has been prepared under the direction of the Iron and Steel Standards Committee. It is a combined standard superseding BS 980 : 1950, BS 1775 : 1964 and BS 3014 : 1958 which are withdrawn.

In BS 6323 manufacturing processes have been aligned with current procedures, and processes no longer used, i.e. oxy-acetylene welding and hydraulic lap welding, have been deleted. Terminology relating to the designation of certain manufacturing processes has been updated, i.e. SAW replaces EFW, and CFS replaces CDS. Additionally, in combining the standards, steel grades have been rationalized and aligned, with delivery conditions now being clearly designated by letter codes.

This standard is published in eight separate Parts as follows:

- Part 1. General requirements
- Part 2. Specific requirements for hot finished welded steel tubes
- Part 3. Specific requirements for hot finished seamless steel tubes
- Part 4. Specific requirements for cold finished seamless steel tubes

Part 5. Specific requirements for electric resistance welded (including induction welded) steel tubes

Part 6. Specific requirements for cold finished electric resistance welded (including induction welded) steel tubes

Part 7. Specific requirements for submerged arc welded steel tubes

Part 8. Specific requirements for longitudinally welded stainless steel tubes

This Part of the standard contains a number of appendices.

Appendix A gives a summary table of chemical compositions and mechanical properties of all steels covered by this standard.

Appendix B gives the sectional properties of the tube, e.g. moment of inertia, elastic modulus, etc.

Appendix C gives a comparison between the steel grades and designations covered by this standard and those given in BS 980 : 1950, BS 1775 : 1964, BS 3014 : 1958 and the relevant ISO standards. It should be noted that although there are similarities in the designations used in this standard and in BS 980, BS 1775 and BS 3014 confusion will be prevented provided that the British Standard number is always quoted to prefix the grade reference (see clause 4).



Compliance with a British Standard does not of itself confer immunity from legal obligations.

British Standard Specification for

Seamless and welded steel tubes for automobile, mechanical and general engineering purposes

Part 1. General requirements

1. Scope

This Part of BS 6323 specifies the general requirements for the hot and cold finished seamless and welded steel tubes for use in the automobile, mechanical and general engineering industries included in Parts 2 to 8 of this British Standard. Parts 2 to 8 specify the chemical compositions, mechanical properties, dimensions, dimensional tolerances and technical delivery conditions for each type of tube.

Leak tightness testing is covered only in Parts 4, 5, 6 and 8.

NOTE 1. For tubes for pressure purposes, attention is drawn to BS 3601 to BS 3605 and for hollow sections for structural purposes to BS 4360 and BS 4848 : Part 2 and BS 6363.

NOTE 2. The titles of the publications referred to in this Part of this standard are listed on the inside back cover.

2. General

Each type of tube shall comply with the general requirements of this Part of BS 6323 and the specific requirements of the relevant Part of the same standard.

3. Symbols

The following symbols are used in the Parts of BS 6323:

<i>a</i>	specified thickness (in mm)
<i>A</i>	percentage elongation on gauge length after fracture
<i>C</i>	constant factor of deformation (flattening test) varying with steel grade
<i>D</i>	specified outside diameter (in mm)
<i>H</i>	distance between the platens or outside surfaces (in mm)
<i>L₀</i>	original gauge length of tensile test piece (in mm)
<i>R_e</i>	yield strength (in N/mm ²)
<i>R_{eH}</i>	upper yield stress (in N/mm ²)
<i>R_m</i>	tensile strength (in N/mm ²)
<i>R_{p 0.2}</i>	0.2 % proof stress (non-proportional elongation) (in N/mm ²)
<i>R_{t 0.5}</i>	0.5 % proof stress (total elongation) (in N/mm ²)
<i>S₀</i>	original cross-sectional area of the gauge length (in mm ²)

4. Designations

The tubes shall be designated by:

- the number of this British Standard and the Part number of the relevant specific requirements, e.g. BS 6323/2;
- the reference from table 1, indicating the method of manufacture;

(c) the reference from table 2, indicating the grade of steel;

(d) the reference from table 3 indicating the delivery condition, where applicable.

Examples

- BS 6323/2 HFW 4 designates a hot finished welded tube in a 0.25 % carbon maximum steel having a minimum tensile strength of 410 N/mm².
- BS 6323/4 CFS 7 BKW designates a cold finished seamless tube in 0.20/0.30 % carbon, carbon manganese steel in the cold finished/soft condition.
- BS 6323/8 LWCF 22 GBK(S) designates a longitudinally welded cold finished austenitic chromium nickel molybdenum (2.5 %) steel 316S13

Table 1. Designation of steel tubes: method of manufacture

Method of manufacture	Reference	Applicable Part of BS 6323
Hot finished welded	HFW	2
Hot finished seamless	HFS	3
Cold finished seamless	CFS	4
Electric resistance welded (including induction welded)	ERW	5
Cold finished electric resistance welded (including induction welded)	CEW	6
Submerged arc welded	SAW	7
Longitudinally welded stainless	LW	8
Cold finished longitudinally welded stainless	LWCF	8

5. Information to be supplied by the purchaser

5.1 The purchaser shall state in his enquiry and order:

- the number and Part number of this British Standard, e.g. BS 6323/2 and the designation of the tube in terms of the method of manufacture of tube, the grade of steel and, where applicable, the appropriate delivery condition (see clause 4);
- the tube dimensions, e.g. outside diameter or, where applicable, inside diameter, thickness and length and, where tube is to be subsequently machined, the finished dimensions;

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(c) the quantity required in metres or number of lengths.

5.2 Certain alternatives are permitted by this standard and the purchaser shall also state in his enquiry and order his requirements as follows, but if no such statement is made, supply will be at the option of the manufacturer.

(a) whether a check analysis on the product is required (see 8.2);

(b) any special requirements regarding straightness (see 11.3);

(c) whether tubes are required machined to finished dimensions (see 11.4);

(d) whether other tests are required specifically related to his order (see clause 14);

(e) whether tests are required specifically related to the order or, if not, whether a certificate of compliance is required (see 17.1 and 17.2);

(f) whether a finish other than the manufacturer's normal protective coating or an uncoated finish is required or special protection of the tubes for transit and storage is required (see clause 18);

(g) whether cold finished tubes are required free from phosphate or other residues (see clause 3 of BS 6323 : Parts 4 and 6 : 1982);

(h) whether closer tolerances are required (see note in 8.3 of the relevant Part (Parts 2 to 8) of BS 6323 : 1982);

(i) whether specified cut lengths are required instead of random lengths in BS 6323 : Parts 2 to 8 or mill lengths in Part 5 (see 8.3 of the relevant Part of BS 6323 : 1982);

(j) in the case of BS 6323 : Parts 4, 5, 6 and 8, whether tubes are to be subject to a leak tightness test and if so which type of test is required (see 9.3 of BS 6323 : Parts 4 and 8 : 1982 and 9.4 of BS 6323 : Parts 5 and 6 : 1982);

(k) whether tubes are required bright annealed (see clause 4 of BS 6323 : Parts 4, 5, 6 and 8 : 1982);

(l) the outside diameter tolerance required for tubes, where the ratio of outside diameter to thickness is greater than 33:1 (see clause 8 of BS 6323 : Parts 4 and 6 : 1982);

(m) whether the internal weld upset of welded tubes is to be reduced (see 8.2 of BS 6323 : Part 5 : 1982);

(n) whether special surface finishing is required, e.g. polishing (see clause 4 of BS 6323 : Part 8 : 1982).

(o) if hot finished seamless tubes are specified by outside diameter and inside diameter, the tolerances required (see clauses 7 and 8 of BS 6323 : Part 3 : 1982).

