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Specification for

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

**Part 4: Specific requirements for cold
finished seamless steel tubes**

UDC 669.14-462.3:621.774.3

Cooperating organizations

The Iron and Steel Standards Committee, under whose direction this British Standard was prepared, consists of representatives from the following:

British Constructional Steelwork Association
 British Internal Combustion Engine Manufacturers' Association
 British Ironfounders' Association
 British Railways Board
 British Steel Industry*
 British Steel Industry — Wire Section
 Concrete Society Ltd
 Council of Ironfoundry Associations
 Department of Industry (National Physical Laboratory)
 Electricity Supply Industry in England and Wales
 Engineering Equipment Users' Association
 Federation of Civil Engineering Contractors
 Institute of Quality Assurance
 Institution of Production Engineers
 Institution of Structural Engineers
 International Tin Research Institute
 Lloyd's Register of Shipping
 National Association of Drop Forgers and Stampers
 Oil Companies' Materials Association
 Process Plant Association
 Royal Institute of British Architects
 Society of Motor Manufacturers and Traders Ltd*
 Steel Casting Research and Trade Association
 Water-tube Boilermakers' Association

The organizations marked with an asterisk in the above list, together with the following, were directly represented on the Technical Committee entrusted with the preparation of this British Standard:

Association of Hydraulic Equipment Manufacturers
 British Steel Corporation
 British Welded Steel Tube Manufacturers' Association
 Chartered Institution of Building Services
 Confederation of British Industry
 Mechanical Handling Engineers' Association
 Ministry of Defence
 Motor Cycle Association of Great Britain
 Coopted members

This British Standard, having been prepared under the direction of the Iron and Steel Standards Committee, was published under the authority of the Board of BSI and comes into effect on 31 December 1982

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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 It is a combined standard superseding BS 980:1950, BS 1775:1964 and BS 3014:1958 which are withdrawn.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.*

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 4, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS 6323, which is used in conjunction with Part 1 of the same standard, covers the specific requirements for cold finished seamless steel tubes for use in the automobile, mechanical and general engineering industries. It specifies the chemical composition, mechanical properties, dimensions, dimensional tolerances and technical delivery condition of the tubes.

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 4848-2.

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

2 General

The tubes shall comply with the general requirements of BS 6323-1 and the specific requirements of this Part of the same standard, which covers tubes up to and including 230 mm outside diameter.

The tubes shall be of steel grades 3, 3A, 4, 5, 6, 7, 8, 9, 10 and 11. The grade required shall be specified in the enquiry and order, together with other details as specified in clause 5 of BS 6323-1:1982, as appropriate.

If specified in the enquiry and order, tubes having an outside diameter up to and including 50 mm and in the annealed or normalized condition shall be subject to a leak tightness test (see 9.3).

3 Method of manufacture

The tubes shall be manufactured by a seamless process and shall be cold finished.

It is permissible for cold finished tubes to have on internal or external surfaces an adherent layer of residual lubricant originating from the drawing process. If phosphate or other residues are detrimental to subsequent processing, then their removal shall be the subject of an agreement between the manufacturer and the purchaser.

4 Delivery condition

4.1 The tubes shall be supplied in one of the following delivery conditions (see Table 3 in BS 6323-1:1982).

- a) Cold finished/hard (cold finished as drawn): BK;
- b) Cold finished/soft (lightly cold worked): BKW (see note to 4.2);
- c) Annealed: GBK (see 4.2);
- d) Annealed (including de-scaling): GZF;
- e) Normalized: NBK (see 4.2);
- f) Normalized (including de-scaling): NZF.

4.2 It is permissible for tubes supplied in the GBK and NBK condition to be discoloured, but they shall be free from loose scale.

Where tubes in the GBK condition are required bright annealed, this shall be the subject of an agreement between the purchaser and the manufacturer.

NOTE Tubes in the BKW condition may be tempered at the option of the manufacturer.

5 Chemical composition

The steel shall show on ladle analysis the composition given in Table 1 appropriate to the steel grade specified.

6 Mechanical properties

The tensile properties of the tubes, appropriate to their steel grade and delivery condition, determined in accordance with 15.2 of BS 6323-1:1982 shall be as given in Table 1.