Table 2. Designation of steel tubes: type and grade of steel

Type	BS 6323 grade designation reference	Applicable Part of BS 6323
<i>Carbon and carbon manganese steels</i>		
0.13 % carbon maximum 280*	1	5, 6
0.16 % carbon maximum 320*	2	2, 5, 6
0.20 % carbon maximum 360*	3	2, 3, 4, 5 and 6
0.20 % carbon maximum (case hardening) 360*	3A	4
0.25 % carbon maximum 410*	4	2, 3, 4, 5, 6 and 7
0.23 % carbon maximum 490*	5	2, 3, 4, 5, 6 and 7
0.30 % to 0.40 % carbon 460*	6	4
0.20 % to 0.30 % carbon 1.2 % to 1.5 % manganese 7	7	4
0.40 % to 0.55 % carbon 540*	8	3 and 4
<i>Low alloy steels</i>		
244† manganese molybdenum 9	9	4
623† low carbon 1 % chromium 0.25 % molybdenum 10	10	4
624† high carbon 1 % chromium 0.25 % molybdenum 11	11	4
<i>Stainless steels</i>		
Ferritic 11 % chromium titanium steel 12	12	8
409S19† ferritic 11 % chromium titanium steel 19	19	8
304S11† austenitic chromium nickel steel 20	20	8
304S15† austenitic chromium nickel steel 21	21	8
316S13† austenitic chromium nickel molybdenum (2.75 %) steel 22	22	8
316S33† austenitic chromium nickel molybdenum (2.75 %) steel 23	23	8
321S31† austenitic chromium nickel titanium steel 24	24	8

*For carbon and carbon manganese steels this number relates to the minimum tensile strength in N/mm² in the hot finished or normalized condition.

†This designation is used in other British Standards.

Table 3. Designation of steel tubes: delivery condition

Delivery condition	Description	Reference	Applicable Part of BS 6323
Cold finished/hard (cold finished as drawn)	No heat treatment after the last cold finishing process NOTE. The extent to which the tube can be cold deformed is limited.	BK	4, 6
Cold finished/soft (lightly cold worked)	After the last heat treatment there is a light finishing pass (cold pass) NOTE. With proper subsequent processing the tube can be cold deformed within certain limits (bending, expanding, etc.).	BKW	4, 6
As welded and sized	No heat treatment after the welding and sizing process	KM	5, 8
Annealed	After the final cold finishing process the tubes are subcritically annealed in a controlled atmosphere	GBK	4, 6
	After welding and sizing, the tubes are subcritically annealed in a controlled atmosphere	GKM	5
	After the final cold finishing or the welding and sizing process, the tubes are subcritically annealed and then de-scaled mechanically or chemically	GZF	4, 5, 6
Normalized	After the final cold finishing process, the tubes are heated to a temperature above the upper transformation point and cooled. Both stages of heat treatment are carried out in a controlled atmosphere	NBK	4, 6
	After welding and sizing, the tubes are heated to a temperature above the upper transformation point and cooled. Both stages of heat treatment are carried out in a controlled atmosphere	NKM	5
	After the final cold finishing or the welding and sizing process, the tubes are heated to a temperature above the upper transformation point, cooled in air and then de-scaled mechanically or chemically	NZF	4, 5, 6
Welded and sized (fully softened)	After welding and sizing the tubes are annealed (solution treated) in a controlled atmosphere	GKM(S)	8
	After welding and sizing the tubes are annealed (solution treated) and then de-scaled mechanically or chemically	GZF(S)	8
Cold finished (fully softened)	After cold finishing, the tubes are annealed (solution treated) in a controlled atmosphere	GBK(S)	8
	After cold finishing the tubes are annealed (solution treated) and then de-scaled mechanically or chemically	GZF(S)	8

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6. Manufacture of the steel

6.1 The steelmaking process within the provision of **6.2** and the deoxidation practice within the provision of **6.3** shall be at the option of the steel manufacturer.

6.2 The steel shall be produced by the open hearth, an electric process or one of the basic oxygen processes.

6.3 Steel for all grades of seamless tubes shall be fully killed. Welded tubes of steel grades 1, 2 and 3 shall be rimmed or semi-killed or fully killed. Welded tubes of steel grade 4 shall be either semi-killed or fully killed and grade 5 shall be fully killed.

7. Manufacture of the product

The tubes shall be manufactured by a seamless or welded process as detailed in the relevant Part of BS 6323.

8. Chemical composition

8.1 Ladle analysis. The steel shall show on ladle analysis the composition given in the tables for chemical composition included in the relevant Part of BS 6323 for the steel grade specified.

8.2 Product analysis. If a check analysis on the product is carried out, the permissible deviations given in table 4 apply to the ladle analysis given in appendix A, or table 1 of the relevant Part of BS 6323 : 1982, for samples taken from the position as specified in this subclause. If a check analysis for acceptance purposes is required this shall be stated in the enquiry and order and the number of samples shall be agreed between the purchaser and the manufacturer. The samples shall be taken either from the test pieces used for the verification of the mechanical properties, or from the tube at the same location as for the mechanical test samples.

In cases of dispute the methods of chemical analysis shall be in accordance with British Standard Handbook No. 19.

Table 4. Permitted deviation from specified composition

(a) Permitted deviation from the specified composition for carbon, carbon manganese and low alloy steels

Element	Permissible deviation* from the specified composition
	%
Carbon	± 0.03
Silicon	± 0.05
Manganese	± 0.10
Phosphorus	+ 0.005
Sulphur	+ 0.005
Chromium	± 0.04
Molybdenum	± 0.04

*These values apply only to fully killed and semi-killed steels.

(b) Permitted deviation from the specified composition for stainless steels

Element	Maximum of specification range	Permissible deviation* from the specified composition
	%	%
Carbon	Up to and including 0.03 Over 0.03 up to and including 0.25	+ 0.005 + 0.01
Silicon	Up to and including 1.0	± 0.05
Manganese	Up to and including 0.70 Over 1.0 up to and including 2.00	+ 0.03 ± 0.05
Phosphorus	Specified max. up to and including 0.045	+ 0.004
Sulphur	Specified max. up to and including 0.030	+ 0.003
Chromium	Over 10.0 up to and including 15.0 Over 15.0 up to and including 20.0	± 0.15 ± 0.20
Molybdenum	Over 2.0 up to and including 3.0	± 0.08
Nickel	Up to and including 1.0 Over 10.0 up to and including 20.0	+ 0.03 ± 0.15
Nitrogen	Up to and including 0.25	+ 0.01
Titanium	All ranges	± 0.05

NOTE. The deviations, other than when maxima only are specified, apply either above or below the specified limits of the range but not both above and below for the same element from different sample products from the same cast. When maxima only are specified the deviations are positive only. The values are valid only if the samples were selected according to **8.2**.

9. Delivery condition

The tubes shall be supplied in the condition or in one of the conditions given in clause 4 of the relevant Part of BS 6323 : 1982.

10. Mechanical properties

The mechanical properties at room temperature to be determined on test pieces selected, prepared and tested in accordance with clauses 14 and 15 shall be as specified in the appropriate clauses of the relevant Part of BS 6323.

11. Appearance and soundness

11.1 The tubes shall have a workmanlike finish consistent with their method of manufacture and condition of supply. Small imperfections are permissible and it is permissible for these to be dressed out provided that the tube thickness after dressing remains within the tolerance limit given in the relevant Part of BS 6323. Peening of surface defects is not permitted.

11.2 Tube ends shall be cut nominally square with the axis of the tube and shall be free from excessive burrs.

11.3 Tubes shall not depart from straightness by more than 1.5 in 1000 of any length measured at the centre of that length. Special requirements regarding straightness and the method of measurement shall be the subject of agreement between purchaser and manufacturer.

In cases of dispute the deviation shall be measured relative to a straight edge or taut line.

11.4 Where tubes are required to be machined, this shall be stated on the enquiry and order together with the finished dimensions.

11.5 Pickled tubes shall be lightly oiled.

12. Dimensions and tolerances

Dimensions and tolerances shall be as detailed in clauses 7 and 8 of the relevant Part of BS 6323 : 1982.

13. Inspection

The purchaser, or his representative, shall have access at all reasonable times to those parts of the manufacturer's works engaged on the production and testing of the tubes that he has ordered.

14. Testing

The manufacturer shall carry out the specified tests applicable to each type of tube to ensure that the tubes comply with the requirements of this Part of BS 6323 and the relevant Part covering the specific requirements.

Where the purchaser requires tests specifically related to his order, the tests as detailed in the relevant Part of BS 6323 shall be carried out at the rate of one set of tests per batch of up to and including 1500 m of one size of tube ordered, with an additional test for each additional 1500 m or part thereof.

If other tests are required these shall be agreed between the purchaser and the manufacturer and specified in the enquiry and order.

15. Test methods

15.1 General. The tests described in 15.2 to 15.8 shall be carried out as applicable to the relevant Part of BS 6323.

15.2 Tensile test. The tensile test shall be carried out in accordance with BS 18 : Part 4. The test pieces shall be either longitudinal or transverse, at the option of the manufacturer.

The tensile strength R_m , the yield strength R_e and the elongation A shall be determined and the results obtained shall be as given in table 1 of the relevant Part of BS 6323 : 1982 and for material grade specified. For the yield strength, either the upper yield stress R_{eH} , the 0.5 % proof stress (total elongation) $R_{t0.5}$ or the 0.2 % proof stress (non-proportional elongation) $R_{p0.2}$ shall be determined, depending on the steel grade.

The percentage elongation shall be reported with reference to a gauge length of $L_0 = 5.65 \sqrt{S_0}$. If other gauge lengths are used, the corresponding percentage elongation on $5.65 \sqrt{S_0}$ shall be obtained by reference to BS 3894 : Part 1 for carbon and low alloy steels. In cases of dispute, a gauge length of $5.65 \sqrt{S_0}$ shall be used.

15.3 Flattening test. A ring not less than 40 mm long taken from one end of each selected tube shall be flattened cold between parallel flat platens without showing either crack or flaw until the distance between the platens, measured under load, is not greater than the value specified in the appropriate clause of the relevant Part of BS 6323. It is permissible for hammer blows to be used, in which case the distance between the outside surfaces shall be as given in the appropriate clause of the relevant Part of BS 6323. Slight premature failure at the edges shall not be considered a cause for non-compliance with the requirements.

15.4 Bend test (strip). The test piece shall be a circumferential strip not less than 40 mm wide cut from one end of each selected tube. Where the tube is over 20 mm thick, the test piece shall be machined so as to have a rectangular cross section 40 mm wide x 20 mm thick; in each case it is permissible for the edges to be rounded to a radius of 1.5 mm.

The test piece shall be doubled over cold around the bar of the diameter specified in the relevant Part of BS 6323 without showing crack or flaw. Slight premature failure at the edges shall not be cause for non-compliance with the requirements.

For seamless tubes, the test piece shall be bent in the direction of original curvature. For submerged arc welded tubes, the test piece shall be bent with the root of the weld in tension. The weld shall be in the middle of the test piece at approximately 90° to the major axis, and the weld reinforcement shall be removed from both faces. It is permissible to flatten the test piece before testing.

15.5 Bend test (whole tube). The tube shall be bent cold through 180° , by means of a tube bending machine, around a grooved former having, at the bottom of the groove, the radius specified in the relevant Part of BS 6323. The tube shall not be filled and the weld shall be at 90° to the plane of bending. The tube shall show no sign of crack or flaw as a result of this test.

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15.6 Drift expanding test. A test piece approximately 100 mm in length cut from one end of the tube shall be expanded cold, by means of a conical drift having an included angle of 30° to 60°, until the outside diameter of the tube has been increased by not less than the percentage specified in the relevant Part of BS 6323. The tube shall show no sign of crack or flaw as a result of this test.

15.7 Hydraulic leak tightness test. For tubes which are hydraulically tested (see BS 6323 : Parts 4, 5, 6 and 8) the test pressure shall be 50 bar* or the pressure calculated from the formula below, whichever is the less. The test pressure shall be maintained sufficiently long for proof and inspection.

$$P = \frac{20 Sa}{D}$$

where

P is the test pressure (in bar)

D is the specified outside diameter (in mm)

a is the specified thickness (in mm)

S is a stress (in N/mm²*) which shall be taken as 60 % of the specified minimum yield strength at room temperature

15.8 Eddy current test. For tubes which are leak tightness tested by the eddy current test method, this shall be in accordance with BS 3889 : Part 2A†.

16. Retests

If a tube selected for testing fails in any of the tests required by the relevant Part of BS 6323, the batch of tubes (see clause 14) which it represents shall be deemed not to comply with the requirements of the relevant Part of BS 6323 unless:

- (a) two further tests of the same kind that produced failure are made from the same tube, or from another

tube from the same batch, and both these further tests prove satisfactory or;

- (b) if either of the further tests required by (a) proves unsatisfactory, the tubes represented are suitably heat treated and samples are selected and tested in accordance with all of the specified tests required by the relevant Part of BS 6323 and all these tests are satisfactory.

Any tube which has failed in tests shall be deemed not to comply with the requirements of the relevant Part of BS 6323 unless it has itself been retested successfully in accordance with (a) or (b) above.

17. Manufacturer's certificate

17.1 If required by the purchaser, the manufacturer shall supply a certificate stating that the tubes supplied comply with the requirements of the relevant Part of BS 6323.

17.2 If tests specifically related to the order are required by the purchaser and are specified in the enquiry and order, the manufacturer shall supply a certificate giving the test results. The manufacturer shall also state that the material meets the chemical analysis requirements of the relevant Part of BS 6323.

17.3 When a product analysis is agreed and specified on the order, the results of the analysis shall be given on the test certificate.

18. Protection

Unless otherwise specified by the purchaser, the tubes shall be supplied uncoated or with the manufacturer's normal protective coating. Special protection of the tubes for transit and storage shall be the subject of an agreement between the purchaser and the manufacturer.

*10 bar = 1 N/mm² = 1 MPa.

†In course of revision.

Appendix A

Summary of steel grades, delivery conditions, compositions and mechanical properties