For other mechanical properties, see clause 9.

7 Dimensions

The dimensions of tubes shall be designated by the outside diameter and thickness, by inside diameter and thickness or by the outside and inside diameter. A list of the sizes most commonly used is given in Table 5.

8 Tolerances

8.1 **Diameter.** The tolerance on the diameter, including ovality, as designated in clause 7 for tubes having a diameter to thickness ratio not exceeding 33 : 1 shall be as given in Table 2.

Table 1 — Chemical composition and mechanical properties (see note)

Designation	Chemical composition (ladle analysis)							Mechanical properties and delivery condition											
	C	Si	Mn	P max.	S max.	Cr	Mo	BK ^c (cold finished/hard)			BKW ^c (cold finished/soft)			GBK and GZF (annealed)			NBK and NZF (normalized)		
								R _e min.	R _m min.	A min.	R _e min.	R _m min.	A min.	R _e min.	R _m min.	A min.	R _e min.	R _m min.	A min.
	%	%	%	%	%	%	%	N/mm ²	N/mm ²	%	N/mm ²	N/mm ²	%	N/mm ²	N/mm ²	%	N/mm ²	N/mm ²	%
CFS 3	0.20 max.	0.35 max.	0.90 max.	0.050	0.050	—	—	360	450	6	280	400	9	170	340	26	215	360	24
CFS 3A ^a	0.20 max.	0.10 to 0.35	0.60 to 1.00	0.050	0.050	—	—	360	450	6	280	400	9	170	340	26	215	360	24
CFS 4	0.25 max.	0.35 max.	1.20 max.	0.050	0.050	—	—	415	520	5	315	450	8	200	400	24	235	410	22
CFS 5 ^b	0.23 max.	0.50 max.	1.50 max.	0.050	0.050	—	—	480	600	4	385	550	6	—	—	—	340	490	20
CFS 6	0.30 to 0.40	0.35 max.	0.50 to 0.90	0.050	0.050	—	—	470	590	5	350	540	7	300	440	22	280	460	21
CFS 7	0.20 to 0.30	0.35 max.	1.20 to 1.50	0.050	0.050	—	—	560	700	4	460	650	7	—	—	—	—	—	—
CFS 8 ^d	0.40 to 0.55	0.35 max.	0.50 to 0.90	0.050	0.050	—	—	575	720	4	470	670	6	300	510	20	340	540	18
CFS 9	0.29 max.	0.35 max.	1.50 max.	0.050	0.050	—	0.15 to 0.25	575	720	4	470	670	6	—	—	—	—	—	—
CFS 10	0.26 max.	0.35 max.	0.80 max.	0.050	0.050	0.80 to 1.20	0.15 to 0.30	575	720	4	470	670	6	—	—	—	—	—	—
CFS 11	0.45 max.	0.35 max.	1.00 max.	0.050	0.050	0.80 to 1.20	0.15 to 0.30	575	720	4	—	670	6	—	—	—	—	—	—

NOTE Welding of tubes of grades 3, 3A, 4 and 5 does not require special techniques but care should be taken and welding carried out in accordance with the guidance given in the appropriate British Standard for welding, e.g. BS 5135. The welding of other grades shown may require special techniques.

^a Grade 3A shall be suitable for case hardening purposes.

^b Grain refining elements may be added at the option of the manufacturer.

^c If tubes in the BK and GKW condition are subsequently welded, brazed or heated the mechanical properties in the heat affected zone may be reduced to those given for the delivery condition GBK or NBK.

^d Steels within the limits shown, but in accordance with the chemical composition of BS 970-1, may be supplied if agreed at the time of order or enquiry.

Table 2 — Tolerance on diameter

Diameter		Tolerance
Over	Up to and including	
mm	mm	mm
	30	± 0.10
30	50	± 0.15
50	70	± 0.20
70	90	± 0.25
90	110	± 0.30
110	130	± 0.35
130	160	± 0.45
160	190	± 0.55
190	220	± 0.65
220	250	± 0.75

Where the ratio of diameter to thickness is greater than 33 : 1, the tolerance shall be agreed between the purchaser and the manufacturer.