BS 6323 Part number	Designation	Steel	Chemical composition (ladle analysis)																Mechanical pro		
			C		Si		Mn		P	S	Cr		Mo		Ni		N	Ti	HF**		
																				R _e	R _m
			min.	max.	min.	max.	min.	max.	max.	max.	min.	max.	min.	max.	min.	max.	max.	min.	max.	min.	min.
			%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	N/mm ²	N/mi	
2	HFW 2	Carbon	—	0.16*	—	—	—	0.70	0.050	0.050	—	—	—	—	—	—	—	—	—	195	320
	HFW 3	Carbon	—	0.20	—	0.35	—	0.90	0.050	0.050	—	—	—	—	—	—	—	—	215	360	
	HFW 4	Carbon	—	0.25	—	0.35	—	1.20	0.050	0.050	—	—	—	—	—	—	—	—	235	410	
	HFW 5†	Carbon	—	0.23	—	0.35	—	1.50	0.050	0.050	—	—	—	—	—	—	—	—	340	490	
3	HFS 3	Carbon	—	0.20	—	0.35	—	0.90	0.050	0.050	—	—	—	—	—	—	—	—	215	360	
	HFS 4	Carbon	—	0.25	—	0.35	—	1.20	0.050	0.050	—	—	—	—	—	—	—	—	235	410	
	HFS 5††‡	Carbon	—	0.23	—	0.50	—	1.50	0.050	0.050	—	—	—	—	—	—	—	—	340	490	
	HFS 8	Carbon	0.40	0.55	—	0.35	0.50	0.90	0.050	0.050	—	—	—	—	—	—	—	—	340	540	
4	CFS 3	Carbon	—	0.20	—	0.35	—	0.90	0.050	0.050	—	—	—	—	—	—	—	—	—	—	
	CFS 3A‡	Case hardening	—	0.20	0.10	0.35	0.60	1.00	0.050	0.050	—	—	—	—	—	—	—	—	—	—	
	CFS 4	Carbon	—	0.25	—	0.35	—	1.20	0.050	0.050	—	—	—	—	—	—	—	—	—	—	
	CFS 5†	Carbon	—	0.23	—	0.50	—	1.50	0.050	0.050	—	—	—	—	—	—	—	—	—	—	
	CFS 6	Carbon	0.30	0.40	—	0.35	0.50	0.90	0.050	0.050	—	—	—	—	—	—	—	—	—	—	
	CFS 7	Carbon	0.20	0.30	—	0.35	1.20	1.50	0.050	0.050	—	—	—	—	—	—	—	—	—	—	
	CFS 8††	Carbon	0.40	0.55	—	0.35	0.50	0.90	0.050	0.050	—	—	—	—	—	—	—	—	—	—	
	CFS 9	Mn - Mo	—	0.29	—	0.35	—	1.50	0.050	0.050	—	—	0.15	0.25	—	—	—	—	—	—	
	CFS 10	Cr - Mo	—	0.26	—	0.35	—	0.80	0.050	0.050	0.80	1.20	0.15	0.30	—	—	—	—	—	—	
	CFS 11	Cr - Mo	—	0.45	—	0.35	—	1.00	0.050	0.050	0.80	1.20	0.15	0.30	—	—	—	—	—	—	
5	ERW 1	Carbon	—	0.13*	—	—	—	0.60	0.050	0.050	—	—	—	—	—	—	—	—	—	—	
	ERW 2	Carbon	—	0.16*	—	—	—	0.70	0.050	0.050	—	—	—	—	—	—	—	—	—	—	
	ERW 3	Carbon	—	0.20*	—	0.35	—	0.90	0.050	0.050	—	—	—	—	—	—	—	—	—	—	
	ERW 4†	Carbon	—	0.25	—	0.35	—	1.20	0.050	0.050	—	—	—	—	—	—	—	—	—	—	
	ERW 5†	Carbon	—	0.23	—	0.50	—	1.50	0.050	0.050	—	—	—	—	—	—	—	—	—	—	
6	CEW 1	Carbon	—	0.13*	—	—	—	0.60	0.050	0.050	—	—	—	—	—	—	—	—	—	—	
	CEW 2	Carbon	—	0.16*	—	—	—	0.70	0.050	0.050	—	—	—	—	—	—	—	—	—	—	
	CEW 3	Carbon	—	0.20*	—	0.35	—	0.90	0.050	0.050	—	—	—	—	—	—	—	—	—	—	
	CEW 4†	Carbon	—	0.25	—	0.35	—	1.20	0.050	0.050	—	—	—	—	—	—	—	—	—	—	
	CEW 5†	Carbon	—	0.23	—	0.50	—	1.50	0.050	0.050	—	—	—	—	—	—	—	—	—	—	
7	SAW 4	Carbon	—	0.25	—	0.35	—	1.20	0.050	0.050	—	—	—	—	—	—	—	—	235	410	
	SAW 5†	Carbon	—	0.23	—	0.50	—	1.50	0.050	0.050	—	—	—	—	—	—	—	—	340	490	
8	LW 12¶	Stainless	—	0.06	—	0.90	—	0.60	0.040	0.020	11.0	13.0	—	—	—	0.50	0.025	5X C	0.70	—	
	LW 19	Stainless	—	0.08	—	1.00	—	1.00	0.040	0.030	10.5	12.5	—	—	—	1.00	—	6X C	1.0	—	
	LW 20	Stainless	—	0.03	—	1.00	—	2.00	0.045	0.030	17.0	19.0	—	—	9.0	12.0	—	—	—	—	
	LW 21	Stainless	—	0.06	—	1.00	—	2.00	0.045	0.030	17.5	19.0	—	—	8.0	11.0	—	—	—	—	
	LW 22	Stainless	—	0.03	—	1.00	—	2.00	0.045	0.030	16.5	18.5	2.5	3.0	11.5	14.5	—	—	—	—	
	LW 23	Stainless	—	0.07	—	1.00	—	2.00	0.045	0.030	16.5	18.5	2.5	3.0	11.0	14.0	—	—	—	—	
	LW 24	Stainless	—	0.08	—	1.00	—	2.00	0.045	0.030	17.0	19.0	—	—	9.0	12.0	—	5X C	0.80	—	
	LWCF 20	Stainless	—	0.03	—	1.00	—	2.00	0.045	0.030	17.0	19.0	—	—	9.0	12.0	—	—	—	—	
	LWCF 21	Stainless	—	0.06	—	1.00	—	2.00	0.045	0.030	17.5	19.0	—	—	8.0	11.0	—	—	—	—	
	LWCF 22	Stainless	—	0.03	—	1.00	—	2.00	0.045	0.030	16.5	18.5	2.5	3.0	11.5	14.5	—	—	—	—	
	LWCF 23	Stainless	—	0.07	—	1.00	—	2.00	0.045	0.030	16.5	18.5	2.5	3.0	11.0	14.0	—	—	—	—	
	LWCF 24	Stainless	—	0.08	—	1.00	—	2.00	0.045	0.030	17.0	19.0	—	—	9.0	12.0	—	5X C	0.80	—	

Mechanical properties at room temperature appropriate to delivery conditions																			
	HF**			BK§			BKW§			KM				GBK/GBK(S) §§ GKM/GKM(S) §§ GZF/GZF(S) §§			NBK NKM NZF		
	R_e	R_m	A	R_e	R_m	A	R_e	R_m	A	R_e	R_m	A min.		R_e	R_m	A	R_e	R_m	A
κ.	min.	min.	min.	min.	min.	min.	min.	min.	min.	min.	min.	D/a ≤ 20	D/a > 20	min.	min.	min.	min.	min.	min.
	N/mm ² 195	N/mm ² 320	% 25	N/mm ² —	N/mm ² —	% —	N/mm ² —	N/mm ² —	% —	N/mm ² —	N/mm ² —	% —	% —	N/mm ² —	N/mm ² —	% —	N/mm ² —	N/mm ² —	% —
	215	360	24	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	235	410	22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	340	490	20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	215	360	24	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	235	410	22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	340	490	20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	340	540	18	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	360	450	6	280	400	9	—	—	—	—	170	340	26	215	360	24
	—	—	—	360	450	6	280	400	9	—	—	—	—	170	340	26	215	360	24
	—	—	—	415	520	5	315	450	8	—	—	—	—	200	400	24	235	410	22
	—	—	—	480	600	4	385	550	6	—	—	—	—	—	—	—	340	490	20
	—	—	—	470	590	5	350	540	7	—	—	—	—	300	440	22	280	460	21
	—	—	—	560	700	4	460	650	7	—	—	—	—	—	—	—	—	—	—
	—	—	—	575	720	4	470	670	6	—	—	—	—	300	510	20	340	540	18
	—	—	—	575	720	4	470	670	6	—	—	—	—	—	—	—	—	—	—
	—	—	—	575	720	4	470	670	6	—	—	—	—	—	—	—	—	—	—
	—	—	—	575	720	4	—	670	6	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	200	300	10	20	150	270	27	155	280	25
	—	—	—	—	—	—	—	—	—	250	340	8	15	160	300	27	195	320	25
	—	—	—	—	—	—	—	—	—	300	400	7	12	170	340	26	215	360	24
	—	—	—	—	—	—	—	—	—	350	450	6	10	200	400	24	235	410	22
	—	—	—	—	—	—	—	—	—	420	500	6	8	—	—	—	340	490	20
	—	—	—	320	400	6	245	350	10	—	—	—	—	150	270	27	155	280	25
	—	—	—	355	420	6	260	370	10	—	—	—	—	160	300	27	195	320	25
	—	—	—	360	450	6	280	400	9	—	—	—	—	170	340	26	215	360	24
	—	—	—	415	520	5	315	450	8	—	—	—	—	200	400	24	235	410	22
	—	—	—	480	600	4	385	550	6	—	—	—	—	—	—	—	340	490	20
	235	410	22	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	340	490	20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
0	—	—	—	—	—	—	—	—	—	300	400	10	10	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	300	400	10	10	200	350	20	—	—	—
	—	—	—	—	—	—	—	—	—	420	520	25	25	185	480	30	—	—	—
	—	—	—	—	—	—	—	—	—	450	560	25	25	210	510	30	—	—	—
	—	—	—	—	—	—	—	—	—	420	520	25	25	185	480	30	—	—	—
	—	—	—	—	—	—	—	—	—	450	560	25	25	210	510	30	—	—	—
0	—	—	—	—	—	—	—	—	—	450	560	25	25	210	510	30	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	185	480	30	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	210	510	30	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	185	480	30	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	210	510	30	—	—	—
0	—	—	—	—	—	—	—	—	—	—	—	—	—	210	510	30	—	—	—

Appendix B

Sectional properties of steel tubes

Outside diameter	Thickness	Mass*	Sectional area	Moment of inertia	Radius of gyration	Elastic modulus	Plastic modulus	Torsional moment of inertia	Torsional modulus	Superficial area per metre	Thickness	Outside diameter
mm	mm	kg/m	cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³	m ²	mm	mm
21.3	2.0	0.95	1.21	0.57	0.686	0.54	0.75	1.14	1.07	0.067	2.0	21.3
	2.6	1.20	1.53	0.68	0.668	0.64	0.92	1.36	1.28	0.067	2.6	
	3.2	1.43	1.82	0.77	0.650	0.72	1.06	1.54	1.44	0.067	3.2	
26.9	2.3	1.40	1.78	1.36	0.875	1.01	1.40	2.71	2.02	0.085	2.3	26.9
	2.6	1.56	1.98	1.48	0.864	1.10	1.54	2.96	2.20	0.085	2.6	
	3.2	1.87	2.38	1.70	0.846	1.27	1.18	3.41	2.53	0.085	3.2	
33.7	2.6	1.99	2.54	3.09	1.10	1.84	2.52	6.19	3.67	0.106	2.6	33.7
	3.2	2.41	3.07	3.60	1.08	2.14	2.99	7.21	4.28	0.106	3.2	
	4.0	2.93	3.73	4.19	1.06	2.49	3.55	8.38	4.97	0.106	4.0	
	5.0	3.54	4.51	4.78	1.03	2.84	4.16	9.57	5.68	0.106	5.0	
38.0	3.2	2.75	3.50	5.34	1.24	2.81	3.89	10.7	5.62	0.119	3.2	38.0
	4.0	3.35	4.27	6.26	1.21	3.29	4.65	12.5	6.59	0.119	4.0	
	5.0	4.07	5.18	7.22	1.18	3.80	5.49	14.4	7.60	0.119	5.0	
	5.6	4.47	5.70	7.70	1.16	4.05	5.94	15.4	8.11	0.119	5.6	
42.4	2.6	2.55	3.25	6.46	1.41	3.05	4.12	12.9	6.10	0.133	2.6	42.4
	3.2	3.09	3.94	7.62	1.39	3.59	4.93	15.2	7.19	0.133	3.2	
	4.0	3.79	4.83	8.99	1.36	4.24	5.92	18.0	8.48	0.133	4.0	
	5.6	5.08	6.47	11.2	1.32	5.29	7.64	22.4	10.6	0.133	5.6	
48.3	2.9	3.25	4.14	10.7	1.61	4.43	5.99	21.4	8.86	0.152	2.9	48.3
	3.2	3.56	4.53	11.6	1.60	4.80	6.52	23.2	9.59	0.152	3.2	
	4.0	4.37	5.57	13.8	1.57	5.70	7.87	27.5	11.4	0.152	4.0	
	5.0	5.34	6.80	16.2	1.54	6.69	9.42	32.3	13.4	0.152	5.0	
	5.6	5.90	7.51	17.4	1.52	7.21	10.3	34.8	14.4	0.152	5.6	
60.3	2.9	4.11	5.23	21.6	2.03	7.16	9.56	43.2	14.3	0.189	2.9	60.3
	3.2	4.51	5.74	23.5	2.02	7.78	10.4	46.9	15.6	0.189	3.2	
	3.6	5.03	6.41	25.9	2.01	8.58	11.6	51.7	17.2	0.189	3.6	
	4.0	5.55	7.07	28.2	2.00	9.34	12.7	56.3	18.7	0.189	4.0	
	4.5	6.19	7.89	30.9	1.98	10.2	14.0	61.8	20.5	0.189	4.5	
	5.0	6.82	8.69	33.5	1.96	11.1	15.3	67.0	22.2	0.189	5.0	
	5.6	7.55	9.62	36.4	1.94	12.1	16.8	72.7	24.1	0.189	5.6	
	6.3	8.39	10.7	39.5	1.92	13.1	18.5	79.0	26.2	0.189	6.3	

*The mass per unit length applies to grades 1 to 11. For grade 12 the mass should be multiplied by a factor of 0.985. For grades 13 to 18 the mass should be multiplied by a factor of 1.015.

Appendix B (continued)

Outside diameter	Thickness	Mass*	Sectional area	Moment of inertia	Radius of gyration	Elastic modulus	Plastic modulus	Torsional moment of inertia	Torsional modulus	Superficial area per metre	Thickness	Outside diameter
mm	mm	kg/m	cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³	m ²	mm	mm
76.1	3.2	5.75	7.33	48.8	2.58	12.8	17.0	97.6	25.6	0.239	3.2	76.1
	3.6	6.44	8.20	54.0	2.57	14.2	18.9	108	28.4	0.239	3.6	
	4.0	7.11	9.06	59.1	2.55	15.5	20.8	118	31.0	0.239	4.0	
	4.5	7.95	10.1	65.1	2.54	17.1	23.1	130	34.2	0.239	4.5	
	5.0	8.77	11.2	70.9	2.52	18.6	25.3	142	37.3	0.239	5.0	
	5.6	9.74	12.4	77.5	2.50	20.4	27.9	155	40.8	0.239	5.6	
	6.3	10.8	13.8	84.8	2.48	22.3	30.8	170	44.6	0.239	6.3	
88.9	3.2	6.76	8.62	79.2	3.03	17.8	23.5	158	35.6	0.279	3.2	88.9
	4.0	8.38	10.7	96.3	3.00	21.7	28.9	193	43.3	0.279	4.0	
	4.5	9.37	11.9	107	2.99	24.0	32.1	213	47.9	0.279	4.5	
	5.0	10.3	13.2	116	2.97	26.2	35.2	233	52.4	0.279	5.0	
	5.6	11.5	14.7	128	2.95	28.7	38.9	255	57.5	0.279	5.6	
	6.3	12.8	16.3	140	2.93	31.5	43.1	280	63.1	0.279	6.3	
101.6	5.0	11.9	15.2	177	3.42	34.9	46.7	355	69.9	0.319	5.0	101.6
	5.6	13.3	16.9	195	3.40	38.4	51.7	390	76.9	0.319	5.6	
	6.3	14.8	18.9	215	3.38	42.3	57.3	430	84.7	0.319	6.3	
114.3	3.6	9.83	12.5	192	3.92	33.6	44.1	384	67.2	0.359	3.6	114.3
	4.5	12.2	15.5	234	3.89	41.0	54.3	469	82.0	0.359	4.5	
	5.0	13.5	17.2	257	3.87	45.0	59.8	514	89.9	0.359	5.0	
	5.4	14.5	18.5	275	3.85	48.0	64.1	549	96.1	0.359	5.4	
	5.6	15.0	19.1	283	3.85	49.6	66.2	566	99.1	0.359	5.6	
	6.3	16.8	21.4	313	3.82	54.7	73.6	625	109	0.359	6.3	
	8.0	21.0	26.7	379	3.77	66.4	90.6	759	133	0.359	8.0	
127.0	5.0	15.0	19.2	357	4.32	56.2	74.5	714	112	0.399	5.0	127.0
	5.6	16.8	21.4	394	4.30	62.1	82.6	789	124	0.399	5.6	
	6.3	18.8	23.9	436	4.27	68.7	91.9	872	137	0.399	6.3	
	8.0	23.5	29.9	532	4.22	83.7	113	1064	167	0.399	8.0	
139.7	5.0	16.6	21.2	481	4.77	68.8	90.8	961	138	0.439	5.0	139.7
	5.6	18.5	23.6	531	4.75	76.1	101	1062	152	0.439	5.6	
	6.3	20.7	26.4	589	4.72	84.3	112	1177	169	0.439	6.3	
	8.0	26.0	33.1	720	4.66	103	139	1441	206	0.439	8.0	
	10.0	32.0	40.7	862	4.60	123	169	1724	247	0.439	10.0	