8.2 Thickness. The tolerance on thickness, including eccentricity, shall be ± 10 % with a minimum of ± 0.1 mm. If the outside diameter and inside diameter are specified, the eccentricity shall be restricted so that the thickness does not deviate by more than ± 10 % of the actual measured mean thickness.

8.3 Length. Tubes shall be supplied in either:

- random lengths of 4 m to 7 m; or
- specified cut lengths to the tolerances given in Table 3.

Table 3 — Tolerance on specified cut length

Specified cut length		Tolerance
Over	Up to and including	
mm	mm	mm
	500	+ 2 – 0
500	2 000	+ 3 – 0
2 000	5 000	+ 5 – 0
5 000	7 000	+ 10 – 0
7 000	—	by agreement

NOTE Closer tolerances may be obtained by agreement between the purchaser and the manufacturer.

9 Tests

9.1 General. In addition to the tensile test specified in clause 6, annealed or normalized tubes shall be subjected to a flattening test as given in 9.2. This test shall be carried out in accordance with 15.3 of BS 6323-1:1982.

9.2 Flattening test. The distance between the platens or in the case of flattening by hammer blows the distance between the outside surfaces, shall be no greater than the value calculated from the formula:

$$H = \frac{(1 + C)a}{C + a/D}$$

where the symbols are as defined in clause 3 of BS 6323-1:1982. Values of *C* are given in Table 4.

Table 4 — Values for deformation factor *C*

Designation	<i>C</i>
CFS 3, 3A	0.09
CFS 4, 6	0.07
CFS 5, 8	0.06

9.3 Leak tightness test. When a leak tightness test is required by the purchaser and specified in his enquiry and order, each tube shall be tested by one of the following methods:

- hydraulic leak tightness test (see 15.7 of BS 6323-1:1982).
- eddy current test (see 15.8 of BS 6323-1:1982).
- any other method giving an equivalent assurance of leak tightness as agreed between the manufacturer and the purchaser.

Selection of the test method shall be at the option of the manufacturer, unless a specific test is required by the purchaser and specified on his enquiry and order.