*The mass per unit length applies to grades 1 to 11. For grade 12 the mass should be multiplied by a factor of 0.985. For grades 13 to 18 the mass should be multiplied by a factor of 1.015.

Appendix B (continued)

Outside diameter	Thickness	Mass*	Sectional area	Moment of inertia	Radius of gyration	Elastic modulus	Plastic modulus	Torsional moment of inertia	Torsional modulus	Superficial area per metre	Thickness	Outside diameter
mm	mm	kg/m	cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³	m ²	mm	mm
168.3	5.0	20.1	25.7	856	5.78	102	133	1712	203	0.529	5.0	168.3
	5.6	22.5	28.6	948	5.76	113	148	1897	225	0.529	5.6	
	6.3	25.2	32.1	1053	5.73	125	165	2107	250	0.529	6.3	
	7.1	28.2	36.0	1170	5.70	139	185	2340	278	0.529	7.1	
	8.0	31.6	40.3	1297	5.67	154	206	2595	308	0.529	8.0	
	10.0	39.0	49.7	1564	5.61	186	251	3128	372	0.529	10.0	
193.7	5.6	26.0	33.1	1465	6.65	151	198	2930	303	0.609	5.6	193.7
	6.3	29.1	37.1	1630	6.63	168	221	3260	337	0.609	6.3	
	8.0	36.6	46.7	2016	6.57	208	276	4031	416	0.609	8.0	
	10.0	45.3	57.7	2442	6.50	252	338	4883	504	0.609	10.0	
	12.5	55.9	71.2	2934	6.42	303	411	5869	606	0.609	12.5	
219.1	5.6	29.5	37.6	2142	7.55	195	255	4283	391	0.688	5.6	219.1
	6.3	33.1	42.1	2386	7.53	218	285	4772	436	0.688	6.3	
	8.0	41.6	53.1	2960	7.47	270	357	5919	540	0.688	8.0	
	10.0	51.6	65.7	3598	7.40	328	438	7197	657	0.688	10.0	
	12.5	63.7	81.1	4345	7.32	397	534	8689	793	0.688	12.5	
244.5	6.3	37.0	47.1	3346	8.42	274	358	6692	547	0.768	6.3	244.5
	7.1	41.6	53.0	3734	8.40	305	400	7468	611	0.768	7.1	
	8.0	46.7	59.4	4160	8.37	340	448	8321	681	0.768	8.0	
	10.0	57.8	73.7	5073	8.30	415	550	10150	830	0.768	10.0	
	12.5	71.5	91.1	6147	8.21	503	673	12290	1006	0.768	12.5	
273	6.3	41.4	52.8	4696	9.43	344	448	9392	688	0.858	6.3	273
	7.1	46.6	59.3	5245	9.40	384	502	10490	769	0.858	7.1	
	8.0	52.3	66.6	5852	9.37	429	562	11700	857	0.858	8.0	
	10.0	64.9	82.6	7154	9.31	524	692	14310	1048	0.858	10.0	
	12.5	80.3	102	8697	9.22	637	849	17390	1274	0.858	12.5	
323.9	6.3	49.3	62.9	7929	11.2	490	636	15860	979	1.02	6.3	323.9
	7.1	55.5	70.7	8869	11.2	548	713	17740	1095	1.02	7.1	
	8.0	62.3	79.4	9910	11.2	612	799	19820	1224	1.02	8.0	
	10.0	77.4	98.6	12160	11.1	751	986	24320	1501	1.02	10.0	
	12.5	96.0	122	14850	11.0	917	1213	29690	1833	1.02	12.5	

*The mass per unit length applies to grades 1 to 11. For grade 12 the mass should be multiplied by a factor of 0.985. For grades 13 to 18 the mass should be multiplied by a factor of 1.015.

Appendix B (continued)

Outside diameter	Thickness	Mass*	Sectional area	Moment of inertia	Radius of gyration	Elastic modulus	Plastic modulus	Torsional moment of inertia	Torsional modulus	Superficial area per metre	Thickness	Outside diameter
mm	mm	kg/m	cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³	m ²	mm	mm
355.6	8.0	68.6	87.4	13200	12.3	742	967	26400	1485	1.12	8.0	355.6
	10.0	85.2	109	16220	12.2	912	1195	32450	1825	1.12	10.0	
	12.5	106	135	19850	12.1	1117	1472	39700	2233	1.12	12.5	
406.4	10.0	97.8	125	24480	14.0	1205	1572	48950	2409	1.28	10.0	406.4
	12.5	121	155	30030	13.9	1478	1940	60060	2956	1.28	12.5	
457	10.0	110	140	35090	15.8	1536	1998	70180	3071	1.44	10.0	457
	12.5	137	175	43140	15.7	1888	2470	86290	3776	1.44	12.5	
508	8.0	98.6	126	39280	17.7	1546	2000	78560	3093	1.60	8.0	508
	10.0	123	156	48520	17.6	1910	2480	97040	3821	1.60	10.0	
	12.5	153	195	59760	17.5	2353	3070	119500	4705	1.60	12.5	
559	8.0	109	138	52570	19.5	1881	2429	105100	3761	1.76	8.0	559
	10.0	135	172	65000	19.4	2326	3014	130000	4651	1.76	10.0	
	12.5	168	215	80160	19.3	2868	3734	160300	5736	1.76	12.5	
610	8.0	119	151	68550	21.3	2248	2899	137100	4495	1.92	8.0	610
	10.0	148	188	84850	21.2	2782	3600	169700	5564	1.92	10.0	
	12.5	184	235	104800	21.1	3435	4463	209500	6869	1.92	12.5	
	16.0	234	299	131800	21.0	4321	5647	263600	8641	1.92	16.0	
660	8.0	129	164	87090	23.1	2639	3401	174200	5278	2.07	8.0	660
	10.0	160	204	107900	23.0	3269	4225	215700	6538	2.07	10.0	
	12.5	200	254	133300	22.9	4040	5241	266600	8079	2.07	12.5	
	16.0	254	324	167900	22.8	5089	6637	335800	10180	2.07	16.0	
711	8.0	139	177	109200	24.9	3071	3954	218300	6141	2.23	8.0	711
	10.0	173	220	135300	24.8	3806	4914	270600	7612	2.23	10.0	
	12.5	215	274	167300	24.7	4707	6099	334700	9415	2.23	12.5	
	16.0	274	349	211000	24.6	5936	7730	422100	11870	2.23	16.0	
762	10.0	185	236	167000	26.6	4384	5655	334100	8768	2.39	10.0	762
	12.5	231	294	206700	26.5	5426	7023	413500	10850	2.39	12.5	
	16.0	294	375	261000	26.4	6850	8906	521900	13700	2.39	16.0	
813	10.0	198	252	203400	28.4	5003	6448	406700	10010	2.55	10.0	813
	12.5	247	314	251900	28.3	6196	8011	503700	12390	2.55	12.5	
	16.0	314	401	318200	28.2	7828	10160	636400	15660	2.55	16.0	
	20.0	391	498	391900	28.0	9641	12580	783800	19280	2.55	20.0	

*The mass per unit length applies to grades 1 to 11. For grade 12 the mass should be multiplied by a factor of 0.985. For grades 13 to 18 the mass should be multiplied by a factor of 1.015.

Appendix B (concluded)

Outside diameter	Thickness	Mass*	Sectional area	Moment of inertia	Radius of gyration	Elastic modulus	Plastic modulus	Torsional moment of inertia	Torsional modulus	Superficial area per metre	Thickness	Outside diameter
mm	mm	kg/m	cm ²	cm ⁴	cm	cm ³	cm ³	cm ⁴	cm ³	m ²	mm	mm
864	10.0	211	268	244600	30.2	5663	7293	489200	11330	2.71	10.0	864
	12.5	262	334	303100	30.1	7017	9064	606200	14030	2.71	12.5	
	16.0	335	426	383300	30.0	8872	11510	766600	17740	2.71	16.0	
	20.0	416	530	472500	29.8	10940	14250	944900	21870	2.71	20.0	
914	10.0	223	284	290100	32.0	6349	8172	580300	12700	2.87	10.0	914
	12.5	278	354	359700	31.9	7871	10160	719400	15740	2.87	12.5	
	16.0	354	451	455100	31.8	9959	12900	910300	19920	2.87	16.0	
	20.0	441	562	561500	31.6	12290	15990	1123000	24570	2.87	20.0	
1016	12.5	309	394	496100	35.5	9766	12590	992200	19530	3.19	12.5	1016
	16.0	395	503	628500	35.4	12370	16000	1257000	24740	3.19	16.0	
	20.0	491	626	776300	35.2	15280	19840	1553000	30560	3.19	20.0	
	25.0	611	778	956100	35.0	18820	24560	1912000	37640	3.19	25.0	
1220	12.5	372	474	864300	42.7	14170	18230	1729000	28340	3.83	12.5	1220
	16.0	475	605	1097000	42.6	17980	23200	2194000	35960	3.83	16.0	
	20.0	592	754	1358000	42.4	22250	28800	2715000	44510	3.83	20.0	
	25.0	737	939	1676000	42.3	27480	35710	3352000	54950	3.83	25.0	
1420	12.5	434	553	1369000	49.8	19280	24760	2738000	38560	4.46	12.5	1420
	16.0	554	706	1739000	49.6	24500	31540	3478000	48990	4.46	16.0	
	20.0	691	880	2156000	49.5	30360	39200	4311000	60720	4.46	20.0	
	25.0	860	1096	2666000	49.3	37550	48660	5332000	75100	4.46	25.0	
1620	16.0	633	806	2593000	56.7	32010	41170	5186000	64030	5.09	16.0	1620
	20.0	789	1005	3218000	56.6	39720	51200	6435000	79440	5.09	20.0	
	25.0	983	1253	3985000	56.4	49190	63610	7969000	98390	5.09	25.0	
1820	16.0	712	907	3689000	63.8	40540	52070	7378000	81080	5.72	16.0	1820
	20.0	888	1131	4581000	63.6	50340	64800	9162000	100700	5.72	20.0	
	25.0	1107	1410	5679000	63.5	62410	80560	11360000	124800	5.72	25.0	
2020	16.0	791	1007	5057000	70.9	50070	64260	10110000	100100	6.35	16.0	2020
	20.0	986	1257	6284000	70.7	62220	80000	12570000	124400	6.35	20.0	
	25.0	1230	1567	7796000	70.5	77190	99510	15590000	154400	6.35	25.0	

* The mass per unit length applies to grades 1 to 11. For grade 12 the mass should be multiplied by a factor of 0.985. For grades 13 to 18 the mass should be multiplied by a factor of 1.015.

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Appendix C

Related designations of steel tube in the Parts of BS 6323, BS 980, BS 1775, BS 3014, ISO 3304, ISO 3305 and ISO 3306

The following table lists the designations for tubes in this standard. For information, it also gives the nearest equivalents in withdrawn standards BS 980 : 1950, BS 1775 : 1964 and BS 3014 : 1958, and the nearest equivalents in ISO 3304-1975, ISO 3305-1976 and ISO 3306-1975. It should be noted that the designations are indicated as the nearest equivalents and are not necessarily identical.

BS 6323	BS 980 : 1950	BS 1775 : 1964	BS 3014 : 1958	ISO 3304-1975, ISO 3305-1976, ISO 3306-1975
Designation	Designation	Designation	Designation	Designation
HFW 2	—	HFW 13	—	—
HFW 3	—	HFW 13	—	—
HFW 4	—	HFW 16	—	—
HFW 5	—	HFW 23	—	—
HFS 3	—	HFS 13	—	—
HFS 4	—	HFS 16	—	—
HFS 5	—	HFS 23	—	—
HFS 8	—	HFS 20	—	—
CFS 3 BK	CDS 2	CDS 24	—	ISO 3304 R 37
CFS 3 BKW	—	—	—	
CFS 3 GBK	CDS 1	CDS 11	—	
CFS 3 GZF	CDS 1	CDS 11	—	
CFS 3 NBK	—	CDS 13	—	
CFS 3 NZF	—	CDS 13	—	ISO 3304 R 42
CFS 3A BK	CDS 3	—	—	
CFS 3A BKW	—	—	—	
CFS 3A GBK	—	—	—	
CFS 3A GZF	—	—	—	
CFS 3A NBK	—	—	—	
CFS 3A NZF	—	—	—	
CFS 4 BK	—	CDS 28	—	ISO 3304 R 50
CFS 4 BKW	—	—	—	
CFS 4 GBK	—	—	—	
CFS 4 GZF	—	—	—	
CFS 4 NBK	—	CDS 16	—	ISO 3304 R 50
CFS 4 NZF	—	CDS 16	—	
CFS 5 BK	CDS 10	—	—	
CFS 5 BKW	—	—	—	
CFS 5 NBK	—	CDS 23	—	ISO 3304 R 50
CFS 5 NZF	—	CDS 23	—	
CFS 6 BK	CDS 6	—	—	
CFS 6 BKW	—	—	—	
CFS 6 GBK	CDS 5	—	—	ISO 3304 R 50
CFS 6 GZK	CDS 5	—	—	
CFS 6 NBK	CDS 5	—	—	
CFS 6 NZF	CDS 5	—	—	
CFS 7 BK	—	CDS 35	—	ISO 3304 R 50
CFS 7 BKW	—	—	—	
CFS 8 BK	CDS 8	—	—	
CFS 8 BKW	—	—	—	
CFS 8 GBK	—	—	—	ISO 3304 R 50
CFS 8 GZF	—	—	—	
CFS 8 NBK	CDS 7	CDS 20	—	
CFS 8 NZF	CDS 7	CDS 20	—	
CFS 9 BK	CDS 11	—	—	ISO 3304 R 50
CFS 9 BKW	—	—	—	

Appendix C (continued)