Table 5 — Dimensions in common usage for cold finished seamless tubes

Outside diameter (in mm) series ^a		Mass per unit length (in kg/m)																														
		Thickness ^b (in mm)																														
2	3	0.5	0.8	1.0	1.2	1.5	1.8	2.0	2.2	2.5	2.8	3.0	3.5	4.0	4.5	5.0	5.5	6.0	7.0	8.0	9.0	10.0	11.0	12.5	14	16	18	20	22	25		
5		0.056																														
6		0.068	0.103	0.123	0.142																											
8		0.092	0.142	0.173	0.201																											
10		0.117	0.182	0.222	0.260	0.314																										
12		0.142	0.221	0.271	0.320	0.388	0.453	0.493																								
	14	0.166	0.260	0.321	0.379	0.462	0.542	0.592	0.640																							
16		0.191	0.300	0.370	0.438	0.536	0.630	0.691	0.749	0.832																						
	18		0.339	0.419	0.497	0.610	0.719	0.789	0.857	0.956																						
20			0.379	0.469	0.556	0.684	0.808	0.888	0.966	1.08	1.19	1.26																				
	22		0.418	0.518	0.616	0.758	0.897	0.986	1.07	1.20	1.33	1.41	1.60																			
25			0.477	0.592	0.704	0.869	1.03	1.13	1.24	1.39	1.53	1.63	1.86	2.07	2.28	2.47																
	28		0.537	0.666	0.793	0.980	1.16	1.28	1.40	1.57	1.74	1.85	2.11	2.37	2.61	2.84																
	30		0.576	0.715	0.852	1.05	1.25	1.38	1.51	1.70	1.88	2.00	2.29	2.56	2.83	3.08																
32			0.616	0.765	0.911	1.13	1.34	1.48	1.62	1.82	2.02	2.15	2.46	2.76	3.05	3.33																
	35		0.675	0.838	1.00	1.24	1.47	1.63	1.78	2.00	2.22	2.37	2.72	3.06	3.38	3.70	4.00	4.29														
38			0.734	0.912	1.09	1.35	1.61	1.78	1.94	2.19	2.43	2.59	2.98	3.35	3.72	4.07	4.41	4.74														
40			0.773	0.962	1.15	1.42	1.70	1.87	2.05	2.31	2.57	2.74	3.15	3.55	3.94	4.32	4.68	5.03	5.70	6.31	6.88											
	45		0.872	1.09	1.30	1.61	1.92	2.12	2.32	2.62	2.91	3.11	3.58	4.04	4.49	4.93	5.36	5.77	6.56	7.30	7.99											
50				1.21	1.44	1.79	2.14	2.37	2.59	2.93	3.26	3.48	4.01	4.54	5.05	5.55	6.04	6.51	7.42	8.29	9.10											
	55				1.59	1.98	2.36	2.61	2.86	3.24	3.60	3.85	4.45	5.03	5.60	6.17	6.71	7.25	8.29	9.27	10.2	11.1	11.9	13.1								
60					1.74	2.16	2.58	2.86	3.14	3.55	3.95	4.22	4.88	5.52	6.16	6.78	7.39	7.99	9.15	10.3	11.3	12.3	13.3	14.6								
70					2.04	2.53	3.03	3.35	3.68	4.16	4.64	4.96	5.74	6.51	7.27	8.01	8.75	9.47	10.9	12.2	13.5	14.8	16.0	17.7								
80					2.90	3.47	3.85	4.22	4.78	5.33	5.70	6.60	7.50	8.38	9.25	10.1	10.9	12.6	14.2	15.8	17.3	18.7	20.8									
	90				3.27	3.92	4.34	4.76	5.39	6.02	6.44	7.47	8.48	9.49	10.5	11.5	12.4	14.3	16.2	18.0	19.7	21.4	23.9	26.2								
100						4.36	4.83	5.31	6.01	6.71	7.18	8.33	9.47	10.6	11.7	12.8	13.9	16.1	18.2	20.2	22.2	24.1	27.0	29.7	33.1							
	110						5.33	5.85	6.63	7.40	7.92	9.19	10.5	11.7	12.9	14.2	15.4	17.8	20.1	22.4	24.7	26.9	30.1	33.1	37.1	40.8						
120							5.82	6.39	7.24	8.09	8.66	10.1	11.4	12.8	14.2	15.5	16.9	19.5	22.1	24.6	27.1	29.6	33.1	36.6	41.0	45.3						
	140								8.48	9.47	10.1	11.8	13.4	15.0	16.6	18.2	19.8	23.0	26.0	29.1	32.1	35.0	39.3	43.5	48.9	54.2						
160										10.9	11.6	13.5	15.4	17.3	19.1	21.0	22.8	26.4	30.0	33.5	37.0	40.4	45.5	50.4	56.8	63.0	69.1					
	180											15.2	17.4	19.5	21.6	23.7	25.7	29.9	33.9	38.0	41.9	45.8	51.6	57.3	64.7	71.9	78.9					
200												17.0	19.3	21.7	24.0	26.4	28.7	33.3	37.9	42.4	46.9	51.3	57.8	64.2	72.6	80.8	88.8	96.6				
	220												21.3	23.9	26.5	29.1	31.7	36.8	41.8	46.8	51.8	56.7	64.0	71.1	80.5	89.7	98.6	107	120			

NOTE Diameters and thicknesses other than those listed are available by agreement between the purchaser and the manufacturer.

^a The series numbers align with those in ISO 4200, published by the International Organization for Standardization (ISO).

^b The thicknesses printed in heavy type should preferably be chosen.

Publications referred to

BS 970, *Specification for wrought steels for mechanical and allied engineering purposes.*

BS 970-1, *General inspection and testing procedures and specific requirements for carbon, carbon manganese, alloy and stainless steels.*

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.*

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 4360, *Specification for weldable structural steels.*

BS 4848, *Hot-rolled structural steel sections.*

BS 4848-2, *Hollow sections.*

BS 5135, *Metal-arc welding of carbon and carbon manganese steels.*

BS 6323, *Specification for seamless and welded steel tubes for automobile, mechanical and general engineering purposes.*

BS 6323-1, *General requirements.*

ISO 4200, *Plain end steel tubes, welded and seamless — General tables of dimensions and masses per unit length.*

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