BS 6323	BS 980 : 1950	BS 1775 : 1964	BS 3014 : 1958	ISO 3304, 3305, 3306
Designation	Designation	Designation	Designation	Designation
CFS 10 BK	CDS 12	—	—	—
CFS 10 BKW	—	—	—	—
CFS 11 BK	CDS 13	—	—	—
CFS 11 BKW	—	—	—	—
ERW 1 KM	ERW 1	ERW 11	—	ISO 3306 R 28 R28
ERW 1 GKM	ERW 1	ERW 11	—	
ERW 1 GZF	ERW 1	ERW 11	—	
ERW 1 NKM	ERW 1	ERW 11	—	
ERW 1 NZF	ERW 1	ERW 11	—	
ERW 2 KM	ERW 1	ERW 11	—	ISO 3306 R 33 R 33
ERW 2 GKM	ERW 1 or 2	ERW 11	—	
ERW 2 GZF	ERW 1 or 2	ERW 11	—	
ERW 2 NKM	ERW 1 or 2	ERW 11	—	
ERW 2 NZF	ERW 1 or 2	ERW 11	—	
ERW 3 KM	ERW 2	ERW 16	—	ISO 3306 R 37 R 37
ERW 3 GKM	ERW 2 or 3	—	—	
ERW 3 GZF	ERW 2 or 3	—	—	
ERW 3 NKM	ERW 2 or 3	—	—	
ERW 3 NZF	ERW 2 or 3	—	—	
ERW 4 KM	ERW 3	ERW 20 or 23	—	ISO 3306 R 42 R 42
ERW 4 GKM	—	—	—	
ERW 4 GZF	—	—	—	
ERW 4 NKM	—	—	—	
ERW 4 NZF	—	—	—	
ERW 5 KM	—	ERW 23	—	—
ERW 5 NKM	—	—	—	—
ERW 5 NZF	—	—	—	—
CEW 1 BK	—	—	—	ISO 3305 R 28
CEW 1 BKW	—	—	—	
CEW 1 GBK	—	—	—	
CEW 1 GZF	—	—	—	
CEW 1 NBK	—	—	—	
CEW 1 NZF	—	—	—	ISO 3305 R 33
CEW 2 BK	CEW 2	CEW 24	—	
CEW 2 BKW	—	—	—	
CEW 2 GBK	CEW 1	CEW 11	—	
CEW 2 GZF	CEW 1	CEW 11	—	
CEW 2 NBK	CEW 1	CEW 11	—	ISO 3305 R 37
CEW 2 NZF	CEW 1	CEW 11	—	
CEW 3 BK	—	CEW 24	—	
CEW 3 BKW	—	—	—	
CEW 3 GBK	—	CEW 11	—	
CEW 3 GZF	—	CEW 11	—	ISO 3305 R 42
CEW 3 NBK	—	—	—	
CEW 3 NZF	—	—	—	
CEW 4 BK	CEW 4	CEW 28	—	
CEW 4 BKW	—	—	—	
CEW 4 GBK	—	CEW 16	—	ISO 3305 R 42
CEW 4 GZF	—	CEW 16	—	
CEW 4 NBK	CEW 3	CEW 16	—	
CEW 4 NZF	CEW 3	CEW 16	—	

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Appendix C (concluded)

BS 6323	BS 980 : 1950	BS 1775 : 1964	BS 3014 : 1958	ISO 3304, 3305, 3306
Designation	Designation	Designation	Designation	Designation
CEW 5 BK	—	—	—	ISO 3305 R 50
CEW 5 BKW	—	—	—	
CEW 5 NBK	—	CEW 23	—	
CEW 5 NZF	—	CEW 23	—	
SAW 4*	—	EFW 16	—	—
SAW 5*	—	—	—	—
LW 12 KM	—	—	—	—
LW 19 KM	—	—	—	—
LW 19 GKM(S)	—	—	—	—
LW 19 GZF(S)	—	—	—	—
LW 20 KM	—	—	—	—
LW 20 GKM(S)	—	—	—	—
LW 20 GZF(S)	—	—	—	—
LW 21 KM	—	—	—	—
LW 21 GKM(S)	—	—	—	—
LW 21 GZF(S)	—	—	—	—
LW 22 KM	—	—	—	—
LW 22 GKM(S)	—	—	—	—
LW 22 GZF(S)	—	—	—	—
LW 23 KM	—	—	6 (part two)	—
LW 23 GKM(S)	—	—	6 (part two)	—
LW 23 GZF(S)	—	—	6 (part two)	—
LW 24 KM	—	—	3 (part two)	—
LW 24 GKM(S)	—	—	3 (part two)	—
LW 24 GZF(S)	—	—	3 (part two)	—
LWCF 20 GBK(S)	—	—	—	—
LWCF 20 GZF(S)	—	—	—	—
LWCF 21 GBK(S)	—	—	—	—
LWCF 21 GZF(S)	—	—	—	—
LWCF 22 GBK(S)	—	—	—	—
LWCF 22 GZF(S)	—	—	—	—
LWCF 23 GBK(S)	—	—	6 (part three)	—
LWCF 23 GZF(S)	—	—	6 (part three)	—
LWCF 24 GBK(S)	—	—	3 (part three)	—
LWCF 24 GZF(S)	—	—	3 (part three)	—

*Material may be supplied as welded or hot or cold sized at the option of the manufacturer. Cold sized tubes may be heat treated at the option of the manufacturer.

Publications referred to

- BS 18 Methods for tensile testing of metals
Part 4 Steel tubes
- BS 970 Specification for wrought steels for mechanical and allied engineering purposes
Part 1 General inspection and testing procedures and specific requirements for carbon, carbon manganese, alloy and stainless steels
- BS 980 (Withdrawn)
- BS 1775 (Withdrawn)
- BS 3014 (Withdrawn)
- BS 3601 Steel pipes and tubes for pressure purposes: carbon steel with specified room temperature properties
- BS 3602 Specification for steel pipes and tubes for pressure purposes: carbon and carbon manganese steel with specified elevated temperature properties
Part 1 Seamless, electric resistance welded and induction welded tubes
Part 2 Submerged arc welded tubes
- BS 3603 Specification for steel pipes and tubes for pressure purposes: carbon and alloy steel with specified low temperature properties
- BS 3604 Specification for steel pipes and tubes for pressure purposes: ferritic alloy steel with specified elevated temperature properties
- BS 3605 Seamless and welded austenitic stainless steel pipes and tubes for pressure purposes
- BS 3889 Methods for non-destructive testing of pipes and tubes
Part 2A Eddy current testing of ferrous pipes and tubes
- BS 3894 Method for converting elongation values for steel
Part 1 Carbon and low alloy steels
- BS 4360 Specification for weldable structural steels
- BS 4848 Hot-rolled structural steel sections
Part 2 Hollow sections
- BS 6363 Specification for welded cold formed steel structural hollow sections
- BS Handbook No. 19 Methods for the sampling and analysis of iron, steel and other ferrous metals
- ISO 3304 Plain end seamless precision steel tubes — Technical conditions for delivery
- ISO 3305 Plain end welded precision steel tubes — Technical conditions for delivery
- ISO 3306 Plain end as-welded and sized precision steel tubes — Technical conditions for delivery

BS 6323: Part 1: 1982

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Amendments issued since publication

Amd. No.	Date of issue	Text affected
5137	June 1986	Indicated by a line in the margin

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AMD 6020

Amendment No. 2
published and effective from 30 June 1989
to BS 6323 : Part 1 : 1982

Specification for seamless and welded steel tubes for
automobile, mechanical and general engineering purposes
Part 1. General requirements

Revised text

AMD 6020
June 1989

Foreword

In lines 11 and 13 of paragraph 3, delete 'and induction welded' and substitute '(including induction welded)'.

AMD 6020
June 1989

Back cover

In the paragraph relating to BSI references and at the bottom of the page, delete 'ISE/50' and substitute 'PSE/8 (formerly ISE/50)' and 'PSE/8' respectively.

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PSE/8